User's Manual

Model CM6G
Gas Calorimeter

IM 11R02A01-02E

vigilantplant.®

YOKOGAWA
Yokogawa Electric Corporation

IM 11R02A01-02E
3rd Edition

Introduction

For the safe use of this equipment

(1) About This Manual

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

(2) Safety and Modification Precautions

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

(3) The following safety symbols are used on the product as well as in this manual.

 DANGER

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

 WARNING

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

 CAUTION

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

 **TIP**

This symbol gives information that complements the current topic.

 **See Also**

This symbol identifies a source to be referred to.

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⏚	This symbol indicates Protective Ground Terminal
⏚	This symbol indicates Function Ground Terminal (Do not use this terminal as the protective ground terminal).
~	This symbol indicates Alternating current

After-Sales Warranty

- Do not modify the product.
- During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.
- Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.
- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation. Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.
- In the following cases, customer will be charged repair fee regardless of warranty period.
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa did not supply.
  - Failure due to improper or insufficient maintenance by user.
  - Failure due to misoperation, misuse or modification which Yokogawa does not authorize.
  - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
  - Failure caused by any usage out of scope of recommended usage.
  - Any damage from fire, earthquake, a 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 will not bear responsibility when the user configures the product into systems or resells the product.
- Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair this product, please contact the nearest sales office described in this instruction manual.

Contents

1. Outline

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

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

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

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

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2. Specifications

2.1 Standard Specifications

2.1.1 Town Gas Application

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

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

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

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

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

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

Utility:

Instrument Air:

Approx. 50 Nl/min., pressure 300 to 700 kPa, dew point of 0 °C or less

Power Supply:

100 V AC ±10%, single phase, 50/60 Hz (Note 3), 860 VA max.

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

Panel: Construction: For indoor installation, rack panel

Paint Color: Munsell 5Y7/1 (inside and outside)

Ambient Temperature:

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

2.1.2 Steel Mill Application

Purpose: Measurement and control of the calorific value of fuel gas for a steel mill.

Measurement: WI or calorific value of fuel gas.

Measuring range: 3 to 62 MJ/Nm^3

Conditions at the Sampling Point:

Dust: 100 mg/Nm^3 or less

Temperature:

50 °C or less

Pressure: (1) 8 kPa or over: standard

(2) 8 kPa or under: with pump

Range: Select scale range so that it will be within 30 to 50% of maximum value of the span for general gas. In case of gas mixed with butane, butene and air, the range must be within 20 to 30%. In case of gas mixed with propane, propylene and air, the range must be within 25 to 40%.

Output: 1 to 5 V DC, 4 to 20 mA DC (simultaneously), non-isolated, load resistance 750 Ω or less

Alarm Contact Output: Flame off alarm, low orifice temperature alarm, remote ignition
100 V AC, 5 A, closed when alarm occurs (resistance load)

Repeatability:

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

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

Sample Gas Flow Rate: Approx. 10 l/min.

Response Time (Note 2):

Max. WI measured	Dead time	Time constant (63.2%)
50 or over	Approx. 32 sec	Approx. 60 sec
Approx. 38	Approx. 29 sec	Approx. 50 sec
Approx. 25	Approx. 26 sec	Approx. 40 sec
13 or under	Approx. 20 sec	Approx. 35 sec

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

Utility:

Water: Approx. 0.2 l/min, pressure 200 to 600 kPa

Instrument Air:

Approx. 50 Nl/min, pressure 300 to 700 kPa, dew point of 0 °C or less

Power Supply:

100 V AC ±10%, single phase, 50/60 Hz (Note 3), 1100 VA max.

Note 3: In case of low calorific value measurement, frequency variation should be within ±4.0%. If frequency variation exceeds ±0.4%, consult with Yokogawa.

Panel: Construction: For indoor installation, rack panel

Paint Color: Munsell 5Y7/1 (inside an outside)

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

2.2 Model and Suffix Code

2.2.1 Gas Calorimeter

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

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Note: Measuring range and unit must be specified.

2.2.2 Density Meter

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

Converter: GD400G-N-10-N-□/PA

Detector: GD300S-J-□/KU

Measuring range and unit (specific gravity or density) should be specified.

2.2.3 Option

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

2.3 Standard Systems for Each Application

2.3.1 Standard Systems for Each Application

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

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

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

2.3.2 Instructions for System Selection

(1) The quake-proof type gas calorimeter is always equipped with the density meter.

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

2.4 Standard Accessories

Followings are the standard accessories supplied.

