General Specifications

Model CM6G
Gas Calorimeter

GS 11R2A1-E

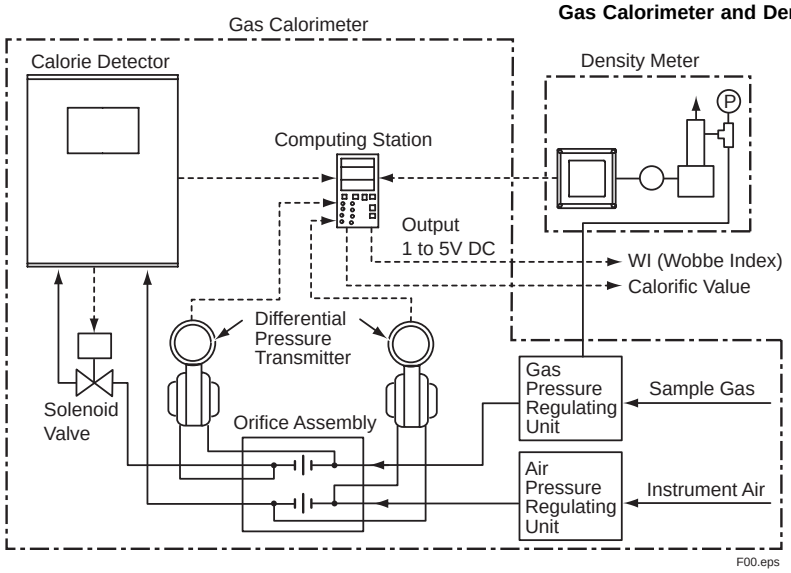
■GENERAL

Model CM6G Gas Calorimeter is used to measure and control the calorific value or Wobbe Index (WI) of the sample gas. In this calorimeter the sample gas is burnt at the burner with air and the temperature difference between the combustion exhaust gas and the feed air at the burner inlet is detected by using a thermocouple.

This calorimeter detects the flow rate of both the sample gas and the air as the differential pressure by using the orifice and converts the differential pressure to the digital signal then compensates the flow rate variation by the digital calculation. This method gives an excellent high reliability, therefore it can be used for the control of thermal input for the various type furnaces in the steel mill and petrochemical industries, also for the calorie control of the town gas.

Gas Calorimeter and Density Meter

■ TYPICAL SYSTEM CONFIGURATION



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■ COMPONENTS AND FUNCTIONS

Item	Function/Description
Calorie detector	Detects WI. Generates an alarm and takes protective actions when the burner flame goes out or abnormal combustion occurs.
Computing station (digital)	Calculates WI or calorific value. Displays selected parameters, e.g., each differential pressure and calorific value. Adjusts zero/span and others.
Density meter	Measures density used for calculation of calorific value. Not required for WI measurement.
Differential pressure transmitter	Detects differential pressure of gas and air before and after orifice, and converts it to an electrical signal.
Orifice assembly	Gas and air orifices housed in the constant temperature chamber.
Solenoid valve	Serves as a safety valve to shut off the sample gas flow.

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GS 11R2A1-E

4th Edition: Jul. 2008

■ STANDARD SPECIFICATIONS

1. Town Gas Application

Purpose: Measurement and control of the calorific value of town gas.
Measurement: WI or calorific value of fuel gas.
Measuring Range: 3 to 62 MJ/Nm^3
Conditions at the Sampling Point:
Dust: 5 mg/Nm^3 or less
Temperature: 50°C or less
Humidity: dew point of 0°C or less
Pressure: (1) 10 to 20 kPa: standard
(2) 10 kPa or under: with pump
(3) 100 to 600 kPa: with pressure reducing valve
Range: Select scale range (Span):
General Gas: 30 to 50% of maximum value of the span.
Butane or Butene + Air:20 to 30% of maximum value of the span.
Propane or Propylene + Air: 25 to 40% of maximum value of the span.
Output: 1 to 5 V DC, 4 to 20 mA DC (simultaneously), non-isolated, load resistance 750 Ω or less
Alarm Contact Output: Flame off alarm, low orifice temperature alarm, remote ignition
100 V AC, 5 A, closed when alarm occurs (resistance load)
Repeatability:

Measurement	Measuring range Note 1	Repeatability
WI	High calorific value	±0.5% of measured value
	Low calorific value	±1.0% of measured value
Calorific value MJ/Nm^3	High calorific value	±1.0% of measured value
	Low calorific value	±1.5% of measured value

Note 1: High calorific value means 6.3 MJ/Nm^3 or higher. Low calorific value means below 6.3 MJ/Nm^3.

Sample Gas Flow Rate: Approx. 10 l/min
Response Time (Note 2):

Max. WI measured	Dead time	Time constant (63.2%)
50 or over	Approx. 20 sec	Approx. 50 sec
Approx. 38	Approx. 17 sec	Approx. 43 sec
Approx. 25	Approx. 13 sec	Approx. 37 sec
13 or under	Approx. 11 sec	Approx. 31 sec

Note 2: Response time varies depending on the WI of a sample gas. This is due to the different sample gas flow rate of the calorimeter. The flow rate is preset depending on the WI of the sample gas to prevent the calorific value at the detector burner from exceeding the upper limit.

Utility:
Instrument Air: Approx. 50 Nl/min, pressure 300 to 700 kPa, dew point of 0°C or less
Power Supply: 100 V AC ±10%, single phase, 50/60 Hz (Note 3), 860 VA max.

Note 3: In case of low calorific value measurement, frequency variation should be within ±0.4%. If frequency variation exceeds ±0.4%, consult with Yokogawa.

