

◆ Introduction

Thank you for purchasing Model CM6G Gas Calorimeter.

In order to have the product deliver its full capabilities, read this instruction manual thoroughly before you use it.

On how to use the Gas density meter, read the instruction manual which comes with the product.



WARNING

Since the ignition starts until it completes, or right after the flame is extinguished, sample gas mixed with the air will be released from the top of the equipment into the installation space. 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 calorimeter detector.

■ About This Manual

- This manual should be passed on to the end user so that the user can refer to the manual whenever they need.
- If the product is not used in a manner specified in this manual, the safety of this product may be impaired.
- 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.

■ Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted, for the convenience of description.

■ Inspection on delivery

After the delivery, open the product package carefully and inspect for damages caused during the transport. Should there be any damage or breakage on the product, please contact YOKOGAWA immediately. Retain all the packing materials, containers and boxes that came with the product. After unpacking, make sure the delivered products include all of the component equipment you ordered. When confirming the specifications, refer to the model and suffix codes indicated on the nameplate on the product. The models are indicated on the name plates. Check also those of accessories. For further information, please read subsection 1.2 of this document.

◆ Safety Precautions

■ Safety, Protection, Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following safety symbols are used on the product as well as in this manual.



WARNING

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 and health including risk of injury, electric shock, or fatalities. or the damages to instruments. The manual describes what special care the operator must take to avoid such risks.



CAUTION

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the operator or instrument from being injured, or damaged.

The following are signal words to be found only in our instruction manuals.

CAUTION

This symbol gives essential information to avoid damages of soft or hardware, or system failure.

NOTE

This symbol indicates information that complements the present topic.

■ Warning and Disclaimer

- The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA can not predict in advance.

■ Trademark policy

All company or product and product names mentioned in this document are trade names, trademarks or registered trademarks of their representative companies. In this document, trademarks or trade names are not indicated with TM or ® as trademark symbols.

◆ After-sales Warranty

- Do not modify the product.
- 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.
- 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.
- 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 or damage caused by relocation of the instrument.
 - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
 - Failure caused by any usage at location or its maintenance that Yokogawa does not authorize.
 - 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 direct / indirect responsibility for any damage an end user might incur, 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 the product, please contact the nearest sales office described in this instruction manual.

Model CM6G

Gas Calorimeter

IM 11R02A01-02E 6th Edition

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1. Outline

Model CM6G Gas calorimeter measures and controls a calorific value of gases, Wobbe-Index (hereinafter referred to as WI), a theoretical air requirement, and a heat input for various kind of gas burning furnaces.

It detects a temperature rise of a sample gas, whose pressure is normally controlled, by burning it at a 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 outputs a 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, outputs a calorific signal.

1.1 Standard Specifications

**EMC : EMC Regulatory Arrangement in Australia and New Zealand
Korea Electromagnetic Conformity Standard Class A** 한국 전자파적합성 기준

A급 기기 (업무용 방송통신기자재)
이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는
사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서
사용하는 것을 목적으로 합니다.

■ 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/Nm³

Sample Conditions :

- Dust ; 5 mg/Nm³ 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 2 mA or less (100 V AC)
- Orifice 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/Nm³ or more. Low calorific value means below 6.3 MJ/Nm³.

Sample Gas Flow Rate : Approx. 10 l/min

Response Time (Note 2):

Max. WI measured	Dead time	Response time (63.2%)
50 or more	Approx. 30 sec or less	Approx. 60 sec or less
32 or more, less than 50	Approx. 27 sec or less	Approx. 53 sec or less
13 or more, less than 32	Approx. 23 sec or less	Approx. 47 sec or less
Less than 13	Approx. 21 sec or less	Approx. 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 NI/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: When you perform a low calorific value measurement, the frequency variation should be within ±0.4%. If the frequency variation exceeds ±0.4% (especially for exporting overseas), consult with Yokogawa.

■ 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/Nm³

Sample Conditions:

Dust; 100 mg/Nm³ 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 750Ω 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 2 mA or less (100V AC)

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/Nm³ or more. Low calorific value means below 6.3 MJ/Nm³.

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
Less than 13	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 NI/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)

1.2 Model and Suffix Codes

■ CM6G 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.

● Standard Accessories

Followings are the standard accessories supplied.

- Calorie Detector

Name	Q'ty	Remarks
Mirror	1	For burner flame inspection
Fuse	2	3.15 A (A1113EF)

• Orifice Assembly

Name	Q'ty	Remarks
O-Ring	1	P16 (Viton) (Y9114XB)
O-Ring	3	P20 (Silicon) (L9817MT)
Hexagon Wrench	1	Nominal size 1.5 mm
Hexagon Wrench	1	Nominal size 2.5 mm

■ Gas Density Meter

Gas Density Meter compensates a density value 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. See GS 11T3E1-01E for further information.

■ Option

You must purchase options separately.

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

1.3 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 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	With 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

* The code is basic for gas pressure and measurement.

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

■ Instructions for System Selection

- The quake-proof type gas calorimeter is always equipped with the density meter.
- 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 $1/\sqrt{\rho_g}$.

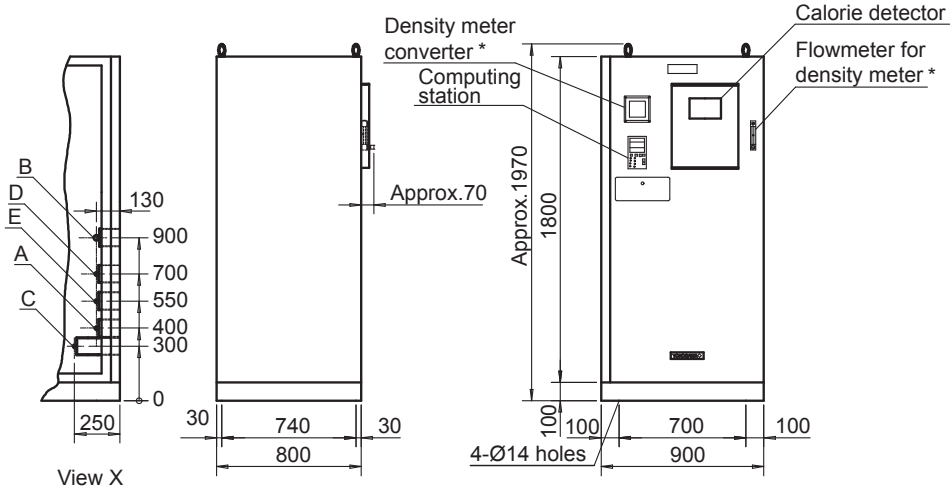
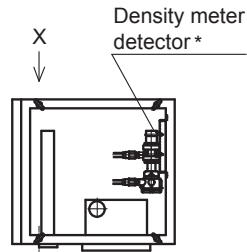
1.4 External Dimensions

■ For Town Gas Applications

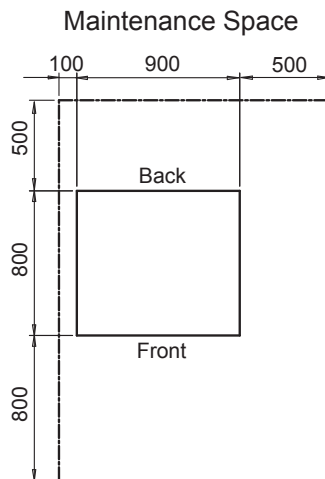
CM6G-S6200, S6210, S6300, S6310, S6400, S6410

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



* CM6G-S6□10 (with density meter) only



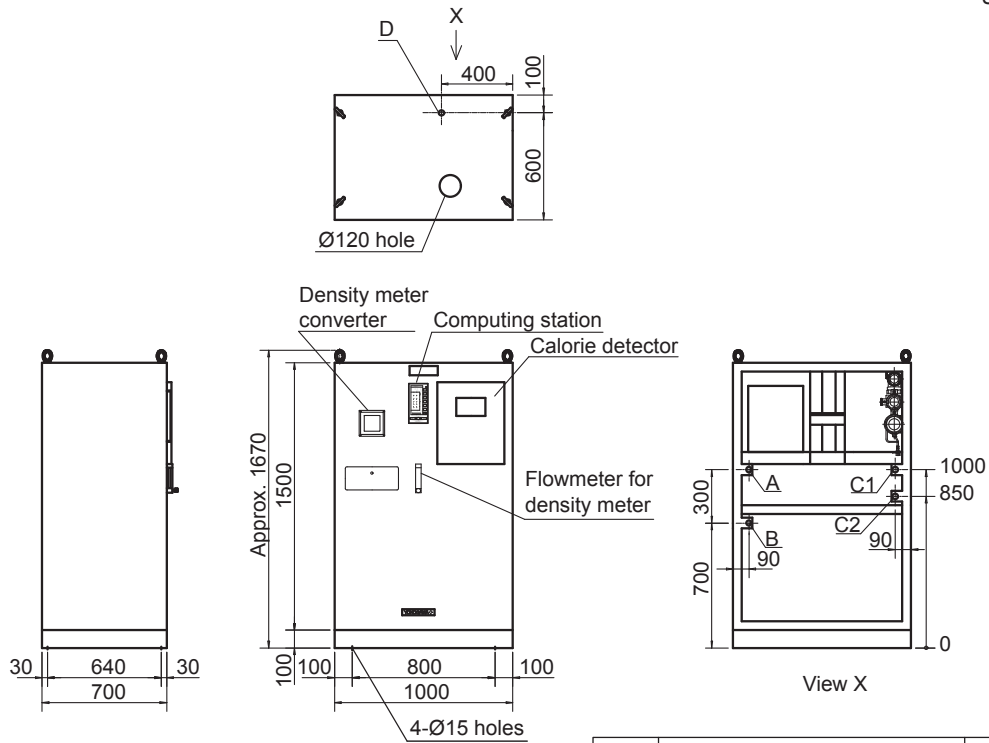
Weight: Approx. 300kg

Dim-6210.ai

■ For Town Gas Application (Quake-proof Type)

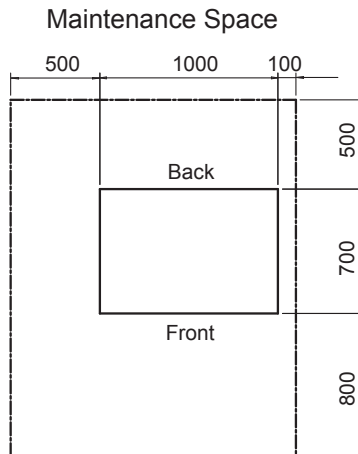
CM6G-S6110

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.



Weight: Approx. 350kg

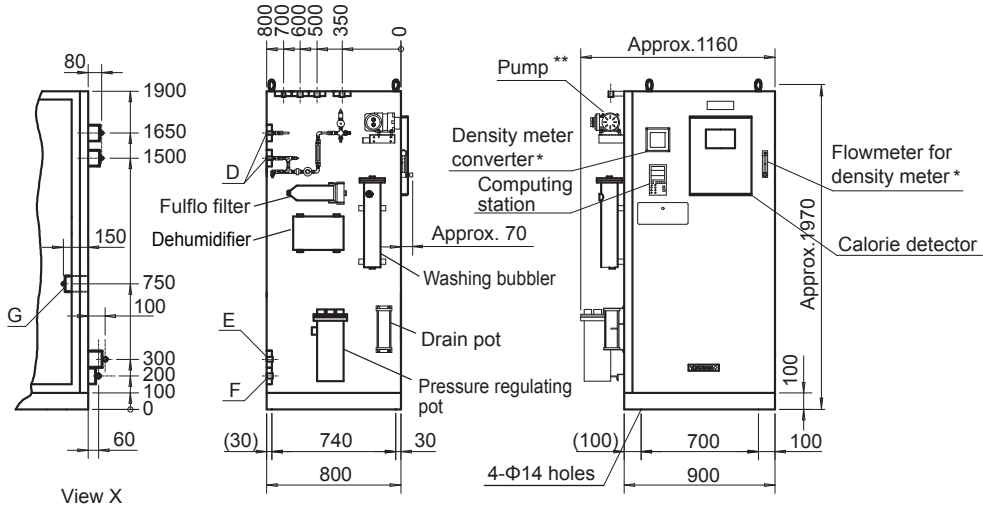
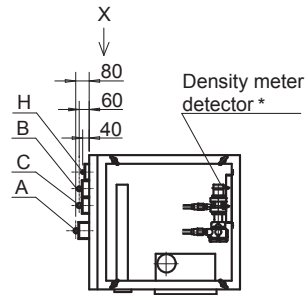
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■ For Steel Mill Application

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

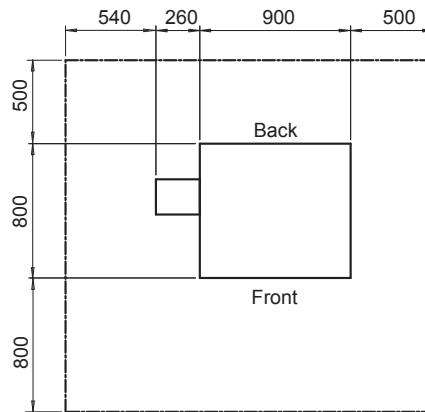
Unit: mm

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



* CM6G-S6□10 (with density meter and flowmeter)
 ** CM6G-S67□0, CM6G-S68□0 (with pump)