• Detector

Name	Q'ty	Part No.	Remarks
Mirror	1	E7023FF	644Y02, (Brass)
Fuse	1	G7012EF	0.5 A
	1	G7015EF	3 A

• Orifice Assembly

Name	Q'ty	Part No.	Remarks
O-Ring	1	Y9114XB	P16 (Viton)
O-Ring	1	G7021XL	P20 (Silicon)
Hexagon Wrench	1	G7003YZ	Nominal size 1.5 mm

• Computing Station

Name	Q'ty	Part No.	Remarks
Fuse	1	S9510VA	1 A

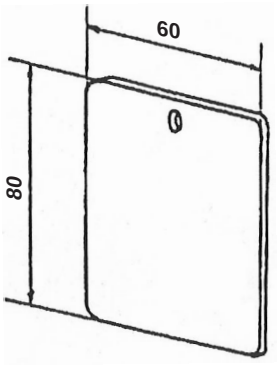


Figure 2.1 Mirror

2.5 External Dimensions

2.5.1 Dimensions for Each Application

1. Town Gas Application

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

Unit:mm

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

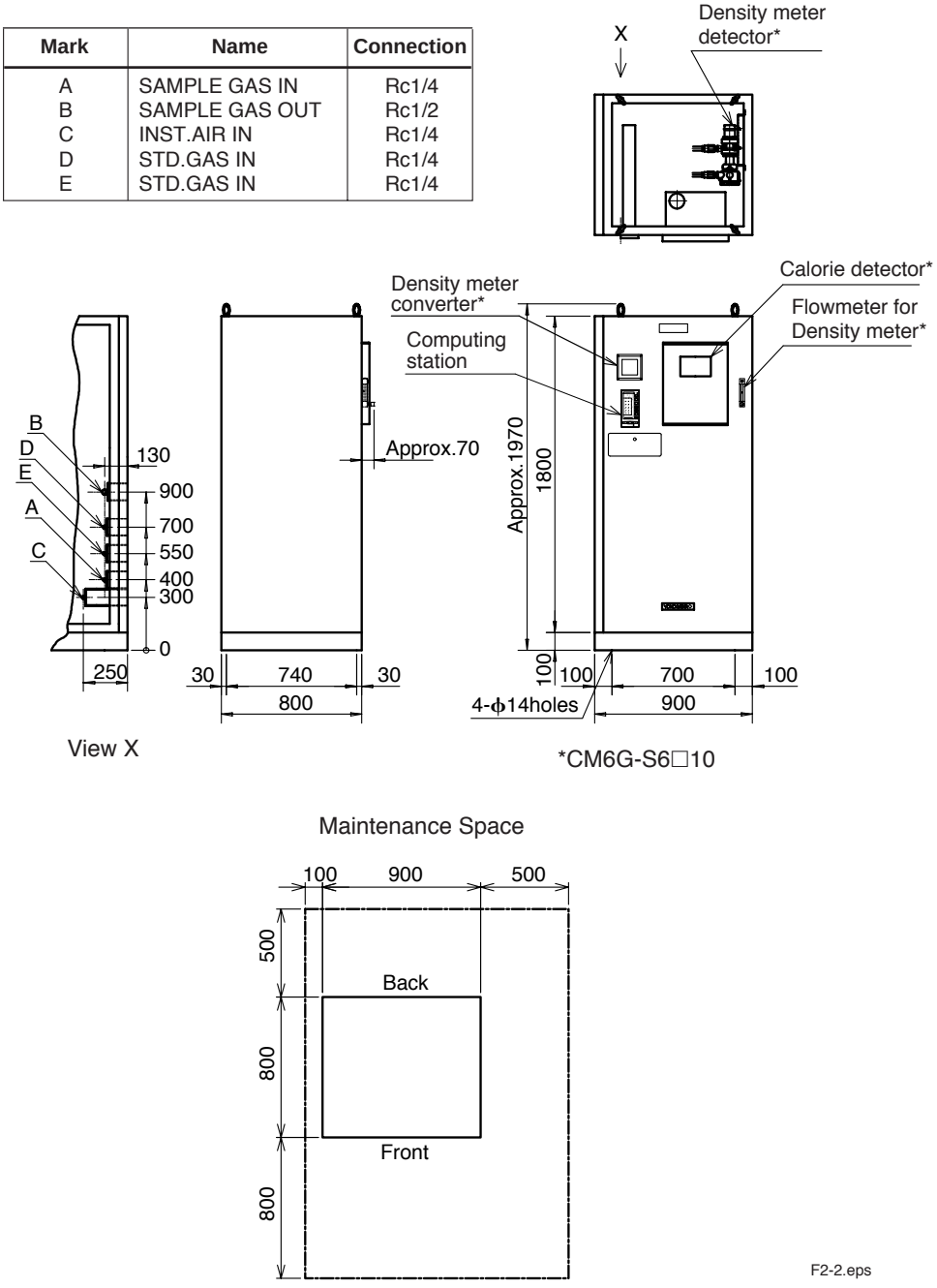
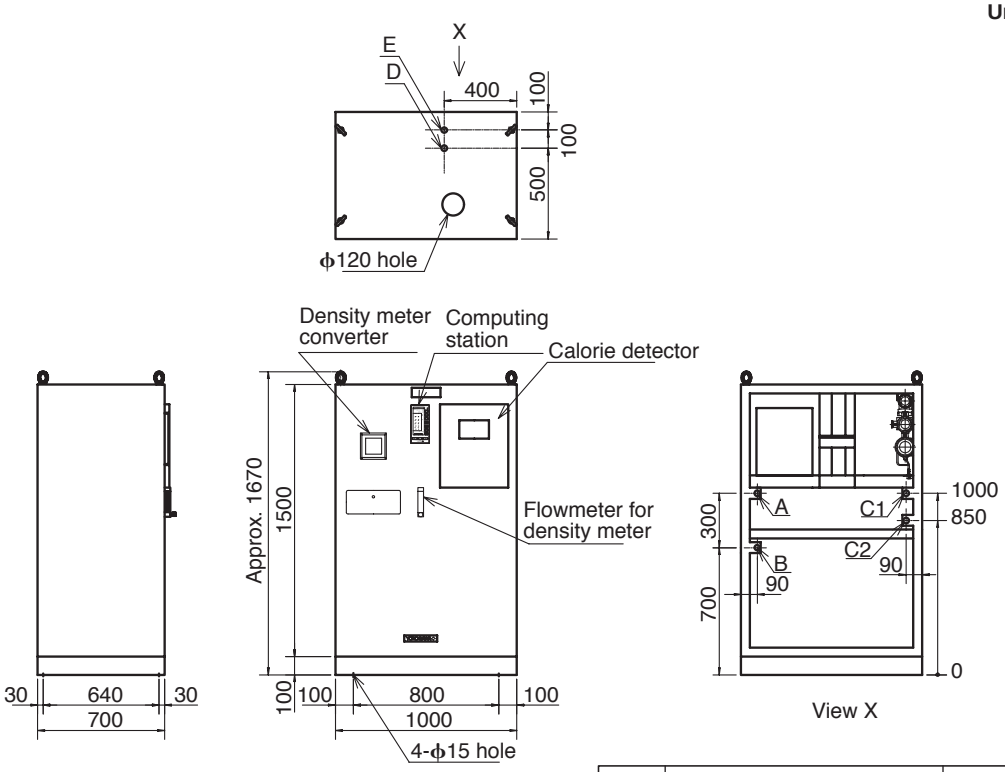


