User's Manual

Model CM6G
Gas Calorimeter

IM 11R02A01-02E

vigilantplant.®

YOKOGAWA
Yokogawa Electric Corporation

IM 11R02A01-02E
4th Edition

INTRODUCTION

◆ For the safe use of this equipment

■ About This Manual

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- The contents of this manual shall not be reproduced or copied, in part or in whole,without permission.
- This manual explains the functions contained in this product, but does not warrant that they are suitable for the particular purpose of the user.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, when you realize mistaken expressions or omissions, please contact the nearest Yokogawa Electric representative or sales office.
- This manual does not cover the special specifications. This manual may be left unchanged on any change of specification, construction or parts when the change does not affect the functions or performance of the product.
- If the product is not used in a manner specified in this manual, the safety of this product may be impaired.

■ Safety and Modification Precautions

- Follow the safety precautions in this manual when using the product to ensure protection and safety of the human body, the product and the system containing the product.

■ The following safety symbols are used on the product as well as in this manual.

 DANGER

This symbol indicates that an operator must follow the instructions laid out in this manual in order to avoid the risks, for the human body, of injury, electric shock, or fatalities. The manual describes what special care the operator must take to avoid such risks.

 WARNING

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.

 CAUTION

This symbol gives information essential for understanding the operations and functions.

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TIP

This symbol gives information that complements the current topic.

SEE ALSO

This symbol identifies a source to be referred to.

This symbol indicates Protective Ground Terminal

This symbol indicates Function Ground Terminal (Do not use this terminal as the protective ground terminal).

This symbol indicates Alternating current

DANGER

During the time from the start of ignition action to ignition and directly after flame extinction, sample gas mixed with the air will be released from the top of the equipment into the installation space of the equipment.

Even though the sample gas will be diluted sufficiently by the air, great attention should be paid to the following points if the sample gas contains harmful gases such as CO.

- Confirm that the air is supplied before introducing the sample gas.
- Use the equipment in a well-ventilated environment equipped with a ventilation system.
- Do not expose your face above the top of the calorie detector.

◆ After-sales Warranty

■ Do not modify the product.

■ During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you. Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.

- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.

■ In the following cases, customer will be charged repair fee regardless of warranty period.

- Failure of components which are out of scope of warranty stated in instruction manual.
- Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
- Failure due to improper or insufficient maintenance by user.
- Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
- Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
- Failure caused by any usage out of scope of recommended usage.
- Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.

■ Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.

■ Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.

■ Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.

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Model CM6G
Gas Calorimeter

IM 11R02A01-02E 4th Edition

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1. Outline

Model CM6G Gas calorimeter is used to measure and control the calorific value of gases, Wobbe-Index, the theoretical air requirement, and the heat input for various kind of gas burning furnaces.

It detects the temperature rise of the sample gas, which pressure is normally controlled, by burning it at the burner through the medium of air.

It picks up the flow rate of the sample gas and the air as the differential pressure signal and gives you an output signal of WI after compensating calculation of the indication difference caused by the flow rate variation.

It also detects density of the sample gas by a density meter, and add to WI signal density compensation, then, gives you an output of the calorific signal.

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2. Specifications

2.1 Standard Specifications

2.1.1 Town Gas Application

Measurement Object : Measurement and control of WI or the calorific value of fuel gas for town gas.

Measuring Range : 3 to 62 MJ/Nm^3

Sample Conditions :
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; 100 V AC, 5 A, closed when alarm occurs (resistance load)
Temperature alarm; 100 V AC, 3 A, closed when alarm occurs (resistance load)

Contact Input : Remote ignition (Custom order); 24 V DC, 0.1A or more

Repeatability

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

Note 1: High calorific value means 6.3 MJ/Nm^3 or more. 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	Response time (63.2%)
50 or more	30 sec or less	60 sec or less
32 or more, less than 50	27 sec or less	53 sec or less
13 or more, less than 32	23 sec or less	47 sec or less
13 or less	21 sec or less	41 sec or less

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 3.2PB7.4/1.2 (inside and outside)

Ambient Temperature: 0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

2.1.2 Steel Mill Application

Measurement Object : Measurement and control of WI or the calorific value of fuel gas for a steel mill.

Measuring range : 3 to 62 MJ/Nm^3

Sample Conditions :
Dust: 100 mg/Nm^3 or less
Temperature: 50°C or less
Pressure: (1) 8 kPa or over: 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: 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 750Ω or less

Alarm Contact Output : Flame off alarm; 100 V AC, 5 A, closed when alarm occurs (resistance load)
Temperature alarm; 100 V AC, 3 A, closed when alarm occurs (resistance load)

Contact Input: Remote ignition (Custom order); 24 V DC, 0.1A or more

Repeatability :

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

Note 1: High calorific value means 6.3 MJ/Nm^3 or more. 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	Response time (63.2%)
50 or more	42 sec or less	70 sec or less
32 or more, less than 50	39 sec or less	60 sec or less
13 or more, less than 32	36 sec or less	50 sec or less
13 or less	30 sec or less	45 sec or less

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 unit.

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 ± 10%, 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 3.2PB7.4/1.2 (inside and outside)

Ambient Temperature: 0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

2.2 Model and Suffix Codes

2.2.1 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 ro 600 kPa for town gas
	5	- - - - - - - - - -	Gas pressure 8 kPa or over for steel mill, without preheating
	6	- - - - - - - - - -	Gas pressure 8 kPa or over 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	*C	- - - - - - - - - -	Style C

Note: Measuring range and unit must be specified.

2.2.2 Standard Accessories

Followings are the standard accessories supplied.

• Calorie Detector

Name	Q'ty	Part No.	Remarks
Mirror	1	E7023FF	644Y02, (Brass)
Fuse	2	A1094EF	3 A

• Orifice Assembly

Name	Q'ty	Part No.	Remarks
O-Ring	1	Y9114XB	P16 (Viton)
O-Ring	3	L9817MT	P20 (Silicon)
Hexagon Wrench	1	L9827AB	Nominal size 1.5 mm
Hexagon Wrench	1	L9827AC	Nominal size 2.5 mm

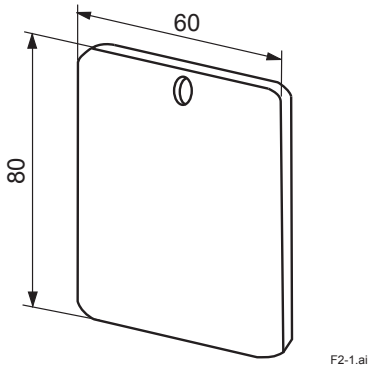


Figure 2.1 Mirror

2.2.3 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.

2.2.4 Option

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

2.3 Standard Systems for Each Application

2.3.1 Standard Systems for Each Application

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

* 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.

2.3.2 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 $1/\sqrt{\rho g}$.

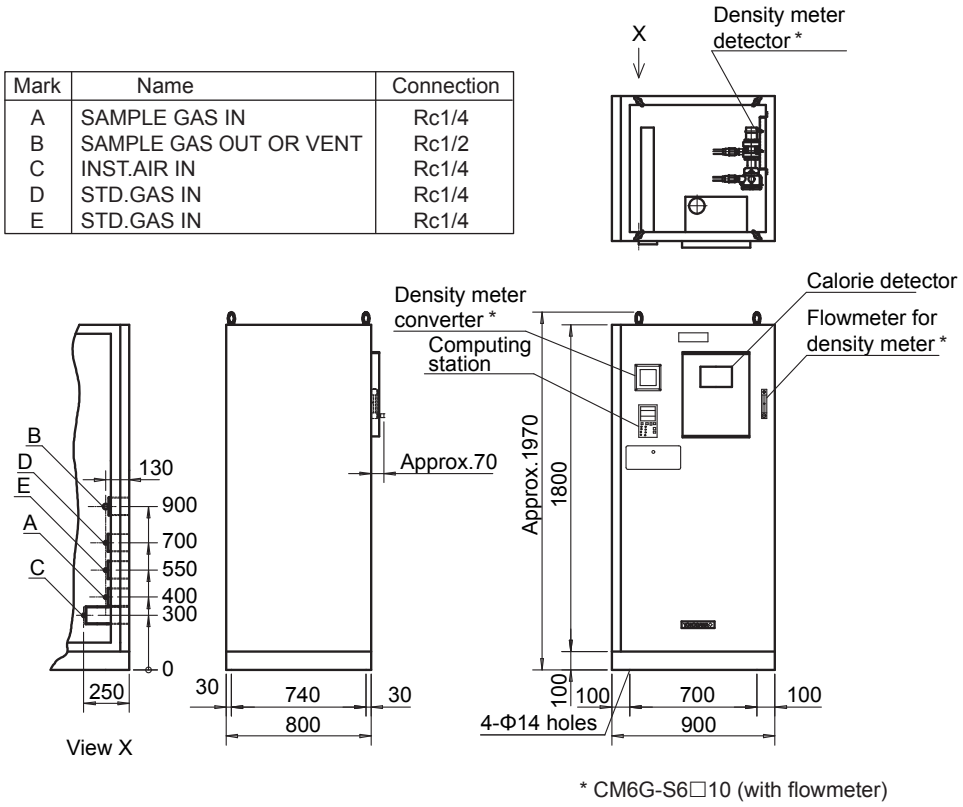
2.4 External Dimensions

2.4.1 For 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 OR VENT	Rc1/2
C	INST.AIR IN	Rc1/4
D	STD.GAS IN	Rc1/4
E	STD.GAS IN	Rc1/4



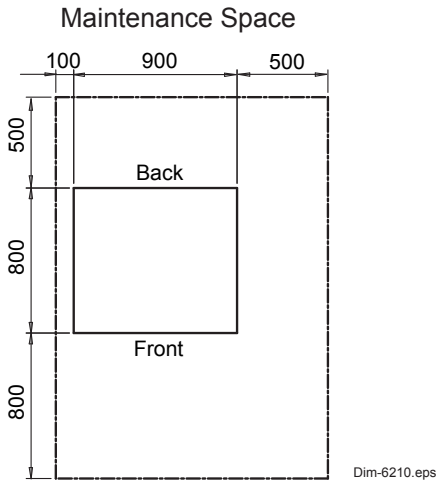
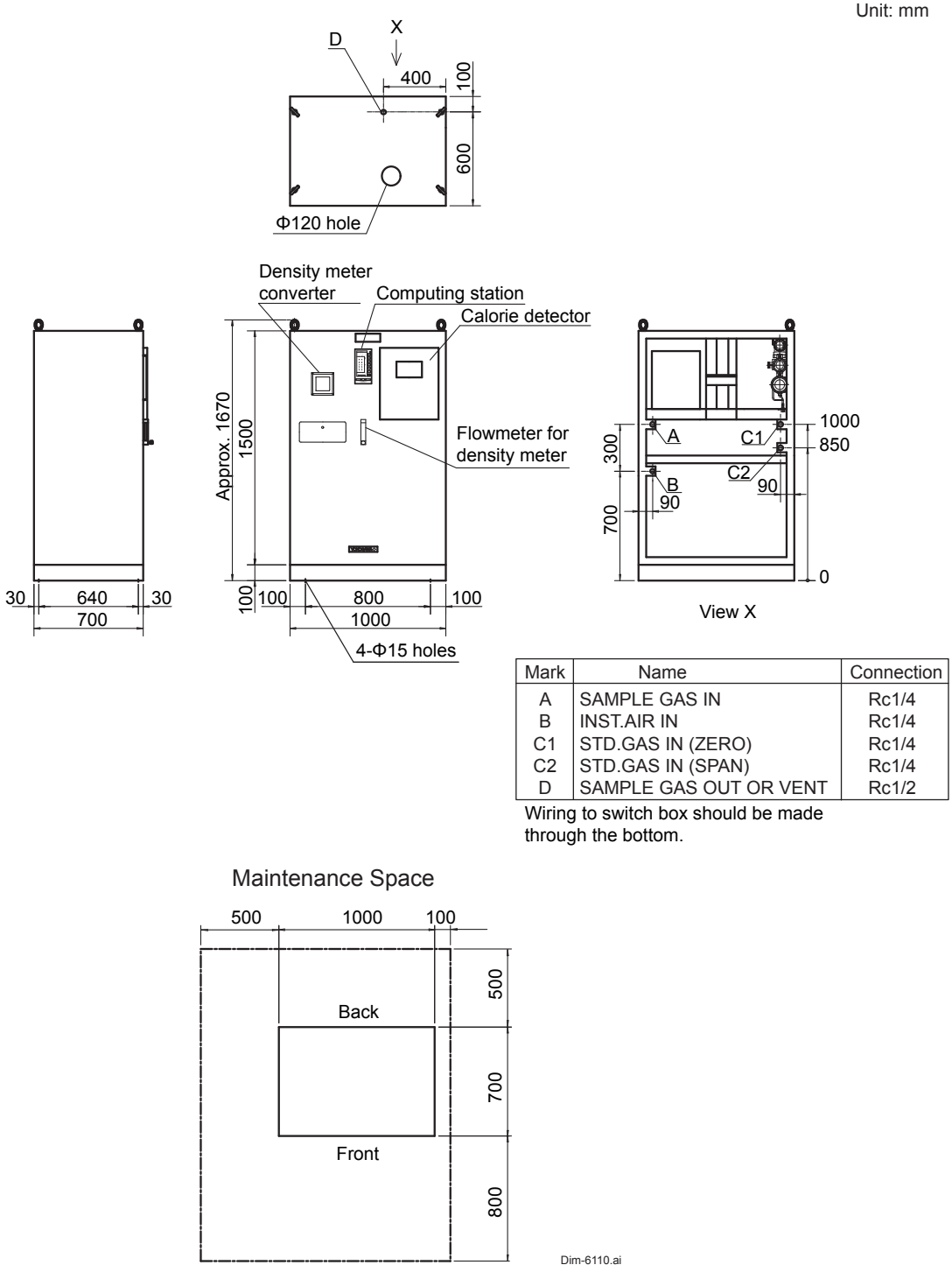


Figure 2.2 External Dimensions For Town Gas Use

2.4.2 For 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 OUT OR VENT	Rc1/2

Wiring to switch box should be made through the bottom.

Figure 2.3 External Dimensions For Town Gas Use (Quake-proof Type)

2.4.3. For 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

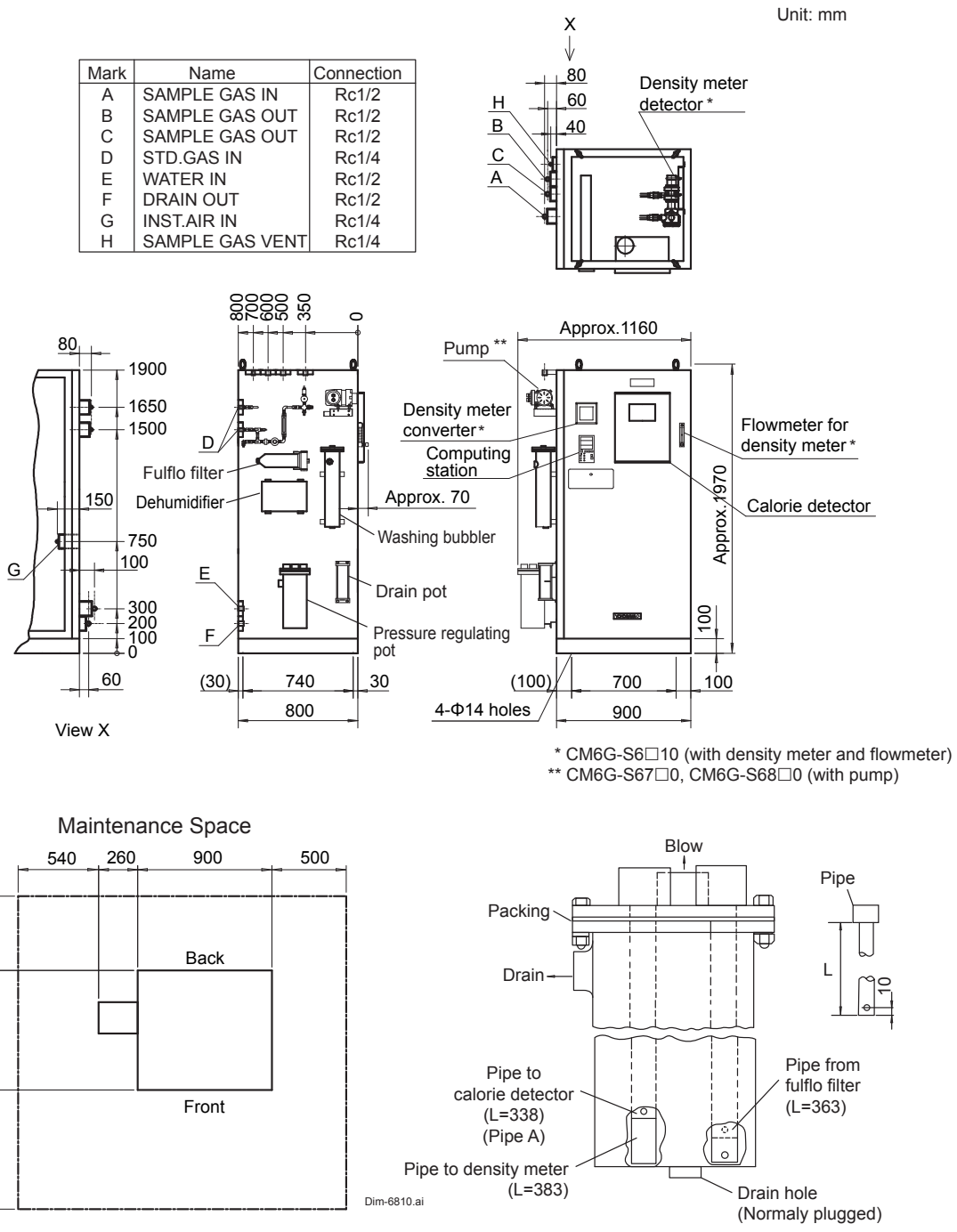


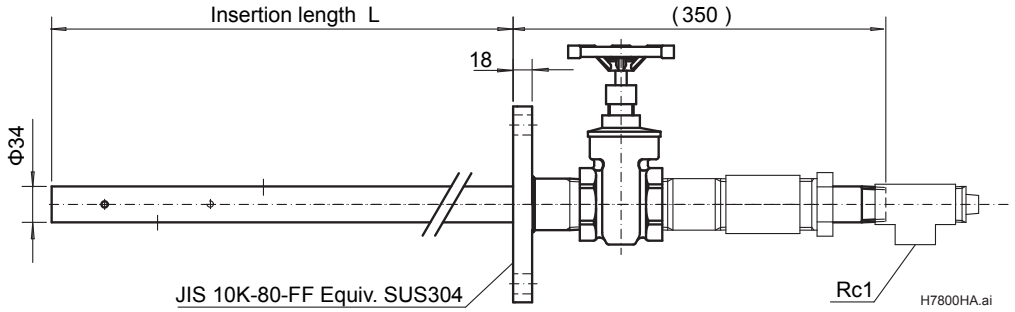
Figure 2.4 External Dimensions For Steel Mill Use

2.4.4 Dimensions of Options

1. Probe

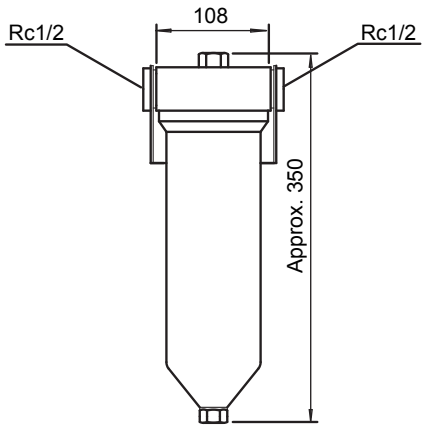
Unit: mm

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



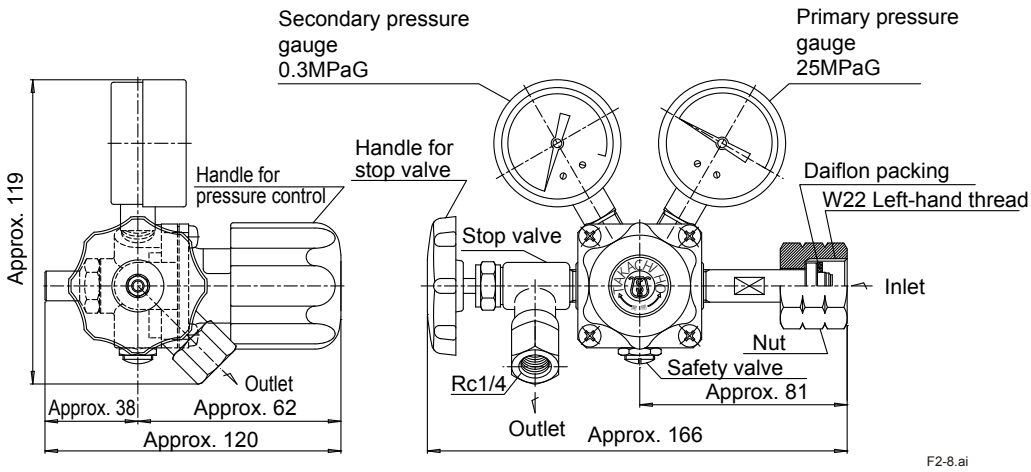
2. Fulflo Filter (Part no.: G7043XJ)

Unit: mm



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

Unit: mm



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3. Installations

Observe the following conditions when installation being held.