Panel:
Construction: For indoor installation, rack panel.
Paint Color: Munsell 5Y7/1 (inside and outside)
Ambient Temperature: 0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

2. Steel Mill Application

Purpose: Measurement and control of the calorific value of fuel gas for a steel mill.
Measurement: WI or calorific value of fuel gas.
Measuring range: 3 to 62 MJ/Nm^3
Conditions at the Sampling Point:
Dust: 100 mg/Nm^3 or less
Temperature: 50°C or less
Pressure: (1) 8 to 15 kPa: standard
(2) 8 kPa or under: with pump
Range: Select scale range(Span):
General Gas: 30 to 50% of maximum value of the span.
Butane or Butene + Air:25 to 40% of maximum value of the span.
Output: 1 to 5 V DC, 4 to 20 mA DC (simultaneously), non-isolated, load resistance 750 Ω or less
Alarm Contact Output: Flame off alarm, low orifice temperature alarm, remote ignition
100 V AC, 5 A, closed when alarm occurs (resistance load)
Repeatability:

Measurement	Measuring range Note 1	Repeatability
WI	High calorific value	±0.5% of measured value
	Low calorific value	±1.0% of measured value
Calorific value MJ/Nm^3	High calorific value	±1.0% of measured value
	Low calorific value	±1.5% of measured value

Note 1: High calorific value means 6.3 MJ/Nm^3 or higher. Low calorific value means below 6.3 MJ/Nm^3.

Sample Gas Flow Rate: Approx. 10 l/min
Response Time (Note 2):

Max. WI measured	Dead time	Time constant (63.2%)
50 or over	Approx. 32 sec	Approx. 90 sec
Approx. 38	Approx. 29 sec	Approx. 80 sec
Approx. 25	Approx. 26 sec	Approx. 70 sec
13 or under	Approx. 20 sec	Approx. 65 sec

Note 2: Response time varies depending on the WI of a sample gas. This is due to the different sample gas flow rate of the calorimeter. The flow rate is preset depending on the WI of the sample gas to prevent the calorific value at the detector burner from exceeding the upper limit
When the orifice protective filter is added, the time constant becomes 30 seconds longer.

Utility:
Water: Approx. 0.2 l/min, pressure 200 to 600 kPa
Instrument Air: Approx. 50 Nl/min, pressure 300 to 700 kPa, dew point of 0 °C or less
Power Supply:100 V AC 610%, single phase, 50/60 Hz (Note 3), 1100 VA max.

Note 3: In case of low calorific value measurement, frequency variation should be within ±0.4%. If frequency variation exceeds ±0.4%, consult with Yokogawa.

Panel:
Construction: For indoor installation, rack panel.
Paint Color: Munsell 5Y7/1 (inside an outside).
Ambient Temperature: 0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

■ MODEL AND SUFFIX CODE

1. Gas Calorimeter

Model	Suffix code		Option code	Description
CM6G	----------		----------	Gas calorimeter
———	-S6		----------	Always -S6
Gas pressure	1		----------	Gas pressure 10 to 20 kPa for town gas, quake-proof
	2		----------	Gas pressure 10 to 20 kPa for town gas
	3		----------	Gas pressure 10 kPa or under for town gas
	4		----------	Gas pressure 100 to 600 kPa for town gas
	5		----------	Gas pressure 8 to 15 kPa for steel mill, without preheating
	6		----------	Gas pressure 8 to 15 kPa for steel mill, with preheating
	7		----------	Gas pressure 8 kPa or under for steel mill, without preheating
	8		----------	Gas pressure 8 kPa or under for steel mill, with preheating
Measurement		00	----------	WI measurement
		10	----------	Calorific value measurement (GD400G should be purchased separately.)
Power supply		-5	----------	100 V AC 50 Hz
		-6	----------	100 V AC 60 Hz
Range		R	----------	Measuring range
Style		*B	----------	Style B

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Note: Measuring range and unit must be specified.

2. Density Meter

Gas Density Meter is required for density compensation in calorific value measurement. It is not required for WI measurement.

Converter: GD400G-N-10-N-□/PA
Detector: GD300S-J-□/KU
Measuring range and unit (specific gravity or density) should be specified.

3. Option

Item	Part no.	Description
Open probe	H7800HA	Insertion length 650 mm
Open probe	H7800HB	Insertion length 1150 mm
Open probe	H7800HC	Insertion length 1650 mm
Fulflo filter	G7043XJ	Element material: Polypropylene Pore size: 50µm Body: SUS 316 Connection: Rc 1/2
Pressure reducing valve	G7008XF	Primary pressure: 15 MPa max. Secondary pressure: 0 to 200 kPa Material: Brass

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■ STANDARD SYSTEMS FOR EACH APPLICATION

Application	Measurement	System specification		Suffix code*
Town Gas	WI	Without density meter	Gas pressure 10 to 20 kPa: Standard	-S6200
			Gas pressure 10 kPa or under: With pump	-S6300
			Gas pressure 100 to 600 kPa: With pressure reducing valve	-S6400
	Calorific value MJ/Nm^3	With density meter	Gas pressure 10 to 20 kPa: Quake-proof	-S6110
			Gas pressure 10 to 20 kPa: Standard	-S6210
			Gas pressure 10 kPa or under: With pump	-S6310
			Gas pressure 100 to 600 kPa: With pressure reducing valve	-S6410
Steel Mill	WI	Without density meter	Gas pressure 8 to 15 kPa: Without preheating	-S6500
			Gas pressure 8 to 15 kPa: With preheating	-S6600
			Gas pressure 8 kPa or under: Without preheating	-S6700
			Gas pressure 8 kPa or under: With preheating	-S6800
	Calorific value MJ/Nm^3	With density meter	Gas pressure 8 to 15 kPa: Without preheating	-S6510
			Gas pressure 8 to 15 kPa: With preheating	-S6610
			Gas pressure 8 kPa or under: Without preheating	-S6710
			Gas pressure 8 kPa or under: With preheating	-S6810

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* Corresponding Suffix Code of "-S6", gas pressure and measurement.