Maintenance Space

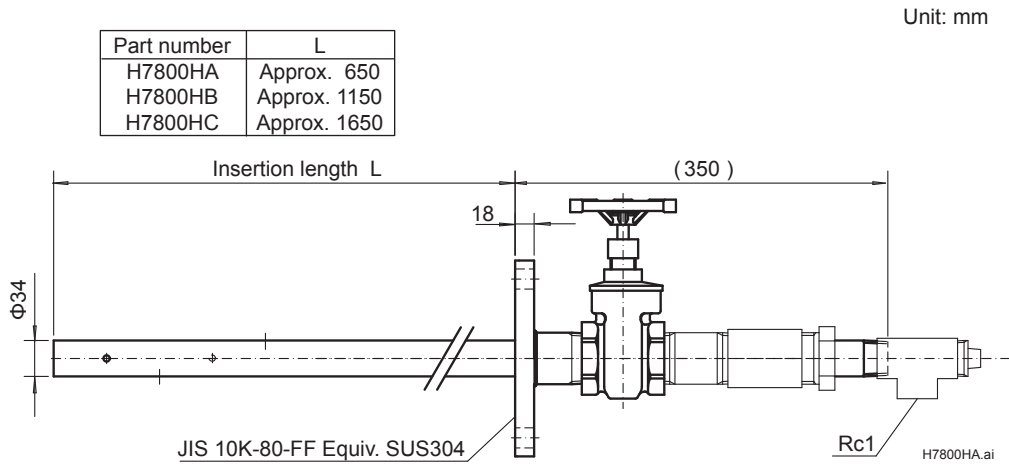


Weight: Approx. 350kg

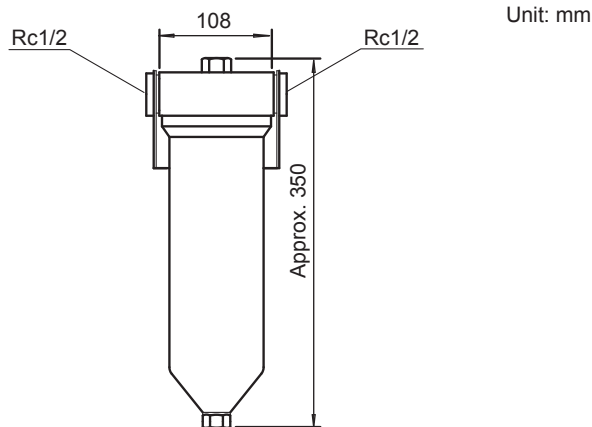
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■ Dimensions of Options

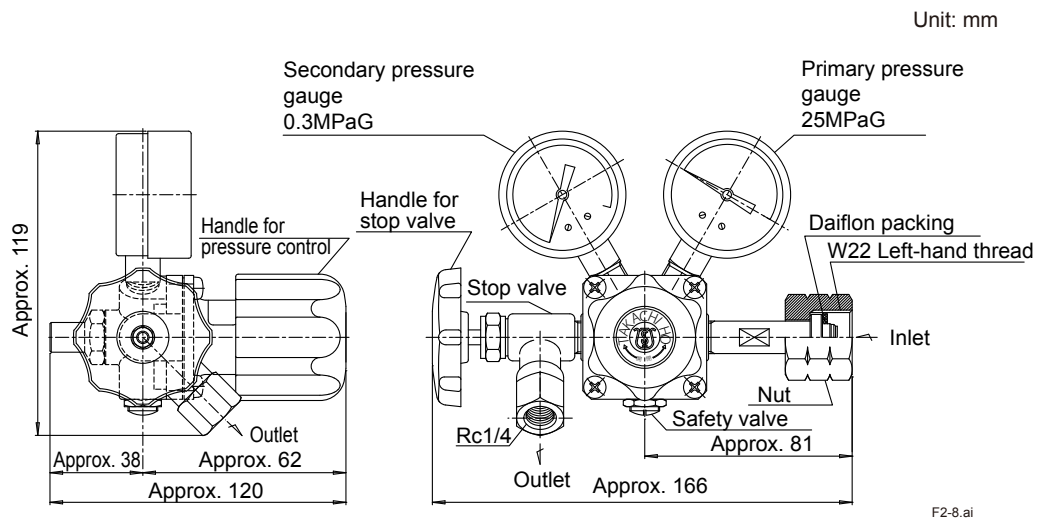
● Probe



● Fulflo Filter (Part no.: G7043XJ)



● Pressure Reducing Valve (Part no.: G7008XF)



1.5 Principle of Measurements

The instrument detects 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 the instrument amplifies the value of temperature difference. It adds the compensating calculation to the output signal and measures the calorific value of WI.

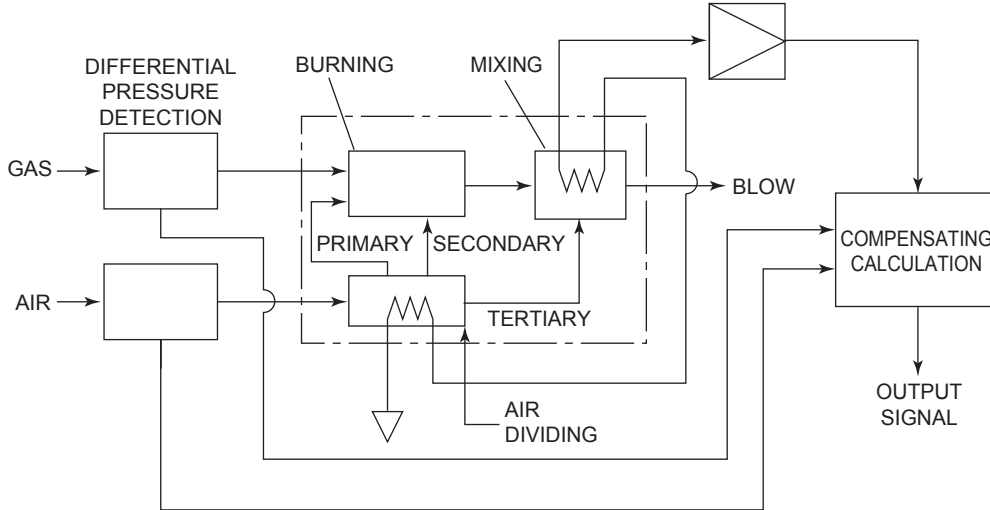


Figure 1.1 Measurement principle diagram

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

$$\Delta\theta = \frac{K \cdot F_g}{C_{ps} \cdot F_s} \tag{1.1}$$

- where K: Calorific value of the sample gas
- F_g: Flow rate of the sample gas
- F_s: Air-diluted combustion exhaust gas flow rate
- C_{ps}: Constant pressure heat ratio of air-diluted combustion exhaust gas

Air flow rate F_a is big enough compared with the sample gas flow rate F_g (F_a:F_g=50-200:1) and C_{ps} = C_{pa}, F_s = F_a+F_g=F_a (1 + g), therefore, the formula (1.1) is as follows:

$$\Delta\theta = \frac{K \cdot F_g}{C_{pa} \cdot F_a (1 + g)} \tag{1.2}$$

- where F_a: Air flow rate
- C_{pa}: Air constant pressure heat ratio
- g: F_g/F_a

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

$$F_a = K_a \sqrt{\frac{\Delta P_a}{\rho_a}} \quad F_g = K_g \sqrt{\frac{\Delta P_g}{\rho_g}} \tag{1.3}$$

- where: ΔP_a, ΔP_g: Air, gas differential pressure between before and after orifice
- ρ_a, ρ_g: Density of the air and the gas
- k_a, k_g: Orifice constant figure of the air and the gas (Orifice coefficient × orifice sectional area)

If insert formula (1.3) into formula (1.2), $\Delta\theta$ is represented by the following formula:

$$\Delta\theta = C.K. \frac{1}{\sqrt{\rho_g}} \cdot \sqrt{\frac{\Delta P_g}{\Delta P_a}} \quad (1.4)$$

$$(C = \frac{1}{C_{pa}(1+g)} \cdot \frac{K_g}{K_a} \cdot \sqrt{\rho_a})$$

According to formula (1.4), if ΔP_a , ΔP_g are constant, temperature difference $\Delta\theta$ is in proportion to WI ($K/\sqrt{\rho_g}$) or calorific value (K). Thus we can measure continuously WI after $\Delta\theta$ measurement, and the calorific value after the measurement and calculation of the density.

2. Installation, Piping, Wiring

2.1 Installations

Observe the following conditions when you install instruments.

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

* See "External Dimension" on 1.4.

(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(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.



WARNING

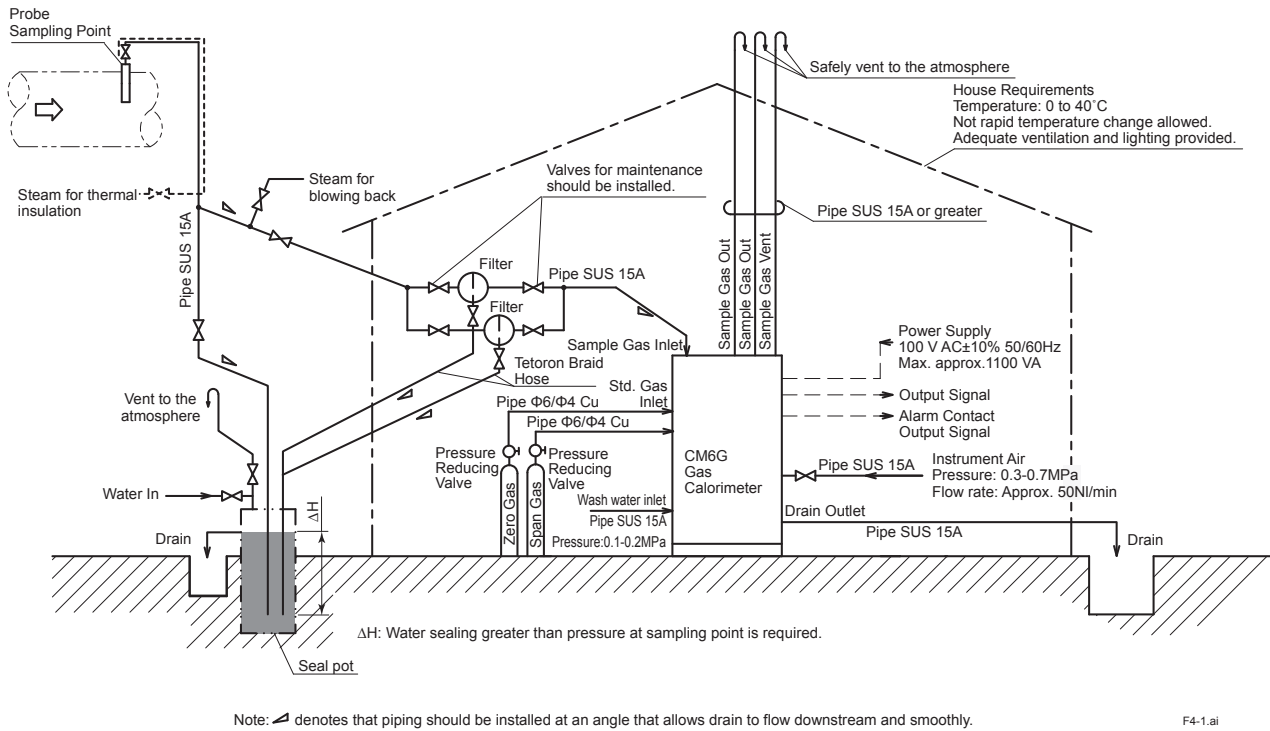
From the moment the ignition starts until it completes, or right after the flame extinction, sample gas mixed with the air will be released from the top of the equipment into the installation space of the equipment. Use the equipment in a well ventilated environment equipped with a ventilation system.

2.2 External piping

Refer to the drawing Figure 1.4. on the connections on the panel

The principal points to be taken care are as follows:

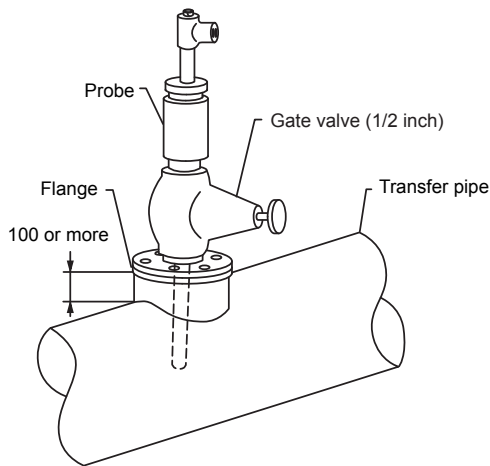
- Bent the outlet of the bent piping as U shape, and prevent it from the rain penetration. Set the outlet at higher position as much as possible where there is little fear of physical danger.
- Drain piping shall be conducted below the level of drain outlet on the panel and confirm no drain is accumulated on the panel bed.
- It is necessary for the sample line of the instrument for steel mill use to provide a slope of more than 1/3, so that there is 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 the drain in the pipe line from freezing.
- Locate the standard gas cylinders at the place where they are comparatively cool and not exposed to direct sunshine.



F4-1.ai

Figure 2.1 Recommended Sampling for Steel Mill Use

- Sampling point shall be made at the location above or side of the transfer pipe. When the instrument is mounted on wall, 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, it is recommended to provide a gate valve of 1/2 inch.



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Figure 2.2 Mounting of the Probe

- Fix filter vertically with their drain outlets facing downward. Mount it firmly to wall or to pillar with U bolt-like bolts. 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 pipes, use flexible pipes.

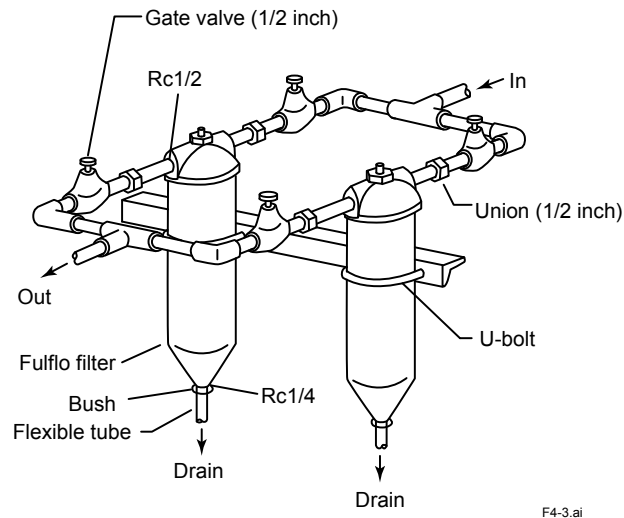


Figure 2.3 Example Fulflo Filters with the Piping

2.3 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.