(1) Adequate space for maintenance should be provided around the gas calorimeter.

(2) The base should be horizontal.

(3) Ambient temperature is 0 to 40°C and no rapid change in ambient temperature is allowed. Rapid change here means a change of approximately 10°C within 30 minutes.

(4) Install the instrument in the place where it is not directly exposed to the current of a conditioned air.

(5) Minimal vibration is allowed (If much vibration is unavoidable, take an appropriate measure to absorb shock, e.g, use of vibration-proof robber).

(6) A ventilation system should be provided.

(7) Corrosive gases and dust are present in small quantities and humidity is low.

(8) The water of the sampling system and the drain line do not freeze up.

 DANGER

During the time from the start of ignition action to ignition and directly after flame extinction, sample gas mixed with the air will be released from the top of the equipment into the installation space of the equipment. Use the equipment in a well ventilated environment equipped with a ventilation system.

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4. Outside Pipings

The connections for panel refer to the drawing Figure 2.2, Figure 2.3 and Figure 2.4.

The principal points to be taken care are as follows:

- Bent the outlet of the blow piping as shape U, and prevent it from the rain penetration. Set the location of the outlet at higher position as much as possible where there is little fear of danger.
- Drain piping shall be conducted so that it stays below the drain outlet and no drain accumulated on the panel bed.
- It is necessary for the sample line of the steel mill use instrument to provide a slope of more than 1/3, so that there happens no blockade to the gas line by the drain at the bending part of the piping. Make piping as short as possible. Equip the sample line with thermal insulation so as to prevent drain in the pipe line to be freezed.
- Locate the standard gas cylinders at the place where they are not exposed to direct sunshine and comparatively cool.

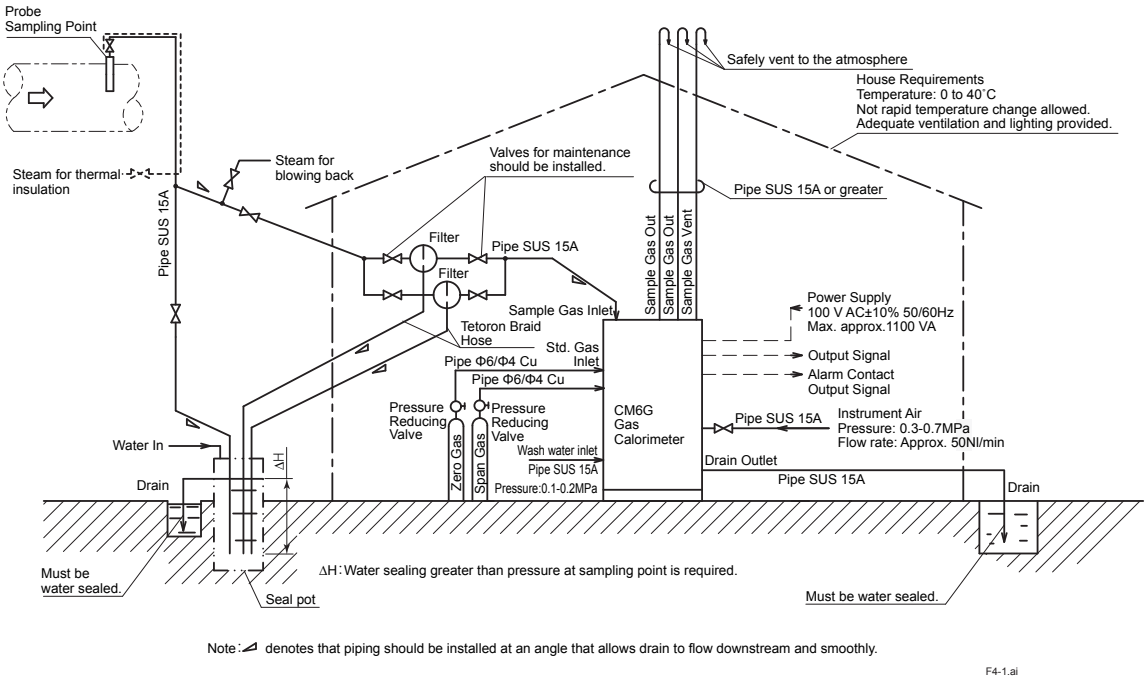


Figure 4.1 Recommended Sampling for Steel Mill Use

- Sampling point shall be made at the location above or side the transfer pipe, and in case of being installed on the side location, fix it with a slope that the top end of the probe is facing downward.
- When fixing the probe use a flange JIS 10K 80A.
- At the sample gas outlet of the probe, recommend to provide a gate valve of 1/2 inch.

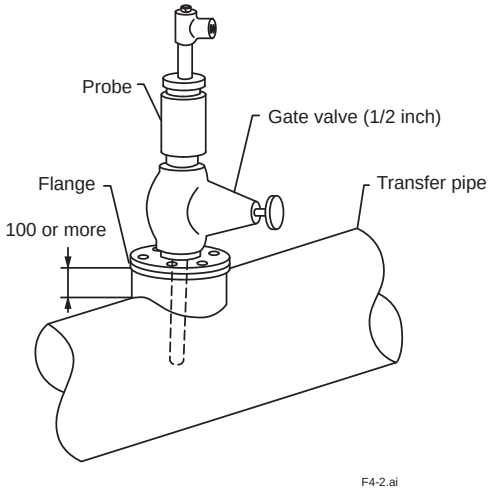


Figure 4.2 Mounting of the Probe

- Fix filter vertically with their drain outlets facing downward, but firmly to wall or to pillar using something like U bolt. Provide 1/2 inch gate valves at the sample gas inlet and outlet. Take an ample space under filters so that checking and replacing of elements can be held easily. For drain exhaust pipe use a flexible pipe

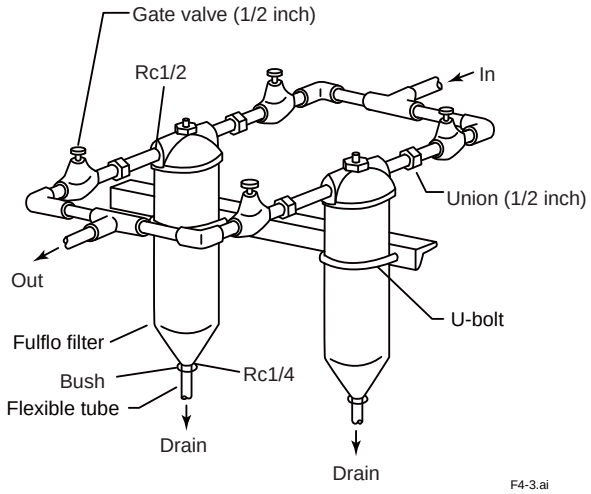


Figure 4.3 Example Fulflo Filters with the Piping

5. External Wirings

External wires shall be connected from the terminal block of the switch box inside the panel. Use M4 terminal screws. Use appropriate crimp terminals at the wire ends.

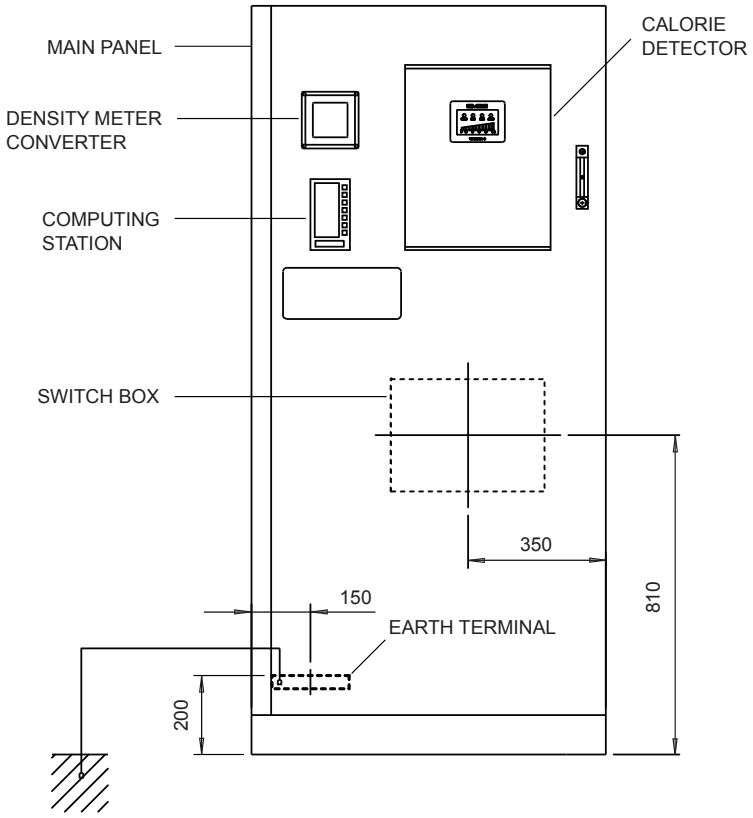


Figure 5.1 Switch Box and Earth

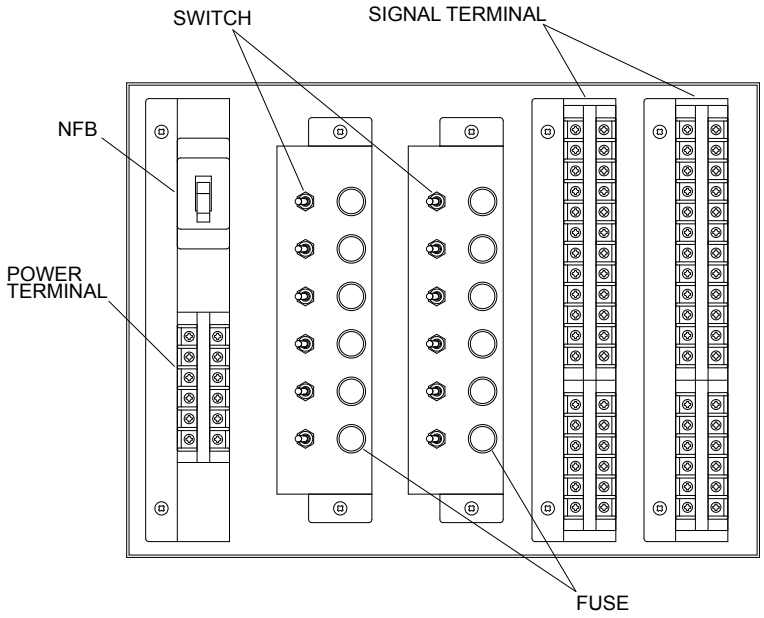


Figure 5.2 Inside a Switch Box

5.1 Notes on Wiring

⚠ WARNING

- Cables and wires must be connected after all power supplies are turned off.
- An electrical wiring duct must not be used for the simultaneous connection of a large capacity converter, motor, or power supply.
- When cables are connected in a place with high or low ambient temperatures, use cables suitable for the place where they are used.
- When cables are used in an atmosphere where harmful gases, liquids, oil, or solvents are present, use cables made of materials capable of withstanding those things.
- Use crimp terminals with insulated sleeve (M4 screws) for the wire ends.

5.2 Wiring to Peripheral Equipment

5.2.1 Power Supply

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm^2 or more, or a wire or cable that is the equivalent or better.

5.2.2 Grounding

Connect a grounding wire to the grounding terminal inside the panel. A grounding wire must be connected so that the grounding resistance becomes 100 Ω or less (equivalent to JIS Class D).

5.2.3 Analog Output (4 to 20 mA DC)

Use a shielded twisted pair cable with a cross-section area of 0.5 mm^2 or more, or a cable that is the equivalent or better, and install it separately from the power supply and alarm output cables and sources of electromagnetic interference. A shielded cable must be connected to the frame ground (FG) beside each of the output terminals. The load resistance from the perspective of this equipment must be 750 Ω or less.

5.2.4 Contact Output

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm^2 or more, or a wire or cable that is the equivalent or better.

The flame extinction alarm contact and orifice chamber temperature drop alarm contact must be non-voltage dry contacts and the contact rating must be as follows.

Contact	Rating
Flame distinction alarm contact	100 V AC 5 A
Orifice chamber temperature drop alarm contact	100 V AC 3 A

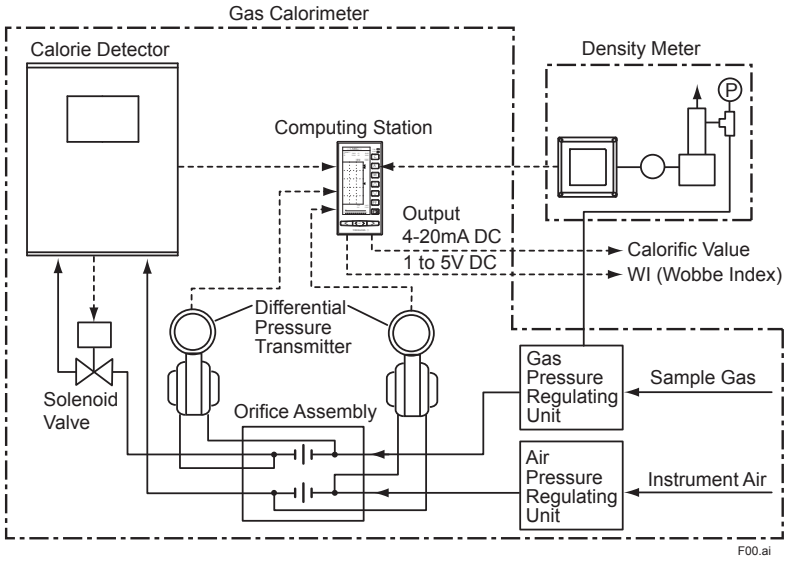
5.2.5 Contact Input (Remote Ignition: Custom Order)

A non-voltage contact must be input as a contact input signal. The contact rating is 24 V DC 1 A. The open or closed state of the input is determined by the resistance value from the perspective of this equipment. The resistance value also includes the wiring resistance.

Contact closed: 200 Ω or less. Contact open: 100 kΩ or more.

6. Construction and Function

Typical System Configuration



Item	Function / Description
Calorie detector	Detects WI or calorific value. 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.

Figure 6.1 Components and Functions of Model CM6G Gas Calorimeter

6.1 Air Pressure Regulating Section

SEE ALSO

Refer to Figure 6.2, 6.3 and 6.4

The instrument air pressure (300 to 700 kPa) is reduced by air set (2-1) to about 200 kPa, further reduced to about 20 kPa by the pressure reducing valve (2-2) and after that the pressure is set by needle valve (V-16) to the differential pressure 500 Pa.

The air is controlled at 40°C in the preheater, which helps the temperature control by the orifice.

When the temperature is increased more than 60°C, thermostat in the preheater operates and intercepts the power supply of the heater. This air pressure regulating section is common to all systems.

6.2 Gas Pressure Control Section

The gas pressure regulating section has two different kind types, town gas use and steel mill use.

6.2.1 Town Gas Use

See Also

Refer to Figure 6.2 and 6.3

The sample gas, introduced through line filter (3-1), increase its pressure by pump, or decrease by pressure reducing valves, according to the pressure at the sampling point. The pressure gauge (3-2) indicates 8 to 18 kPa and the flowmeter (3-3) approx. 10 l/min, respectively. The sample gas, then, is set its differential pressure to 500 Pa by pressure reducing valve (3-4) and (3-6), and at this time the pressure gauge (3-5) indicates approx. 3 kPa. When the density compensation system is equipped, it is introduced to the density meter with the flow rate of 1 l/min, through the flowmeter (5-3).

The standard gas is reduced its pressure to 8 to 18 kPa by the pressure reducing valve (4-1), and supplied, same as the sample gas, with the flow rate approx. 10 l/min.

6.2.2 Steel Mill Use

See Also

Refer to Figure 6.4.

The pressure of the sample gas is increased, by the pump, according to that of the sampling point.

The pressure gauge (3-1) indicates approx. 6 kPa. The sample gas then flows through the washing bubbler (3-2) and the fulflo filter (3-3), and then secure a constant pressure in the pressure regulating pot (3-4) through the water sealed pipe from the dehumidifier (3-5), then set the differential pressure by the pressure reducing valve (3-6) to 500 Pa.

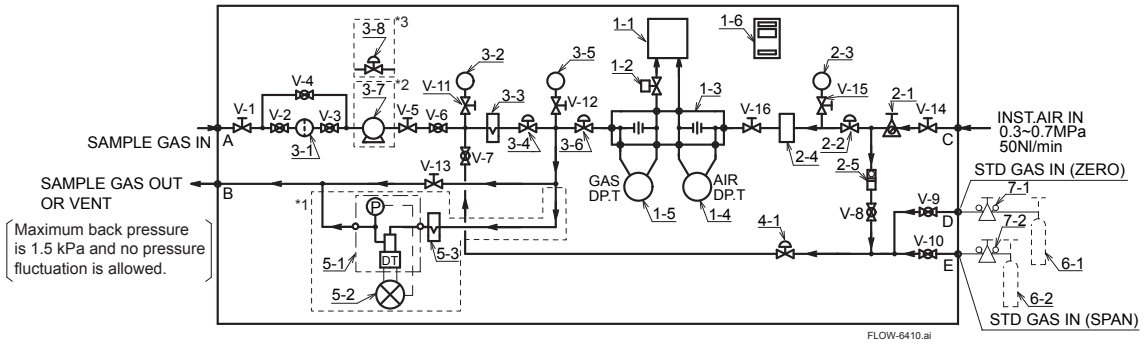
In case of increasing the pressure by the pump, the drain pot (3-9) is added. When the density compensation system is equipped, the sample gas is supplied to the density meter with its flow rate of 1 l/min, through the flowmeter (5-3). The pressure of the standard gas is reduced by the pressure reducing valve (4-1) to about 6 kPa and is supplied by the flowmeter (4-2) with the flow rate about 10 l/min.