Note: A wet sample gas in the town gas application is outside the scope of the standard specifications. Consult with Yokogawa.

■ INSTRUCTIONS FOR SYSTEM SELECTION

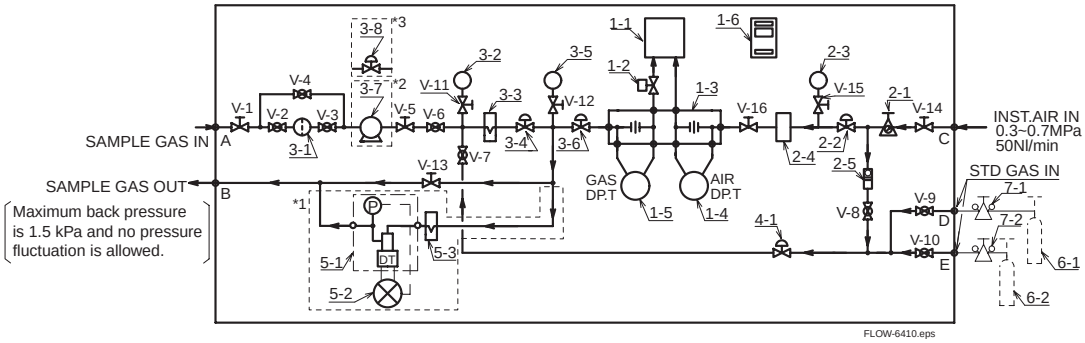
(1) The quake-proof type gas calorimeter is always equipped with the density meter.
(2) The CM6G Gas Calorimeter controls the flow rate under a constant differential pressure. In the calorific value measurement, if the density of a sample gas changes, a flow rate error proportional to the reciprocal of the square root of the density of the sample gas, $1/\sqrt{\rho_g}$, will be generated, which directly affects the calorific value. Therefore, density compensation is required using a density meter. For the WI measurement, a density meter is not required since the WI is a value proportional to $1/\sqrt{\rho_g}$.

■ STANDARD FLOW SHEET

1. Town Gas Application (Standard Type)

CM6G-S6200, S6210, S6300, S6310, S6400, S6410

No.	Item	No.	Item	No.	Item
1-1	Calorie detector	3-1	Line filter	5-1	Density meter detector (when specified)
1-2	Solenoid valve	3-2	Pressure gauge	5-2	Density meter converter (when specified)
1-3	Orifice assembly	3-3	Flowmeter	5-3	Flowmeter for density meter (when specified)
1-4	Differential pressure transmitter (air)	3-4	Pressure reducing valve	6-1	Standard gas cylinder (supplied by customer)
1-5	Differential pressure transmitter (gas)	3-5	Pressure gauge	6-2	Standard gas cylinder (supplied by customer)
1-6	Computing station	3-6	Pressure reducing valve	7-1	Pressure reducing valve for cylinder (optional)
2-1	Air set	3-7	Diaphragm pump (when specified)	7-2	Pressure reducing valve for cylinder (optional)
2-2	Pressure reducing valve	3-8	Pressure reducing valve (when specified)		
2-3	Pressure gauge	4-1	Pressure reducing valve	V1...16	Ball valve, needle valve
2-4	Preheating chamber				
2-5	One touch coupler				

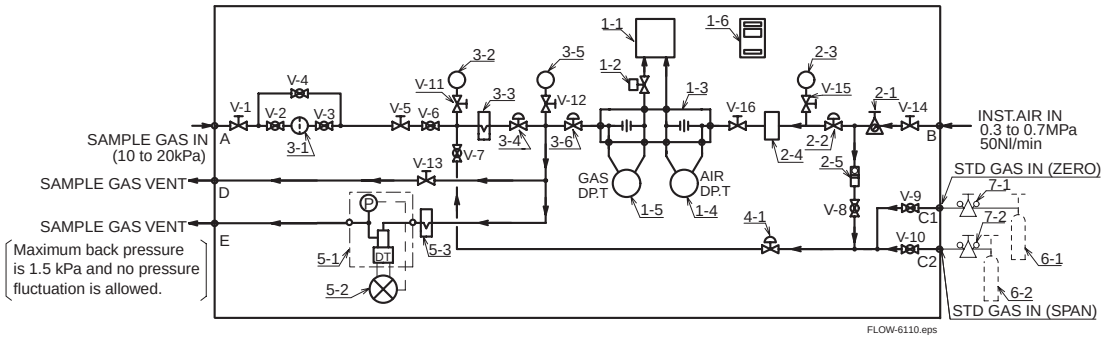


*1: CM6G-S6□10 (with density meter)
*2: CM6G-S63□0 (with diaphragm pump)
*3: CM6G-S64□0 (with pressure reducing valve)