Figure 2.2 Panel External Dimensions (For Town Gas Use)

2. Town Gas Application (Quake-proof Type)

CM6G-S6110

Unit: mm



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

Wiring to switch box should be made through the bottom.

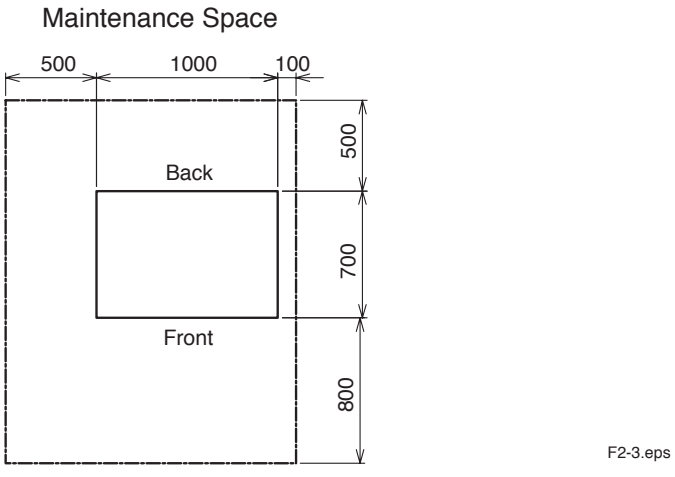


Figure 2.3 Panel External Dimensions (For Town Gas Use)