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)

Figure 6.2 Flow Sheet (for Town Gas)

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				

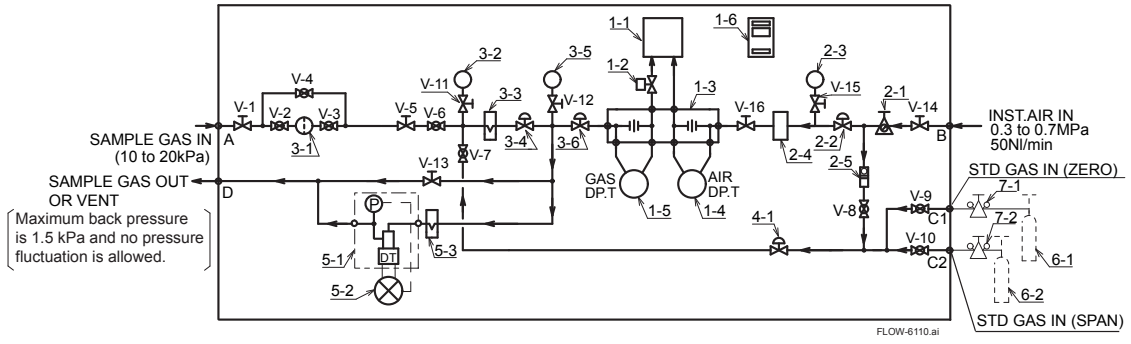


Figure 6.3 Flow Sheet (for Town Gas)

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 bubbler	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 pot	6-1	Water Flowmeter
1-5	Differential pressure transmitter (gas)	3-5	Dehumidifier	7-1	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 pot (supplied by customer)
				V1...16	Ball valve, needle valve

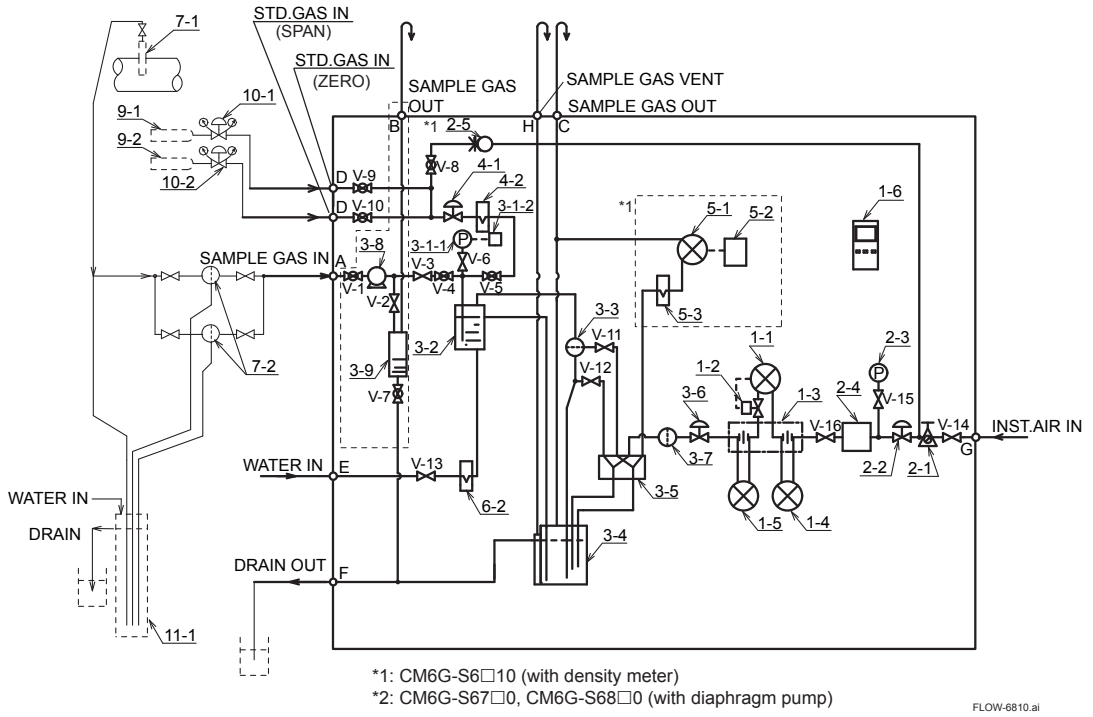


Figure 6.4 Flow Sheet (Steel Mill Use)

6.3 Differential Pressure Detection Part

In order to calculate the differential pressure correction value, the flow rate is acquired from the orifice as a differential pressure and converted to an electrical signal using the differential pressure transmitter. The orifice is housed in a constant temperature chamber (orifice assembly), the temperature of which is maintained at approximately 50°C by the temperature controller, to prevent the temperature drift of the actual flow rate.

When the temperature exceeds 90°C, the safety thermostat is activated to shut off the heater power supply. When the temperature falls after the power supply is shut off, the alarm thermostat is activated to provide an alarm (closed contact) output.

⚠ WARNING

Power is supplied to the differential pressure transmitter and the temperature controller from the calorie detector. To operate the transmitter and the controller, turn on the calorie detector switch of the switch box and the POWER switch on the front panel of the calorie detector.

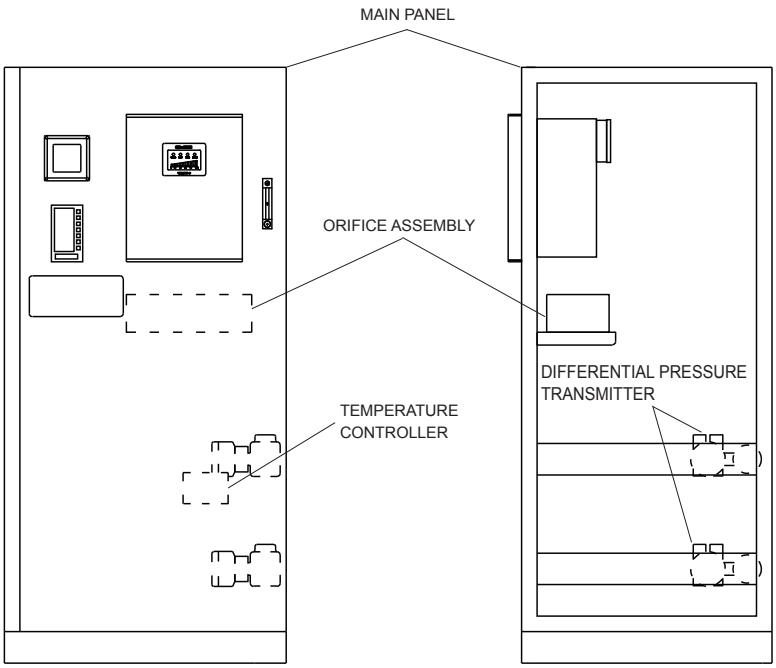
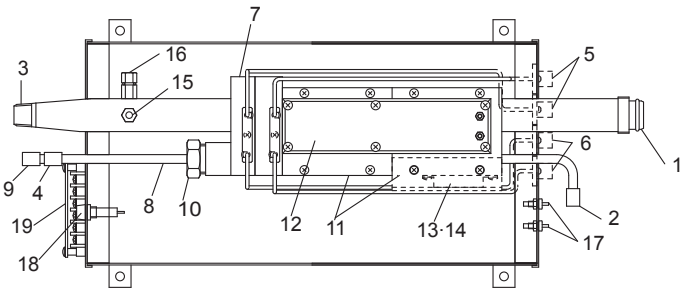


Figure 6.5 Differential Pressure Detection Equipment



No.	Name	No.	Name	No.	Name
1	Air inlet	8	Gas orifice section	15	Thermistor (check)
2	Gas inlet	9	Crotchet joint	16	Thermistor (control)
3	Air outlet	10	Fitting screw	17	Temperature check terminal
4	Gas outlet	11	Heat conversion block	18	Neon lamp
5	Air differential pressure take-out	12	Heater plate	19	Terminal
6	Gas differential pressure take-out	13	Safety thermostat (up)		
7	Gas orifice section	14	Alarm thermostat (down)		

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Figure 6.6 Orifice Assembly

6.4 Calorie Detector

The calorie detector consists of a burner unit, which detects the temperature difference before and after the sample gas is burned, a detected signal amplification and ignition-and safety sequence circuit, and distributor circuits of the transmitter for air and the transmitter for gas.

The detected signal is converted from approximately 0 - 20 mV to 1 - 5 V DC and input to the computing station. If burner flame extinction or excessive combustion occurs, an alarm (closed contact) output is produced.

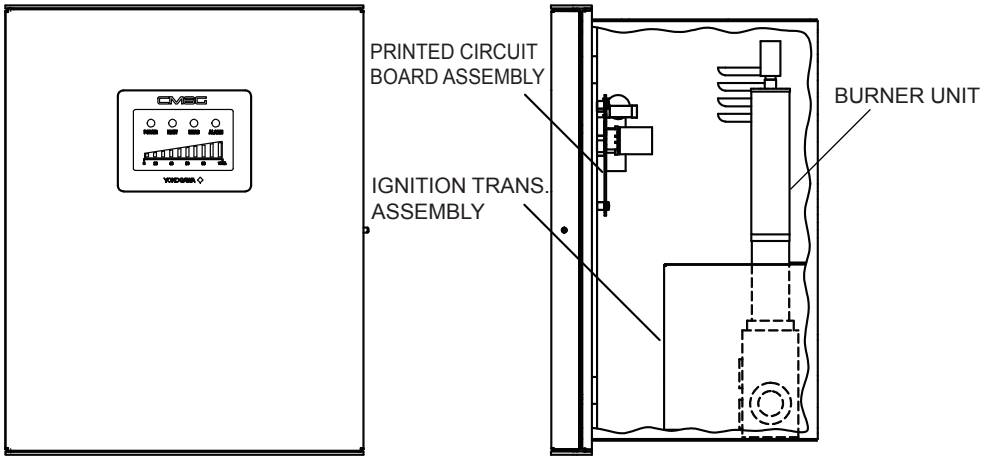
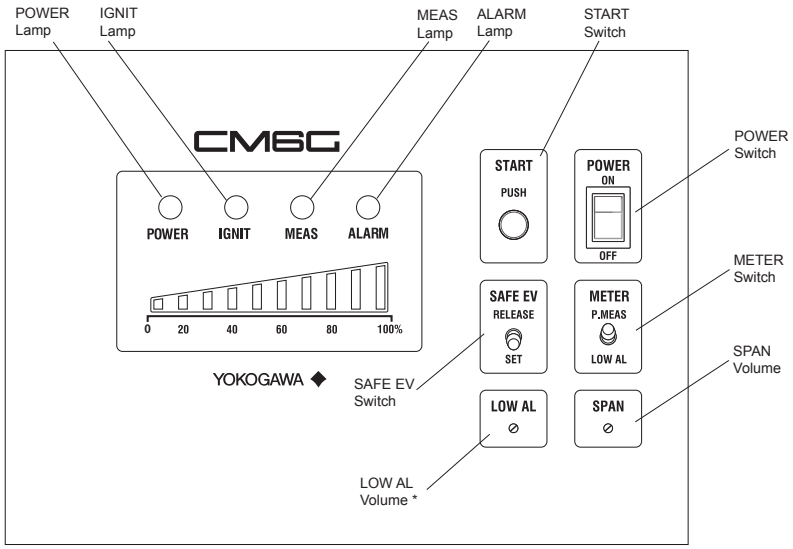


Figure 6.7 Calorie Detector



*: After diselectrifying, perform the adjustment by using SPAN volume and LOW AL volume.

Figure 6.8 Front Panel Assembly

Table 6.1 Function and operation procedure for each switch of the calorie detector

Name	Function and operation procedures
"POWER" switch	• Power supply switch. • Turn to "ON", power supply is supplied to the calorie detector and at the same time light the amps, "POWER" and "ALARM".
"START" switch	• After one push on "START" switch, the gas is supplied to the burner unit and operate the ignition. • On the same time light the lamp "IGNIT", the lamp "ALARM" is lit off. • If ignite within the preset time, the lamp "IGNIT" is lit off but light the lamp "MEAS". • If not ignite within the preset time, the lamp "IGNIT" is lit off and light the lamp "ALARM" again.
"SAFE EV" switch	• Normally leave the switch at "SET" portion. • When adjust the differential pressure turn it to "RELEASE". When the lamp "ALARM" is let off, alarm is released and solenoid valve of the gas line is opened. • If leave the switch position stay at "RELEASE" from "SET" nothing happens, but in such case no alarm signal is given even when extinguishing the burner, so be careful of this matter. • When the switch shows "RELEASE", it doesn't start even if the switch "START" be pushed.
"METER" switch	• Pressing this switch switches the indication of the indicator and the X5 display*1 of the computing station between "P.MEAS" and "LOW AL" • The switching does not affect the final output and sequence action.
"SPAN" volume	• With this span volume you can adjust the output of the calorie detector to 1 - 5 V DC. • If turn to the right the span point becomes bigger.
"LOW AL" volume	• The level set for the extinction alarm (lower alarm) is decided by this volume. • If turn to the right the alarm level becomes higher.
"POWER" lamp	• When the lamp is lit, power is being supplied to the calorie detector, differential pressure transmitter, and temperature controller.
"IGNIT" lamp	• During the lamp is lighting, this is ready to be ignited.
"MEAS" lamp	• During the lamp is lighting, it is under the measurement condition.
"ALARM" lamp	• During the lamp lighting, alarm function is being given.

(*1) The display range of X5 is 0 to 30.0 mV. "P.MEAS" and "LOW AL" indicate the following values.

	Signal Name	Display Value
"P.MEAS"	Thermocouple electromotive force	0 - 20.0 mV
"LOW AL"	Flame extinction alarm threshold value	0 - 10.0 mV (= 0 - 100%)

6.4.1 Burner Unit

The sample gas burns inside the burner unit and a thermocouple detects the burning temperature increase. The air is introduced from the air inlet and divided to the primary, secondary and tertiary air. The primary and secondary ones are for burning the sample gas and the tertiary is for diluting and stirring the exhaust gas. The sample gas is mixed with the primary air (In case of the low calorie gas, the primary air is throttled), and burnt completely by the secondary air. Then, the combustion temperature generates, and burnt gas is promptly diluted and stirred by the tertiary air. Finally the gas is exhausted out from the top of the calorie detector.

The increased temperature is measured with the difference of the electromotive force between the cold junction point (located at the air inlet) and the hot junction point (inside the mixed diluted exhaust gas). The heating wire wound the burner tip is used for both ignition and preheating. (In case of low calorie gas)

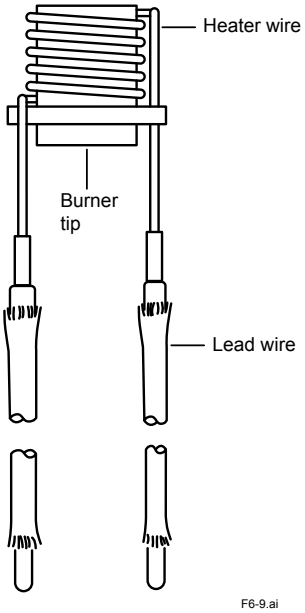
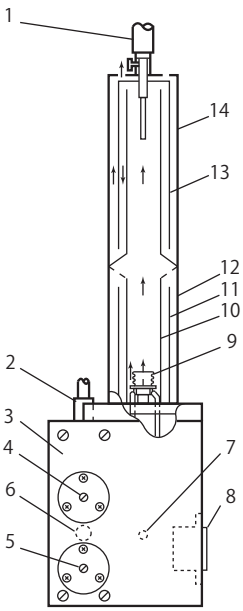


Figure 6.9 Burner Tip Assembly



No.	Name
1	Hot junction detect point
2	Cold junction detect point
3	Air divider
4	Secondary air throttle screw
5	Primary air throttle screw
6	Air inlet
7	Gas inlet
8	Connector
9	Burner tip assembly
10	Combustion pipe
11	Stream contact pipe
12	Measuring pipe
13	Reverse flow pipe
14	External pipe

Figure 6.10 Burner Unit

6.4.2 High/Low Alarm Action

Higher and lower alarm limits are set for the amplified thermocouple output, respectively, to execute a sequence.

The higher alarm limit is the alarm point for the excessive combustion of the burner, which is set to approximately 120% of the span. The lower alarm limit is the alarm point for the flame extinction of the burner, which can be changed in a range appropriate to each measurement range using the “LOW AL” volume on the front panel of the calorie detector. This alarm point is set to an appropriate value in the final adjustment test at the factory before shipment.

If the higher or lower limit alarm occurs, the electromagnetic valve (EV) is closed to stop the supply of gas

6.4.3 Ignition Action

When the START switch on the front panel of the calorie detector is pressed, the ignition action starts. The ignition action constitutes one cycle that consists of the time during which the ignition voltage is applied to the heater (T1) and the time during which the voltage is not applied (T2) (in the case of gas with low calorific value, the time during which the preheating voltage is applied). This cycle is repeated five times normally. The T1 time and T2 time are set independently within the range from approximately 2 to 20 seconds depending on the measurement range and gas composition.

If the amplified thermocouple output exceeds the lower alarm limit, the burner is determined to be ignited and the ignition action is stopped even if it is not completed. If the burner is not ignited after the ignition voltage is applied five times, the ignition action is stopped after the ignition voltage is applied for the fifth time. In that case, when the START switch is pressed again, the ignition action starts.

If the burner is extinguished as a result of the alarm, removing the cause of the failure and pressing the START switch will start the ignition action again. If the alarm occurs due to excessive combustion and the alarm status continues, the ignition action cannot be started until the thermocouple output falls below the lower alarm limit (*1). Indication lamps turn ON or OFF in accordance with each stage of the sequence.

Figure 6.11 shows the ignition sequence for which the lower alarm limit is set to 50%.

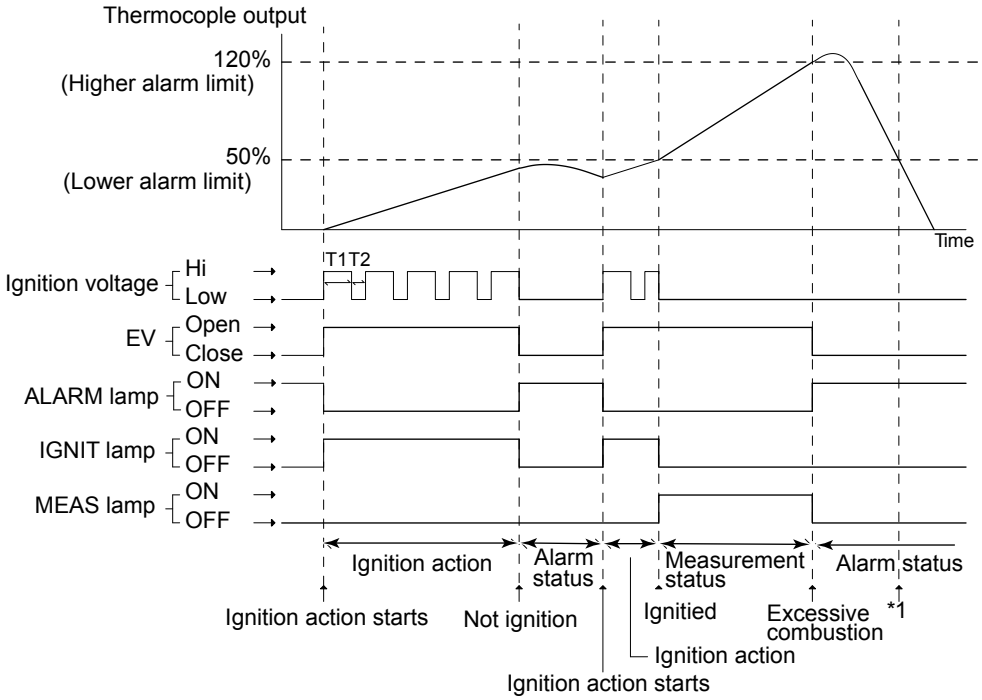


Figure 6.11 Ignition Sequence

6.5 Computing Station

By calculate the calorie detector signal with each differential pressure signal, the WI signal is generated. And on the same time, the calorific signal is generated by compensating the density with the density signal.

Each input, after A-D conversion, digitally computed, then D-A conversion generate DC 4 to 20 mA (DC 1 to 5 V) output.

