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FN Mass Flow Meter

(hydrogen gas)

KC-7730H



FN Mass Flow Meter(KC-7730H)

Product Introduction

It is used in industrial settings to detect hydrogen gas flow and adjust and measure flow rates. Available in threaded, LOK fitting, and flanged configurations, it utilizes a microprocessor to simultaneously measure, adjust, and diagnose flow rates. Instantaneous mass flow rates, total flow rates, and environmental settings can be configured, and are displayed on a 2 x 16 LCD panel. The programmable transmitter allows for easy configuration via the RS-485S communication port, Golden Rule's high-performance interface software, or the instrument panel display. Golden Rule's FN Mass Flow Meter for hydrogen measurement is designed based on differential pressure flow measurement technology. Its two FN sensors reduce error as pressure increases from low to high, resulting in improved flow rate accuracy. Unlike the simple temperature and pressure compensation method of existing flow meters, this flow meter provides users with density, enthalpy, etc. in addition to the flow rate value by applying the compression coefficient, viscosity coefficient, and expansion coefficient according to temperature and pressure in a two-step method with a built-in flow function. The flow rate algorithm is a product that has obtained NET (New Excellent Technology Certification) from the Korean government.

Product Features (for multi-measurement)

- 5-Multi-Measurement: Instantaneous/Totalized, Volume/Mass Flow, Temperature, Pressure, Density, and Heat Indicator
- Power Supply: DC 24 V $\pm 10\%$, < 100 mA / AC 100-240 V (Optional)
- Output Accuracy: $\pm 0.1\%$, $\pm 2.5\ \mu\text{A}$
- Interface (RS-485) for on-site adjustment in case of flow meter malfunction
- Direct mass flow measurement eliminates the need for separate temperature and pressure compensation
- Simple on-site signal processing and calibration
- Built-in direct calculation of compressibility, expansion, and viscosity coefficient flow functions
- Excellent long-term stability and excellent reproducibility
- Best price-to-performance ratio
- Easy adaptability to different applications
- No moving parts
- Significantly reduced upstream piping requirements (Optional: 7 to 3D)
- Wide measurable flow rate range: 20:1 (Optional: 35:1)
- Fast response to flow rate changes (0.1 sec)
- Semiconductor and special gases Measurement Capabilities
- Capable of measuring high-pressure hydrogen gas for hydrogen charging stations (up to 100 barg)
- Capable of measuring low-temperature fluids up to -70°C and high-temperature fluids up to 400°C
- Automatic flow rate ratio calculation function (4-20 mA input: Basic Mode (optional))
- CE, Ex (IP67)

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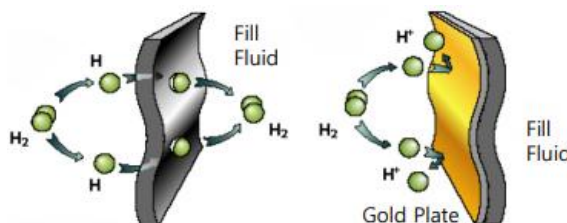
Product performance

- Accuracy
F.S. $\pm 0.5\%$ / R.D. $\pm 1.0\%$
(Option: $\pm 0.1\%$ of F.S. / $\pm 0.5\%$ R.D.)
- Turndown ratio
35:1 (Option 50:1)
- Reproducibility
 $\pm 0.2\%$ of Full Scale
- Sensor Accuracy
< 0.05% of span
- Pressure Compensation
Temperature constant $\pm 0.02\%$ / 10K
- Response Time
< 0.1 sec
- Measuring Range
(0.1 ~ 100) m/sec



Operating Specifications

- Fluid
Hydrogen gas, hydrogen mixed gas
- Power Supply
DC 24 V $\pm 10\%$, < 100 mA
AC 100-240V $\pm 10\%$, < 10watts (Option)
- Output Signal (Standard)
선형의 DC 4 ~ 20 mA HART, 4-Wire, Pulse
RS-485 (Option)
Error display Alarm (H/L): Reverse flow, sensor range exceeded
- Pressure Drop 0.1 to 0.3 Bar or less
- Pressure sensor allowable pressure
System static pressure: 45 Mpa
One-sided overload pressure: 30% F.S.