3. Steel Mill Application

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

Unit:mm

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

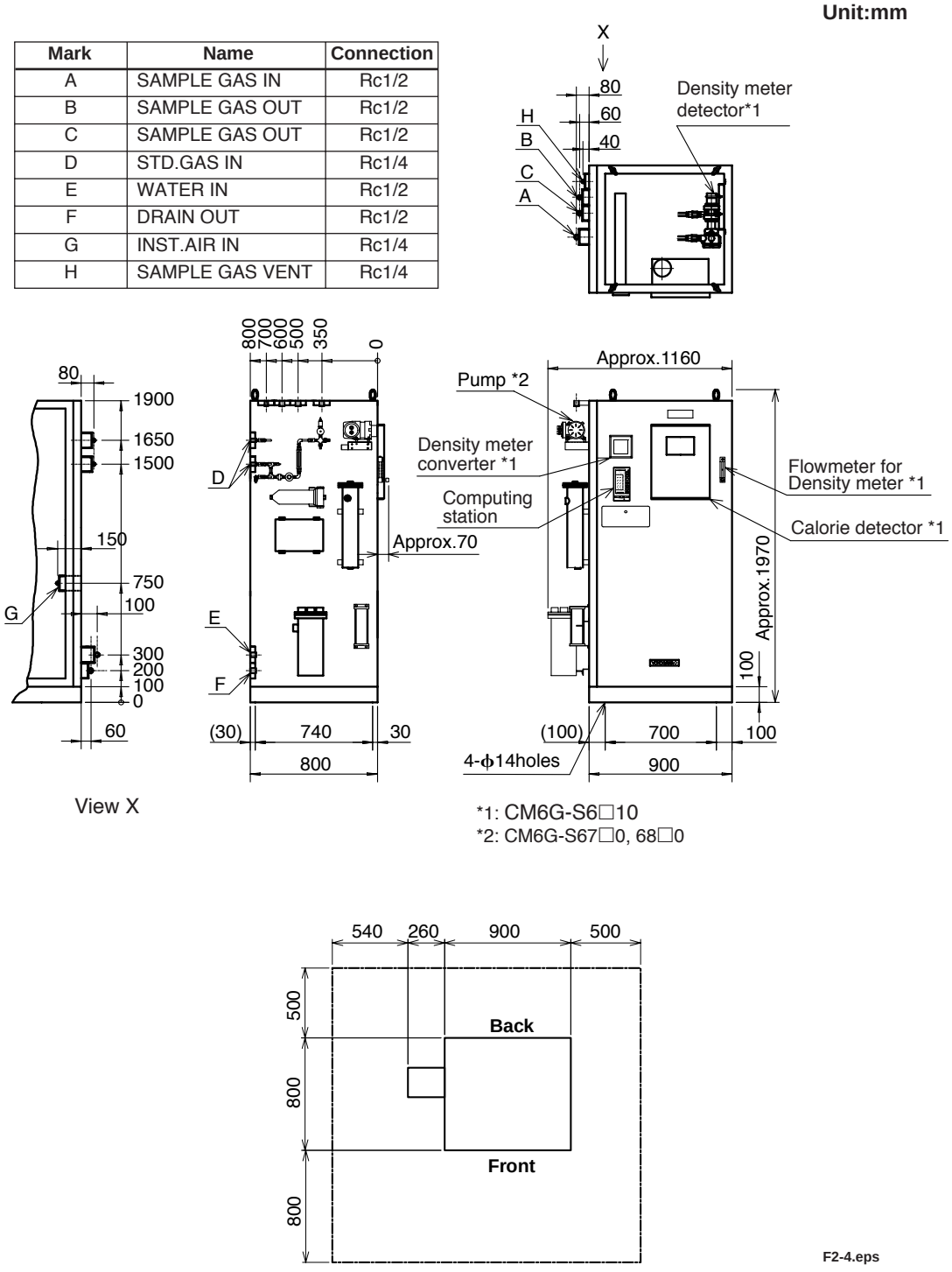


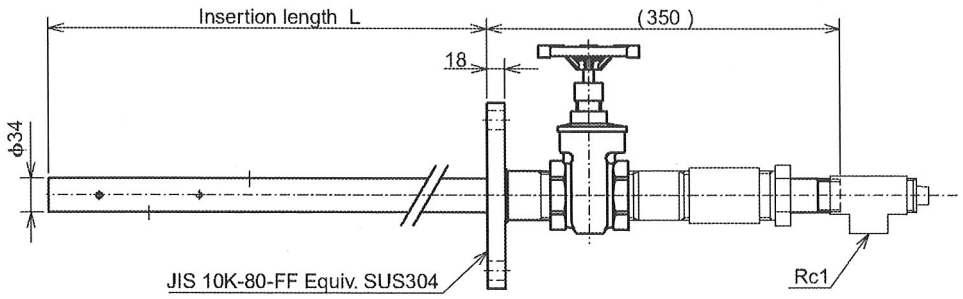
Figure 2.4 Panel External Dimensions (For Steel Mill Use)