6.5.1 Indication Selection

■ Explanation of display indication

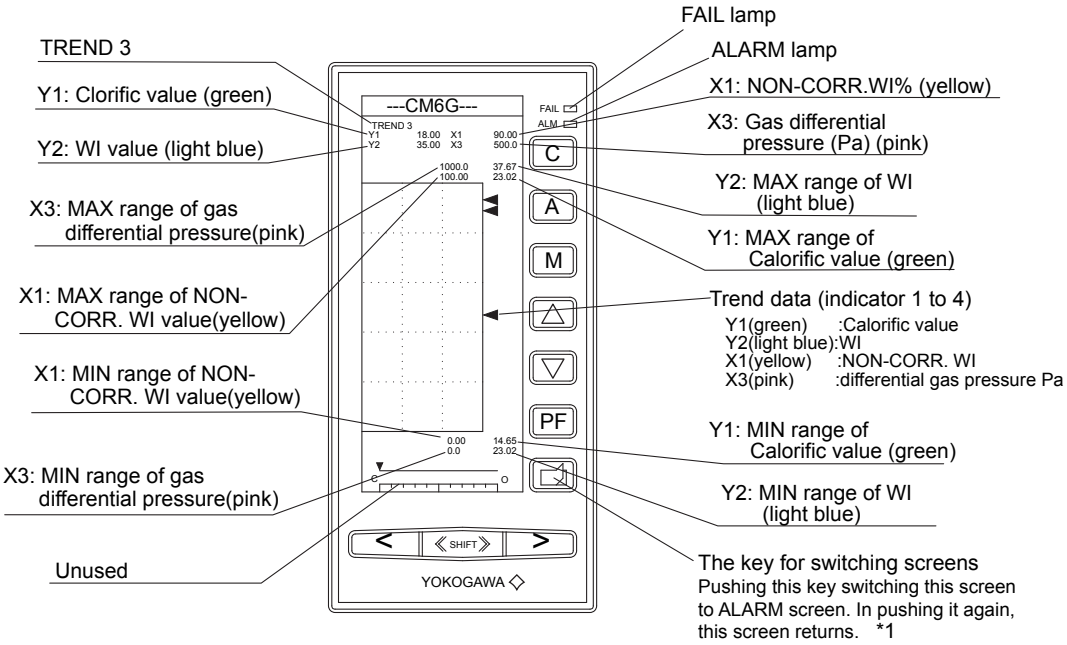


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Figure 6.12 Measuring Display

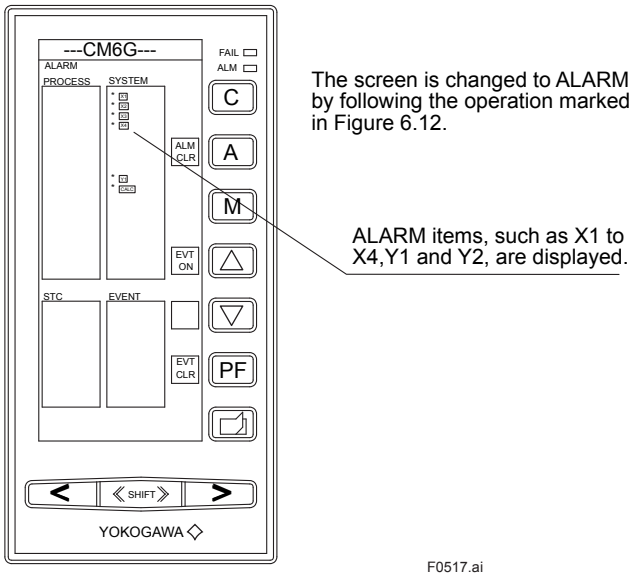

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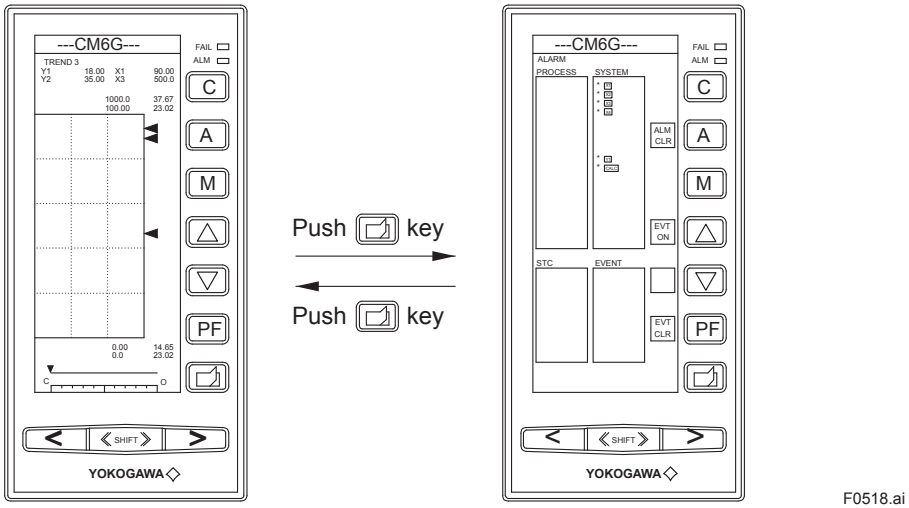
Figure 6.13 Alarm Display

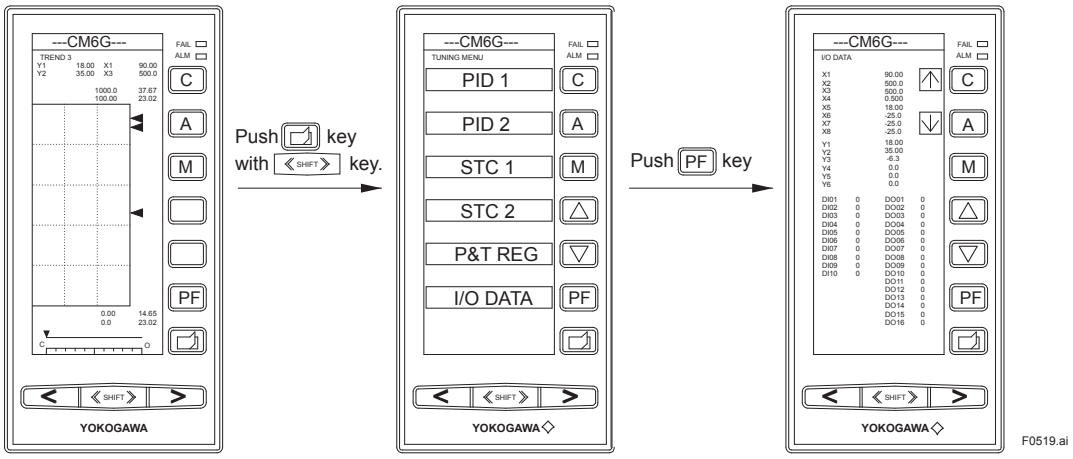
■ Switching to alarm display



(1) Measuring display (2) Alarm display

Figure 6.14 Switching operation to alarm display

■ Confirmation of Input/Output data



(1) Measuring display (2) Tuning display (3) Input/Output status display

This screen is for confirming Input/Output status and for setting X1,X2 and X3.
Displayed characters become bigger by pushing A key.

Figure 6.15 Switching operation to Input/output status display

■ Parameter setting

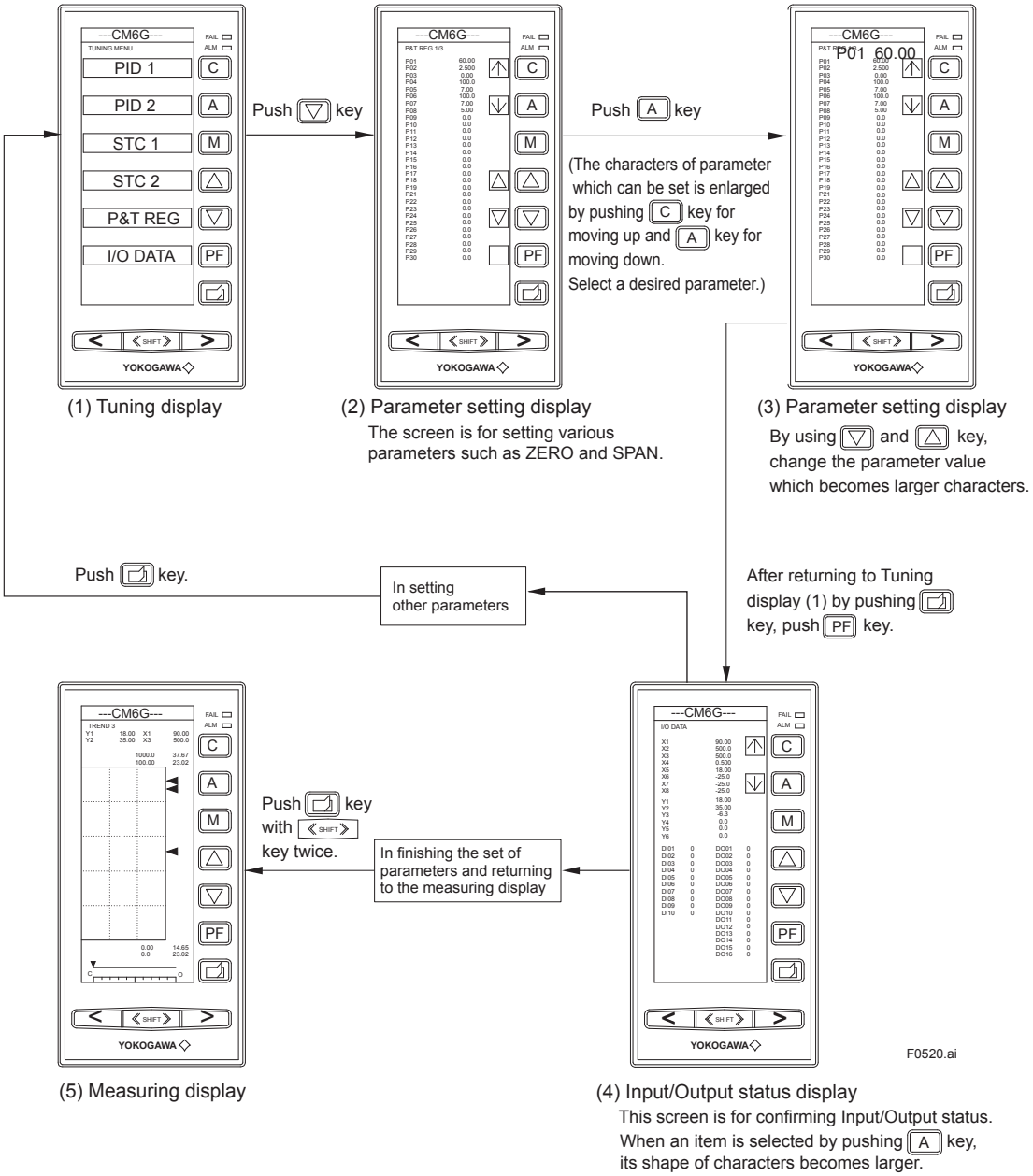


Figure 6.16 Flow Chart of Various Parameter Setting and Confirmation

6.5.2 Contents of the Data Display

Contents of the data display are as follows:

Table 6.2 Contents of the data displsy

Kind		Data abbreviated		Data contents	Data range
Input X_N	X1	NON-CORR. WI	[%]	WI valve before correction	0.0 to 100.0
	X2	A-PRESS	[Pa]	Air differential pressure	0.0 to 1000
	X3	G-PRESS	[Pa]	Sample gas differential pressure	0.0 to 1000
	X4	SQT. DENSITY		A square root of the sample gas density	*1
	X5	TC or LOW ALARM *2	[mV]	Thermocouple electromotive force or flame extinction alarm threshold value	0 to 30
	X6~X8	Unused		————	———
Output Y_N	Y1	cal	[MJ/Nm^3]	Calorific value	*1
	Y2	WI		Wobbe index	*1
	Y3	Option		Option	*1
	Y4	BIAS CHECK		Preheating check output	0.0 to 100.0
	Y5, Y6	Unused		————	———
Variable data P_N	P01	ZERO		Zero adjustment	0.0 to 100.0
	P02	SPAN		Span adjustment	*1
	P03	BIAS		Preheating adjustment	0.0 to100.0
	P04	A-CORR. RATE	[%]	Air differential pressure signal computing correction rate	0.0 to 200.0
	P05	A-TIME	[sec]	Time constant of air differential pressure signal delay time	0.0 to 100.0
	P06	G-CORR. RATE	[%]	Sample gas differential pressure signal computing correction rate	0.0 to 200.0
	P07	G-TIME	[sec]	Time constant of sample gas differential pressure signal delay time	0.0 to 100.0
	P08	PRESS.ALARM SET	[%]	Differential pressure warning setting	0.0 to 100.0
	P09 to P30	Unused		————	———

*1: Differs depending on each specification.
*2: Switched by pressing the “METER” switch.

6.5.3 Correcting Computation

As this calorimeter sets the differential pressure of both sample gas (ΔPg) and air (ΔPa) to 500 Pa, but, in order to correct the indication error due to the variation of the differential pressure (Flow rate), the correcting computation is practiced.

The detection signal is obtained through the measurement with the standard differential pressure of 500 Pa, but if each differential pressure change to ΔPg and ΔPa (≠500 Pa), the detection signal shall be changed from Eo to E'o.

$$E'o = Eo \cdot \frac{\sqrt{\Delta Pg}}{\sqrt{\Delta Pa}} \qquad (6.1)$$

Therefore, if we multiply the detection signal E'o $\sqrt{\Delta Pa} / \sqrt{\Delta Pg}$, we can correct to the value at the standard differential pressure.

In the computing program, each differential pressure is extracted of the square root and provide a differential pressure correcting computation. The signal after corrected is range suppressed (ZERO) and to further extended to SPAN. In case when it has a preheat circuit deduct the amount of preheated value and extend to SPAN, then being range suppressed and shall be extended again to SPAN. Further as to generate the output of the calorific signal, the following density correction is necessary:

$$K = C(WI) \cdot \sqrt{\rho g} \qquad (6.2)$$

Also it is necessary for each signal to operate with a timing matched with the signal of the calorie detector and for this reason, dynamic characteristic function is provided. (A-CORR. RATE, A-TIME, G-CORR. RATE, G-TIME)

Remarks: In case of pre-heating circuit exists, the formula is as follows:

$$\Delta\theta = C_1 \cdot \frac{K}{\sqrt{\rho g}} \cdot \frac{\sqrt{\Delta Pg}}{\sqrt{\Delta Pa}} + C_2 \cdot \frac{H}{\sqrt{\Delta Pa}} \qquad (6.3)$$

H : Pre-heat calorie
C_1, C_2 : Constant
ρg : Density of the gas

If the correction computation of the differential pressure is provided to Δθ in the formula (6.3), it is shown as per the following formula:

$$\Delta\theta \cdot \frac{\sqrt{\Delta Pg}}{\sqrt{\Delta Pa}} = C_1 \cdot \frac{K}{\sqrt{\rho g}} + C_2 \cdot \frac{H}{\sqrt{\Delta Pg}} \qquad (6.4)$$

The second clause of the right part in the formula (6.4) represent the preheat calorie, which, as you can see in the formula (6.4), the matters concerning the preheating is varied according to the change of differential pressure (ΔPg).

In this computing program, if there is preheating circuit, multiply the constant by the differential pressure signal, and after correcting the differential pressure to the preheating, the deduction of the preheat calorie is computed.

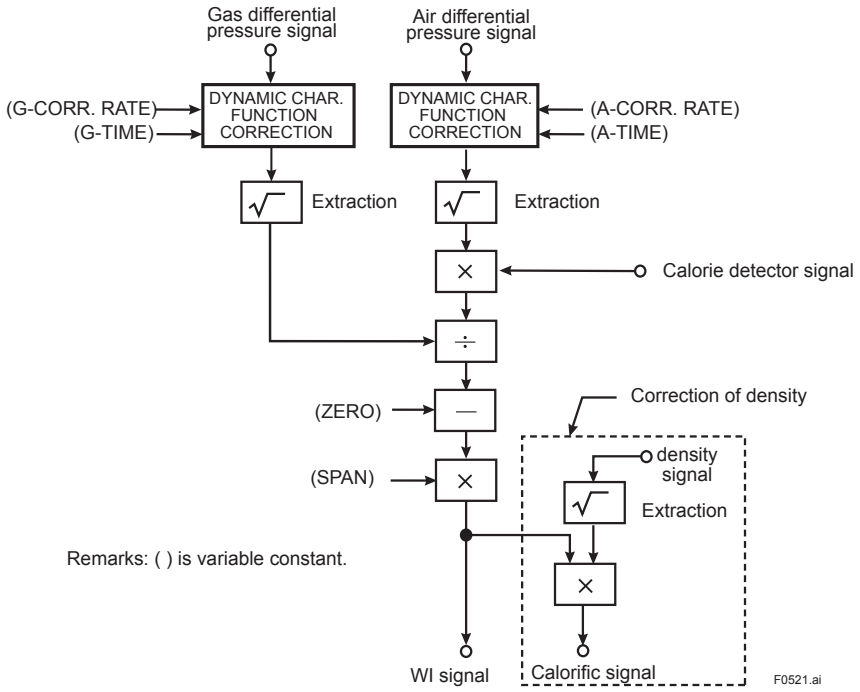


Figure 6.17 Computing Block Diagram (Preheating Circuit Does Not Exist)

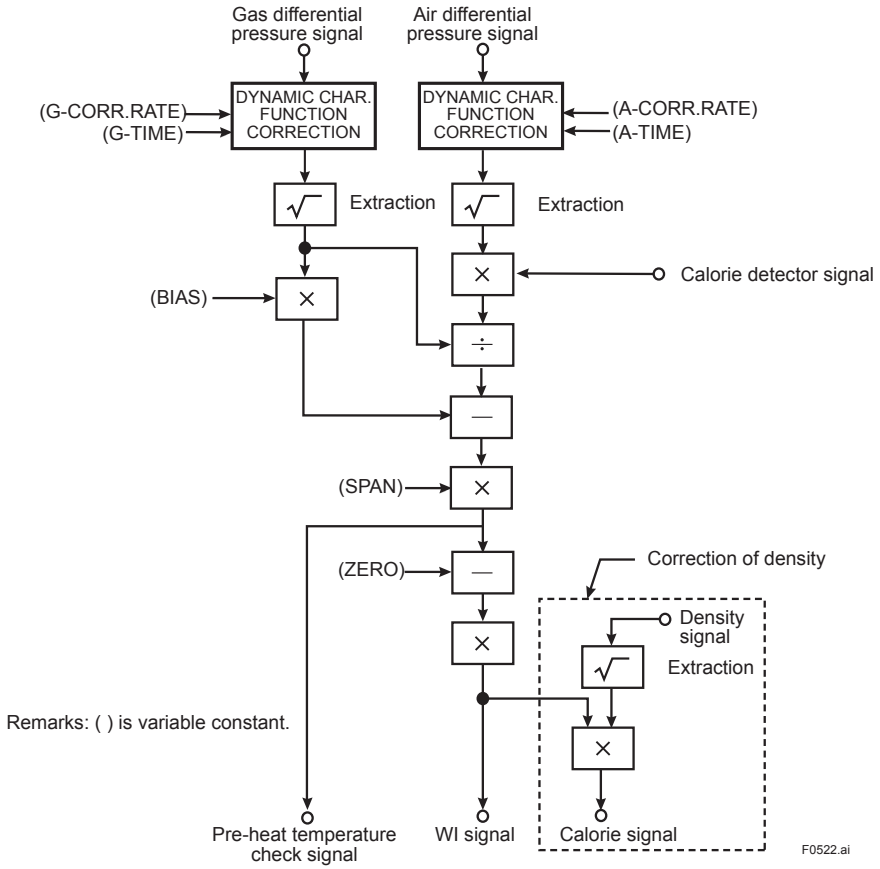


Figure 6.18 Computing Block Diagram (Preheating Circuit Exists)

6.6 Density Meter

The GD400G is used for gas density meter.

Regarding GD400G Gas density meter, refer to attached Instruction Manual IM 11T3B1-01E.

7. Preparation of Operation

⚠ WARNING

Before start operation check outside wirings, pipings and confirm no gas leakage found.
Refer to Figure 6.2, 6.3 and 6.4.

7.1 Sampling Section

a) If the drain pot is located outside the panel, supply water fully until the water overflows from the drain outlet.

b) Open the gate valve when it is in the sample line.

c) If two fulflo filters are located in parallel on the sample line one of them is not used.