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H2 Gas Flow Ranges(수소가스 유량 범위)							
Pipe Size		NL/min		Nm ³ /h		Fluid	Pressure/Temp'
A	B	min	max	min	max	Fluid	Press'/Temp'
10A	⅜-inch	5.7	200	0.34	12.00	H ₂	3-5Barg/20°C
10A	⅜-inch	4.3	150	0.28	9.00	H ₂	3-5Barg/20°C
10A	⅜-inch	33.0	666.7	2.0	40.00	H ₂	8.2Barg/25°C
10A	⅜-inch	50.0	416.6	3.0	25.00	H ₂	7Barg/20°C
10A	⅜-inch	11.42	400	0.68	24	H ₂	3~69Barg/65°C
15A	½-inch	300	5,000	18.0	300.0	H ₂	40Barg/95°C
15A	½-inch	55.0	1,520	3.30	91.20	H ₂	17-30Barg/ 20°C
15A	½-inch	23.83	833.3	1.43	50.00	H ₂	7Barg/25°C
15A	½-inch	2.38	83.33	0.14	5.00	H ₂	1-5Barg/20°C
15A	½-inch	5.83	205	0.35	12.3	H ₂	4Barg/40°C
15A	½-inch	10.83	383.3	0.65	23	H ₂	800mmAq/20°C
20A	¾-inch	23.83	833.3	1.43	50.00	H ₂ +Mix	7.3Barg/20°C
20A	¾-inch	23.83	833.3	1.43	50.00	H ₂ +Mix	6.9Barg/20°C
20A	¾-inch	9.52	333.3	0.60	20.00	H ₂	9.7Barg/ 40-90°C
20A	¾-inch	47.61	1,666	2.90	100	H ₂	9.7Barg/ 40-90°C
20A	¾-inch	10.83	383.3	0.65	23	H ₂	800mm/50°C
25A	1-inch	23.83	833.3	1.43	50.00	H ₂	7Barg/25°C
50A	2-inch	0.12 kg/min	4.20 kg/min	7.20 kg/h	252 kg/h	H ₂	8.2Barg/200°C
50A	2-inch	100 kg/min	3,500 kg/min	6.00 kg/h	210.5 kg/h	H ₂	7.9Barg/150°C
50A	2-inch	266.7	9,333.3	16	560	H ₂	72Barg/ 26~250°C
50A	2-inch	95.16	3,333.3	5.71	200	H ₂	16Barg/40°C

FN Mass Flow Meter(KC-7730H)

- **Fluid & Environment Temperature**

Gas: -40 to 100°C (-50 to 212°F) Optional: -70 to 400°C (-94 to 752°F)

Pipe Temperature: 300°C or higher (572°F)

Environment: -4 to 176°F (-20 to 80°C) Optional: -70 to 100°C (-94 to 212°F)

Fluid Properties: Insulation Index / Density / Viscosity Coefficient / Enthalpy / Compressibility Coefficient

- **Fluid Pressure Range (Assembly Part)**

Compression Fitting: 500 psig (35 barg)

150 lb, JIS 10k RF, PN16 DIN Flange (-40 to 150°C (-40 to 302°F)): 230 psig (15.9 barg)

150 lb, JIS 10k RF, PN16 DIN Flange (121 °C (250 °F)): 185 psig (12.8 barg)

150 lb, JIS 10k RF, PN16 DIN Flange (400 °C (752 °F)): 155 psig (10.7 barg)

NPT ((-40 ~ 150) °C ((-40 ~ 302) °F)): 508 psig (35 barg)

- **Liquid Crystal Display**

Display indications: Instantaneous & totalized, volume, mass measurement

Numeric character array 2 x 16 backlit LCD & alarm function

Adjustable via remote control switch on the instrument panel or via Windows via RS-485S interface

Adjustable variables: Flow rate range: (0 ~ 100) %

Flow rate unit: m³/h (m³), L/h (L), mL/h (mL), Nm³/h (Nm³), Sm³/h (Sm³), kg/h (kg)

Response Time / Correction Value: (0.1) sec / 0.5 ~ 5Zero & Span

- **Totalization**10-digit engineering units (9,999,999,99.9 Count),

Flow rate and totalization decimal point (0000. / 000.0 / 00.00 / 0.000)Can be reset via software or the LCD remote control switch.