2.5.2 Dimensions of Options

1. Open Probe

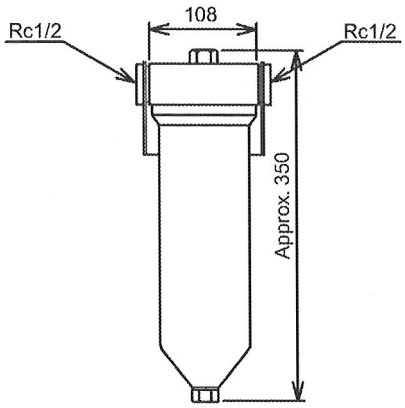
Part number	L
H7800HA	Approx. 650
H7800HB	Approx. 1150
H7800HC	Approx. 1650

Unit: mm



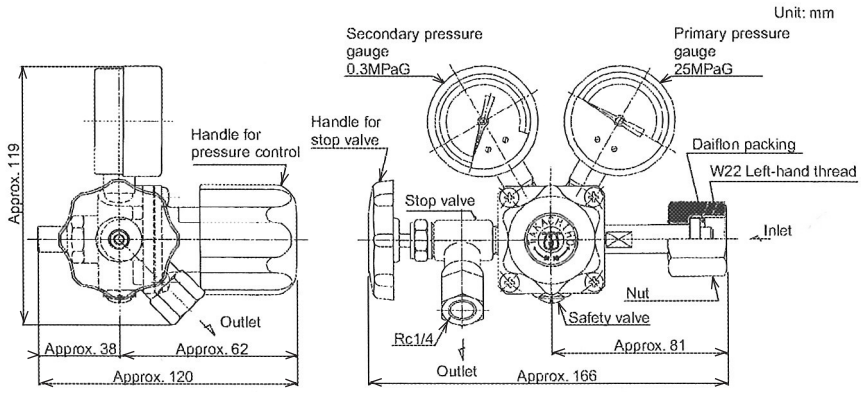
2. Fulflo Filter (Part no.: G7043XJ)

Unit: mm



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

Unit: mm



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3. Installations

3.1 Conditions for Installation

Please observe the following conditions when installation being held.

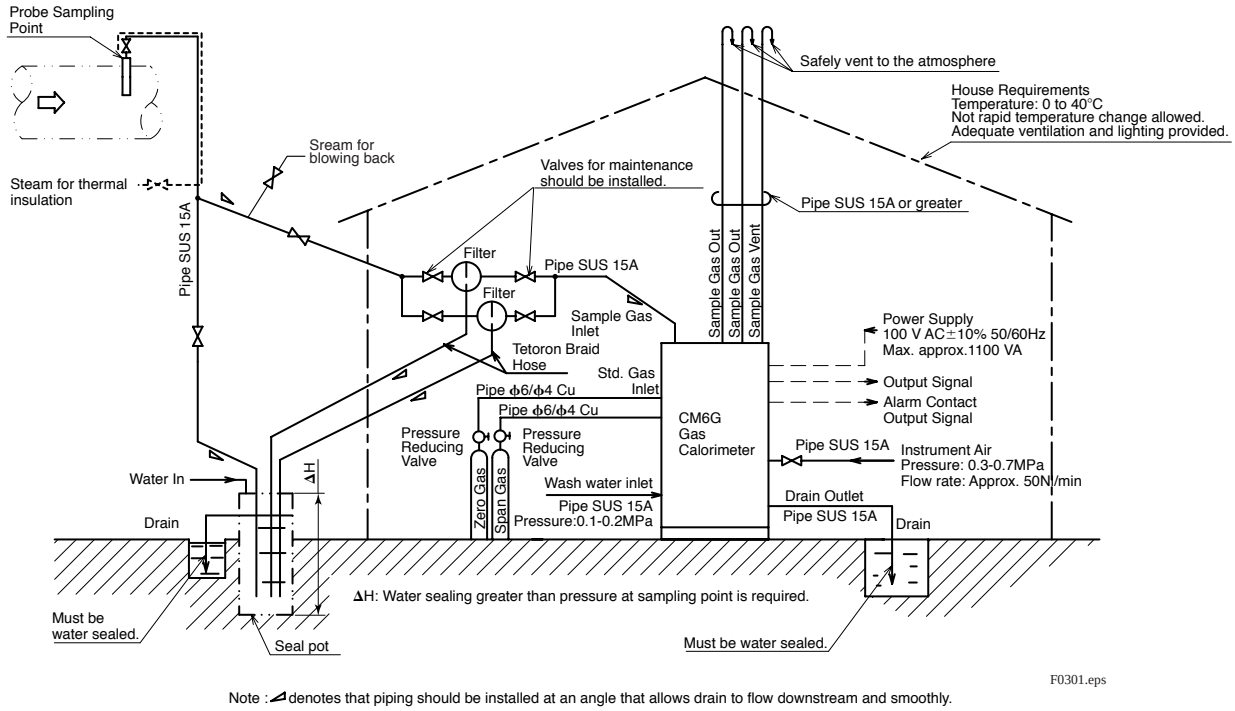
(1) Adequate space for maintenance should be provided around the gas calorimeter.
(2) The base should be horizontal.
(3) No rapid change in ambient temperature is allowed. Rapid change here means a change of approximately 10 ℃ within 30 minutes.
(4) Install the instrument in the place where it is not dilectly exposed to the cuurent of a conditioned air .
(5) Minimal vibration is allowed (If much vibration is unavoidable, take an appropriate measure to absorb shock, e.g., use of vibration-proof robber).
(6) A ventilation system should be provided.
(7) Corrosive gases and dust are present in small quantities and humidity is low.