7.2 Status of Valves

Confirm and open or close according to the following table.

For town gas use

Valve No.	Open or Close	Valve No.	Open or Close
V-1	Close	V-9	Close
V-2	Open	V-10	Close
V-3	Open	V-11	Open
V-4	Close	V-12	Open
V-5	*	V-13	*
V-6	Open	V-14	Close
V-7	Close	V-15	Open
V-8	Close	V-16	*

For steel mill use

Valve No.	Open or Close	Valve No.	Open or Close
V-1	Close	V-9	Close
V-2	*	V-10	Close
V-3	*	V-11	*
V-4	Close	V-12	*
V-5	Close	V-13	Close
V-6	Open	V-14	Close
V-7	Close	V-15	Open
V-8	Close	V-16	*

Remarks: Valve with the mark * are the flow adjustment use and preliminary adjusted and not necessary to adjust.

7.3 Water Supply (For Steel Mill Use)

a) Open valve V-13 and supply water until it overflows from the drain exhaust outlet of the washing bubbler (3-2) and the pressure regulating pot (3-4). (Refer to Figure 6.4).

b) The flowmeter (6-1) indicates the flow rate of 0.2 l/min.

7.4 Supply of the Air

Open valve V-14 and supply the air. The normal pressure is as undermentioned:

Pressure Gauge	Normal pressure
Pressure gauge of air set Pressure gauge (2-3)	approx. 200 kPa approx. 20 kPa

When the pressure is not normal, adjust it by the following procedures.

a) Adjust the pressure gauge of the air set to become approx. 200 kPa, using the air set valve (2-1). When turn the valve to the right, the pressure becomes higher.

b) Adjust the pressure gauge (2-3) to become about 20 kPa, using the pressure reducing valve (2-2) and V-16. If turning the valve of the pressure reducing valve to the right, the pressure becomes higher.

7.5 Supply of Power

a) Set the positions of each switch on the front panel of the calorie detector to the followings:

Switch	Position
POWER	OFF
SAFE EV	SET
METER	P.MEAS

b) Turn on the switches of the following components in the switch box.

- Calorie Detector
- Orifice Assembly (NFB)
- Pre-heater (NFB)
- Computing station
- Density. meter (With density compensation)
- Dehumidifier (For steel mill use only)

c) When turning on the “POWER” switch on the front of the calorie detector, in this time, both ”POWER” and “ALARM” lamps are lit which means it is in the state of alarm.

d) When supplying power to the computing station, the alarm lamp on the front (yellow) goes on and off, but this is not out of order.

e) “POWER” switch on in gas density meter (in case of with GD400G)

f) After elapsed for about 60 minutes the lamp of the orifice assembly starts flickering the temperature of the orifice constant chamber become stable.

7.6 The Zero Adjustment of the Differential Pressure Transmitter

a) Remove the impulse lines from the transmitters.

b) Turn on the main breaker of the switch box and the calorie detector switch.

c) Turn on the POWER switch on the front panel of the calorie detector.

d) Measure each of the output terminals on the terminal block with a voltmeter and adjust the voltage to 1 V DC using the “zero adjustment screw” on the differential pressure transmitter. The terminal numbers for gas are 15 and 16, and those for air are 17 and 18.

e) Use a flat-head screwdriver to make the adjustment. Turn the screw clockwise to increase the output, and turn the screw counterclockwise to decrease the output. The adjustment amount of the zero point varies depending on the speed at which the zero adjustment screw is turned. To make a fine adjustment, turn the screw slowly, and to make a rough adjustment, turn the screw quickly.

f) When the adjustment is completed, connect the impulse lines while making sure there is no leakage.

Remarks: Such adjustment shall be conducted whenever the location where the panel being installed is changed.

⚠ WARNING

Be sure to make this adjustment every time the installation location of the panel is changed.

⚠ WARNING

Power is supplied to the differential pressure transmitter from the calorie detector. To operate the differential pressure transmitter, turn on the calorie detector switch of the switch box and the POWER switch on the front panel of the calorie detector.

⚠ WARNING

After the zero-point adjustment is completed, do not turn off the transmitter immediately. If the power is turned off within 30 seconds, the value adjusted by the zero-point adjustment will return to the value before the adjustment.

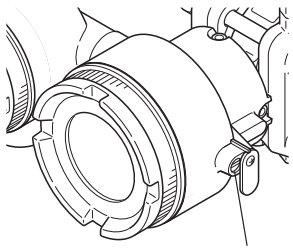


Figure 7.1 Differential Pressure Transmitter

7.7 Air Differential Pressure Adjustment

a) Switch the computing station to the Input/Output status display (refer to Figure 6.15) and check X2 (A-PRESS).

b) Adjust V-16 so that the indicated value becomes “500.”

c) If the indicated value of the pressure gauge (2-3) has deviated from 20 kPa, set the indicated value to 20 kPa using the pressure reducing valve (2-2) and make the adjustment in b) again.

7.8 Pressure Adjustment of the Gas Line

For the pressure adjustment of the gas line we use the air.

■ For town gas use

a) Close V-6 and connect the one touch coupler (2-5).

b) Open V-7 and V-8.

c) Turn the switch “SAFE EV” of the calorie detector to “RELEASE”, in this time, the solenoid valve of the gas line open and the alarm is released.

d) By adjusting the pressure reducing valve (4-1) set the flow rate of the flowmeter (3-3) to 10 l/min. In this time, the pressure gauge (3-2) indicate 8 to 18 kPa.

e) Adjust, by using the pressure reducing valve (3-4), the pressure gauge (3-5) to become approx. 3 kPa.

f) When a density meter is attached, adjust the throttle valve of the flowmeter (5-3) so that the indication becomes 0.5 to 1 l/min.

g) Set the indication of the computing station to Input/Output status display and check X3 (G-PRESS).

h) Adjust by pressure reducing valve (3-6) so that the indication “X3” becomes “500”. When the pressure indication of the pressure gauge (3-5) differs from about 3 kPa, adjust again the procedure in item e), then conduct the adjustment.

i) When the adjustment completed, close V-8, V-7, separate the one touch coupler (2-5), and open V-6.

j) Set the “SAFE EV” switch of the calorie detector to “SET”.

■ For steel mill use

a) Close V-4, connect the one touch coupler (2-5) and open V-5 and V-8.

b) Set the switch “SAFE EV” of the calorie detector to “RELEASE”, when the solenoid valve of the gas line open and the alarm is released.

c) Adjust the flow rate of the flowmeter (4-2), by using the pressure reducing valve (4-1), to become about 10 l/min. In this time, the pressure gauge (3-1) indicates approx. 6 kPa.

d) When the density meter is attached, adjust the indication of the flowmeter (5-3) to 0.5 to 1 l/min by using V-11.

e) Adjust, by using V-12, the number of bubbles come out from the pipe A of the pressure regulating pot (3-4), 3 - 6 pcs/sec. Open V-12 fully, in case of the low calorie instrument, when no bubbles came out.

f) Set the indication of the computing station to Input/Output status display and check X3 (G-PRESS).

g) With the pressure reducing valve (3-6), adjust the indication “X3” to become “500”. When the number of bubbles from pipe A be changed, adjust the number of bubbles by using V-12, and then, carry out the adjustment.

h) When complete the adjustment, close V-8 and V-5, separate the one touch coupler (2-5), and open V-4.

i) Turn the switch “SAFE EV” of calorie detector to “SET”.

8. Operation

8.1 Start Operation

DANGER

- Confirm the air is supplied before start operation.
- Confirm that the ventilation system is running before introducing the gas.

8.1.1 Introduction of the Sample Gas

■ For town gas use

a) Open V-1 fully.

b) When the pump is attached, turn the power supply switch of the pump to “ON” in this time.

c) When the pressure is 100 to 200 kPa or increased by the pump, adjust, by V-5, so that the indication of the pressure gauge (3-2) become 8 to 18 kPa. While the pressure is reduced by the pressure reducing valve, adjust the indication of the pressure gauge (3-2) to become 8 to 18 kPa, by the pressure reducing valve (3-8).

■ For steel mill use.

a) In the case that the pressure is above 8 kPa, open V-4, and in the case that the pressure is increased by the pump, open V-1, V-4 respectively.

b) When the pump is attached, turn on the power supply switch of the pump in this time.

c) Adjust the pressure of the pressure gauge (3-1), using V-3 in the case of standard pressure (above 8 kPa), and using V-2, V-3 in the case of the pressure increased by the pump, to become approx. 6 kPa.

8.1.2 Start Operation of the Calorie Detector

Confirm the switch “SAFE EV” is set at “SET” then push the switch “START”.

8.1.3 Differential Pressure Readjustment

When the burner be ignited and the output becomes stable (after 20 to 30 min.) adjust again the differential pressure.

■ For town gas use

a) When the pressure indication of the pressure gauge (3-5) differs from approx. 3 kPa, adjust it by the pressure reducing valve (3-4).

b) When the density meter is attached and the flowmeter (5-3) indicate out of 0.5 to 1 l/min, adjust its indication again.

c) Set the computing station to Input/Output status display (refer to Figure 6.15). If the indication of “X2 (A-PRESS)” and “X3 (G-PRESS)” is not ”500”, adjust each with the pressure reducing valve (3-6) and V-16.

■ For steel mill use

a) When the density meter is attached, adjust again the indication of the flowmeter (5- 3) by V-11.

b) When the number of bubbles coming out from the pipe A is not constant, adjust it by V-12.

c) Set the computing station to Input/Output status display (refer to Figure 6.15). If the indication of “X2 (A-PRESS)” and “X3 (G-PRESS)” is not ”500”, adjust each with the pressure reducing valve (3-6) and V-16.

8.2 Stopping Operations

8.2.1 Long Timer Stopping

a) Close V-1. In case of the standard pressure for steel mill use, close V-4. If the pump is attached, switch the pump off at first.

b) When the gas supply suspended and the burner extinguished, the lamp “MEAS” of the calorie detector is lit off and the lamp “ALARM” on.

c) Set the switch of the calorie detector “SAFE EV” to “RELEASE”.

d) In the case of the town gas use, close V-6 and open V-7, V-8. In case of the steel mill use, close V-4 and open V-5, V-8. By such operation the sample gas in the gas line is blown off by the air.

e) After continuing the blow for 3 to 5 min., turn off the “POWER” switch of the calorie detector and if the density meter is attached, cut the power supply switch inside the density meter.

f) Turn off all switches of the switch box.

g) Lastly, close V-14 and stop the air supply.

8.2.2 Short Time Stopping

Same as mentioned above, suspend the supply of sample gas only.

If this state is to be held, the warm up time is not necessary for the restarting operation.

9. Calibration

For calibration, zero and span gases are necessary. Use the gas with the specifications as near to each measuring range for both lower limit and upper limit as possible.

9.1 Supply of the Calibration Gas

9.1.1 For Town Gas Use

SEE ALSO

Refer to Figure 6.2 and 6.3.

a) Close V-6 and open V-7. In this time, the burner is extinguished. But if the pump is attached, close V-6 and open V-7, after turn off the power supply of the pump.

b) Adjust the secondary pressure of the pressure reducing valve for calibration gas cylinder, to become approx. 200 kPa.

c) Open V-9 or V-10 and introduce the calibration gas.

d) Adjust the indication of the flowmeter (3-3), by the pressure reducing valve (4-1), to become about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.

e) Push the “START” switch of the calorie detector to ignite.

f) Set the computing station to Input/Output display screen (refer to Figure 6.15). If the indication of “X2 (A-PRESS)” and “X3 (G-PRESS)” is not ”500”, adjust each with the pressure reducing valve (3-6) and V-16.

g) In the case of the density meter being attached, confirm and readjust (if necessary) the indication of the flowmeter (5-3).

h) When the calibration is completed, close V-9, V-10, V-7, and open V-6. In the case of the pump being attached, supply the power supply of the pump as the next step.

i) Push the “START” switch of the calorie detector to ignite.

j) Confirm and readjust (if necessary) the gas differential pressure and the flow rate to the density meter.

k) Do not forget to close the root valve of the calibration gas cylinder.

9.1.2 For Steel Mill Use

SEE ALSO

Refer to Figure 6.2 and 6.3.

a) Close V-4 and open V-5. The burner is extinguished. However, if the pump being attached, turn off the power supply of it in advance.

b) Set the secondary pressure of the pressure reducing valve for calibration gas cylinder to approx. 200 kPa.

c) Open V-9 or V-10 and introduce the calibration gas.

d) Using the pressure reducing valve (4-1), adjust the indication of the flowmeter (4-2) to become about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.

e) Push the “START” switch of the calorie detector to ignite.

f) Set the computing station to Input/Output status display (refer to Figure 6.15). The indication of “X3 (G-PRESS)” is adjusuted to ”500” with the pressure reducing valve (3-6).
In the case of the density meter being attached, confirm and readjust the flow rate.

g) Confirm “X2 (A-PRESS)” in Input/Output status display and adjust “X2” to “500” by using V-16.

h) When completed the calibration, close V-9, V-10, V-5 and open V-4.
In the case of the pump being attached, supply the power supply of the pump as the next step.

i) Push the “START” switch of the calorie detector to ignite.

j) Readjust both the gas differential pressure and the flow rate to the density meter.

k) Do not forget to close the root valve of the calibration gas cylinder.

9.2 Span Adjustment of the Calorie Detector

This adjustment is not necessary for the usual calibration. This adjustment is held in the case such as the replacement of the thermocouple of the burner unit. This adjustment is different depending upon if the preheating circuit exists or not. This adjustment is to be held after regulating each differential pressure to “500”.

9.2.1 When no Preheating Circuit Exist

a) Set the computing station to Input/Output status display with X1 (NON-CORR. WI%).

b) Introduce the span gas and after ignition, wait until the indication “X1” becomes stable.

c) Adjust the indication, using the “SPAN” potentiometer on the front side of the calorie detector, to become the specified value (x%). WI is used to find out the x value.
Example:
WI value of the span gas = 7960 WI
WI value of the upper range = 8000 WI

$$x = \frac{7960}{8000} \times 100 = 99.5\%$$

9.2.2 When Preheating Circuit Exists

a) Suspend the supply of the sample gas.

b) Same as the gas line pressure adjustment explained in paragraph 6.1.8), introduce the air to the gas line.

c) Set the “SAFE-EV” switch of the calorie detector to “RELEASE”, when the preheating voltage is applied to the ignition heater of the burner unit, by which the increased temperature with an effect of the preheating is detected by the thermocouple.

d) Switch the “METER” switch of the calorie detector to “P.MEAS” and measure X5 of the computing station. Wait until the indicated value is stabilized and then record the value. (E0 mV)

e) Switch the “SAFE EV” switch of the calorie detector to “SET.”

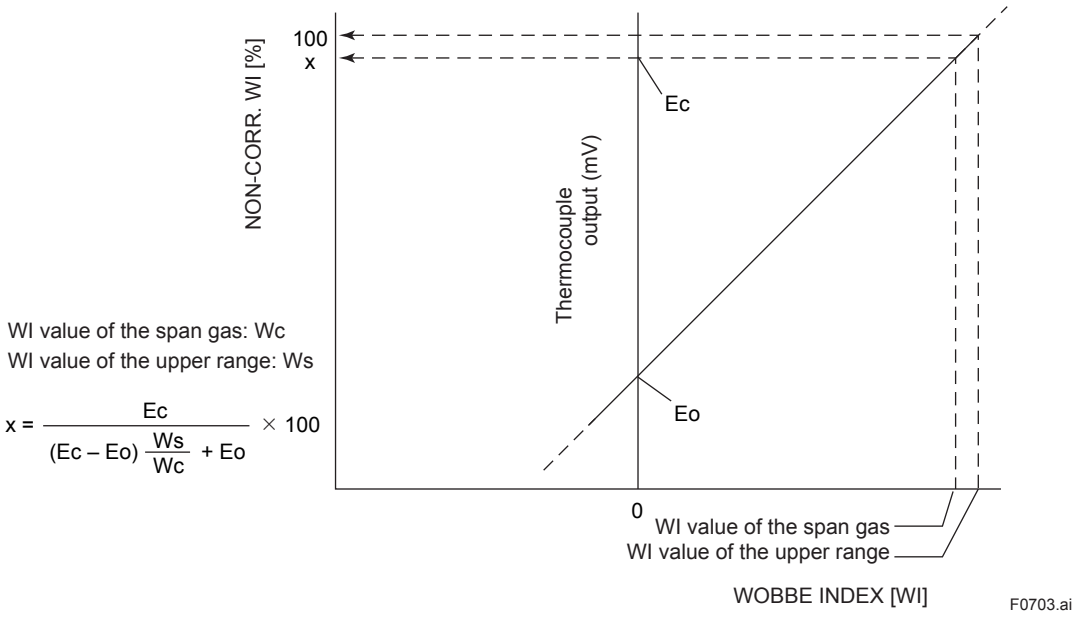
f) Stop the air supply to the gas line, supply the span gas, and start the ignition action.

g) Measure X5 of the computing station. Wait until the indicated value is stabilized and then record the value. (Ec mV)

h) Set the computing station to Input/Output status display and adjust the “SPAN” potentiometer of the calorie detector so that “X1” will show the specified value (x%). WI is to be used to find out the value of x.

For example:
WI value of the upper range = 1200 WI
WI value of the span gad = 1190 WI
Eo = 4 mV Ec = 19 mV

$$x = \frac{19}{(19-4) \times \frac{1200}{1190} + 4} \times 100 = 99.3\ \%$$



WI value of the span gas: Wc
WI value of the upper range: Ws

$$x = \frac{Ec}{(Ec - Eo)\frac{Ws}{Wc} + Eo} \times 100$$

Figure 9.1 How to Find Out x When Preheating Circuit Exists

9.3 Calibration of the Computing Station

Usually this calibration only is conducted. The calibration is conducted as follows according to the difference of the output.

- WI output ..... Calibrate with WI value.
- WI calorie output .. Calibrate with WI value and confirm the calorific value.
- Calorie output ..... Calibrate with calorific value.

In case of existing the preheating, the bias adjustment is carried out firstly.

9.3.1 Bias Adjustment

This adjustment is carried out only when the preheating circuit exists.

a) Suspend the supply of the sample gas, and introduce the air to the gas line.

b) Set the “SAFE EV” switch of the calorie detector to “RELEASE”.

c) Set the computing station to Input/Output status display. After the indication Y4 (BIAS CHECK) become stable (20 to 30 minutes), adjust the (Y4) value of the P03(BIAS) will become [0.0] by the data setting key.

Note) In the above operation c), (Y4) and (P03) are not displayed on the same screen. For bias adjustment, select and display (Y4) and (P03) alternatively.

d) When complete the adjustment, turn the switch “SAFE EV” of the calorie detector to “SET”, and suspend the air supply to the gas line.

9.3.2 Zero and Span Adjustment

a) Introduce the zero gas and ignite.

b) Set the computing station to Input/Output status display. Adjust, with the “P01 (ZERO)” of the operator, to be the “Y2 (WI)” or “Y1 [MJ/Nm^3]” (WI value or the calorific value of the calibration gas).

c) Change from zero gas to span gas, when, if let the span gas start flowing before the zero gas valve is not completely closed, the burner is not extinguished. Same in the case of the other way. If burner is extinguished, ignite.

d) Set the indication of the computing station to Input/Output status display. After the indication “Y2 (WI)” or “Y1 (cal)” becomes stable, adjust, with the “P02 (SPAN)” of the operator, to become WI value or the calorific value of the calibration gas. (Display P02, adjust by the data setting key). (Confirm the result of the adjustment after displaying it as WI or cal)

e) Repeat 2 or 3 times the above adjustments.

f) When complete the adjustment, suspend the supply of the calibration gas.

9.3.3 Other Adjustment

The adjustment of P04 (A-CORR, RATE), P06 (G-CORR, RATE) and P05 (A-TIME), P07 (G-TIME) is usually unnecessary. (Reserve the record of the data in the initial stage).

But when replacing the thermocouple, the regular adjustment for the specific characteristic is performed, but such adjustment, consult to our service personnel.