2. Town Gas Application (Quake-proof Type)

CM6G-S6110

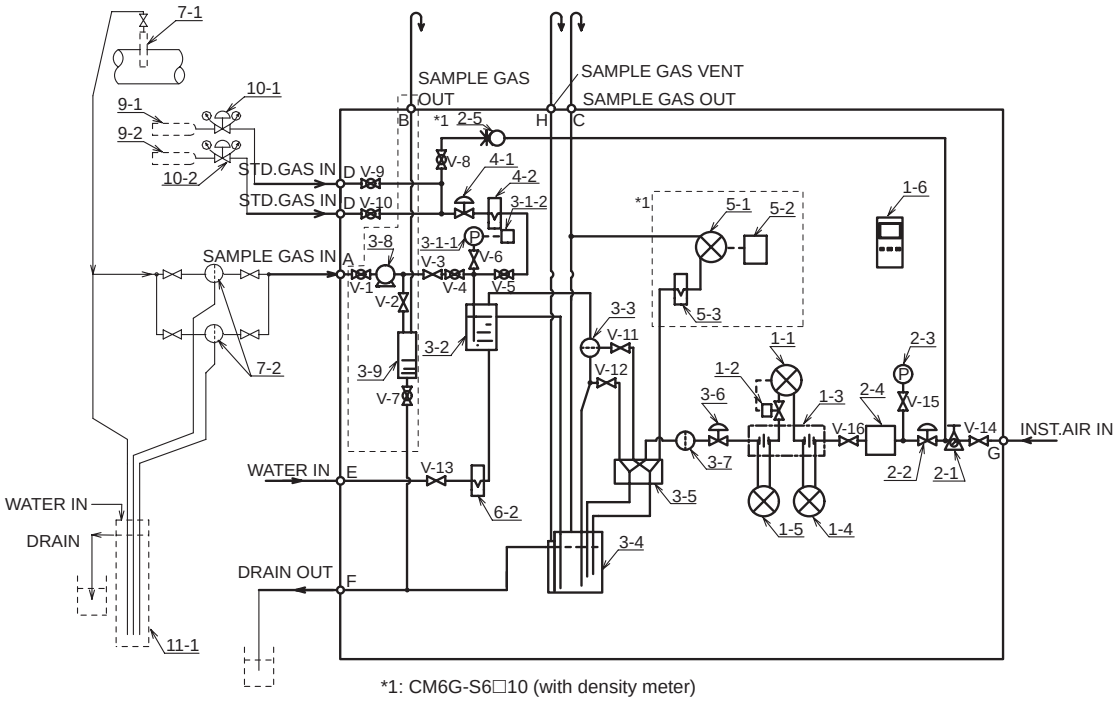
No.	Item	No.	Item	No.	Item
1-1	Calorie detector	3-1	Line filter	6-1	Standard gas cylinder (supplied by customer)
1-2	Solenoid valve	3-2	Pressure gauge	6-2	Standard gas cylinder (supplied by customer)
1-3	Orifice assembly	3-3	Flowmeter	7-1	Pressure reducing valve for cylinder (optional)
1-4	Differential pressure transmitter (air)	3-4	Pressure reducing valve	7-2	Pressure reducing valve for cylinder (optional)
1-5	Differential pressure transmitter (gas)	3-5	Pressure gauge		
1-6	Computing station	3-6	Pressure reducing valve	V1...16	Ball valve, needle valve
2-1	Air set	4-1	Pressure reducing valve		
2-2	Pressure reducing valve	5-1	Density meter detector		
2-3	Pressure gauge	5-2	Density meter converter		
2-4	Preheating chamber	5-3	Flowmeter for density meter		
2-5	One touch coupler				



3. Steel Mill Application

CM6G-S6500, S6510, S6600, S6610, S6700, S6710, S6800, S6810

No.	Item	No.	Item	No.	Item
1-1	Calorie detector	3-1	Pressure gauge	5-1	Density meter detector (when specified)
1-2	Solenoid valve	3-2	Washing babbler	5-2	Density meter converter (when specified)
1-3	Orifice assembly	3-3	Fulflo filter	5-3	Flowmeter for density meter (when specified)
1-4	Differential pressure transmitter (air)	3-4	Pressure regulating unit	6-1	Water Flowmeter
1-5	Differential pressure transmitter (gas)	3-5	Dehumidifier	7-1	Open probe (optional)
1-6	Computing station	3-6	Pressure reducing valve	7-2	Fulflo filter (optional)
2-1	Air set	3-7	Line filter	9-1	Pressure reducing valve for cylinder (optional)
2-2	Pressure reducing valve	3-8	Diaphragm pump (when specified)	9-2	Pressure reducing valve for cylinder (optional)
2-3	Pressure gauge	3-9	Drain pot (when specified)	10-1	Standard gas cylinder (supplied by customer)
2-4	Preheating chamber	4-1	Pressure reducing valve for cylinder	10-2	Standard gas cylinder (supplied by customer)
2-5	One touch coupler	4-2	Flowmeter	11-1	Drain seal pot (supplied by customer)
				V1...16	Ball valve, needle valve



*1: CM6G-S6□10 (with density meter)
*2: CM6G-S67□0, CM6G-S68□0 (with diaphragm pump)