3.2 Outside Pipings

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

The principal points to be taken care are as follows:

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



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

Figure 3.1 Recommended Sampling for Steel Mill Use

- Sampling point shall be made at the location above or side the transfer pipe, and in case of being installed on the side location, fix it with a slope that the top end of the probe is facing downward.
- When fixing the probe use a flange JIS 10K80A.
- At the sample gas outlet of the probe, recommend to provide a gate valve of 1/2″.

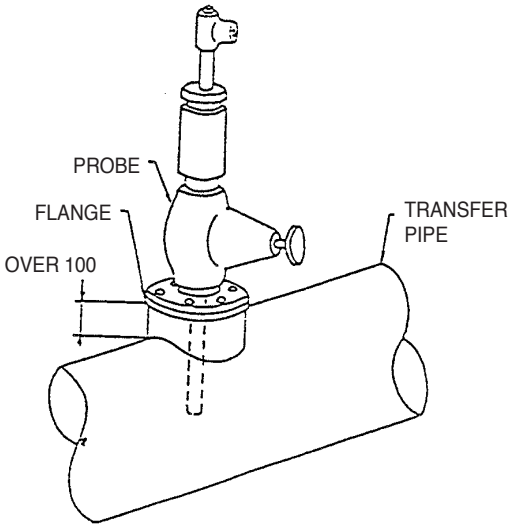


Figure 3.2 Mounting of the Probe

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

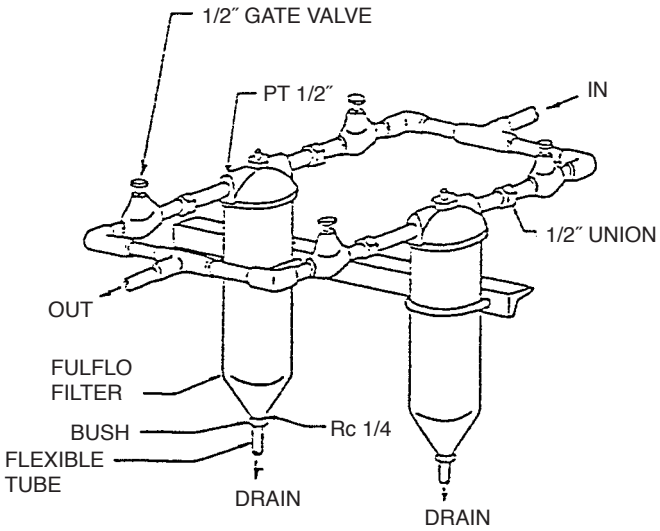


Figure 3.3 Example Fulflo Filters with the Piping

3.3 External Wirings

External wirings shall be connected from the terminal block of the switch box inside the panel. Use crimp-type terminal as the wiring end. Followings are the kind of wires to be used.

- **Power supply, alarm output**
  Use wire or cable of 600 V grade polyvinyl chloride insulated and sheathed portable power cables (JIS C3312) with the sectional size of more than 2 mm^2, or equivalent.
- **Signal output, REMOTE**
  Use twist shield wire with the sectional size of more than 0.5 mm^2 or equivalent, and separate completely from power supply or alarm output wirings, also from any noise inducing sources.
- **Earth wiring**
  Make the ground connection surely, taking the earth wire of more than 2 mm^2 from earth terminal in the panel, then solder it to the copper board or steel band and lay under the marshy ground.