9.4 Calibration of the Density Meter

Regarding GD400G Gas density meter, refer to attached Instruction Manual IM 11T3B1-01E.

10. Maintenance

10.1 Daily Check

10.1.1 Air, Gas Differential Pressure Adjustment

Confirm the air or gas differential pressure or adjust the indication of X2 (A-PRESS), X3 (G-PRESS) to the “500”. The way how to adjust shall be carried out according to the paragraph 7.7 and 7.8.

10.1.2 Take Out the Water Out of the Drain Pot (Pump for Steel Mill Use)

If the drain is accumulated, open V-7 and take it out, and after the drain is taken out, be sure to close the valve.

10.1.3 Take Out the Drain from the Air Set

Turn the knob at the bottom of the air set and take out the drain. After the drain is taken out, be sure to turn the knob to close tightly.

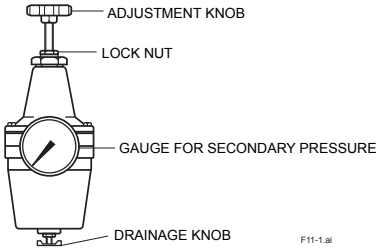


Figure 10.1 Air Set

10.2 Regular Check

Refer to Figure 6.2 , 6.3 and 6.4. The flow sheet depends on the specification.

10.2.1 Cleaning of the Orifice Plate and Replacement of O-ring

When something like dust adhere to the orifice holes, the output power decreased. Therefore, clean them with the following way:

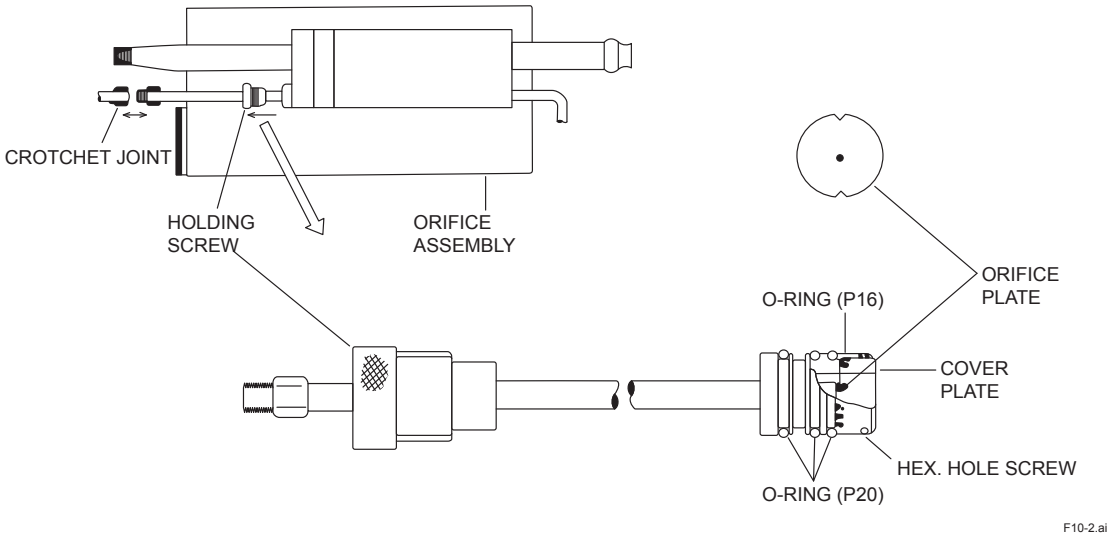


Figure 10.2 Orifice System

a) Suspend the supply of the sample gas, then blow the gas line with the air.

b) Remove the crotchet joint.

c) Turn the holding screw and take out.

d) Pull out slowly to the direction as shown on Figure 10.2.

e) Loosen the set screw by using the hexagonal wrench attached there-to and take out the orifice plate together with the cover plate.

f) For the cleaning use something like a supersonic cleaner and never insert into the orifice holes anything like a stick or rod.

g) When the O-rings are worn out, replace them with the spare parts.

h) When the cleaning and replacement completed, assemble the parts according to the order contrary to above mentioned.

Remarks: The orifice system is temperature controlled by a plate heater, so better finish the cleaning and replacement as quick as possible.

10.2.2 Fulflo Filter (For Steel Mill Use)

The material of the element is polypropylene. The cleaning and the replacement of the element shall be carried out as under mentioned:

a) Turn the nut and remove the cover.

b) Pull out the element and clean or replace.

c) Assembly is carried out in contrary order to above.

d) When the packing or gasket is worn out, replace it.

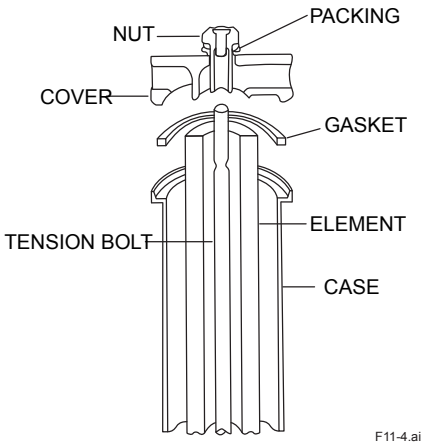


Figure 10.3 Fulflo Filter

10.2.3 Line Filter (For Town Gas Use)

Disassemble 3 screws, and open the cover, there inside exist the element. If it is stained, replace by a new one. Also if the O-ring is fatigued, replace it.

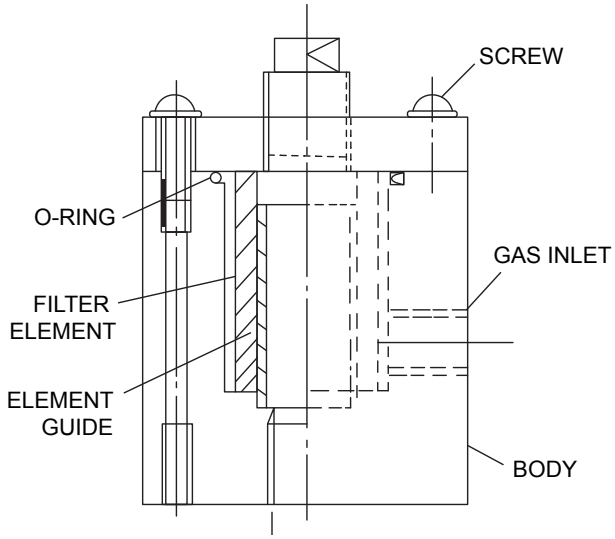


Figure 10.4 Line Filter

10.2.4 Washing Bubbler or Pressure Regulating Pot

If inside of case become dirty by the weeds grown in the water, pull the plug at the bottom of the bubbler and exhaust and renew the water. If inside the bubbler is stained, remove the cover and clean it. Be careful not to scatter the water around the panel.

When the water level becomes higher than the drain exhaust outlet position, there would be a possible contamination in the exhaust pipe line, so the cleaning is necessary.

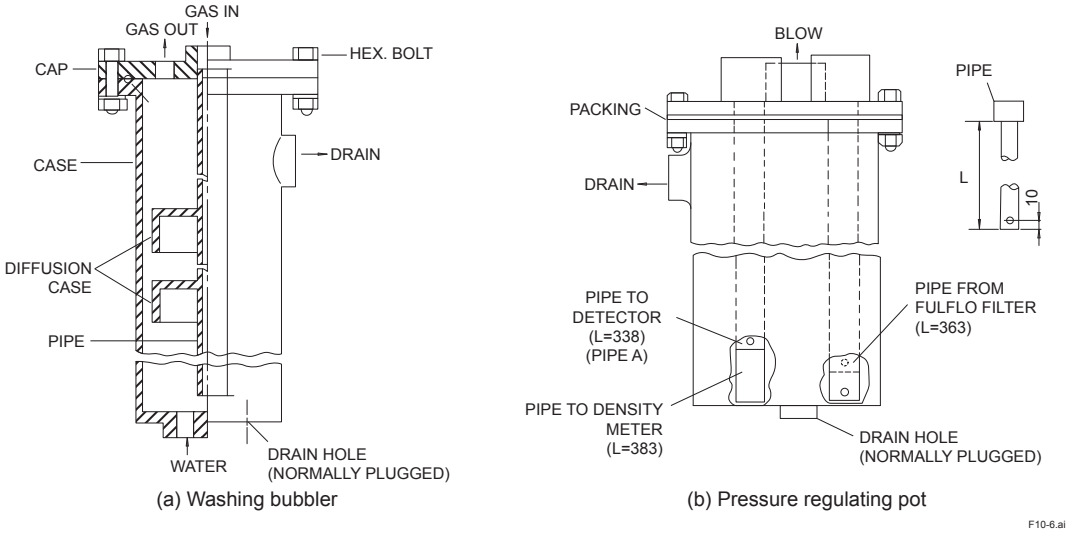


Figure 10.5 Washing Bubbler and Pressure Regulating Pot

10.2.5 Dehumidifier (For Steel Mill Use)

If the naphthalene is too much contained in the sample gas, in spite of the gas gone through the washing bubbler there might happen the case such naphthalene can hardly be cleaned and contaminated in the state of being crystallized in the pipings inside the dehumidifier. If such case happen, stop the sample gas flow, and remove 4 pipes at the top of the dehumidifier and introduce the hot water of 70°C to 80°C, the naphthalene is dissolved into the hot water and no contamination left.

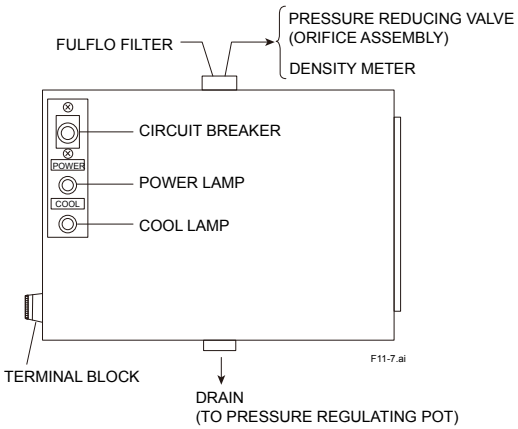


Figure 10.6 Dehumidifier

10.2.6 Density Meter

It is recommended to replace the O-ring of the GD300S detector every 2 or 3 years and wash the sensor if necessary. Consult to our service for washing the sensor.

10.3 Check at the Regular Service

10.3.1 Check the Burner Flame

Whether the sample gas is completely burnt or not shall be judged by observing the shape and the color of the burner flame.

- The shape of the flame for the complete combustion is as shown in Figure 10.7 - (A) of a shape sharply outlined, and the height of the inner flame is about a half size of the outer flame.
- When the primary air is too much, the flame becomes, as shown in Figure 10.7 - (B), flickering and when the secondary air is not sufficient, the flame outline is the same.
- When the primary air is not sufficient, the color of the flame is clear yellow and sometimes soots come out.
- When there is any blockade or leakage is the air line, the flame becomes like the shape as shown in Figure 10.7 - (D).

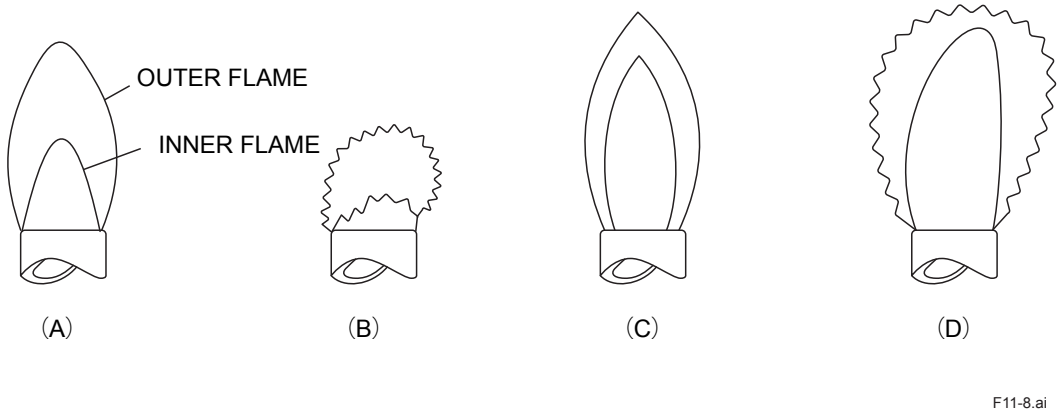


Figure 10.7 Burner Flames

Check the flames of the burner according to the following procedures. As to the adjustment of the squeezing screw of the primary air and the secondary air and the cleaning of the air distribution part, ask to our service personnel.

a) Remove the screw (4 pcs) fixing the external pipe, then remove the connectors to the terminal of the hot junction detecting point.

b) Disassemble the external pipe and take out the jet plate by pulling upward. (The direction to pull for removal is shown in Figure 10.8 by the sign of arrow).

c) Insert the attached mirror herewith into the ventilator.

d) When ignite, the flame reflected on the above mirror can be observed from slanting upside.

e) Assembly shall be conducted in the contrary way to the above procedures.

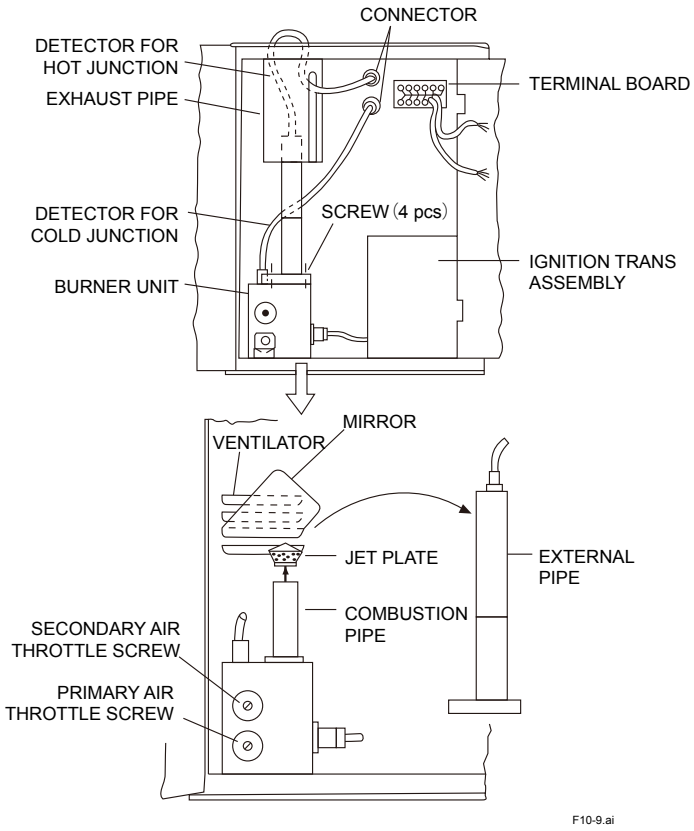


Figure 10.8 Flame Checking

10.3.2 Zero Adjustment of the Differential Pressure Transmitter

Adjust according to the procedure described in paragraph 7.6.

10.3.3 Others

If necessary, conduct each regular check mentioned in paragraph 10.2.

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11. Troubleshooting

The cause measured value shows very much different from normally observed, is mainly considered by two cases one is due to the change of gas composition caused by the change of the process conditions and another is due to the failure of the measuring system.

If the trouble is considered coming from the failure of the measuring system, the following items should be checked as for troubleshooting.

11.1 Gas Sampling Pressure Regulating Section

Refer to Figure 6.2, 6.3 and 6.4.

11.1.1 For Town Gas Use

1) Check if any blockade or leakage exist in the sampling line up to the panel.
   →If any blockade found, blow the sampling line by air.

2) Check the filter element of the line filter.
   →According to the paragraph 10.2.3, clean or replace.

3) If above is normal, the pressure gauge (3-2) indicates 8 to 18 kPa.
   →When the pump is attached and if the pressure does not indicate normal value even after open V-5 fully, the decrease of the suction ability of the pump might be a cause of trouble.
   →If the pressure reducing valve is attached, and the indication of the pressure gauge (3-2) does not change even after the operation of the pressure reducing valve (3-8), the pressure reducing valve may be defective.

4) When introducing the check gas, confirm the indication of the flowmeter (3-3) is about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.
   →If the flow rate can not be satisfactorily set by the pressure regulator (4-1), it is due to the defect of the pressure regulator.

5) Confirm the pressure gauge (3-5) indicate approx. 3 kPa.
   →If the pressure cannot be satisfactorily set by the pressure reducing valve (3-4), it may be defective.

6) When the density meter is attached, confirm the indication of the flowmeter (5-3) is 0.5 to 1 l/min.
   →If no indication appeared on the flowmeter, the trouble is considered to be due to the clogging of the gas pipe inside the density meter.

7) Confirm the indication of the computing station is about “500”, after set the indication to “X3 (G-PRESS)”.
   →When the differential pressure setting is impossible with the pressure reducing valve (3-6), it is due to the defect of the pressure reducing valve.

8) For all gas lines, check any leakage at each joint connection.

11.1.2 For Steel Mill Use

As for the sampling system outside the panel, this is recommended by our company.

1) Check if the water level of the drain pot (11-1) equipped outside the panel is higher than 15 kPa.

2) Check for any findings of clogging, accumulation of drain or leakage in the pipings, between the probe (7-1) and the fulflo filter (7-2) equipped outside.
   →When found any clogging, blow by the air.
   →When the piping has any U bending, the drain is likely to be accumulated there, so in such case give a slope to the piping.

3) Check the element of the outside fulflo filter (7-2).
   →When found clogged, clean or replace as according to the paragraph 10.2.2.

4) Check the indication of the pressure gauge (3-1) is approx. 6 kPa.
   →If there is no water accumulated in the washing bubbler, no indication appeared on the pressure gauge, in such case, supply water to the washing bubbler.
   →If the pump is attached, and its suction ability decreased, the case might happen that the pressure gauge does not indicate the normal value after the adjustment by only V-2 and V-3.

5) When introducing the calibration gas, check the indication of the flowmeter (4-2) is approx. 10 l/min.
   →When cannot be adjusted by the pressure reducing valve (4-1), it is likely that the pressure reducing valve is defective.

6) Check the element of the fulflo filter (3-3).
   →If it is clogged, clean or replace as according to the paragraph 10.2.2.

7) Check the water level of the pressure regulating pot.
   →If necessary, supply water or clean.

8) Check if the bubbles are coming out 3 - 6 pcs/sec from the pipe A of the pressure regulating pot.
   →Even after using V-11, V-12 fail to adjust, clean the piping inside the dehumidifier as according to the paragraph 10.2.5.
   Note no bubbles are coming out, however, in case of low calorie gas.

9) When the density meter is attached, check if the indication of the flowmeter (5-3) is 0.5 to 1 l/min.

10) Check if the indication of the computing station is “500” when setting the indication of “X3 (G-PRESS)”.
   →When the adjustment is impossible even by using the pressure reducing valve (3-6), it is likely the pressure reducing valve is defective.

11) For all gas lines, check the leakage at each joint connection.

11.2 Air Pressure Adjustment Section

1) Check the secondary pressure gauge of the air set (2-1) is about 200 kPa
   →When the adjustment of the air set is impossible even when the primary pressure of the instrument air is normal, it is likely the air set is defective.

2) Check the pressure gauge (2-3) indicates approx. 20 kPa.
   →We cannot adjust it when even using the pressure reducing valver (2-2), it is likely the pressure reducing valve is defective.

3) If the above are found normal, we can adjust by using V-16 the air differential pressure to “500”.

11.3 Differential Pressure Transmitter Section

1) Check the orifice section of the orifice assembly.
   →When the orifice plate is contaminated, clean it as according to the paragraph 10.2.1.

2) Check any leakage in the pressure transmission pipe of each differential pressure transmitter.

3) Check the temperature (thermistor resistance value) setting of orifice assembly.
   →If the resistance value is not 3.6 to 4.2 kΩ, the temperature controller may have a failure.

11.4 Signal Section

Measure the output of each components by using digital voltmeter.