- **Software (Optional):** Area code 1~249, 966~115,200 bps

Windows® Software 16MB RAM required (minimum 8MB RAM required)RS-485S communication:

Instantaneous, totalization, volume, mass, temperature, pressure, density, and heat measurement

Additional Functions: Zero Cut-Off Adjustment, Linearization Adjustment, Save / Load adjustment, flow meter condition check

Main Body Specifications

- **Fluid Wetted Parts**

FN Sensor – STS316L+Gold Plate (hydrogen gas), STS316L (special gas)

Flow Body – Seamless STS304 (Option: STS316, STS316L)

- **Flow Meter Body**

Waterproof IP67 & Case for Explosion-Proof Areas (Ex d IIC T6: Hydrogen Explosion-Proof)

- **Wire Connections :** 2 x ½" PF or Exp Cable Gland (SS) 22C

- **Flow Meter Connections (Optional)**

Thread, Cone & Thread tubing(400Bar), Lok, ANSI 150lb Flange, JIS 10k RF Flange

- **Certifications**

Ex (Ex d IIC T6)

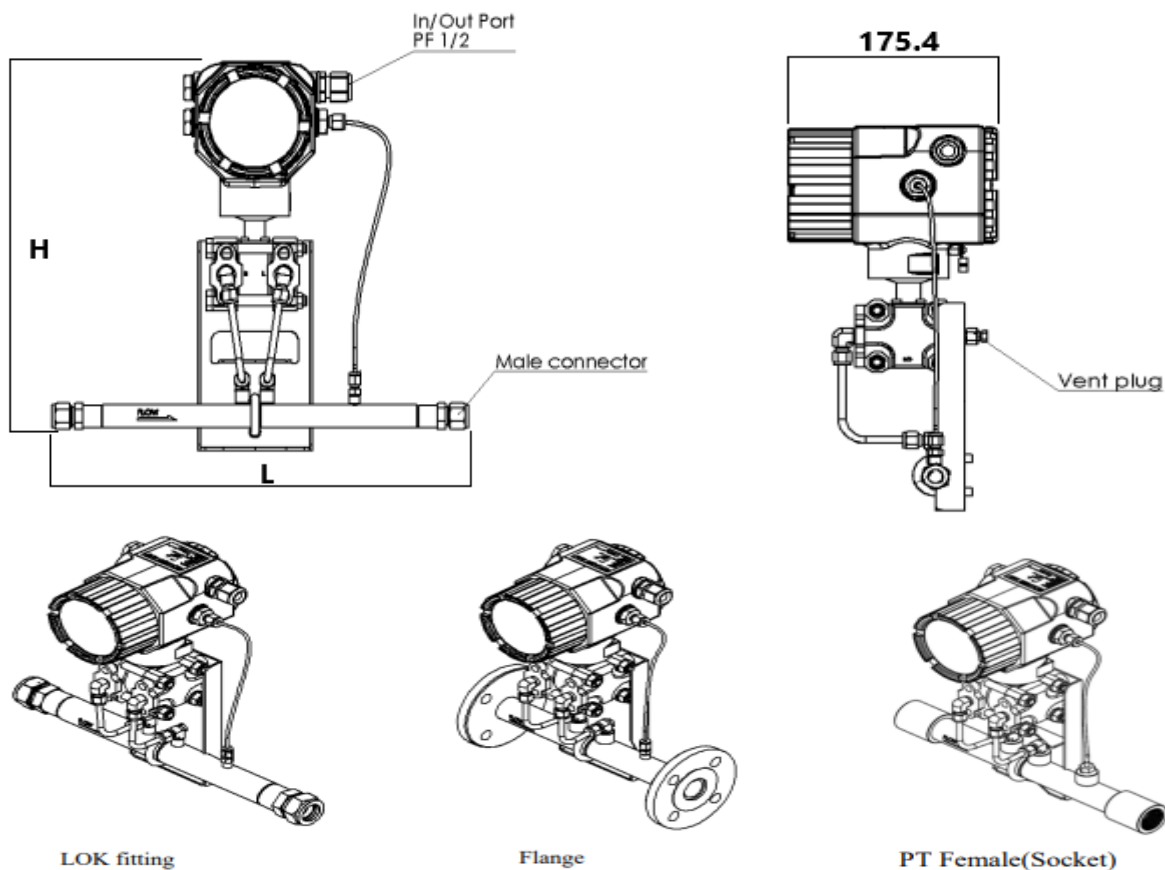
CE (Complete CASE)