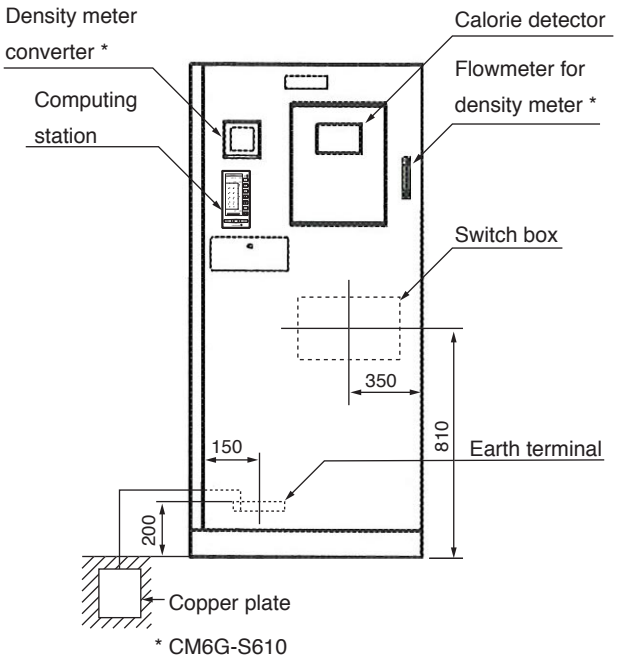


Figure 3.4 Switch Box and Earth

4. Principle of Measurement

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

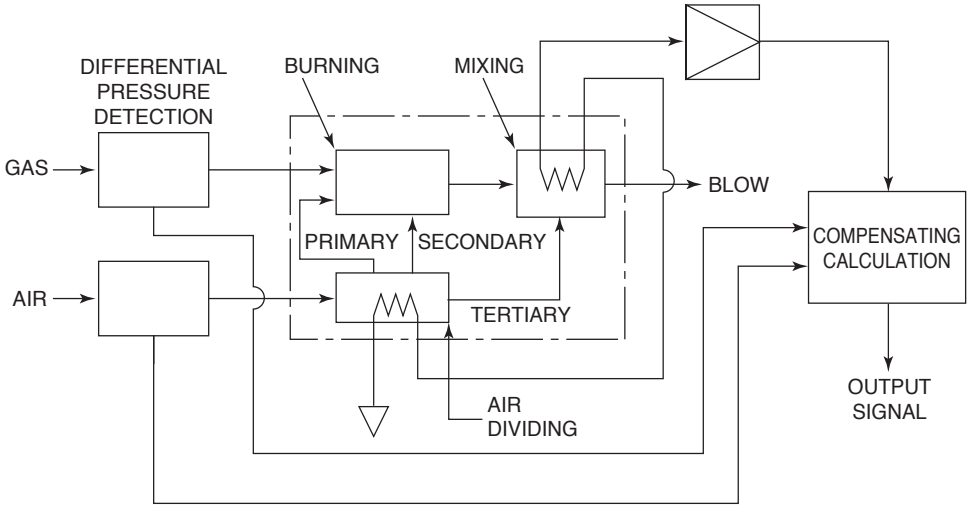


Figure 4.1 Measurement principle diagram

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

$$\Delta\theta = \frac{K \cdot Fg}{Cps \cdot Fs} \qquad (4.1)$$

where K: Calorific value of the sample gas

Fg: Flow rate of the sample gas

Fs: Air-diluted combustion exhaust gas flow rate

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

Air flow rate Fa is big enough compared with the sample gas flow rate

Fg (Fa:Fg=50-200:1) and Cps≃Cpa, Fs≃Fa+Fg=Fa (1÷g), therefore, the formula (4.1) is as follows:

$$\Delta\theta = \frac{K \cdot Fg}{Cpa \cdot Fa\,(1+g)} \qquad (4.2)$$

where Fa: Air flow rate

Cpa: Air constant pressure heat ratio

g: Fg/Fa

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

$$Fa = Ka\sqrt{\frac{\Delta Pa}{\rho a}} \qquad Fg = Kg\sqrt{\frac{\Delta Pg}{\rho g}} \tag{4.3}$$

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

ρa, ρg: Density of the air and the gas

ka, kg: Orifice constant figure of the air and the gas

(Orifice coefficient $\times$ orifice sectional area)

If insert formula (4.3) into formula (4.2), $\Delta\theta$ is represented by the following formula:

$$\Delta\theta = C.K.\ \frac{1}{\sqrt{\rho g}} \cdot \sqrt{\frac{\Delta Pg}{\Delta Pa}} \tag{4.4}$$

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

According to formula (4.4), if ΔPa, ΔPg 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 valve after the measurement and calculation of the density.