1) Set the “METER” switch on the front panel of the calorie detector to “P.MEAS” and measure X5 of the computing station. If preheating is not required, the appropriate output is approximately 0 to 20 mV, which is nearly proportional to 0 to (WI value, namely the highest value in the measurement range). If preheating is required, the appropriate output is approximately 4 to 20 mV, which is nearly proportional to 0 to (WI value, namely the highest value in the measurement range).

For example:

When the WI value of the highest level in the measuring range is 100 WI, if the sample gas is 80 WI, the output voltage is about 16 mV (when no preheating circuit).

In spite of both the gas pressure control section and the differential pressure being normal, the output is widely different, it is likely to be some blockade in the air flow distribution line of the burner unit. If such case happens, check the burner flame as mentioned in paragraph 10.3.1.

→If the output has very weak power in spite of the burner being well burning, it is likely the wire disconnection in the thermocouple happens.

2) Measure 3 (+) and 4 (-) on the terminal board of the calorie detector, which normal output, when preheating circuit does not exist, is 1 to 5 V almost in proportion to 0 to (WI value, namely the highest value in the measurement range). If preheating circuit exist, approx. 1.8 to 5 V is almost in proportion to 0 to (WI value, namely the highest value in the measurement range).

3) Measure 17 (+) and 18 (-) on the terminal block of the calorie detector. The appropriate value is 23 V ±1%.

   →If difficult to obtain the normal value, it is due to the defect of the distributor in the calorie detector.

4) Measure 15 (+) and 16 (-) on the terminal block of the calorie detector. The appropriate value is 23 V ±1%.

   →If difficult to obtain the normal value, it is due to the defect of the distributor in the calorie detector.

5) Measure 8 (+) and 7 (-) on the terminal block of the calorie detector. The appropriate value is 3 V ± 0.2 V.

   →If the measured value varied very much in spite of the air pressure control section being normal, it is likely the differential pressure transmitter considered to be defective.

6) Measure 6 (+) and 7 (-) on the terminal block of the calorie detector. The appropriate value is 3 V ± 0.2 V.

   → If the measurement value is greater than the appropriate value, even though the gas pressure controller is normal, the differential pressure transmitter considered to be defective.

7) When the density meter is attached, measure 3 (+) and 4 (-) of the density meter

. →If the appropriate value is out of data in spite of no leakage, calibrate as according to the paragraph 7.4.

Regarding GD400G, Gas density meter, refer to attached Instruction Manual IM11T3B1-01E.

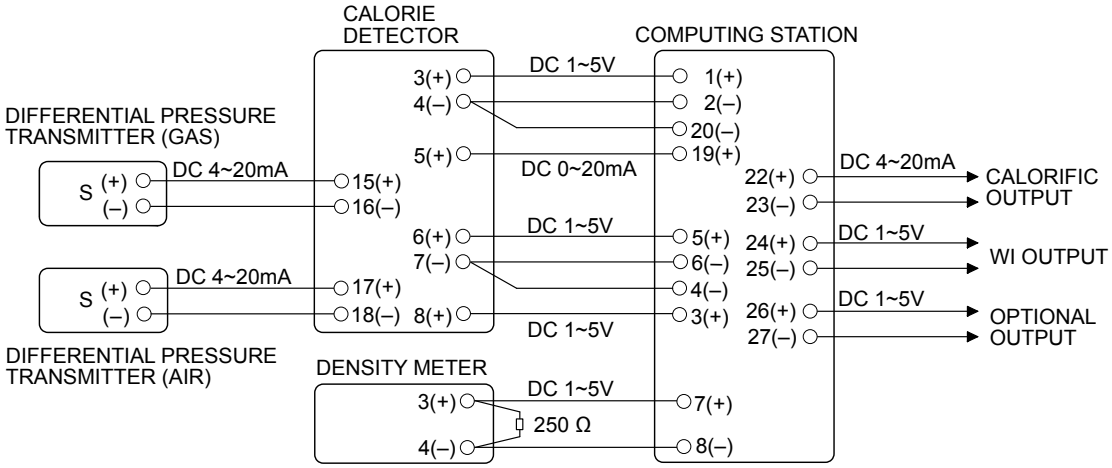

Figure 11.1 Signal Circuit Diagram

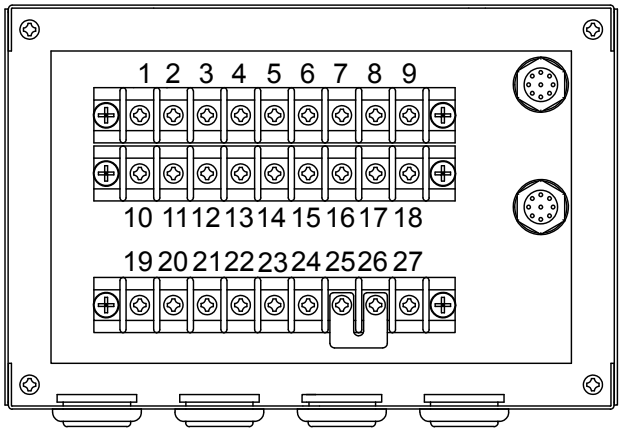

Figure 11.2 Terminal Block of the Calorie Detector

11.5 Computing Station

If the value is all normal, each input of the computing station shows the following normal values in the table.

Mark of input data		Normal indication
NON-CORR.	W.I %	*
A-PRESS	Pa	500 ± 50
G-PRESS	Pa	500 ± 50
SQT. DENSITY		Same as density meter

*: When pre-heating circuit does not exist, 0 to 100% is almost in proportion to 0 - (the highest level WI value in the measurement range).
When preheating exists, about 20 to 100% is almost in proportion to 0 - (The highest level WI value of the measurement range).

The lamps of both alarm and fail of the computing station are lighted in the following case.

1) Lighting of the alarm lamp. (Yellow color)
It lights when the input or output signal is cut off. But in this case, the computing inside the station is kept working. Change to Alarm display (refer to Figure 6.14), and examine the cause of the alarm lamp lighting.

2) Lighting of the fail lamp (Red color)
The lighting of the fail lamp means an occurrence of an abnormal trouble produced inside the instrument. When a fail occurs, the analog output and status output reserve the value just before the occurrence of the failure. Such preservation power has a tendencying of decreasing gradually along with the lopse of the time.
Also, the alarm lamp lights when the operation of the pressure adjustment for the gas, air line, but the lighting when other than under the time of measurement is not abnormal.

11.6 Other Troubleshooting

Check and deal with measures mentioned in paragraph 11.1 to 11.5. As to the trouble not mentioned in this manual, contact to our service personnel. The replacement parts shall be ready for your service as per details mentioned in the “Replacement Parts” in next paragraph 12.

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12. Replacement Parts

12.1 Calorie Detector E7023TA

a) Burner unit E7023BU

No.	Name	Q'ty	Part No.	Remarks
1	Hot Junction Detection Terminal	1	E7023BV	
2	Cold Junction Detection Terminal	1	E7023DR	
3	Burner Tip Assembly	1	E7023DL	
4	O-Ring	1	Y9132XB	Viton
5	O-Ring	1	Y9104XB	Viton
6	O-Ring	1	Y9119XB	Viton
7	O-Ring	1	Y9120XB	Viton
8	O-Ring	1	Y9107XB	Viton
9	O-Ring	2	Y9110XB	Viton
10	Coil Spring	2	E7023DQ	
11	Spring	1	E7023DZ	
12	Receptacle	1	G7011JC	

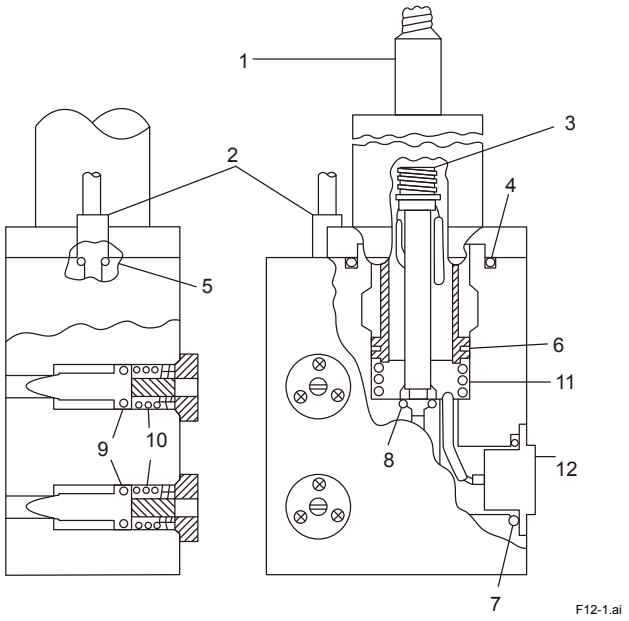


Figure 12.1 Burner Unit

b) Print circuit board assembly E7023RA

No.	Name	Q'ty	Part No.	Remarks
1	Printed Circuit Board Assembly	1	E7023RA	
2	Relay	1	A1322MR	MY2, DC24V OMRON
3	Fuse	2	A1094EF	3A

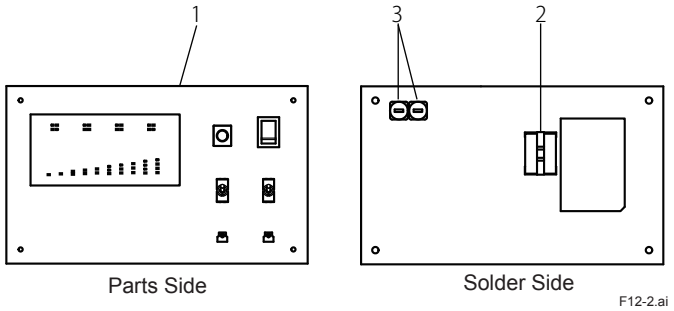


Figure 12.2 Print Circuit Board Assembly

c) Ignition transformer assembly E7023EA

No.	Name	Q'ty	Part No.	Remarks
1	Constant Votage Power Supply Converter	1	G7318MT	
2	Relay	1	A1322MR	

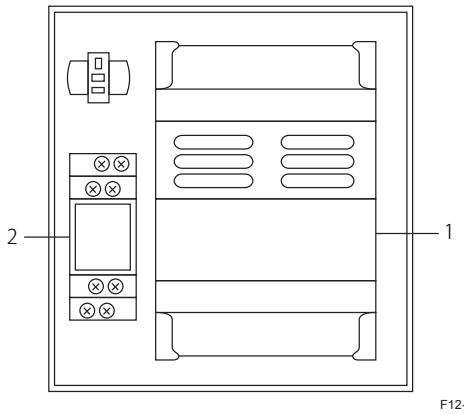


Figure 12.3 Ignition Transformer Assembly

d) Others

No.	Name	Q'ty	Part No.	Remarks
1	O-ring	2	Y9110XB	Viton
2	Packing	1	E7023FB	

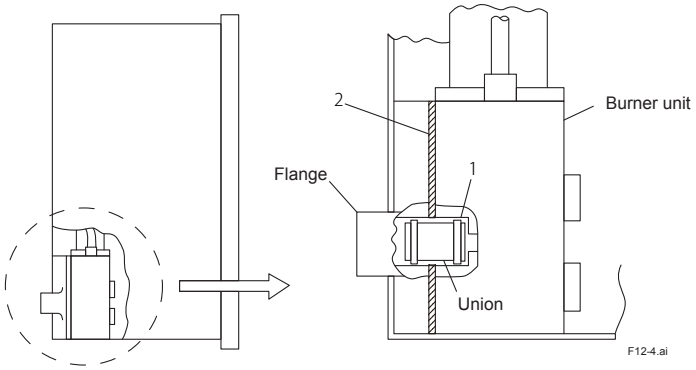
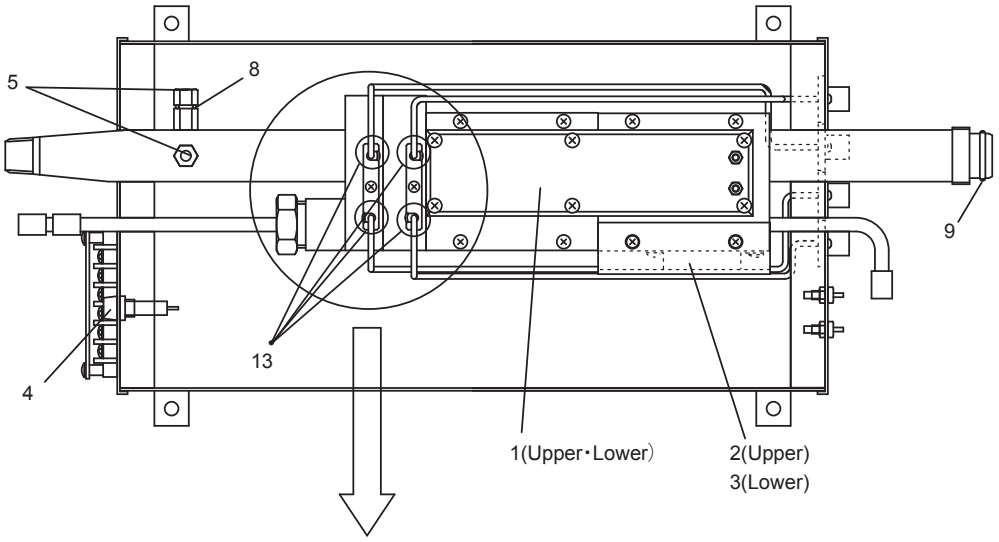
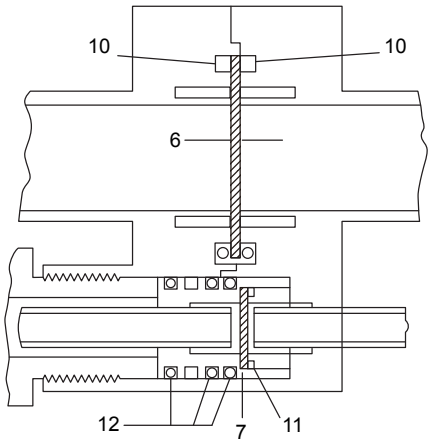


Figure 12.4 Flange Section of the Calorie Detector

12.2 Orifice Assembly E7023NA

No.	Name	Q'ty	Part No.	Remarks
1	Heater Plate	2	G7003RH	
2	Thermostat	1	E7023NS	
3	Thermostat	1	E7023NT	
4	Neon Lamp	1	G7007EP	
5	Temperature Detect Thermistor	2	E7023GY	
6	Orifice Plate	1	E7023GH	
7	Orifice Plate	1	—	Refer to Fig. 10.2
8	O-Ring	2	Y9105XB	Viton
9	O-Ring	1	Y9119XB	Viton
10	O-Ring	2	Y9133XB	Viton
11	O-Ring	1	Y9114XB	Viton
12	O-Ring	3	L9817MT	Viton
13	O-Ring	4	Y9103XB	Viton





Orifice Hole(φ)	Parts No.
0.35	G7025XJ
0.40	G7026XJ
0.45	G7027XJ
0.50	G7028XJ
0.55	G7029XJ
0.60	G7030XJ
0.65	G7031XJ
0.70	G7032XJ
0.75	G7033XJ
0.80	G7034XJ
0.85	G7035XJ
0.90	G7036XJ
1.0	G7037XJ
1.1	G7038XJ
1.2	G7039XJ
1.3	G7040XJ
1.4	G7041XJ
1.5	G7042XJ

F12-5.ai

Figure 12.5 Orifice Assembly

12.3 Preheater E7023NG

No.	Name	Q'ty	Part No.	Remarks
1	Temperature Sensor	1	E7023JM	Thermistor
2	Heater	1	E7023NR	
3	Packing	1	E7023JD	
4	Thermostat	1	E7023NU	

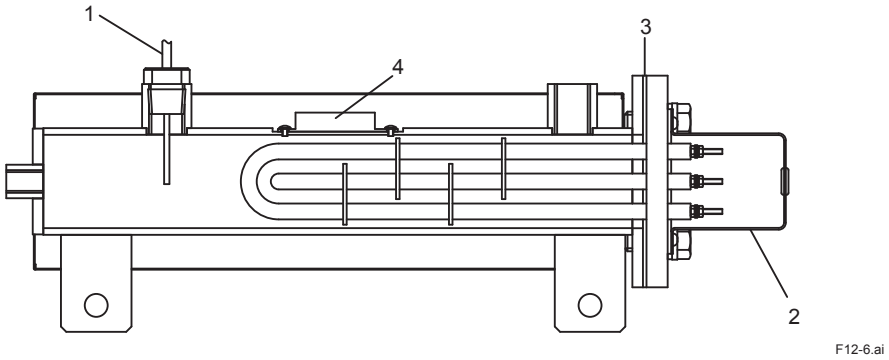


Figure 12.6 Preheater

12.4 Fulflo Filter G7043XJ

No.	Name	Q'ty	Part No.	Remarks
1	Element	1	G7054XJ G7057XJ	10µ polypropylene 50µ
2	Packing	1	G7086XL	PTFE with glass
3	Packing	1		PTFE with glass
4	Packing	1		PTFE with glass
5	Gasket	1		PTFE
6	O-ring	1		PTFE

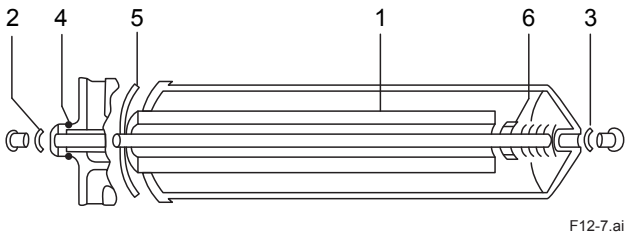


Figure 12.7 Fulflo Filter

12.5 Line Filter H7800EC

No.	Name	Q'ty	Part No.	Remarks
1	Element	1	G7005XJ	
2	O-ring	1	Y9116XB	Viton

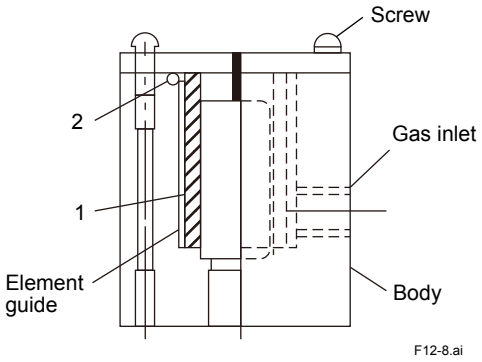


Figure 12.8 Line Filter

12.6 Switch Box H7800HV

No.	Name	Q'ty	Part No.	Remarks
1	Toggle Switch	1	G7321ST	
2	Fuse	1	G7022EF	3A, for Calorie Detector
3	Fuse	1	G7022EF	3A, for Pump
4	Fuse	1	G7022EF	3A, for Dehumidifier
5	Fuse	1	G7013EF	1A, for Comp. Station
6	Fuse	1	G7009EF	2A, for Densty Meter

Note : Depends on specification.