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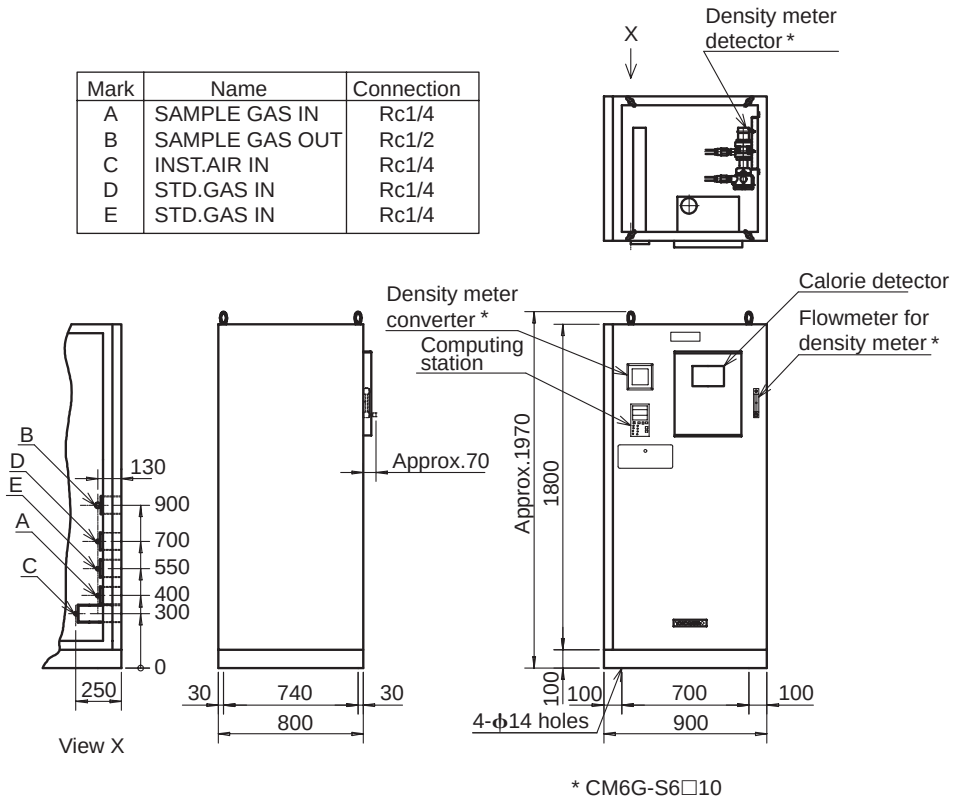
■ DIMENSIONS

1. Town Gas Application

CM6G-S6200, S6210, S6300, S6310, S6400, S6410

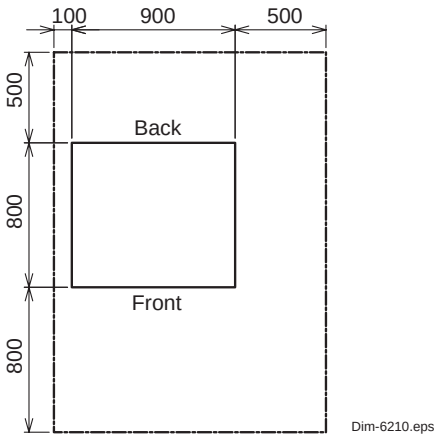
Unit: mm

Mark	Name	Connection
A	SAMPLE GAS IN	Rc1/4
B	SAMPLE GAS OUT	Rc1/2
C	INST.AIR IN	Rc1/4
D	STD.GAS IN	Rc1/4
E	STD.GAS IN	Rc1/4