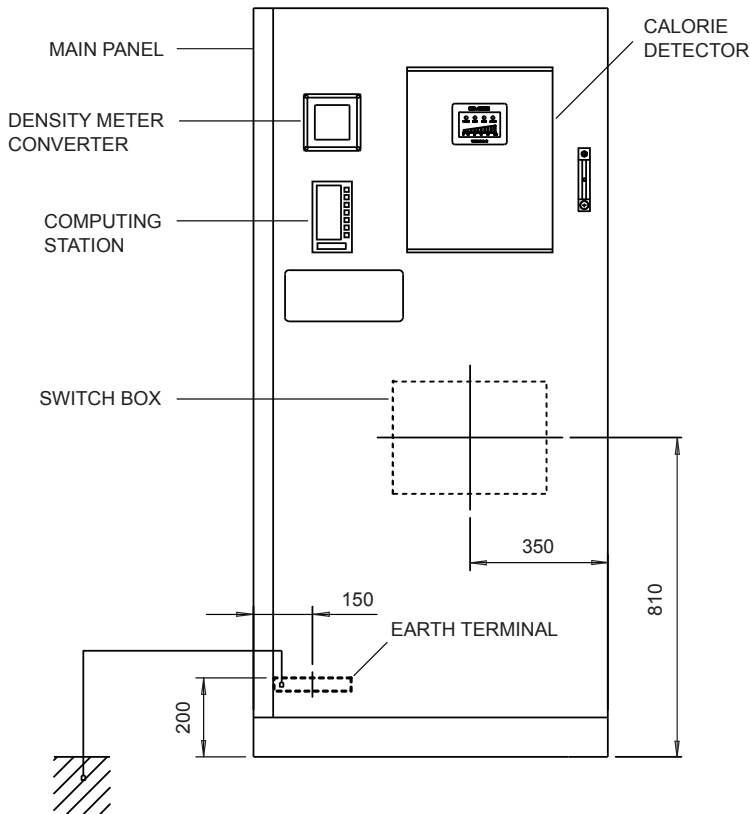


Figure 2.4 Switch Box and Earth

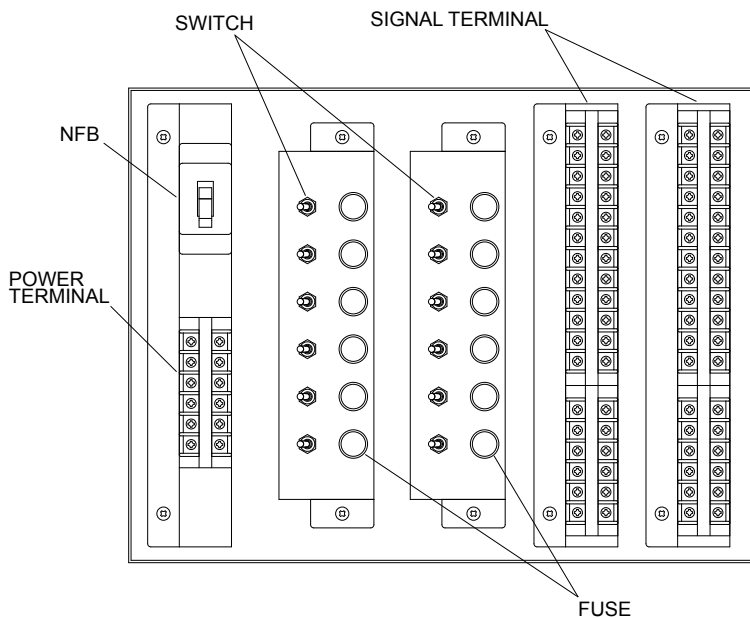


Figure 2.5 Inside a Switch Box

■ **Notes on Wiring**

- Turn off all power supplies while connecting cables and wires.
- 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.
- The material of cables must be capable of withstanding harmful gases, liquids, oil, or solvents when cables are used in the atmosphere where these harmful substances are present.
- Use crimp terminals with insulated sleeve (M4 screws) for the wire ends.

■ **Wiring to Peripheral Equipment**

● **Power Supply**

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm² or more, or a wire or cable that is the equivalent or better.

● **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).

● **Analog Output (4 to 20 mA DC)**

Use a shielded twisted pair cable with a cross-section area of 0.5 mm² 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.

● **Contact Output**

Use a 600 V insulated vinyl cabtyre cable (JIS C3312) with a cross-section area of 2 mm² 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 2 mA 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

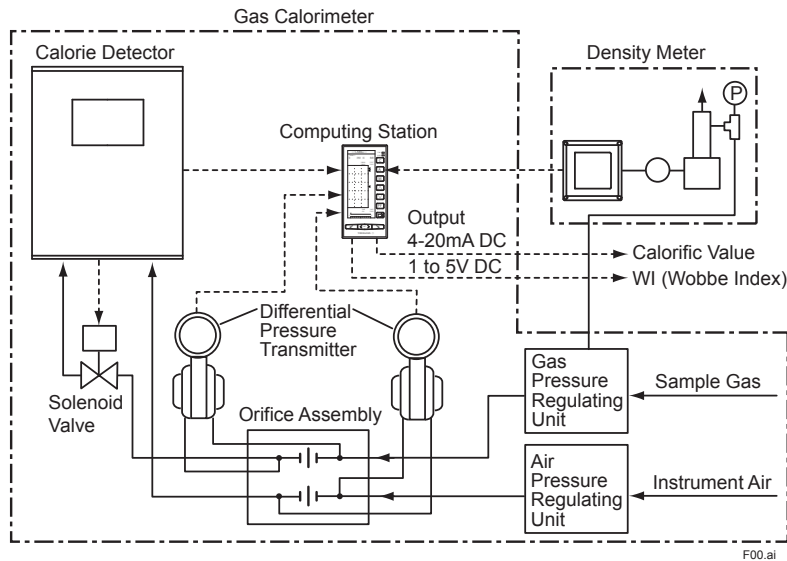
● **Contact Input (Remote Ignition: Made to order)**

Input a non-voltage contact 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.

3. 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 3.1 Components and Functions of Model CM6G Gas Calorimeter

3.1 Air Pressure Regulating System

Refer to Figure 3.2, 3.3 and 3.4. 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). Then the pressure is set by needle valve (V-16) to a differential pressure of 500 Pa.

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

When the temperature rises above 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.

3.2 Gas Pressure Control Section

Refer to Figure 3.2, 3.3 and 3.4. The gas pressure regulating section has two different types; town gas use and steel mill use.

● **Town Gas Use**

The sample gas, introduced through line filter (3-1), increases its pressure by pump, or decreases 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, the sample gas 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.

● **Steel Mill Use**

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.

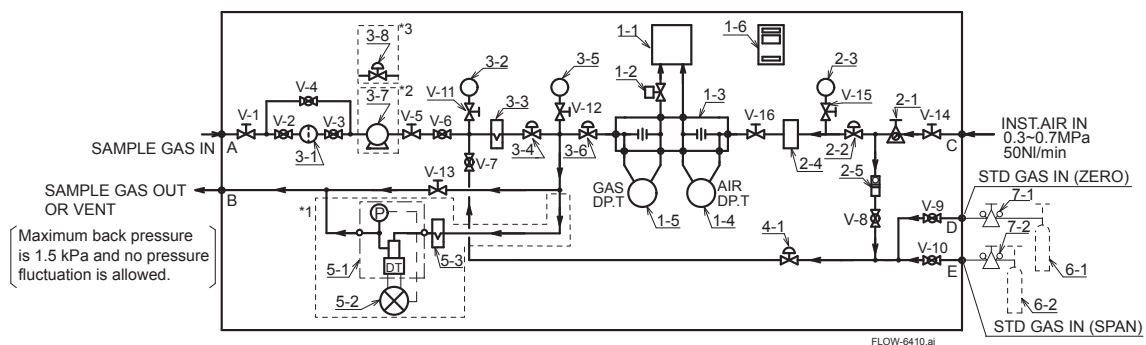
To increase the pressure by the pump, a drain pot (3-9) is added. When the density compensation system is equipped, the sample gas is supplied to the density meter with its flow rate of 1 l/min, through the flowmeter (5-3). The pressure of the standard gas is reduced by the pressure reducing valve (4-1) 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	Zero gas (supplied by customer)
1-5	Differential pressure transmitter (gas)	3-5	Pressure gauge	6-2	Span gas (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)	V1...16	Ball valve, needle valve
2-3	Pressure gauge	4-1	Pressure reducing valve for standard gas		
2-4	Preheating chamber				
2-5	One touch coupler				



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

Figure 3.2 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	Zero gas (supplied by customer)
1-2	Solenoid valve	3-2	Pressure gauge	6-2	Span gas (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	V1...16	Ball valve, needle valve
1-6	Computing station	3-6	Pressure reducing 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				

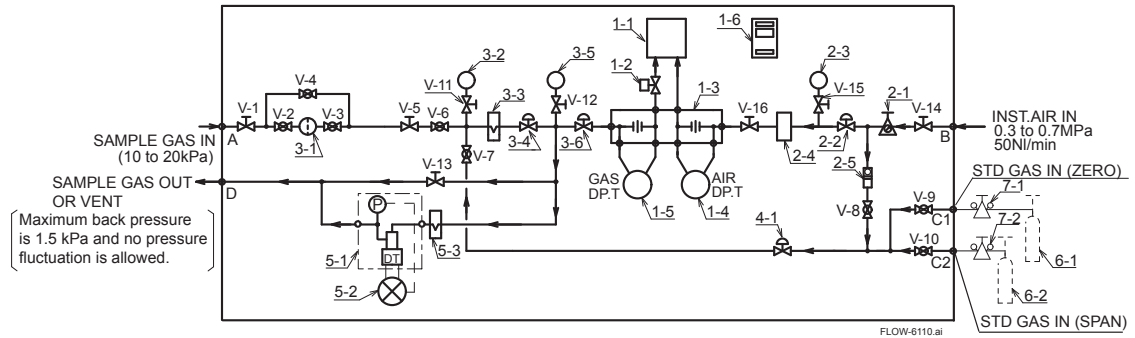


Figure 3.3 Flow Sheet (for Town Gas)

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	Fulfilo 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	Fulfilo 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

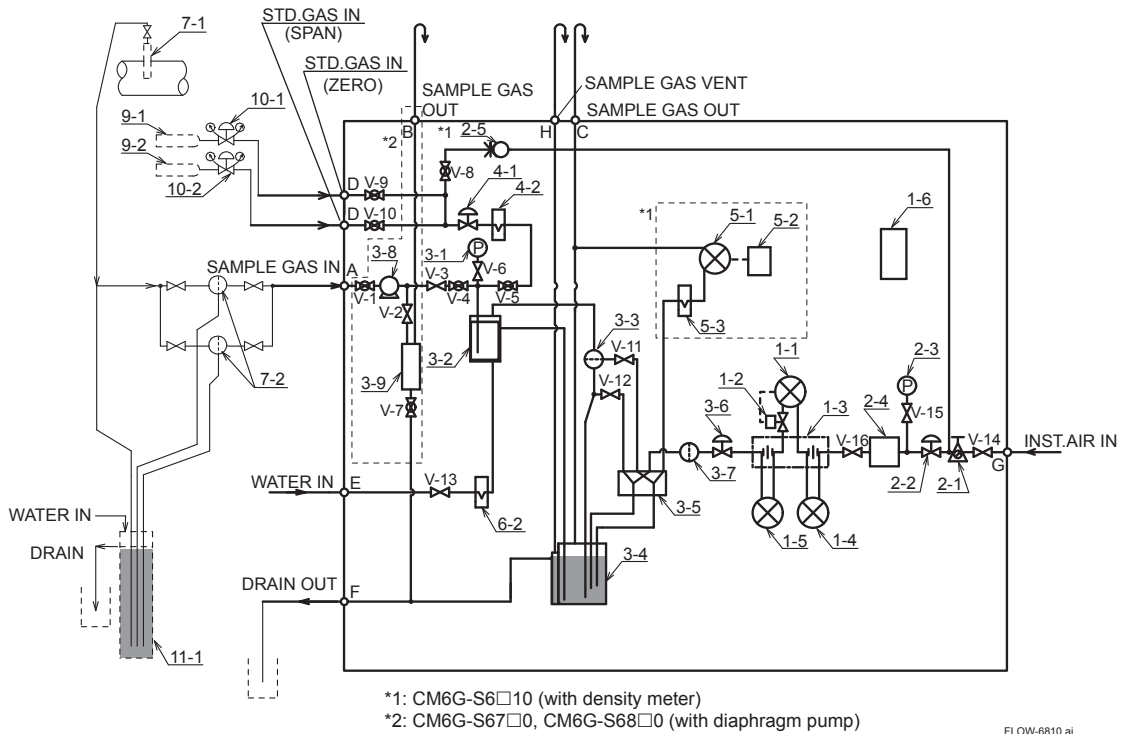


Figure 3.4 Flow Sheet (Steel Mill Use)

3.3 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.

CAUTION

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.