KCS Certificate

Atex Certificate

FN Mass Flow Meter(KC-7730H)

Drawing Dimension Specifications & Diagram I KC-7730H-FM153K



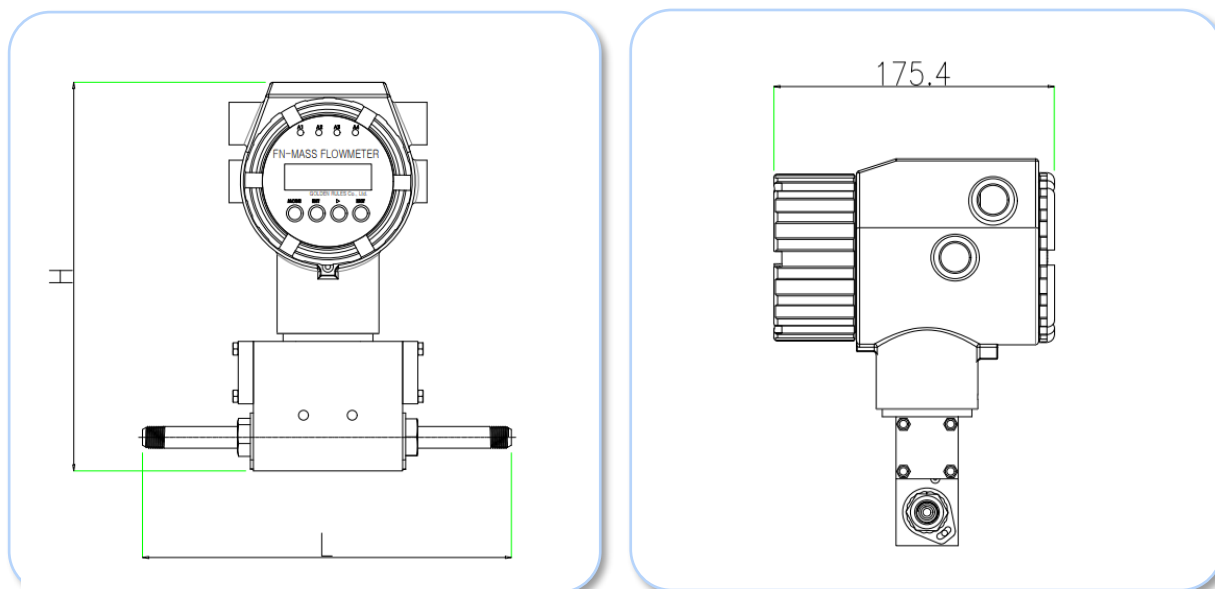
※ The shape of the sensor may change depending on the manufacturer's circumstances. -> Refer to the detailed approval drawing.

Unit : mm

Size	H	L
3/8" Thread / Lok	255.1	300
1/2" Lok / Flange	256.1 / 375	300
3/4" Lok / Flange	257.6	300
1" Flange	358.5	300
32A	402	300
40A	406	300
50A	420	300
65A	442	350
80A	442	400
100A	451	409
125A	508	451
150A	540	522
200A	575	602
250A	626	672

FN Mass Flow Meter(KC-7730H)

Drawing Dimension Specifications & Diagram II High Pressure 100 Bar



※ The shape of the sensor may change depending on the manufacturer's circumstances. -> Refer to the detailed approval drawing.