* CM6G-S6□10

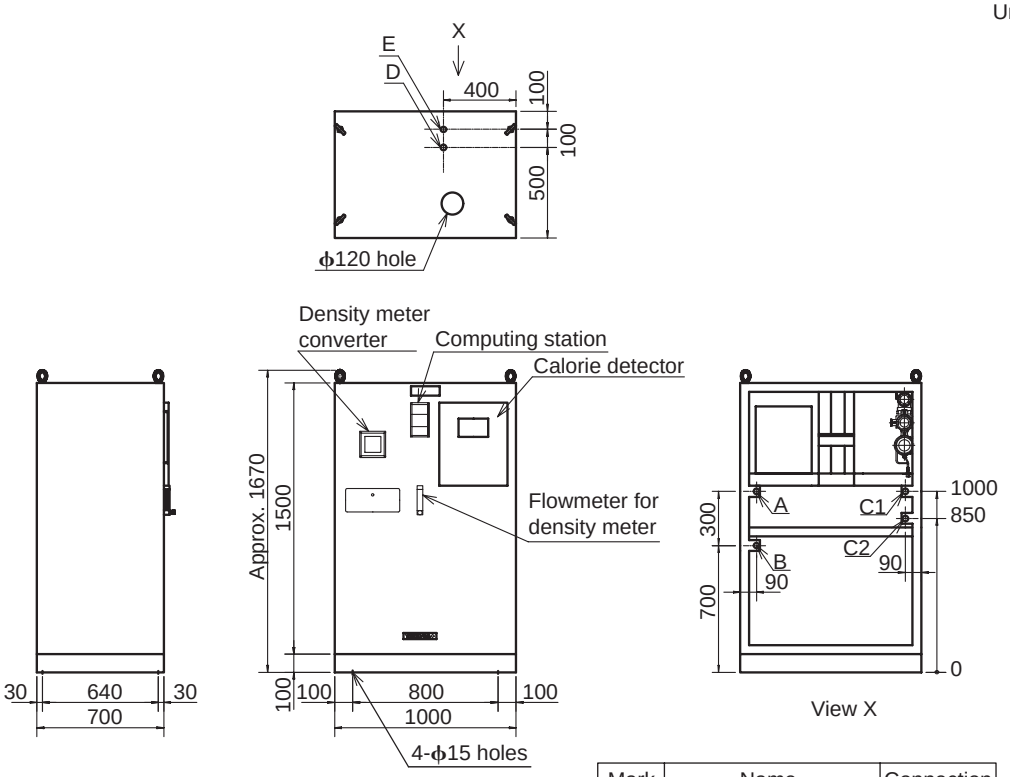
Maintenance Space



2. Town Gas Application (Quake-proof Type)

CM6G-S6110

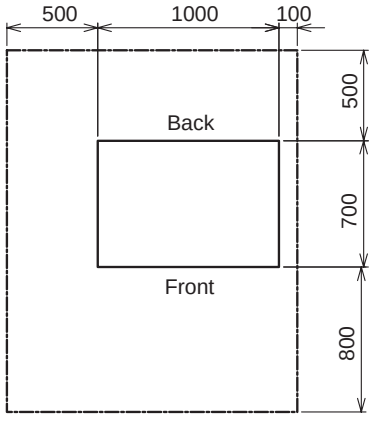
Unit: mm



Mark	Name	Connection
A	SAMPLE GAS IN	Rc1/4
B	INST.AIR IN	Rc1/4
C1	STD.GAS IN (ZERO)	Rc1/4
C2	STD.GAS IN (SPAN)	Rc1/4
D	SAMPLE GAS VENT	Rc1/2
E	SAMPLE GAS VENT	Rc1/2

Wiring to switch box should be made through the bottom.

Maintenance Space



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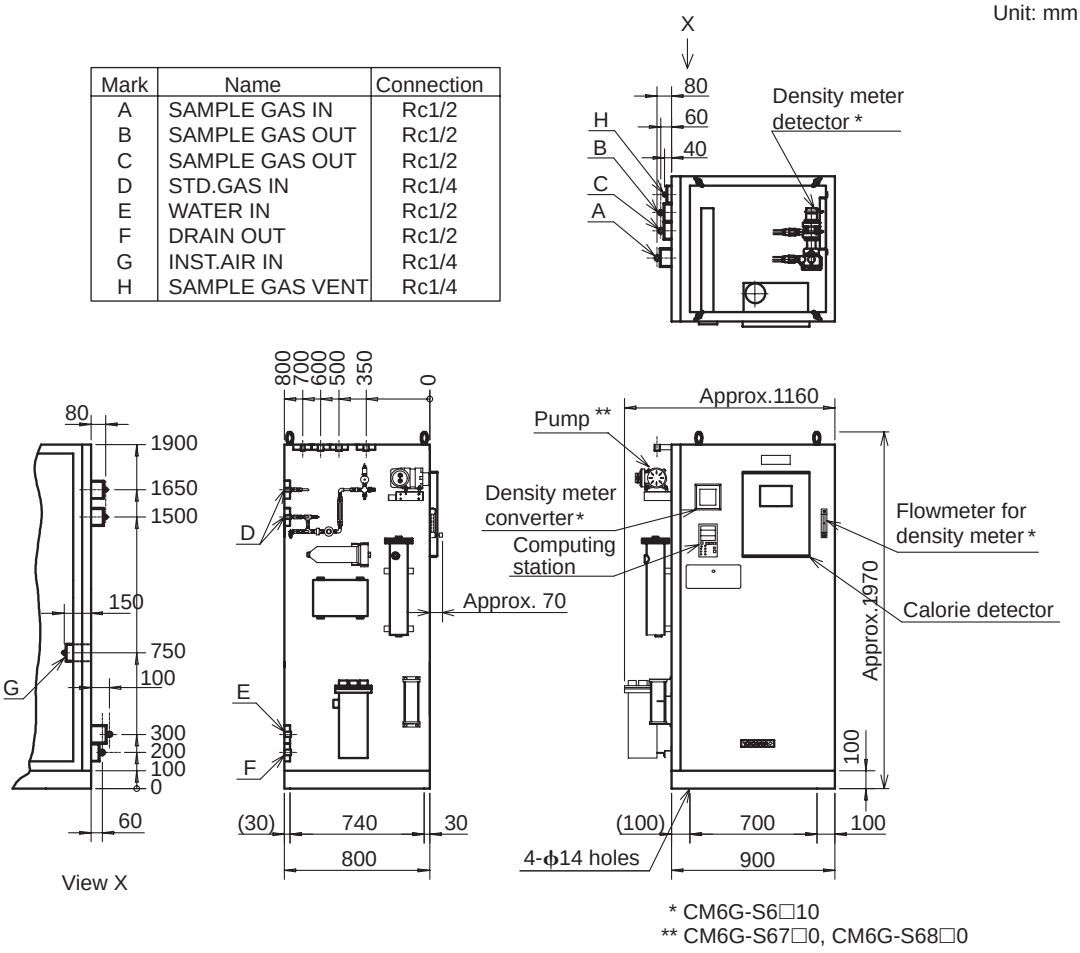
3. Steel Mill Application

CM6G-S6500, S6510, S6600, S6610, S6700, S6710, S6800, S6810

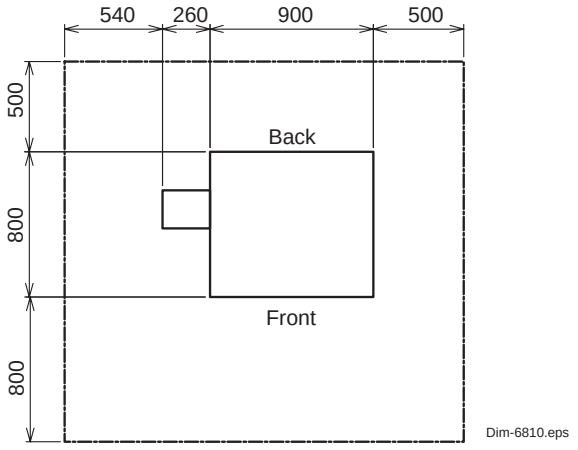
Unit: mm

Mark	Name	Connection
A	SAMPLE GAS IN	Rc1/2
B	SAMPLE GAS OUT	Rc1/2
C	SAMPLE GAS OUT	Rc1/2
D	STD.GAS IN	Rc1/4
E	WATER IN	Rc1/2
F	DRAIN OUT	Rc1/2
G	INST.AIR IN	Rc1/4
H	SAMPLE GAS VENT	Rc1/4