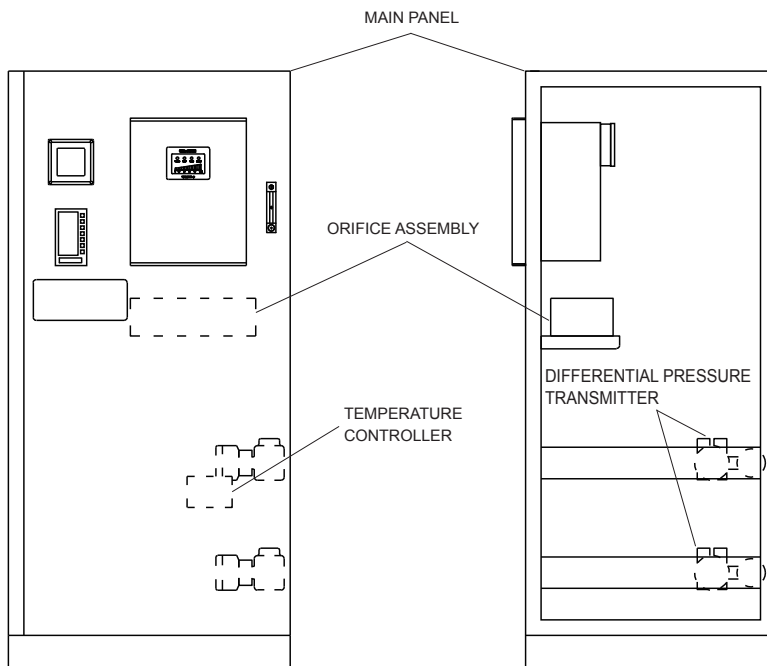
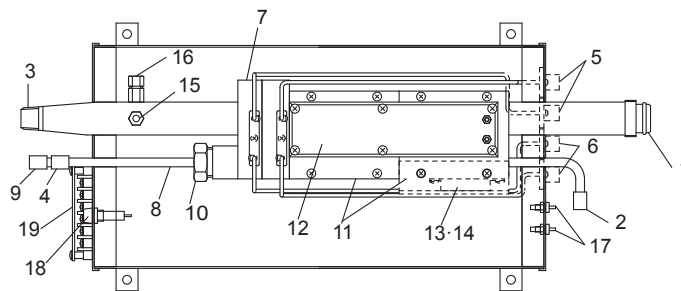


Figure 3.5 Differential Pressure Detection Equipment



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	Orifice section	14	Alarm thermostat (down)		

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Figure 3.6 Orifice Assembly

3.4 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.

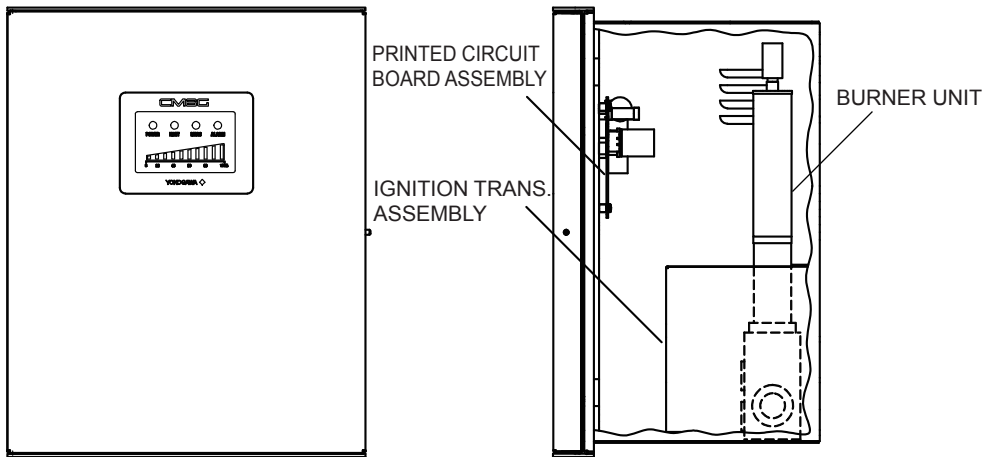


Figure 3.7 Calorie Detector

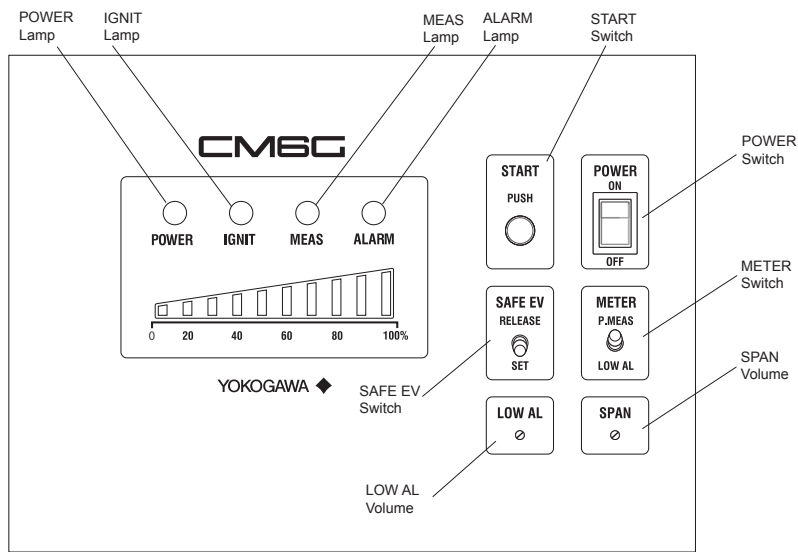


Figure 3.8 Front Panel Assembly

Table 3.1 Function and operation procedure for each switch of the calorie detector

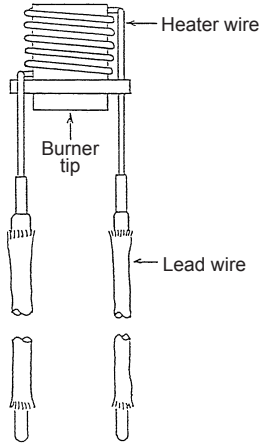
Name	Function and operation procedures
"POWER" switch	<ul style="list-style-type: none"> • Power supply switch. • When the switch turns to "ON", the power is supplied to the calorie detector and at the same time the lamps, "POWER" and "ALARM" are lit on.
"START" switch	<ul style="list-style-type: none"> • One push on "START" switch introduces gas to the burner unit and operates the ignition. • At the same time, the lamp "IGNIT" is on while the lamp "ALARM" is lit off. • If ignition occurs within the preset time, the lamp "IGNIT" is lit off but the lamp "MEAS" turns on. • If ignition does not occur within the preset time, the lamp "IGNIT" is lit off and the lamp "ALARM" turns on again.
"SAFE EV" switch	<ul style="list-style-type: none"> • Normally leave the switch at "SET". • When you adjust the differential pressure, turn it to "RELEASE". Then the lamp "ALARM" is let off, alarm is released and solenoid valve of the gas line is opened. • Switching over from "SET" to "RELEASE" during the operation does not affect anything. However, if you leave the switch at "RELEASE", no alarm signal is given even when the burner flame is off. • When the switch shows "RELEASE", "START" switch does not start the operation.
"METER" switch	<ul style="list-style-type: none"> • The indication of the indicator and the X5 display(*1) of the computing station switches between "P.MEAS" and "LOW AL" • The switching does not affect the final output and sequence action.
"SPAN" volume	<ul style="list-style-type: none"> • With this span volume you can adjust the output of the calorie detector to 1 - 5 V DC. • If you turn this to the right, the span point becomes bigger.
"LOW AL" volume	<ul style="list-style-type: none"> • The level for the extinction alarm (lower alarm) is set by this volume. • If you turn this to the right, the alarm level becomes higher.
"POWER" lamp	<ul style="list-style-type: none"> • When the lamp is lit, power is being supplied to the calorie detector, differential pressure transmitter, and temperature controller.
"IGNIT" lamp	<ul style="list-style-type: none"> • While the lamp is lit, the ignition proceeds.
"MEAS" lamp	<ul style="list-style-type: none"> • While the lamp is lit, the system is under the measurement condition.
"ALARM" lamp	<ul style="list-style-type: none"> • While the lamp is lit, alarm is being released.

(*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%)

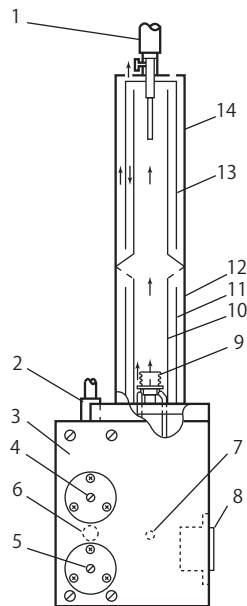
3.4.1 Burner Unit

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 (when lower calorie gas is being used.)



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Figure 3.9 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 3.10 Burner Unit

3.4.2 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 point to alarm the excessive combustion of the burner, which is set to approximately 120% of the span. The lower alarm limit is the point to alarm the flame extinction of the burner. You can change the limit by "LOW AL" volume on the front panel of the calorie detector. However, the lower alarm limit 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

3.4.3 Ignition

Press START on the front panel of the calorie detector to start ignition. One cycle of an ignition constitutes (T1) and (T2). (T1) is when the ignition voltage is applied to the heater (T1). (T2) is when the voltage is not applied (when using low calorific value, the time when the preheating voltage is applied). The cycle repeats five times normally. (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 even 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, press START to start the ignition again.

If the burner flame is extinguished in the event of an alarm, after removing the cause of the failure, press START to start the ignition again. If the alarm occurs due to excessive combustion, you cannot resume the ignition 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 3.11 shows the ignition sequence for which the lower alarm limit is set to 50%.

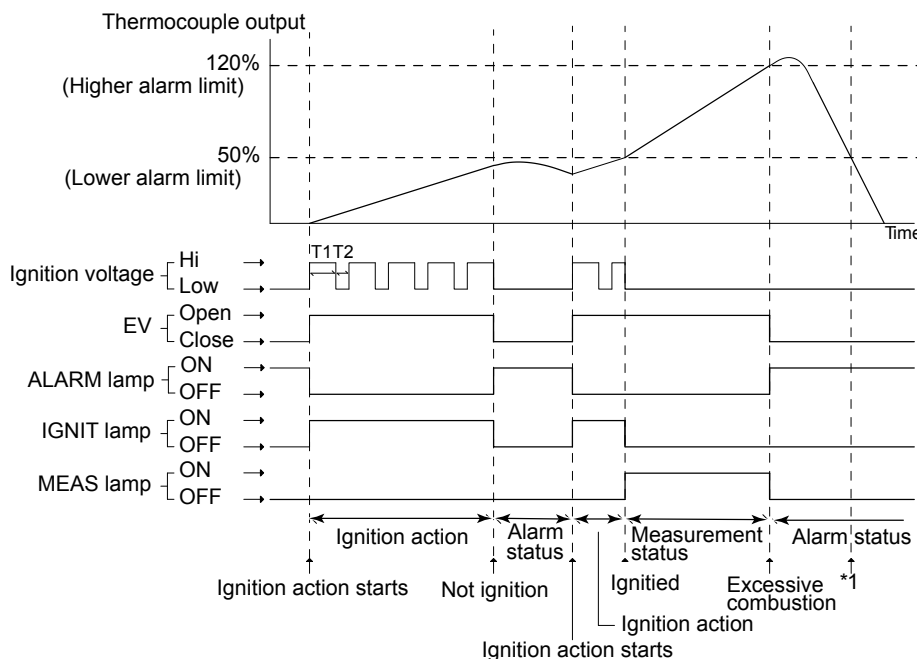


Figure 3.11 Ignition Sequence

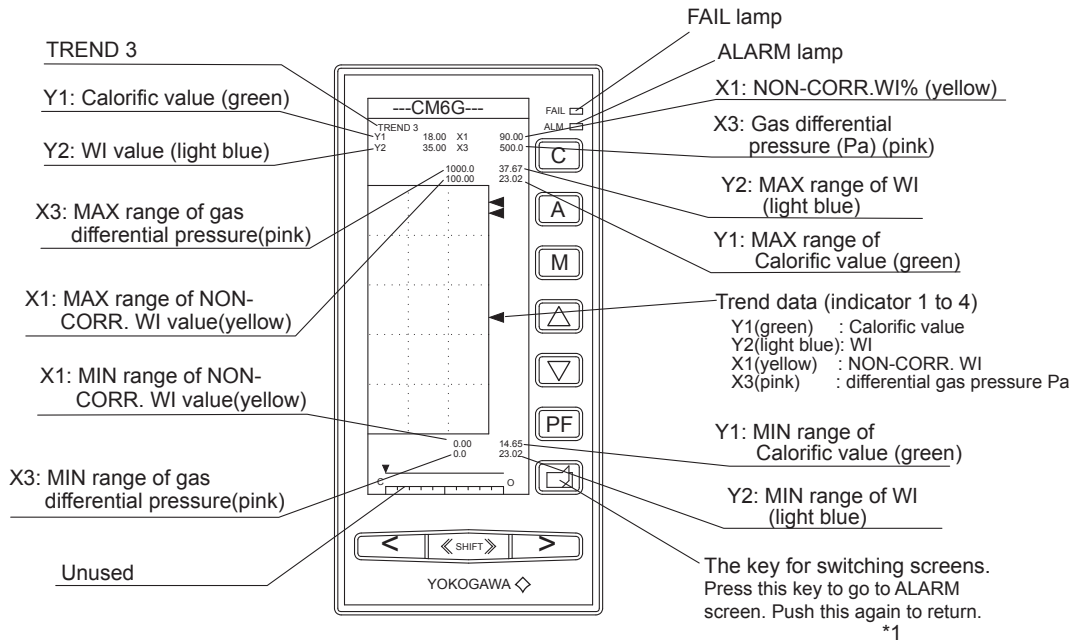
3.5 Computing Station

The computing station generates WI signal by calculating calorific detector signal with each differential pressure signal. It compensates the density with the density signal and generates the calorific signal.

Each input signal is digitally computed after A to D conversion then D to A conversion. It generates DC 4 to 20 mA (DC 1 to 5 V) output.