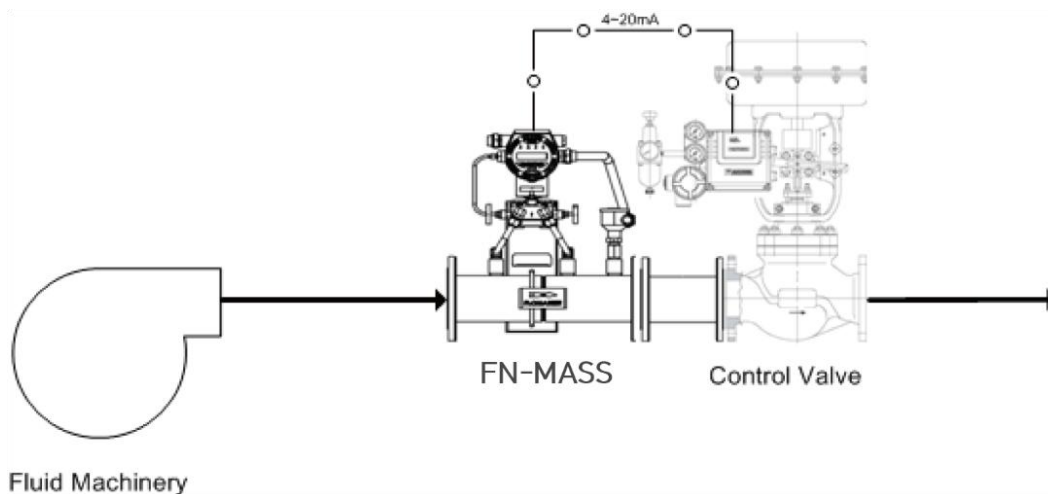
Unit : mm

Size	H	L
3/8" Cone&Thread tubing	255.1	300
1/2" Cone&Thread tubing	256.1 / 375	300
3/4" Cone&Thread tubing	257.6	300
1" Cone&Thread tubing	358.5	300

FN Mass Flow Meter(KC-7730H)

The FN mass flow meter provides the following control options using current output signals:

- | | |
|---|-----------------------------|
| 01 – Mass flow rate (kg/h) control | 02 – Heat (MJ/h) control |
| 03 – Volumetric flow rate (m ³ /h) control | 04 – Pressure (kPa) control |



Its fast response speed allows it to meet customer needs, and its precision control of $\pm 0.1\%$ F.S. allows it to achieve energy savings, minimizing losses in industrial settings.

Upstream and downstream straight pipe conditions (KC-7730H)

Vertical pipe length required for measurement			
Piping condition	KC-7730H Smart– IN™		Orifice Plate(3)
	Upstream(1)	Downstream (2)	
90° Elbow or T-Joint	10D	5D	28D
Zoom out (4:1)	10D	5D	14D
Expansion (4:1)	10D	5D	30D
After the control valve	10D	5D	32D
Two 90° elbows (same horizontal plane)	10D	5D	36D
Two 90° elbows (different horizontal planes)	10D	5D	62D