* CM6G-S6□10
** CM6G-S67□0, CM6G-S68□0

Maintenance Space

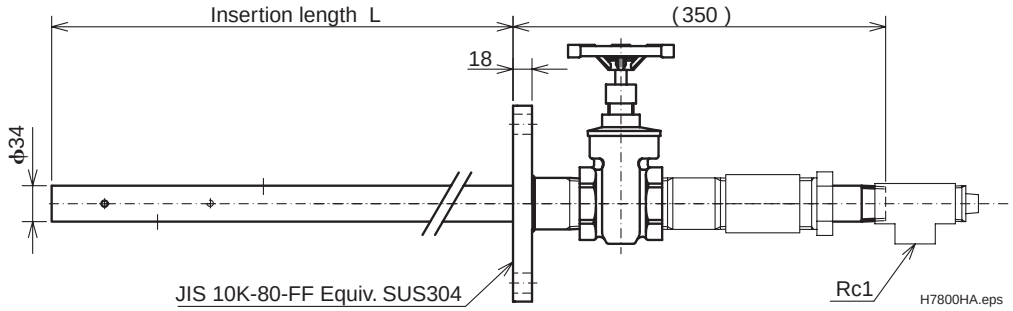


■ DIMENSIONS OF OPTIONS

1. Open Probe

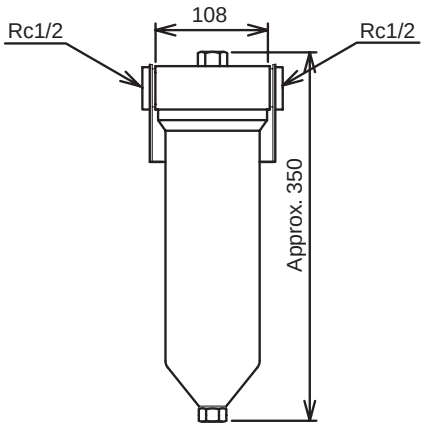
Unit: mm

Part number	L
H7800HA	Approx. 650
H7800HB	Approx. 1150
H7800HC	Approx. 1650



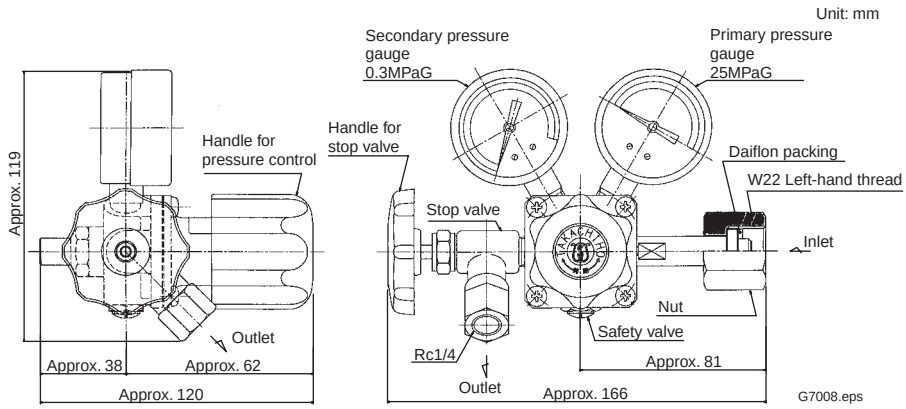
2. Fulflo Filter (Part no.: G7043XJ)

Unit: mm



3. Pressure Reducing Valve (Part no.: G7008XF)

Unit: mm



■ Installation Procedures

Installation Site

(1) Adequate space for maintenance should be provided around the gas calorimeter.
(2) The base should be horizontal.
(3) No rapid change in ambient temperature is allowed. Rapid change here means a change of approximately 10°C within 30 minutes.
(4) Minimal vibration is allowed. (If much vibration is unavoidable, take an appropriate measure to absorb shock, e.g., use of vibration-proof rubber.)
(5) A ventilation system should be provided.
(6) Corrosive gases and dust are present in small quantities and humidity is low.

Installation of the Optional Open Probe (Reference)

(1) The open probe should be installed at an angle that does not allow drain generated at the probe outlet to flow back into the probe.
(2) Steam piping should be installed, if necessary, to prevent drain from freezing.
(3) Steam piping for probe blowback should be installed, if necessary.
(4) Safe space for maintenance should be considered.

Installation of the Seal Pot (Reference)

The seal pot should be positioned so that drain generated in the sample gas between the probe and the seal pot flows into the seal pot.