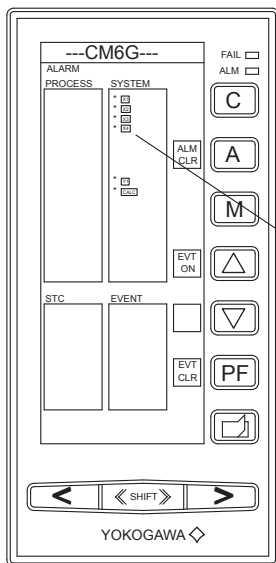
3.5.1 Display

■ Display indication



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Figure 3.12 Measuring Display



Left is ALARM screen you see when input or output is error. Do as *1 of Figure 3.12 to go to ALARM.

ALARM items, such as X1 to X4, Y1 and Y2, are displayed.

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Figure 3.13 Alarm Display

■ Switching to alarm display

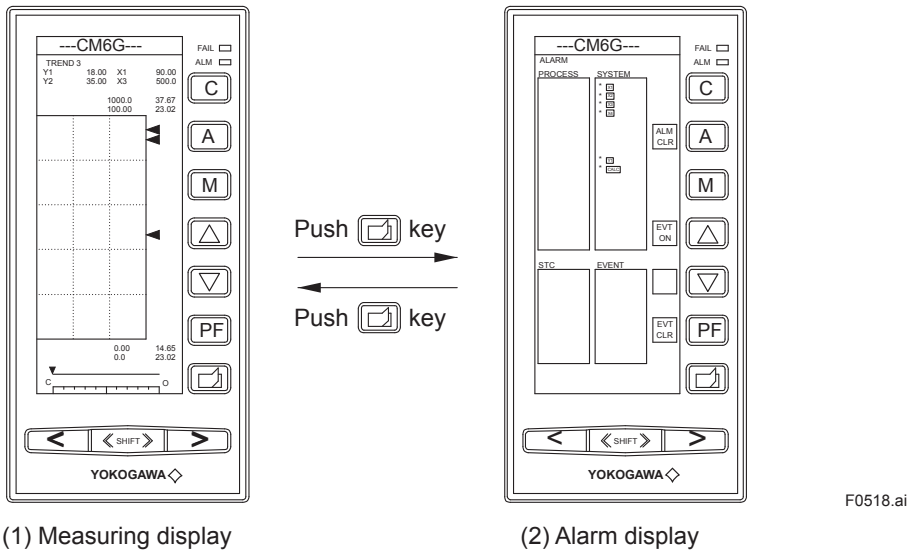


Figure 3.14 Switching operation to alarm display

■ Confirmation of Input / output data

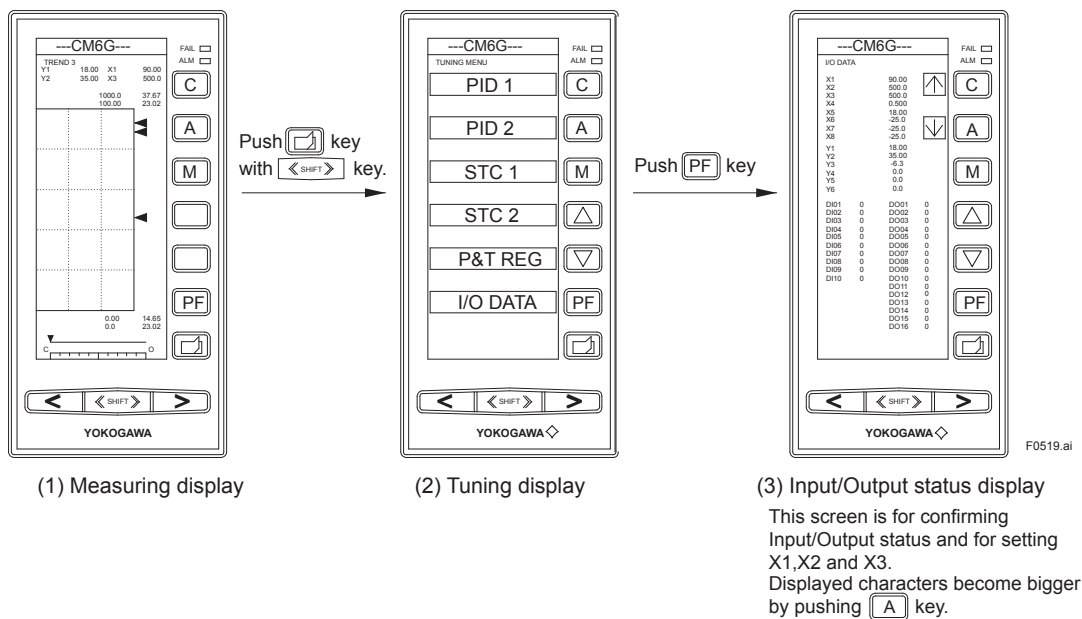


Figure 3.15 Switching operation to Input/output status display

■ Parameter setting

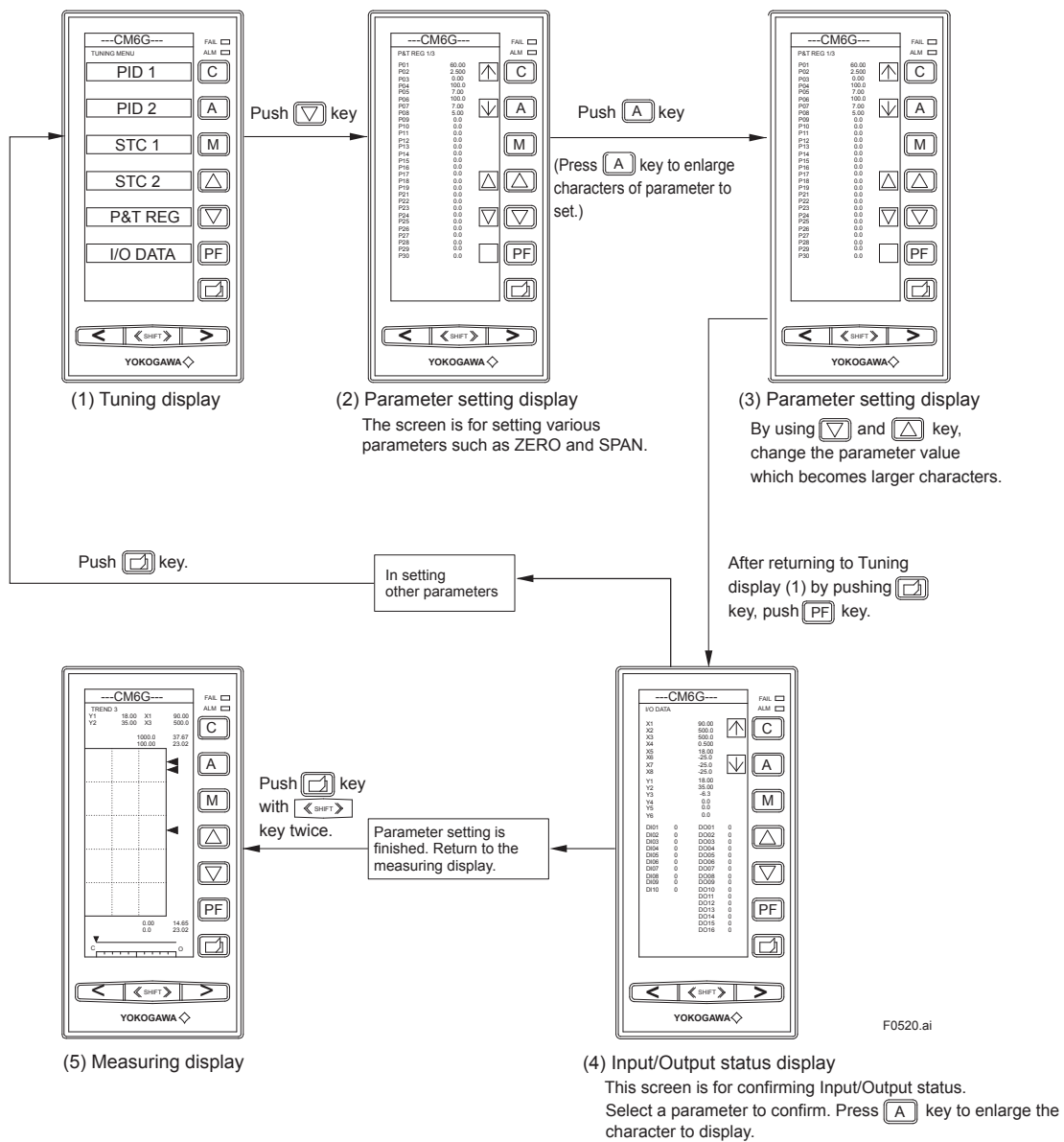


Figure 3.16 Flow Chart of Various Parameter Setting and Confirmation

3.5.2 Contents of the Data Display

Contents of the data display are as follows:

Table 6.2 Contents of the data display

	Kind	Data abbreviated	Data contents	Data range
Input X _N	X1	NON-CORR. WI [%]	WI value 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 [mV] *2	Thermocouple electromotive force or flame extinction alarm threshold value	0 to 30.0
	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 to 100.0
	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: Press "METER" to switch.

3.5.3 Correcting Computation

CM6G sets the differential pressure of both sample gas (ΔP_g) and air (ΔP_a) to 500 Pa. 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 ΔP_g and ΔP_a ($\neq 500$ Pa), the detection signal shall be changed from E_o to $E'o$.

$$E'o = E_o \cdot \frac{\sqrt{\Delta P_g}}{\sqrt{\Delta P_a}} \tag{3.1}$$

Therefore, if you multiply the detection signal $E'o$ by $\sqrt{\Delta P_a} / \sqrt{\Delta P_g}$, you can correct to the value at the standard differential pressure.

In the computing program, each differential pressure is root-extracted and provides a differential pressure correcting computation. The signal after the correction is range suppressed (ZERO) and to further extended to SPAN. 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:

$$K = C(WI) \cdot \sqrt{\rho_g} \tag{3.2}$$

Also it is necessary for each signal to operate with a timing matched with the signal of the calorific 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:

$$\Delta\theta = C_1 \cdot \frac{K}{\sqrt{\rho_g}} \cdot \frac{\sqrt{\Delta P_g}}{\sqrt{\Delta P_a}} + C_2 \cdot \frac{H}{\sqrt{\Delta P_a}} \tag{3.3}$$

H : Pre-heat calorie
 C₁, C₂ : Constant
 ρ_g : Density of the gas

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

$$\Delta\theta \cdot \frac{\sqrt{\Delta P_g}}{\sqrt{\Delta P_a}} = C_1 \cdot \frac{K}{\sqrt{\rho_g}} + C_2 \cdot \frac{H}{\sqrt{\Delta P_g}} \tag{3.4}$$

The second clause of the right part in the formula (3.4) represent the preheat calorie, which, as you can see in the formula (3.4), the matters concerning the preheating is varied according to the change of differential pressure (ΔP_g).

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.

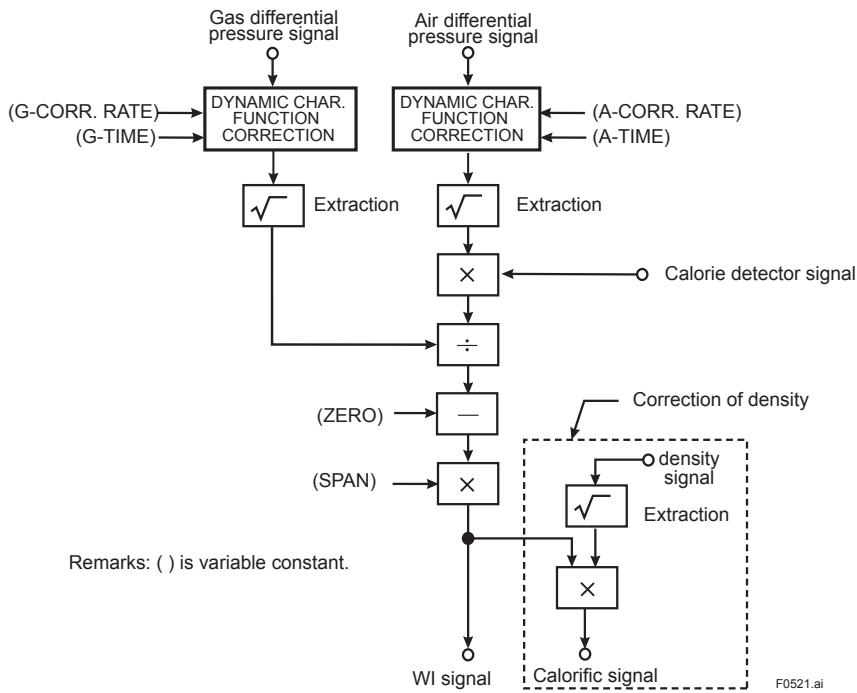


Figure 3.17 Computing Block Diagram (Preheating Circuit Does Not Exist)

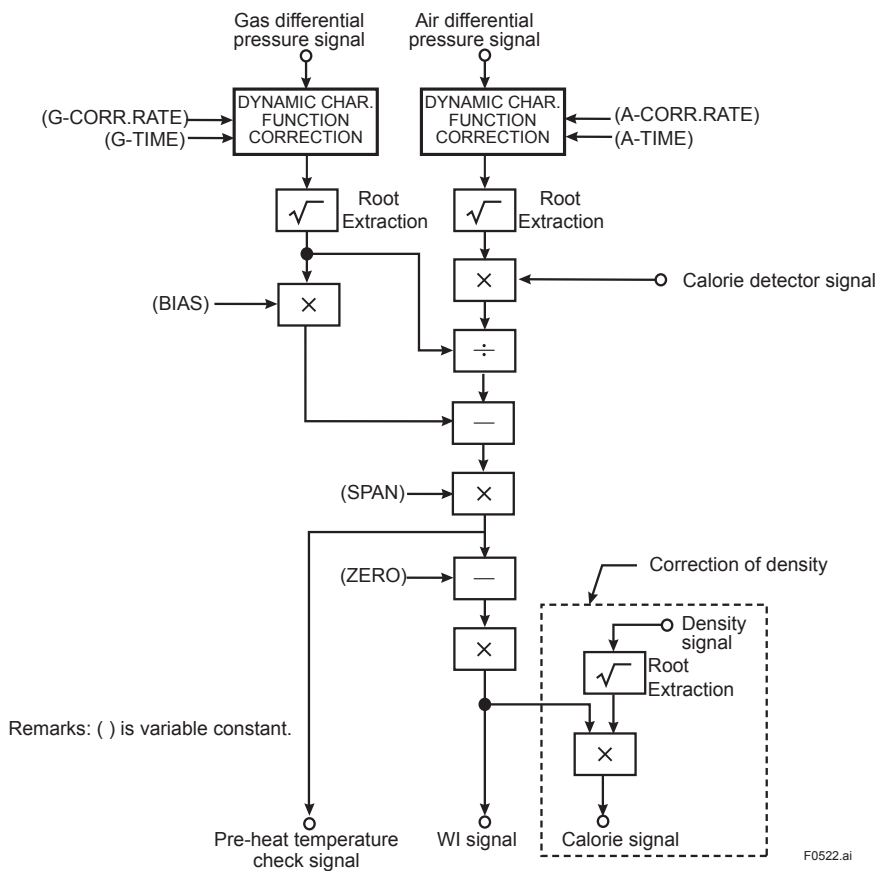


Figure 3.18 Computing Block Diagram (Preheating Circuit Exists)

3.6 Density Meter

The GD400G is used for gas density meter.