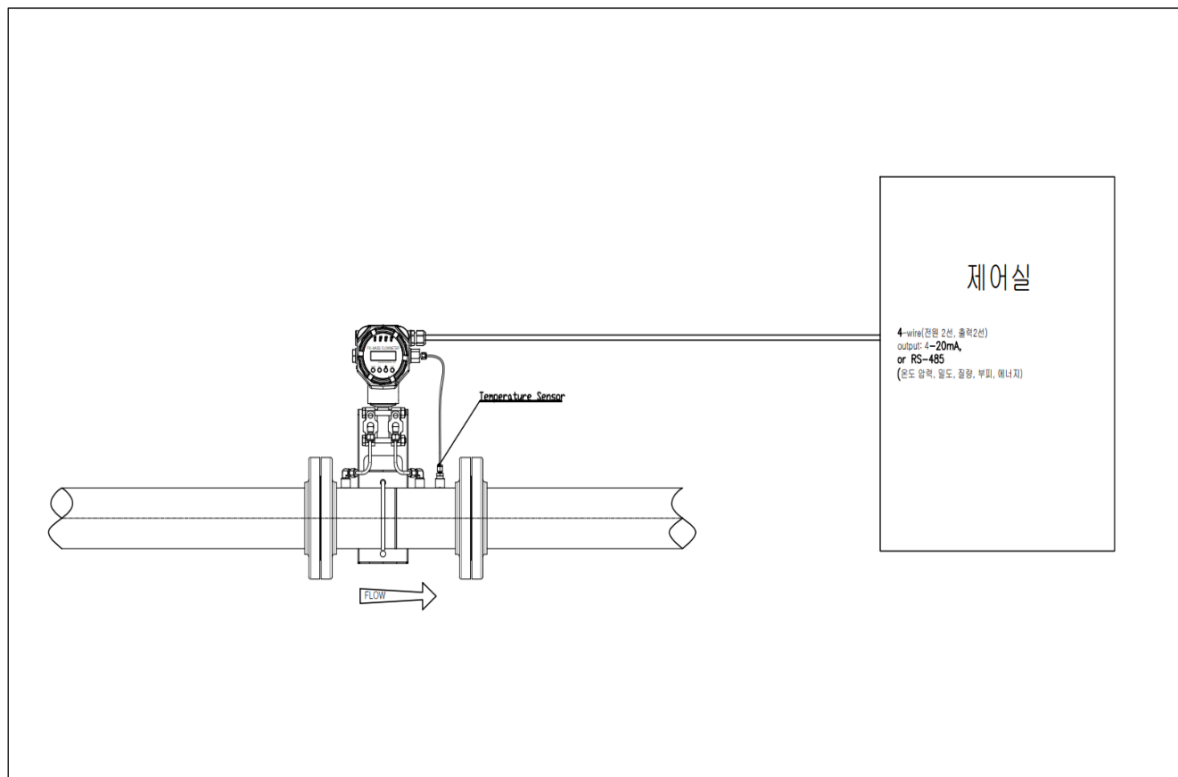
Note :

- The straight pipe diameter multiplier (D) is the straight pipe required between obstructions upstream of the flow meter.
- The required straight pipe length can be shortened by adjusting for field conditions.
- For comparison with our flow meter, this is the required straight pipe length for an orifice flow meter with a diameter ratio of 0.7, as per ISO-5167.
- Contact the manufacturer for pressure effects.

FN Mass Flow Meter(KC-7730H)

Schematic and Advantages of the Integrated FN Mass Flow Meter

1. Significantly reduced installation costs.
2. 2. As a direct-type FN mass flow meter, it boasts significantly higher accuracy ($\pm 0.5\%$ F.S.) than conventional differential pressure meters.
3. 3. Wide flow range for high-temperature, high-pressure, and high-flow measurement (turndown ratio: 35:1).
4. 4. As an FN mass flow meter, the straight pipe section is short (10D upstream and 5D downstream).
5. 5. Simultaneous monitoring of five data points (flow rate, temperature, pressure, density, and heat) in a central monitoring panel is possible through communication output.
6. 6. As an integrated mass flow meter with temperature/pressure sensor/flow computer, installation is simple.



FN Mass Flow Meter(KC-7730H)

Order Code

Type **Conn' Size** **Body** **Power** **Output** **Display** **Direc.** **Press'** **Option**
 KC-7730 - - - **P** - **V** - - - -
 1 **2** **3** **4** **5** **6** **7** **8** **9** **10** **11** **12**

Type	Code 1
Liquid	L
Gas	G
Steam	S
Bio Gas	B

Connection	Code 2
Thread	T
Tri-clamp	C
Lok Fitting	L
DIN / ANSI / JIS Flange	D / A / J
Agency approved, customer specified	W

Size	Code 3
1/2" (DN15)	1
3/4" (DN20)	2
1" (DN25)	3
1-1/2" (DN40)	4
2" (DN50)	5
2-1/2" (DN65)	6

Body1	Code 4
General Type	G
Explosion-Proof Type	E

Body2	Code 5
Integral type	1
Remote type	2
Agency approved, customer specified	W

Body3	Code 6
IP66	1
IP67	2

Input Power	Code 7
DC 24V	2
AC 220V	3
Agency approved, customer specified	W

Output	Code 8
DC 4~20 mA, Pulse active, RS-485	1
Agency approved, customer specified	W