Others (Reference)

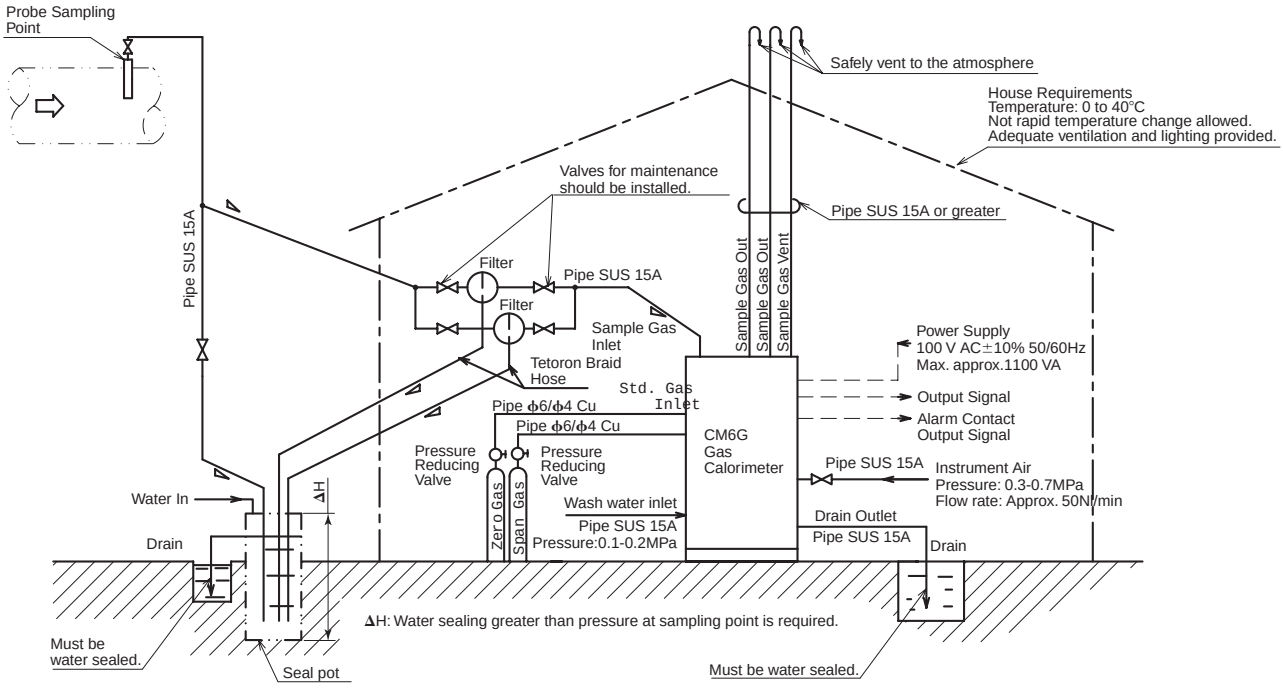
Calibration gas cylinders for the gas calorimeter should be installed and connected. Calibration gas cylinders are heavy, so they should be installed in a place allowing easy replacement. The installation place should also be as close to the gas calorimeter as possible.

Wiring Work

(1) Use conduits for power and other wiring.
(2) Select the appropriate nominal conductor size of the power line based on the power consumption and wiring distance. For example, if the power consumption is 200 VA, the one-way resistance of the wire should be within 1.25 Ω. (If a wire with a nominal size of 1.25 mm^2 is used, the maximum wiring distance is 75 m.)
(3) Upon completing the wiring to the calorimeter, make sure that the wiring is made correctly.
(4) For ground wiring, use an insulated wire with a nominal size of at least 2 mm^2. The ground resistance should be 100 Ω or less (JIS Class D grounding).
(5) For signal wiring, use insulated wires. Wiring work should be appropriately done in accordance with the wiring distance and allowable load resistance.

Piping Work

(1) Before the piping to the gas calorimeter, wash the inside of the pipes to remove oil, dist and other impurities, and dry it.
(2) After the piping, be sure to perform a leak test applying a pressure greater than the operating pressure.
(3) Sample gas may contain dangerous gases such as combustible gas, oxygen-depleted gas, and toxic gas. The gas should be safely discharged through vent pipes in accordance with local regulations. (In principle, the pressure of the discharge point is atmospheric pressure.)
(4) Instrument air to be used must be clean and dehumidified. After installing the pipe for instrument air, make sure that the inside is not stained.
(5) After installing pipes for standard gases, make sure that the inside is not stained.



Note F denotes that piping should be installed at an angle that allows drain to flow downstream and smoothly.

GAS CALORIMETER ENQUIRY SHEET

Thank you for enquiring about our gas calorimeter. Please specify your requirements by making checks in each applicable ☐ and writing in the underlined parts.

1. General Information

Customer: _____ Contact person: _____ Sect: (phone:)
Name of plant: _____
Measuring point: _____
Purpose: ☐ measurement ☐ control ☐ alarm ☐ trading
Power supply: ☐ 100 V AC ☐ 50 Hz ☐ 60 Hz

2. Process Conditions

Sample gas: ☐ town gas ☐ fuel gas in steel plant
Measurement: ☐ WI ☐ calorific value
Measuring range: _____to_____ (specify in the range of 3 to 62 MJ/Nm^3)
Gas pressure: ☐ For town gas
☐ 10 to 20 kPa ☐ 10 kPa or under ☐ 100 to 600 kPa
☐ For steel plant
☐ 8 to 15 kPa (standard) ☐ 8 kPa or under
Gas temperature: _____to_____ °C (normally _____ °C)
Gas humidity: dew point _____ °C
Dust content: ☐ No dust ☐ Little ☐ Much _____to_____ g/Nm^3
Gas composition:

Gas composition	Nor %	Max %	Min %	Gas composition	Nor %	Max %	Min %
H_2				CO			
CH_4				CO_2			
C_2H_4				N_2			
C_2H_6							
C_3H_8							
C_4H_{10}							

Others:

3. Installation

Ambient temperature: _____to_____ °C
Vibration: ☐ NO ☐ YES
Others:

4. Specification Requirements

Measuring range: _____
Output: 1 to 5 V DC, 4-20 mA DC (simultaneously)
With gas density meter: ☐ YES ☐ NO
Others: _____