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

4. Preparation of Operation

CAUTION

Before starting operation, check outside wirings or pipings and confirm if no gas leakage is found.

See Figure 3.2, 3.3 and 3.4.

4.1 Sampling Section (Outside panel)

- If the drain pot is located outside the panel, supply water fully until the water overflows from the drain outlet.
- Open the gate valve when it is in the sample line.
- If two fulflo filters are located in parallel on the sample line, one of them is not used.

4.2 Status of Valves

See the following table, Table 4.1 and Table 4.2 to open/close valves.

Table 4.1 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-15	*

Remarks: Valves with the mark * are the flow adjustment use and preliminary adjusted. They don't need to be adjusted.

Table 4.2 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-15	*

Remarks: Valves with the mark * are the flow adjustment use and preliminary adjusted. They don't need to be adjusted.

4.3 Water Supply (For Steel Mill Use)

- 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 3.4).
- The flowmeter (6-1) indicates the flow rate of approx. 0.2 l/min.

4.4 Supply of the Air

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

Table 4.3

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

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

- 1) Adjust the pressure gauge of the air set to approx. 200 kPa, using the air set valve (2-1). Turn the valve to the right to increase the pressure.
- 2) Adjust the pressure gauge (2-3) to about 20 kPa, using the pressure reducing valve (2-2) and V-16. Turn the pressure reducing valve to the right to increase the pressure.

4.5 Supply of Power

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

Table.4.4

Switch	Position
POWER	OFF
SAFE EV	SET
METER	P.MEAS

- 2) 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)
- 3) When you turn on the "POWER" switch on the front of the calorie detector, both "POWER" and "ALARM" lamps are lit to show an alarm status.
- 4) When the power is supplied to the computing station, the alarm lamp on the front (yellow) lit on, but this does NOT indicate "out of order."
- 5) Turn on "POWER" in gas density meter (for the one with a gas density meter attached)
- 6) Approx. 60 minutes later, the lamp of the orifice assembly starts flashing and the temperature of the orifice constant chamber becomes stable.

4.6 The Zero Adjustment of the Differential Pressure Transmitter

- 1) Remove the impulse lines from transmitters.
- 2) Turn on the main breaker of the switch box and the calorie detector switch.
- 3) Turn on the POWER switch on the front panel of the calorie detector.

- 4) Measure each of the output terminals on the terminal block with a voltmeter. Use the “zero adjustment screw” on the differential pressure transmitter to adjust the voltage to 1 V.DC. The terminal number assigned for gas is 15 and 16, and one for air is 17 and 18.
- 5) Use a flat-head screwdriver to make the adjustment. Turn the screw clockwise to increase the output, and counterclockwise to decrease. The adjustment amount of the zero point varies depending on how quickly 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.
- 6) When the adjustment is completed, connect the impulse lines while making sure there is no leakage.

CAUTION

- Be sure to make this adjustment every time the installation location of the panel is changed.
- 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.
- After the zero-point adjustment is completed, do not turn off the transmitter immediately. If the power is turned off within 30 seconds after the completion of the adjustment, the value will return to the last one before the adjustment takes place.

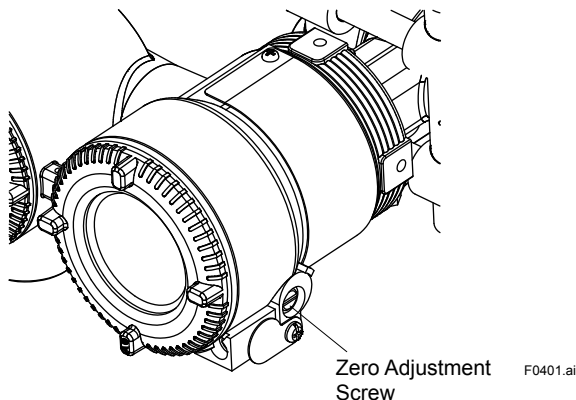


Figure 4.1 Differential Pressure Transmitter

4.7 Air Differential Pressure Adjustment

- 1) Switch the computing station to the Input/Output status display (refer to Figure 3.15) and check X2 (A-PRESS).
- 2) Adjust V-16 so that the indicated value becomes “500.”
- 3) If the indicated value of the pressure gauge (2-3) has deviated from 20 kPa, set the value to 20 kPa using the pressure reducing valve (2-2) and make the adjustment described in (2) again.

4.8 Pressure Adjustment of the Gas Line

The pressure adjustment of the gas line uses air.

■ For town gas use

- 1) Close V-6 and connect the one touch coupler (2-5).
- 2) Open V-7 and V-8.

- 3) Turn the switch "SAFE EV" of the calorie detector to "RELEASE". The solenoid valve of the gas line opens and the alarm is released.
- 4) Adjust the flowmeter (3-3) to approx. 10L/min by using the pressure reducing valve (4-1) and V-13. The pressure gauge (3-2) indicates 8 to 18 kPa.
- 5) Adjust the pressure gauge (3-5) to approx. 3 kPa. by using the pressure reducing valve (3-4).
- 6) When a density meter is attached, adjust the throttle valve of the flowmeter (5-3) to 0.5 to 1 l/min.
- 7) Set the indication of the computing station to Input/Output status display and check X3 (G-PRESS).
- 8) Adjust by pressure reducing valve (3-6) so that "X3" indicates "500". When the value on the pressure gauge (3-5) deviates from about 3 kPa, repeat the procedure (5), then conduct the adjustment.
- 9) When the adjustment is completed, close V-8, V-7, separate the one touch coupler (2-5), and open V-6.
- 10) Set the "SAFE EV" switch of the calorie detector to "SET".

■ For steel mill use

- 1) Close V-4, connect the one touch coupler (2-5) and open V-5 and V-8.
- 2) Set the switch "SAFE EV" of the calorie detector to "RELEASE". The solenoid valve of the gas line opens and the alarm is released.
- 3) Adjust the flow rate of the flowmeter (4-2) to about 10 l/min by using the pressure reducing valve (4-1). The pressure gauge (3-1) indicates approx. 6 kPa.
- 4) When the density meter is attached, adjust the flowmeter (5-3) to 0.5 to 1 l/min by using V-11.
- 5) Adjust, by using V-12, the number of bubbles that come out of pipe A of the pressure regulating pot (3-4). The number of bubbles has to be 3 to 6 pcs/sec. However, if no bubbles come out, when low calorie gas is being used, open V-12 fully,
- 6) Set the indication of the computing station to Input/Output status display and check X3 (G-PRESS).
- 7) Adjust the pressure to "500" by using the pressure reducing valve. "X3" the pressure reducing valve (3-6), adjust the indication "X3" to become "500". When the number of bubbles from pipe A fluctuates, adjust the number by using V-12, then carry out the adjustment.
- 8) When completing the adjustment, close V-8 and V-5. Separate the one touch coupler (2-5), and open V-4.
- 9) Turn the switch "SAFE EV" of calorie detector to "SET".

5. Operation

5.1 Start Operation

WARNING

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

■ Introduction of the Sample Gas

● For town gas use

- 1) Open V-1 fully.
- 2) When the pump is attached, turn ON the power supply before proceeding to (3).
- 3) When the pressure is increased by the pump, adjust the pressure by V-5 so that the pressure gauge (3-2) indicates 8 to 18 kPa. When the pressure is reduced by the pressure reducing valve, adjust the pressure by the pressure reducing valve (3-8) so that the pressure gauge (3-2) indicates 8 to 18 kPa, .

● For steel mill use.

- 1) When you use the standard pressure, open V-4. When the pressure is increased by the pump, open V-1, V-4 respectively.
- 2) When the pump is attached, turn on the power supply switch of the pump at this time.
- 3) Use V-3 for standard pressure or use V-2 and V-3 for the pressure raised by pump to make the pressure gauge indicate approx. 6kPa.

■ Start Operation of the Calorie Detector

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

■ Differential Pressure Readjustment

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

● For town gas use

- 1) When the pressure gauge (3-5) does not indicate approx. 3 kPa, adjust the pressure by the pressure reducing valve (3-4).
- 2) When the density meter is attached and the flowmeter (5-3) indicates out of 0.5 to 1 l/min, adjust its indication again.
- 3) Set the computing station to Input / Output status display. 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**

- 1) When the density meter is attached, adjust again the indication of the flowmeter (5- 3) by V-11.
- 2) When the number of bubbles coming out from the pipe A is not constant, adjust it by V-12.
- 3) Set the computing station to Input / Output status display. If either the indication of "X2 (A-PRESS)" or "X3 (G-PRESS)" is not "500", adjust each with the pressure reducing valve (3-6) and V-16.

5.2 Stopping Operations

■ Long Time Stopping

- 1) Close V-1. To stop standard pressure gas for the steel mill use, close V-4. But when a pump is attached, turn off the power of pump in advance.
- 2) When the gas supply is suspended and the burner is extinguished, the lamp "MEAS" of the calorie detector is lit off and the lamp "ALARM" on.
- 3) Switch the calorie detector from "SAFE EV" to "RELEASE".
- 4) To stop the flow of a town gas , close V-6 and open V-7, V-8. To stop the flow of steel mill gas, close V-4 and open V-5, V-8. The sample gas in the gas line should be blown off by the air then the subtle sample gas will be emitted
- 5) After continuing the blow for 3 to 5 min., turn off the "POWER" switch of the calorie detector. If the density meter is attached, cut the power supply inside the density meter.
- 6) Turn off all switches of the switch box.
- 7) Lastly, close V-14 and stop the air supply.

■ Short Time Stopping

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

If this state is kept on hold, you can skip the warm-up time before another operation starts.

6. Calibration

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

6.1 Supply of the Calibration Gas

6.1.1 For Town Gas Use

Refer to Figure 3.2 and 3.3.

- 1) Close V-6 and open V-7. At this time, the flame of burner is extinguished. But if the pump is attached, turn off the power supply of the pump first, then close V-6 and open V-7.
- 2) Adjust the secondary pressure of the pressure reducing valve for calibration gas cylinder, to approx. 200 kPa.
- 3) Open V-9 or V-10 and introduce the calibration gas.
- 4) 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, the adjustment to approximately 2 to 3 l/min is permissible.
- 5) Push the "START" switch of the calorie detector to ignite.
- 6) Set the computing station to Input/Output display screen. 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.
- 7) In the case of the density meter being attached, confirm and readjust (if necessary) the indication of the flowmeter (5-3).
- 8) When the calibration is completed, close V-9, V-10, V-7, and open V-6. When a pump is attached, turn on the power of pump now.
- 9) Push the "START" switch of the calorie detector to ignite.
- 10) Confirm and readjust (if necessary) the gas differential pressure and the flow rate to the density meter.
- 11) Do not forget to close the root valve of the calibration gas cylinder.

6.1.2 For Steel Mill Use

Refer to Figure 3.4 Flow Sheet (Steel Mill Use).

- 1) 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.
- 2) Set the secondary pressure of the pressure reducing valve for calibration gas cylinder to approx. 200 kPa.
- 3) Open V-9 or V-10 and introduce the calibration gas.
- 4) 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, the adjustment to approximately 2 to 3 l/min is permissible.
- 5) Push the "START" switch of the calorie detector to ignite.
- 6) Set the computing station to Input/Output status display. The indication of "X3 (G-PRESS)" is adjusted to "500" with the pressure reducing valve (3-6). In the case of the density meter being attached, confirm and readjust the flow rate.
- 7) Confirm "X2 (A-PRESS)" in Input/Output status display and adjust "X2" to "500" by using V-16.
- 8) When the calibration is completed, close V-9, V-10, V-5 and open V-4. When the pump is attached, turn on the power of the pump.
- 9) Push the "START" switch of the calorie detector to ignite.
- 10) Readjust both the gas differential pressure and the flow rate to the density meter.
- 11) Do not forget to close the root valve of the calibration gas cylinder.

6.2 Span Adjustment of the Calorie Detector

This adjustment is not necessary for the usual calibration. This adjustment is held when replacement such as the thermocouple of the burner unit takes place. 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".

■ When no Preheating Circuit Exist

- 1) Set the computing station to Input/Output status display with X1 (NON-CORR. WI%).
- 2) Introduce the span gas and after ignition, wait until the indication "X1" becomes stable.
- 3) 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 = 59.00 WI

WI value of the upper range = 60.00 WI

$$x = \frac{59.00}{60.00} \times 100 = 98.3\%$$

■ When Preheating Circuit Exists

- 1) Suspend the supply of the sample gas.
- 2) Same as the gas line pressure adjustment explained in paragraph 4.8), introduce the air to the gas line.
- 3) 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.