Display	Code 9
No Readout	NR
Digital Display	DD
Agency approved, customer specified	W

Flow Direction	Code 10
Horizontal / Left -> Right	1
Horizontal / Right -> Left	2
Vertical / Lower -> Upper	3
Vertical / Upper -> Lower	4
Agency approved, customer specified	W

Pressure Range	Code 11
Low Pressure (Max. 10 bar)	L
Medium Pressure (Max. 30 bar)	M
High Pressure (Max. 200 bar)	H
Agency approved, customer specified	W

Option	Code 12
FN Sensor Mat'l : 316SS, 316LS S	FM
DP Sensor Mat'l : 316LSS	DM
High Press. (max.50 Bar)	HP
Agency approved, customer specified	W

FN Mass Flow Meter(KC-7730H)

Flow Measurement Principle

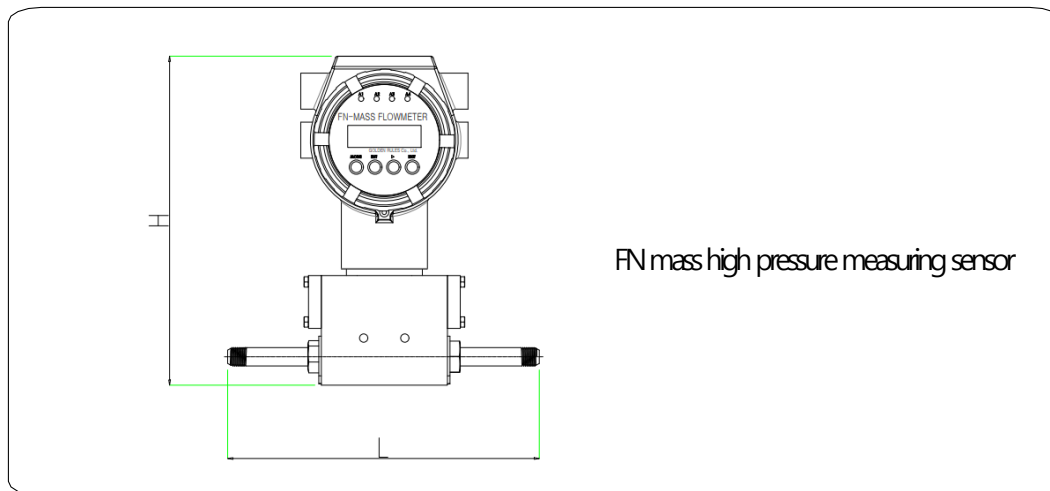
Differential Pressure Mass Flow Sensor

– FN Mass Flow Sensor (Orifice, Flow Nozzle, Venturi Nozzle, Pitot)

Orifice Pipe Size: D-0.5D / Corner / Flange

Absolute Pressure and Differential Pressure Sensor: STS316, STS316L

Temperature Sensor: RTD Pt100 (3-wire)



Golden Rule's unique FN-Mass Flow meter guarantees exceptional accuracy for industrial flow meters, as well as robustness and reliability under high temperatures and pressures.

This is the world's first direct-calculation FN-Mass Flowmeter, a differential pressure mass flow meter. Designed with orifice plates, flow nozzles, and venturi tubes to minimize pressure loss, the sensor measures flow rate using proprietary, patented calculations. This new technology has earned Golden Rule's New Technology Certification. This is a new-concept mass flow transmitter that derives flow rates through sophisticated calculations under the variable physical properties of real fluids. It is capable of engineering demanding industrial conditions. Developed with proprietary domestic technology, it minimizes industrial losses and ensures technical freedom. It also offers superior accuracy and stability. Furthermore, it can be used with a variety of fluids. The straight pipe length required by conventional differential pressure flow meters has been supplemented through various experimental data to maintain the desired accuracy even in short straight pipe sections. A communication network (RS-485) can be configured to monitor the progress of the mass flow meter, and an automatic valve can be installed to control mass flow rates according to user settings. Orifices, flow nozzles, venturi tubes, venturi cones, and pitots are manufactured in compliance with the ISO-5167 standard, and are manufactured under the ISO-9001 and ISO14001 quality management systems.