12.7 Probe H7800HA, H7800HB, H7800HC

No/	Name	Q'ty	Part No.	Remarks
1	Packing	1	G7010YA	

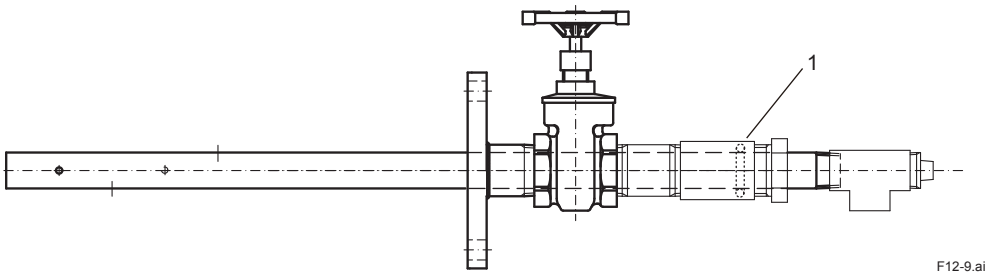


Figure 12.9 Probe

12.8 Temperature Controller E7023RE

No.	Name	Q'ty	Part No.	Remarks
1	Temperature Controller	1	E7023RE	For orifice chamber and preheating chamber

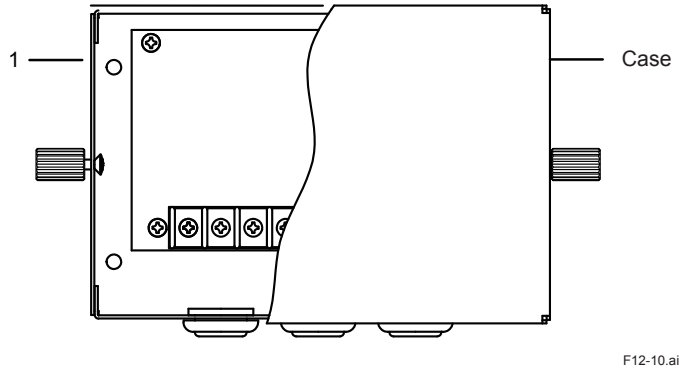


Figure 12.10 Temperature Controller

■ Principle of Measurement

The instrument is to detect the temperature difference, using a thermocouple, between the exhaust combustion gas made after sample gas is burnt in the burner, and the feed air at the inlet of the burner, then amplify and add the compensating calculation to the output signal and measure the calorific value of WI.

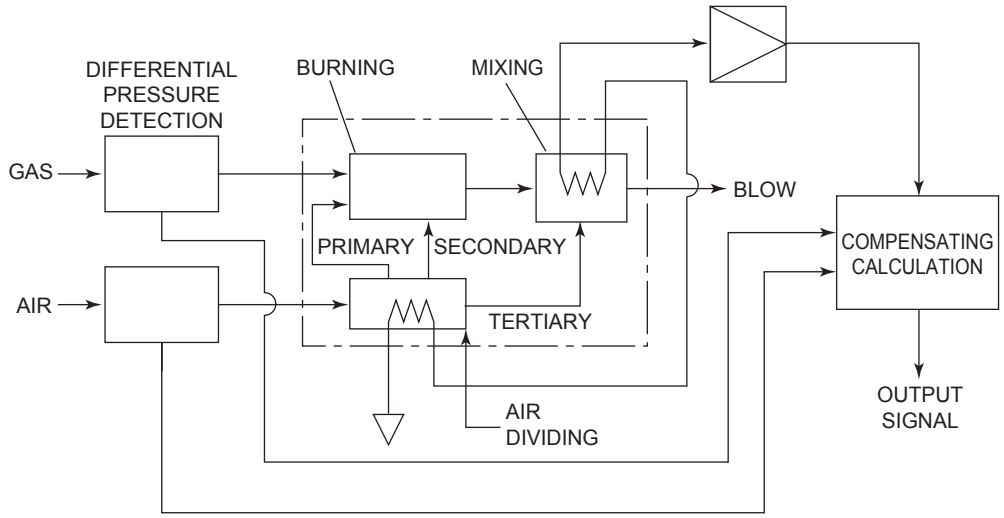


Figure 1.1 Measurement principle diagram

When the sample gas is burnt by the air, the formula of the increased temperature is as follows:

$$\Delta\theta = \frac{K \cdot Fg}{Cps \cdot Fs} \qquad (1.1)$$

where K: Calorific value of the sample gas

Fg: Flow rate of the sample gas

Fs: Air-diluted combustion exhaust gas flow rate

Cps: Constant pressure heat ratio of air-diluted combustion exhaust gas

Air flow rate Fa is big enough compared with the sample gas flow rate Fg (Fa:Fg=50-200:1) and Cps ≃ Cpa, Fs ≃ Fa+Fg=Fa (1 + g), therefore, the formula (1.1) is as follows:

$$\Delta\theta = \frac{K \cdot Fg}{Cpa \cdot Fa\,(1 + g)} \qquad (1.2)$$

where Fa: Air flow rate

Cpa: Air constant pressure heat ratio

g: Fg/Fa

When using orifice and take out Fa, Fg as a differential pressure of before and after orifice, Fa and Fg are represented by the following formula:

$$Fa = Ka \sqrt{\frac{\Delta Pa}{\rho a}} \qquad Fg = Kg \sqrt{\frac{\Delta Pg}{\rho g}} \qquad (1.3)$$

where: ΔPa, ΔPg: Air, gas differential pressure between before and after orifice

ρa, ρg: Density of the air and the gas

ka, kg: Orifice constant figure of the air and the gas
(Orifice coefficient × orifice sectional area)

If insert formula (1.3) into formula (1.2), Δθ is represented by the following formula:

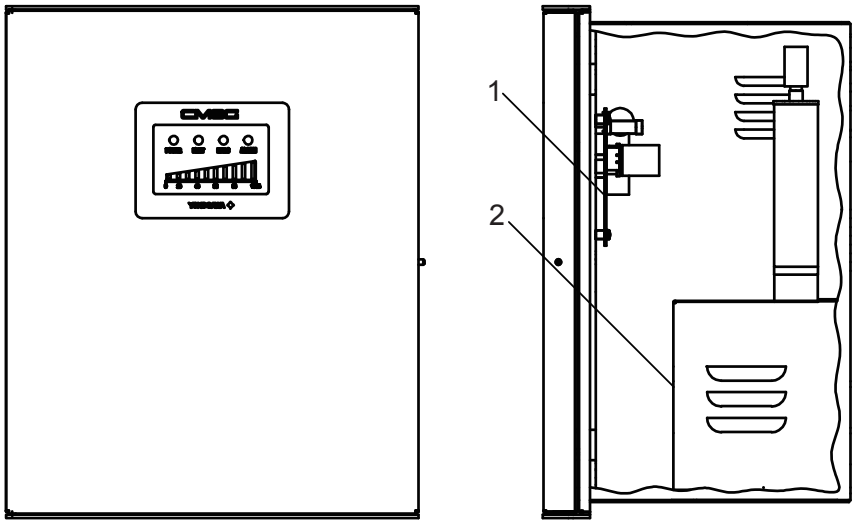
$$\Delta\theta = C.K. \frac{1}{\sqrt{\rho g}} \cdot \sqrt{\frac{\Delta Pg}{\Delta Pa}} \qquad (1.4)$$

$$\left(C = \frac{1}{Cpa\,(1+g)} \cdot \frac{Kg}{Ka} \cdot \sqrt{\rho a}\right)$$

According to formula (1.4), if ΔPa, ΔPg are constant, temperature difference Δθ is in proportion to WI ($k/\sqrt{\rho g}$) or calorific value (K). Thus we can measure continuously WI after Δθ measurement, and the calorific valve after the measurement and calculation of the density.

Customer Maintenance Parts List

Model CM6G
Gas Calorimeter, Calorie Detector



Item	Part No.	Qty	Description
1	E7023RA	1	Print Cir. Board Assy
2	E7023EA	1	Ignition Trans Assy

YOKOGAWA
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CMPL 11R02A01-02E
3nd Edition : Apr. 2011 (YK)

Revision Information

- Title : Model CM6G Gas Calorimeter
- Manual No. : IM 11R02A01-02E

Oct. 2011/4th Edition

All over revised

Chapter 2
- Subsection 2.1.1 :"Town Gas Application," Alarm Contact Output: Changed of description. Added the item of "Contact Input". Panel: Changed of panel color.
- Subsection 2.1.2, "Town Gas Application," Range: Changed of description. Alarm Contact Output: Changed of description. Added the item of "Contact Input". Panel: Chaned of panel color.
- Sunsection 2.2.1, "Gas Calorimeter": Changed of style code.

Nov. 2008/3rd Edition

Revised with the change of style code *B

Chapter 2
- Subsection 2.1.1 :Rated current of alarm contact output is corrected to 3A.
- Subsection 2.1.2 :Description about Range is revised.
- Subsection 2.2.2 :Change to style *B in MS code table
- Subsection 2.3.1 :Suffix code "-S3610" is corrected to "-S6310".
- Section 2.4 :The item "Hexagon Wrentch" is deleted from table list of calorie detector standard accessory.
- Section 2.5 (page2-6 to 2-8): Drawings of Computing Station change to Model YS1700
- Subsection 2.5.2 :In item 1, lengh of H7800HC is corrected.

Chapter 3
- Section 3.1 :Description about "conditioned air" is added
- Section 3.2 :Explanation about "piping" is added to body. Thermal insulation line and steam line is added to Figure 3.1 .
- Section 3.3: In Figure 3.4, drawings of Computing Station change to Model YS1700

Chapter 5
- In Figure 5.1 and 5.5, drawings of Computing Station change to Model YS1700
- Subsection 5.5.1: Complete revision (Application of Model YS1700 operation)
- Subsection 5.5.2: In table 5.3, items X6 to 8, Y5 to 6 and P08 to 30 are added
- Subsection 5.5.3: Equation (5.2) and (5.3) are revised. Figure numbers of 5.17 and 5.18 are changed.

Chapter 6
- Explanation about computing station operation is revised in; subsection 6.1.7 a)&b), 6.1.8 town gas g)&h), steel mill f)&g) and 6.2.3 both of c)
- Range of flow rate is expanded (0.5-1 l/min) in; subsection 6.1.8 town gas f), steel mill d), and 6.2.3 town gas b)

Chapter 7
- Explanation about computing station operation is revised in; subsection 7.1.1 f), 7.1.2 f)&g), 7.2.1 a)&b), 7.2.2 h), 7.3.1 c), 7.3.2 b)&d)
- Description about "indication check" is added to; subsection 7.1.1 d) and 7.1.2 d)
- Title is changed and description with "See also" is inserted to subsection 7.1.1 d) and 7.1.2 d).
- Subsection 7.3.3: P05 is corrected to P02.

Chapter 9
- Explanation about computing station operation is revised in subsection 9.1.1 (7) and 9.1.2 (10).
- Range of flow rate is expanded (0.5-1 l/min) in subsection 9.1.1 (6) and 9.1.2 (9).
- Description about "indication check" is added to 9.1.1 (4).
- Subsection 9.1.2: Unit "Pa" is corrected to "kPa".
- Section 9.4: In item 2), The value "200" is corrected to "20"
- Section 9.4: In Figure 9.1, alphabet marks of the computing station terminal are corrected to number marks. No.19(+) and No.20(-) are written in the station

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Home page: http://www.yokogawa.com/an

terminal, and connected to No.1 and No.2 of the calorie detector, respectively.
Terminal Numbers of distoributor are revised in the body and Figure 9.1.
Section 9.5: Item 1) is revised. 2) is deleted. 3) is partially changed and printed as item 2).

Chapter 10 Subsection 10.1.1 : In item 8, part No. is corrected to “Y9107XB.”

Aug 2007/2nd Edition

All over revised

Jun. 2009/1st Edition

Newly published

User's Manual

Model CM6G Gas Calorimeter

Supplement

Thank you for selecting our Model CM6G Gas Calorimeter.
User's Manual, IM 11R02A01-02E, 4th Edition, supplied with the product, some revisions/additions have been made. Please replace the corresponding pages in your copy with the attached, revised pages.

Revisions:

- page 2-1, Section 2.1.1, "Twon Gas Application" Conditions at the Sampling Point:Changed the description of the pressure (1).
  Section 2.1.1, "Twon Gas Application" Alarm Contact Output: Added of the description.
- page 2-2, Section 2.1.2, "Steel Mill Application" Conditions at the Sampling Point:Changed the description of the pressure (1).
  Section 2.1.2, "Steel Mill Application" Alarm Contact Output: Added of the description.
- page 2-3, Section 2.2.1, "Gas Calorimeter"Table: Changed the descriptions of the system specification.
- page 2-4, Section 2.3.1, "Standard Systems for Each Application"Table:Changed the descriptions of the system specification.
- page 2-5, Section 2.4, "Standard Accessories"• Calorie Detector: Changed the part number of the fuse.
- page 5-2, Section 5.2.4, "Contact Output": Added of the description.
- page 12-2, Section 12.1, "Calorie Detector E7023TA" b) Print circuit board assembly E7023RA:Changed the part number of the fuse, Printed Circuit Board Assembly and Relay.

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Yokogawa Electric Corporation

IM 11R02A01-02E
4th Edition

2. Specifications

2.1 Standard Specifications

2.1.1 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
(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; 100 V AC, 5 A, closed when alarm occurs (resistance load)
when contact is opened, the leakage current is 2mA or less (100V AC)
Temperature alarm; 100 V AC, 3 A, closed when alarm occurs (resistance load)

Contact Input : Remote ignition (Tokuchu); 24 V DC, 0.1A or more

Repeatability

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

Note 1: High calorific value means 6.3 MJ/Nm^3 or more.
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 more	30 sec or less	60 sec or less
32 or more, less than 50	27 sec or less	53 sec or less
13 or more, less than 32	23 sec or less	47 sec or less
13 or less	21 sec or less	41 sec or less

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 ± 0%, 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 3.2PB7.4/1.2 (inside and outside)
Ambient Temperature:	0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

2.1.2 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
	(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:	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; 100 V AC, 5 A, closed when alarm occurs (resistance load)
when contact is opened, the leakage current is 2mA or less (100V AC)
Temperature alarm; 100 V AC, 3 A, closed when alarm occurs (resistance load)

Contact Input: Remote ignition (Tokuchu); 24 V DC, 0.1A or more

Repeatability :

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

Note 1: High calorific value means 6.3 MJ/Nm^3 or more.
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 more	42 sec or less	70 sec or less
32 or more, less than 50	39 sec or less	60 sec or less
13 or more, less than 32	36 sec or less	50 sec or less
13 or less	30 sec or less	45 sec or less

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 unit.

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 ± 0%, 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 3.2PB7.4/1.2 (inside and outside)

Ambient Temperature:

0 to 40°C (little temperature variation, particularly no rapid change in temperature, allowed)

2.2 Model and Suffix Codes

2.2.1 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 ro 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				*C	- - - - - - - - - -	Style C

Note: Measuring range and unit must be specified.

2.2.2 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.

2.2.3 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: 50 µm Body: SUS 316 Connection: Rc 1/2
Pressure reducing valve	G7008XF	Primary pressure: 15 MPa max. Secondary pressure: 0 to 200 kPa Material: Brass

2.3 Standard Systems for Each Application

2.3.1 Standard Systems for Each Application

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

* 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.

2.3.2 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 $1/\sqrt{\rho g}$.

2.4 Standard Accessories

Followings are the standard accessories supplied.

• Detector

Name	Q'ty	Part No.	Remarks
Mirror	1	E7023FF	
Fuse	1	A1113EF	3.15 A

• Orifice Assembly

Name	Q'ty	Part No.	Remarks
O-Ring	1	Y9114XB	P16 (Viton)
O-Ring	1	L9817MT	P20 (Silicon)
Hexagon Wrench	1	L9827AB	Nominal size 1.5 mm
Hexagon Wrench	1	L9827AC	Nominal size 2.5 mm

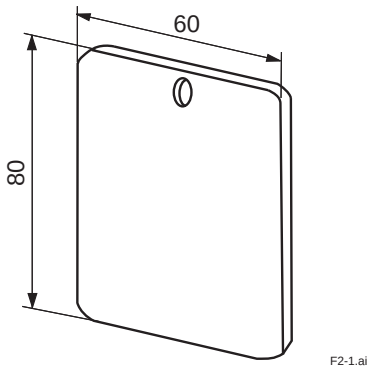

Figure 2.1 Mirror

5.1 Notes on Wiring

DANGER

- Cables and wires must be connected after all power supplies are turned off.
- An electrical wiring duct must not be used for the simultaneous connection of a large capacity converter, motor, or power supply.
- When cables are connected in a place with high or low ambient temperatures, use cables suitable for the place where they are used.
- When cables are used in an atmosphere where harmful gases, liquids, oil, or solvents are present, use cables made of materials capable of withstanding those things.
- Use crimp terminals with insulated sleeve (M4 screws) for the wire ends.

5.2 Wiring to Peripheral Equipment

5.2.1 Power Supply

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm^2 or more, or a wire or cable that is the equivalent or better.

5.2.2 Grounding

Connect a grounding wire to the grounding terminal inside the panel. A grounding wire must be connected so that the grounding resistance becomes 100 Ω or less (equivalent to JIS Class D).

5.2.3 Analog Output (4 to 20 mA DC)

Use a shielded twisted pair cable with a cross-section area of 0.5 mm^2 or more, or a cable that is the equivalent or better, and install it separately from the power supply and alarm output cables and sources of electromagnetic interference. A shielded cable must be connected to the frame ground (FG) beside each of the output terminals. The load resistance from the perspective of this equipment must be 750 Ω or less.

5.2.4 Contact Output

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm^2 or more, or a wire or cable that is the equivalent or better.

The flame extinction alarm contact and orifice chamber temperature drop alarm contact must be non-voltage dry contacts and the contact rating must be as follows. (when contact is opened, the leakage current is 2mA or less (100V AC))

Contact	Rating
Flame distinction alarm contact	100 V AC 5 A
Orifice chamber temperature drop alarm contact	100 V AC 3 A

b) Print circuit board assembly E7023RA

No.	Name	Q'ty	Part No.	Remarks
1	Printed Circuit Board Assembly	1	E7023RA	
2	Relay	1	A1322MR	MY2, DC24V OMRON
3	Fuse	2	A1113EF	3.15 A

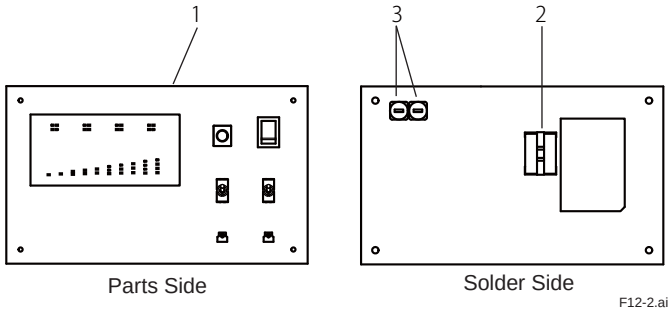

Figure 12.2 Print Circuit Board Assembly

c) Ignition transformer assembly E7023EA

No.	Name	Q'ty	Part No.	Remarks
1	Constant Votage Power Supply Converter	1	G7318MT	
2	Relay	1	A1322MR	

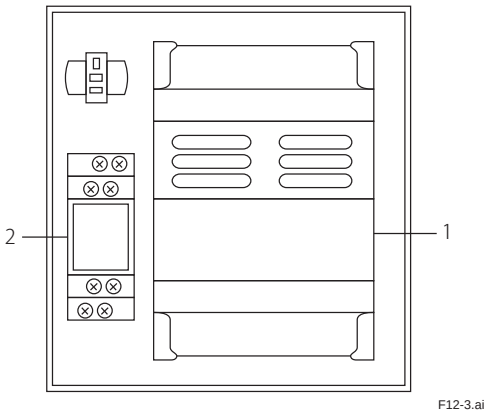

Figure 12.3 Ignition Trans Assembly

d) Others

No.	Name	Q'ty	Part No.	Remarks
1	O-ring	2	Y9110XB	Viton
2	Packing	1	E7023FB	

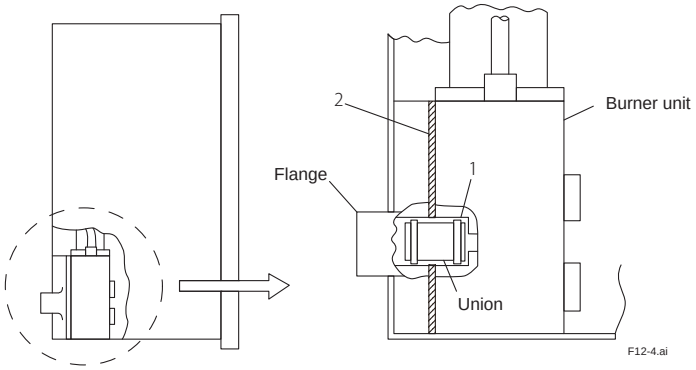

Figure 12.4 Flange Section of the Detector Transmitter