- 4) Switch the "METER" switch of the calorimeter to "P.MEAS" and measure X5 of the computing station. Wait until the indicated value is stabilized and then record the value. (E0 mV)
- 5) Switch the "SAFE EV" switch of the calorimeter to "SET."
- 6) Stop the air supply to the gas line, supply the span gas, and start the ignition action.
- 7) Measure X5 of the computing station. Wait until the indicated value is stabilized and then record the value. (Ec mV)
- 8) Set the computing station to Input/Output status display and adjust the "SPAN" potentiometer of the calorimeter 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 = 5.00 WI

WI value of the span gas = 4.90 WI

Eo = 4 mV, Ec = 19 mV

$$x = \frac{19}{(19-4) \times \frac{5.00}{4.9} + 4} \times 100 = 98.4 \%$$

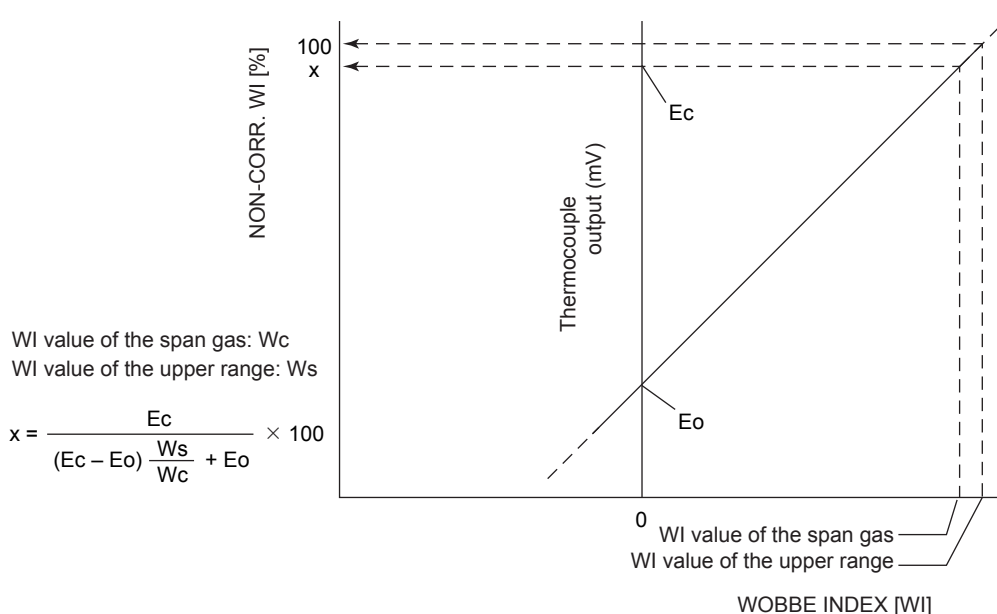


Figure 6.1 How to Find Out x When Preheating Circuit Exists

6.3 Calibration of the Computing Station

This chapter explains an ordinary calibration of the computing station. The calibration is conducted as follows according to the type 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.

■ Bias Adjustment

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

- 1) Suspend the supply of the sample gas, and introduce the air to the gas line.
- 2) Set the "SAFE EV" switch of the calorie detector to "RELEASE".
- 3) Set the computing station to Input/Output status display. After the indication Y4 (BIAS CHECK) becomes stable (20 to 30 minutes), adjust the (Y4) value of the P03(BIAS) will become [0.0] by the data setting key.

Note) When you perform a fine adjustment on a potentiometer, select alternatively between (Y4) and (P03) and display

- 4) When the adjustment is completed, turn the switch "SAFE EV" of the calorie detector to "SET", and suspend the air supply to the gas line.

■ Zero and Span Adjustment

- 1) Introduce the zero gas and ignite.
- 2) 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/Nm³]" (WI value or the calorific value of the calibration gas).
- 3) 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.
- 4) 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)
- 5) Repeat 2 or 3 times the above adjustments.
- 6) When complete the adjustment, suspend the supply of the calibration gas.

■ 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 is required. For the adjustment in detail, consult our service personnel.

6.4 Calibration of the Density Meter

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

7. Maintenance

7.1 Daily Check

7.1.1 Air, Gas Differential Pressure Adjustment

Confirm the air or gas differential pressure or adjust the indication of X2 (A-PRESS), X3 (G-PRESS) to "500". Refer to the paragraph 4.7 or 4.8 then follow the instruction on the adjustment.

7.1.2 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. After the drain is taken out, be sure to close the valve.

7.1.3 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.

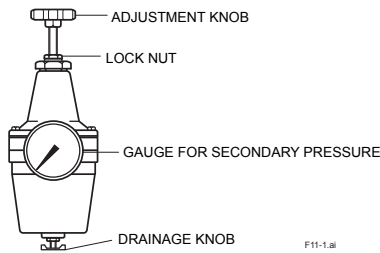


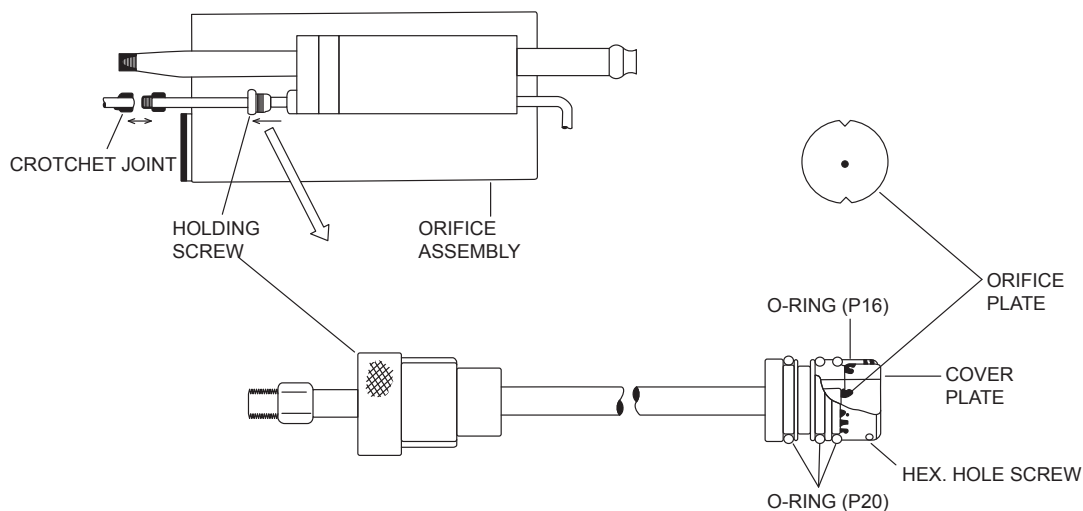
Figure 7.1 Air Set

7.2 Regular Check

Refer to Figure 3.2 , 3.3 and 3.4. The flow sheet depends on the specification.

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

When something like dust adhere to the orifice holes, the output declines. Follow the instruction as below to clean.



F10-2.ai

Figure 7.2 Orifice System

- 1) Suspend the supply of the sample gas, then blow the gas line with the air.
- 2) Remove the crotchet joint.
- 3) Turn the holding screw and take out.
- 4) Pull out slowly to the direction as shown on Figure 10.2.
- 5) Loosen the set screw by using the hexagonal wrench attached to take out the orifice plate together with the cover plate. The following is part number of the orifice plate.

Orifice hole (Ø)	Part number	Orifice hole (Ø)	Part number
0.35	G7025XJ	0.80	G7034XJ
0.40	G7026XJ	0.85	G7035XJ
0.45	G7027XJ	0.90	G7036XJ
0.50	G7028XJ	1.0	G7037XJ
0.55	G7029XJ	1.1	G7038XJ
0.60	G7030XJ	1.2	G7039XJ
0.65	G7031XJ	1.3	G7040XJ
0.70	G7032XJ	1.4	G7041XJ
0.75	G7033XJ	1.5	G7042XJ

- 6) For the cleaning use something like a supersonic cleaner and never insert into the orifice holes anything like a stick or rod.
- 7) When the O-rings are worn out, replace them with the spare parts. Part number of O-rings are Y9114XB (P16) and L9817MT (P20).
- 8) After the cleaning and replacement are completed, assemble the parts in the reverse order of the disassembly as mentioned above.

NOTE

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

7.2.2 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 follows. Same process applies to the option fulflo filter whose element (50µm) is G7057XJ in the part number.

- 1) Turn the nut and remove the cover.
- 2) Pull out the element and clean or replace.
- 3) Assembly is carried out in contrary order to above.
- 4) When the packing or gasket is worn out, replace it. We provide a packet which contains 4 pieces of packing and a gasket. (G7086XL)

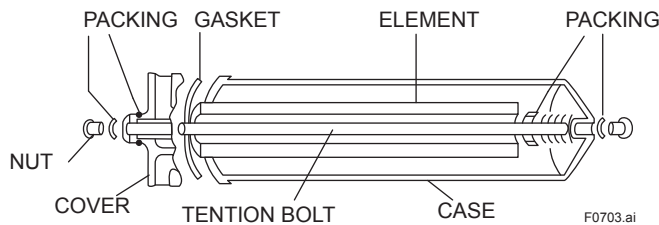


Figure 7.3 Fulflo Filter

7.2.3 Line Filter (For Town Gas Use)

Disassemble 3 screws, and open the cover, there inside exist an element (G7005XJ.) If it is stained, replace by a new one. Also if the O-ring (Y9116XB) is fatigued, replace it with new one.

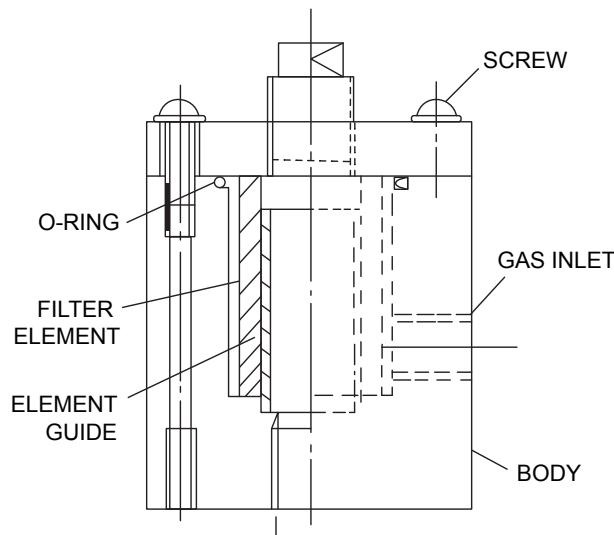
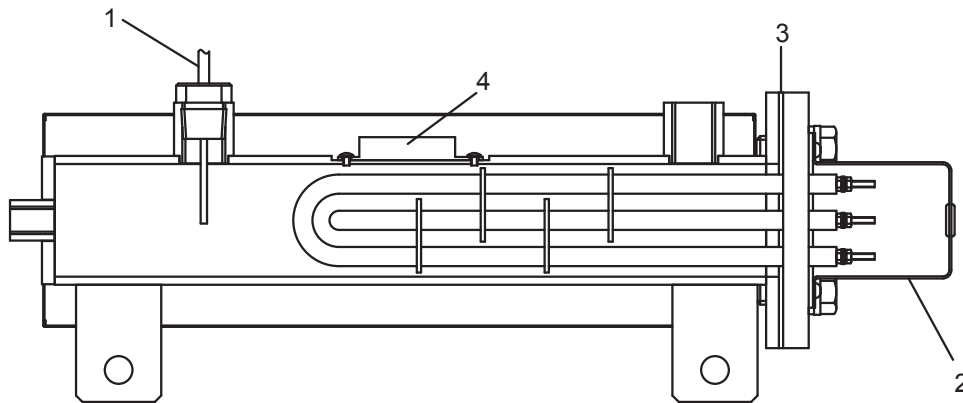


Figure 7.4 Line Filter

7.2.4 Washing Bubbler or Pressure Regulating Pot

If inside of case becomes dirty by the weeds grown in the water, pull the plug at the bottom of the bubbler to drain and refill it with clean water. If inside the bubbler is stained, remove the cover and clean inside of the bubbler. Be careful not to scatter the water around the panel when you drain the water.

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



F12-6.ai

Figure 7.5 Washing Bubbler and Pressure Regulating Pot

7.2.5 Dehumidifier (For Steel Mill Use)

The washing bubbler cannot eliminate all of the naphthalene if it is contained too much in a sample gas. The naphthalene may be crystallized and clog the piping inside of dehumidifier. In such a case, stop the sample gas flow, remove the 4 pipes at the top of the dehumidifier and introduce hot water of 70°C to 80°C. The naphthalene is dissolved into the hot water and is eliminated.

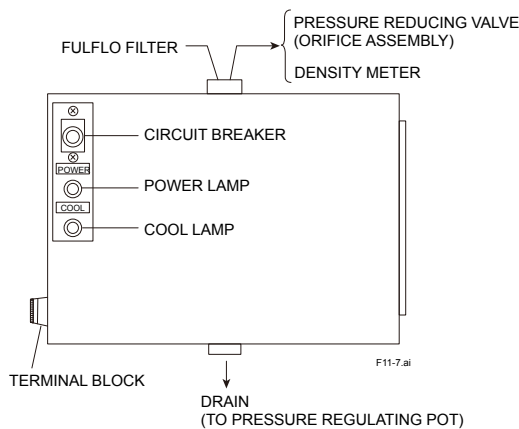


Figure 7.6 Dehumidifier

7.2.6 Density Meter

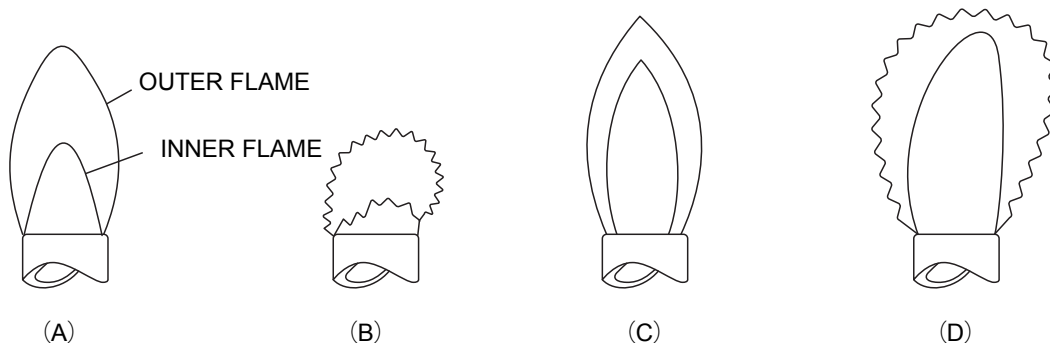
It is recommended to replace the O-ring of the GD300S detector every 2 or 3 years and wash the sensor if necessary. Consult to our service for washing the sensor.