FN Mass Flow Meter(KC-7730H)

Flow calculation formula

Term	Real gas	Perfect gas
Equation of state	$pV = ZRT$	$pV = RT$
Compressibility factor	Z	$Z = 1$
Isothermal deviation factor	$Y = \frac{p}{V} \left(\frac{\partial V}{\partial p} \right)_T = 1 - \frac{p}{Z} \left(\frac{\partial Z}{\partial p} \right)_T$	$Y = 1$
Isobaric deviation factor	$X = \frac{T}{V} \left(\frac{\partial V}{\partial T} \right)_p = 1 - \frac{T}{Z} \left(\frac{\partial Z}{\partial T} \right)_p$	$X = 0$
Isentropic exponent (κ)	$\kappa = - \frac{V}{p} \left(\frac{\partial p}{\partial V} \right)_s = \frac{\gamma}{Y}$	$\kappa = \gamma = \frac{c_p}{c_v}$

coefficient of gas expansion

$$\varepsilon = \sqrt{\left(\frac{\kappa \tau^{2/\kappa}}{\kappa - 1} \right) \left(\frac{1 - \beta^4}{1 - \beta^4 \tau^{2/\kappa}} \right) \left(\frac{1 - \tau^{(\kappa-1)/\kappa}}{1 - \tau} \right)}$$

κ = isentropic exponent

τ = pressure ratio

β = diameter ratio

Flow calculation formula

$$q_m = \frac{C}{\sqrt{1 - \beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2 \Delta p \rho_1}$$

$$q_v = \frac{q_m}{\rho_1}$$

q_m = mass flow rate[kg/s]

q_v = volumetric flow rate[m³/s]

ρ_1 = upstream density[kg/m³]

Δp = differential pressure[Pa]

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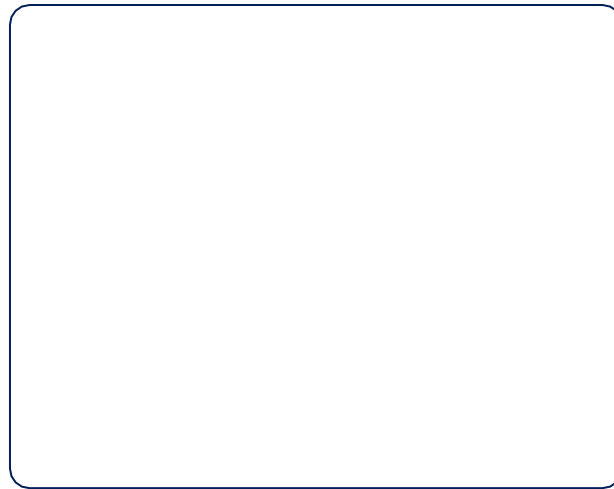
◆Simply select to suit the application

Application	Type		Mass Flowmeter	
			FN-MASS FLOWMETER	
Object of Measurement	Liquid		○	
	Gas		○	
	Vaper		○	
	steam		○	
Application	control		○	
	Monitor		○	
	Supply		○	
Operating condition	Temperature		Gas	– 40 to 100°C (Option:400°C)
			Liquid & Oil	–40 to 100°C(Option:400°C)
			Steam	–20 to 200°C(Option:400°C)
	Pressure		10 barg / 30 barg / Max 100 barg	
	Pressure loss		Negligible	
	Range ability		Large	
Installing condition	Bore		Ø10 to Ø300	
	Straight	upstream	7D	
	Pipe length	downstream	3D	
	Piping work		Required	
	Explosion-proofing		○	
Performance	Accuracy		Gas	±0.5% F.S(Option: 0.1%)
			Liquid & Oil	±0.5% F.S(Option: 0.1%)
			Steam	±0.5% F.S(Option: 0.1%)
	Velocity		Gas	0.1~100 m/s
			Liquid & Oil	0.1~100 m/s
			Steam	0.1~100 m/s



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**Air & Gas & Steam & Liquid
Mass Flowmeter
Specialized Manufacturer**



Certified in accordance with

KC Q ISO 9001 : 2015

KC Q ISO 14001 : 2015

GOLDEN RULES Co.,Ltd