7.3 Check at the Regular Service

7.3.1 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 7.7 - (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 7.7 - (B), flickering and when the secondary air is not sufficient, the flame outline becomes like (B) as well.
- When the primary air is not sufficient, the color of the flame is clear yellow (C) 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 7.7 - (D).



F11-8.ai

Figure 7.7 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.

- 1) Remove the screw (4 pcs) fixing the external pipe, then remove the connectors to the terminal of the hot junction detecting point.
- 2) Disassemble the external pipe and take out the jet plate by pulling upward. (The direction to pull for removal is shown in Figure 7.8 by the sign of arrow).
- 3) Insert the attached mirror herewith into the ventilator.
- 4) When you ignite, the flame reflected on the above mirror can be observed from slanting upside.
- 5) Assemble the burner by following the procedures above in the reverse order.

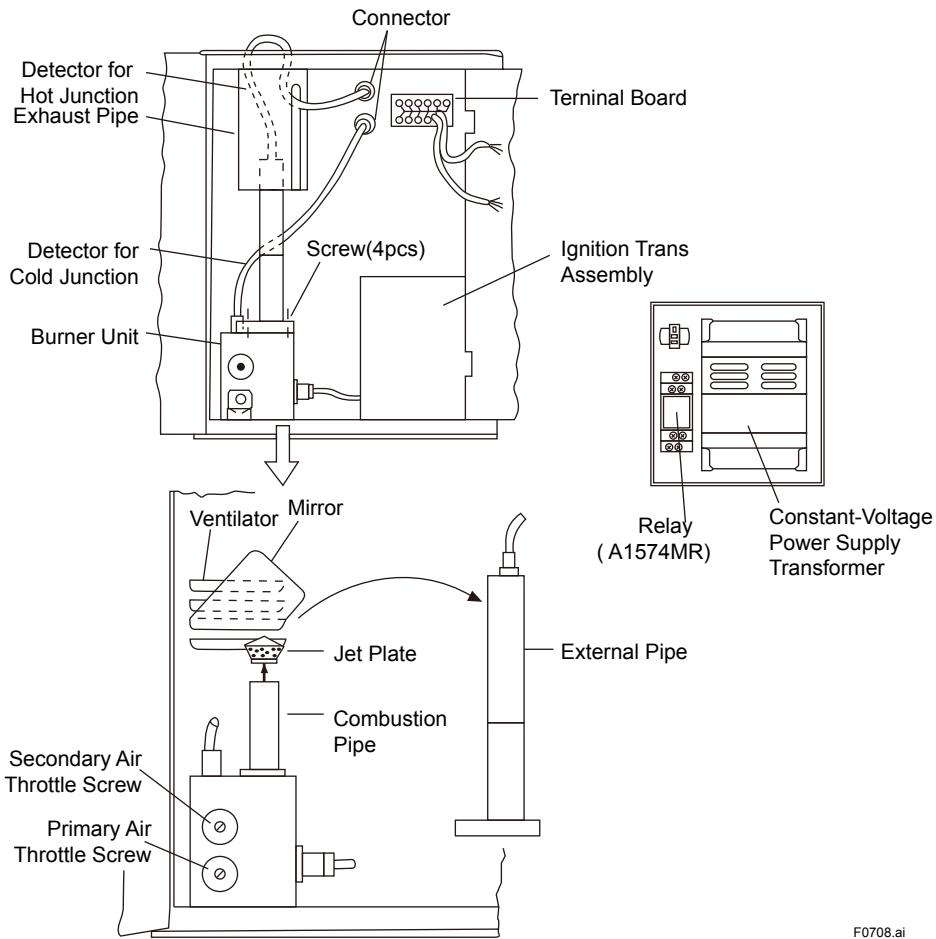


Figure 7.8 Flame Checking

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7.3.2 Zero Adjustment of the Differential Pressure Transmitter

Adjust according to the procedure described in paragraph 4.6.

7.3.3 Others

If necessary, conduct each regular check mentioned in paragraph 7.2.

8. Troubleshooting

Two major factors are considered to make large difference between current measuring result and normally expected ones. One factor is that the process condition is changed, which leads to the change of gas component. The other one is that the measuring system has some errors. If the measuring system has some errors, carry out the following troubleshooting in this chapter.

8.1 Gas Sampling Pressure Regulating Section

■ For Town Gas Use

- 1) See Figure 3.2 and 3.3 Flow Sheet. Check if any blockade or leakage exist in the sampling line up to the panel.
→If any blockade is found, blow the sampling line by air.
- 2) Check the filter element of the line filter.
→According to the paragraph 7.2.3, clean or replace.
- 3) If conditions above mentioned are 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 opening V-5 fully, the decrease of the suction ability of the pump might be a cause of the 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 have a defect.
- 4) When introducing the check gas, confirm the indication of the flowmeter (3-3) is about 10 l/min. If you need to check only an indication, adjust the flowmeter to approximately 2 to 3 l/min.
→It is due to a defect of the pressure regulator that the flow rate cannot be successfully set by the pressure regulator (4-1).
- 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 have a defect.
- 6) When the density meter is attached, confirm the indication of the flowmeter (5-3) is 0.5 to 1 l/min.
→It may be due to the clogging of the gas pipe inside the density meter that no indication appears on the flowmeter.
- 7) Confirm the indication of the computing station is about "500", after setting the indication to "X3 (G-PRESS)".
→When the differential pressure setting cannot be executed with the pressure reducing valve (3-6), it is due to a defect of the pressure reducing valve.
- 8) For all gas lines, check any leakage at each joint connection.

■ For Steel Mill Use

See Figure 3.4 Flow Sheet. The sampling system here (outside the panel) refers to the one we recommend.

- 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 clogging, accumulation of dust or leakage in the pipings between the probe (7-1) and the fulflo filter (7-2) equipped outside.
 - When there is any clogging, blow by the air.
 - When the piping has any U bending, tilt the piping so that the water flows smoothly.
- 3) Check the element of the outside fulflo filter (7-2).
 - When you find any clogging, clean or replace as according to the paragraph 7.2.2.
- 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 appears on the pressure gauge. Supply water to the washing bubbler.
 - If the pump is attached, and its suction ability decreases, the pressure gauge may 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 the pressure valve (4-1) cannot adjust it, there is a high chance that the pressure reducing valve has a defect.
- 6) Check the element of the fulflo filter (3-3).
 - If it is stained, clean or replace as according to the paragraph 7.2.2.
- 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 to 6 pcs/sec from the pipe A of the pressure regulating pot.
 - When V-11, V-12 fail to adjust, clean the piping inside the dehumidifier as according to the paragraph 7.2.5. But no bubbles are coming out, when you use 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), there is a high chance that pressure reducing valve has a defect.
- 11) For all gas lines, check the leakage at each joint connection.

8.2 Air Pressure Adjustment Section

- 1) Check the pressure gauge of the air set (2-1) is about 200 kPa
 - When the primary pressure of the instrument air is normal, but the adjustment of the air set is impossible, there is a high chance that the air set has a defect.
- 2) Check the pressure gauge (2-3) indicates approx. 20 kPa.
 - If you cannot adjust it when even using the pressure reducing valve (2-2), there is a high chance that the pressure reducing valve has a defect.
- 3) If the above are found normal, we can adjust by using V-16 the air differential pressure to "500".

8.3 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 7.2.1.

- 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.

8.4 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 voltage output is about 16 mV (when no preheating circuit).

→Although both the gas pressure control section and the differential pressure are normal, the voltage output might be much varied. In this case there is a high chance that some blockade exist in the air flow distribution line of the burner unit. Check the burner flame as mentioned in paragraph 7.3.1.

→When the gas flame is coming out of the burner but the voltage output is very low , there is a high chance that the wire is disconnected in thermocouple.

- 2) Measure 3 (+) and 4 (-) on the terminal board of the calorie detector. The normal voltage 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 \pm 1%.
→It is due to a defect of the distributor in the calorie detector that the value is not normal.
- 4) Measure 15 (+) and 16 (-) on the terminal block of the calorie detector. The appropriate value is 23 V \pm 1%.
→It is due to a defect of the distributor in the calorie detector that the value is not normal.
- 5) Measure 8 (+) and 7 (-) on the terminal block of the calorie detector. The appropriate value is 3 V \pm 0.2 V.
→If the measured value varies much in spite of the air pressure control section being normal, there is a high chance that the differential pressure transmitter has a defect.
- 6) Measure 6 (+) and 7 (-) on the terminal block of the calorie detector. The appropriate value is 3 V \pm 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 is considered to have a defect.
- 7) When the density meter is attached, measure 3 (+) and 4 (-) of the density meter terminals. Compare the gas density meter and the voltage output, then obtain an appropriate value , while reviewing the characteristics of gas density meters.
→If the appropriate value is out of data in spite of no leakage, calibrate as according to the paragraph 6.4.

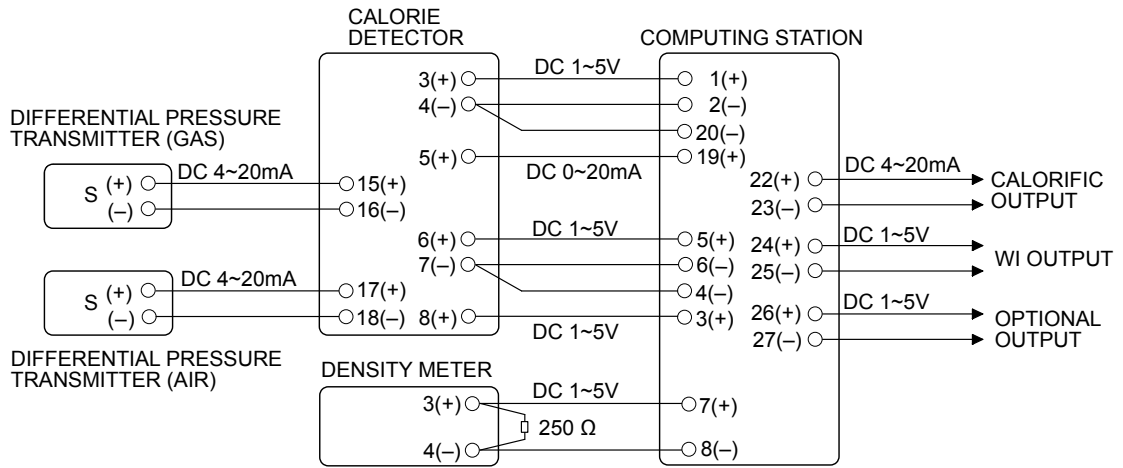


Figure 8.1 Signal Circuit Diagram

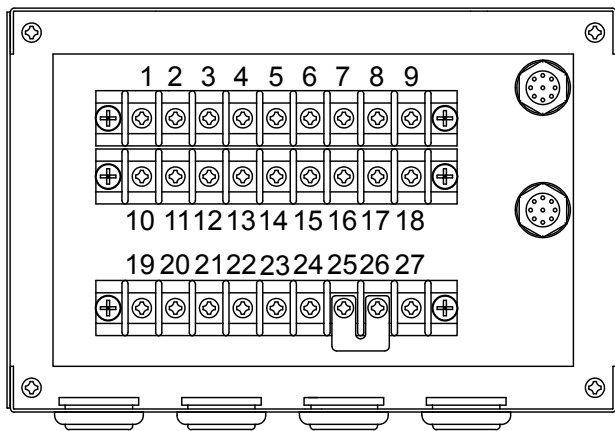


Figure 8.2 Terminal Block of the Calorie Detector

8.5 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.	WI %	*
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 to “the highest level WI value in the measurement range.”

When preheating exists, about 20 to 100% is almost in proportion to 0 to “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 keeps working. Change to Alarm display and examine the cause of the alarm.
- 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 hold output has a tendency of decreasing gradually as time proceeds. When the fail lamp is on, the display of fail will be shown. The alarm lamp lights for the abnormal operation of the pressure adjustment for the gas or air line. The lighting when other than under the time of measurement is not abnormal.

8.6 Other Troubleshooting

Check and deal with measures mentioned in paragraph 8.1 to 8.5. As to the trouble not mentioned in this manual, contact our service personnel and describe how the inspection goes, and if you have any record..

Revision Information

● Title : Model CM6G Gas Calorimeter

● Manual No. : IM 11R02A01-02E

May 2019/6th Edition

Corrections (p. 1-2, 1-3)

Dec. 2016/5th Edition

Full revision. Changed chapter order. Deleted contents described in the former Chapter 12 of and CMPL.

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.
 Subsection 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 Wrench" is deleted from table list of calorie detector standard accessory.
 Section 2.5 (page 2-6 to 2-8): Drawings of Computing Station change to Model YS1700
 Subsection 2.5.2 : In item 1, length 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 .

Chapter 5 Section 3.3: In Figure 3.4, drawings of Computing Station change to Model YS1700
 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 terminal, and connected to No.1 and No.2 of the calorie detector, respectively.
 Terminal Numbers of distributor 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