5. Construction and Function

Typical System Configuration

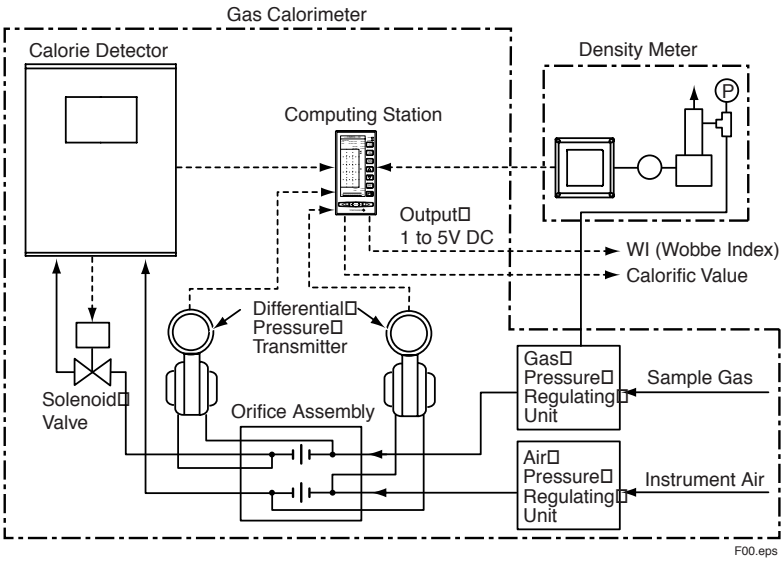


Figure 5.1 Construction of Model CM6G Gas Calorimeter

Components and functions

Item	Function / Description
Calorie detector	Detects WI. Generates an alarm and takes protective actions when the burner flam 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 calorifi 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.
Orific 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.

5.1 Air Pressure Regulating Section

See Also

Please Refer to the Flow Sheets Shown in Figure 5.2, Figure 5.3 and Figure 5.4

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 regulator (2-2) and after that the pressure is set by needle valve (V-16) to the differential pressure 500 Pa.

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

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

5.2 Gas Pressure Control Section

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

5.2.1 Town Gas Use

See Also

Please Refer to the Flow Sheets Shown in Figure 5.2, Figure 5.3

The sample gas, introduced through filter (3-1), increase its pressure by pump, or decrease by pressure regulator, 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 regulators (3-4) and (3-6), and at this time the pressure gauge (3-5) indicates approx. 3 kPa. When the density compensation system is equipped, it is introduced to the density meter with the flow rate of 1 l/min, through the flowmeter (5-3).

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

5.2.2 Steel Mill Use

See Also

Please Refer to the Flow Sheet Shown in Figure 5.4.

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

In case of increasing the pressure by the pump, the drain pot (3-8) 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).

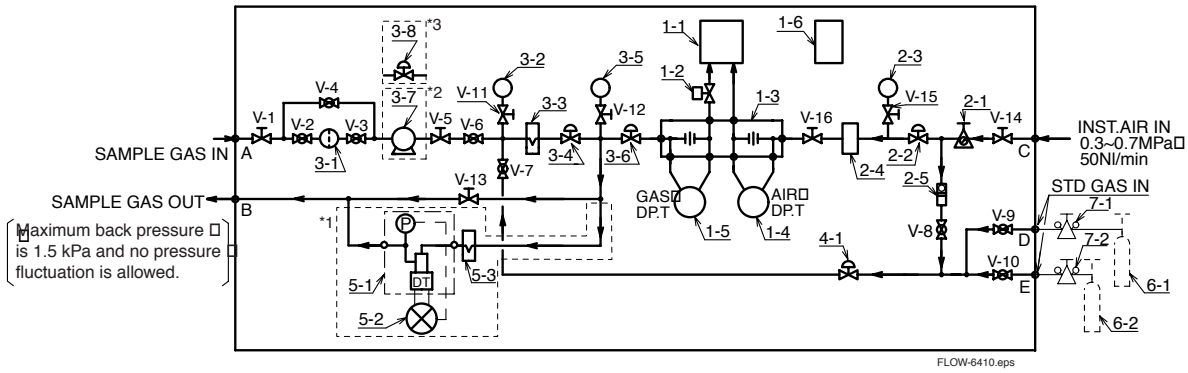
The pressure of the check gas is reduced by the pressure retulator (4-1) to about 6 kPa and is supplied by the flowmeter (4-2) with the flowrate about 10 l/min.

Standard Flow Sheet

1. Town Gas Application (Standard Type)

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

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



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

Figure 5.2 Flow Sheet (for Town Gas)

2. Town Gas Application (Quake-proof Type)

CM6G-S6110

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

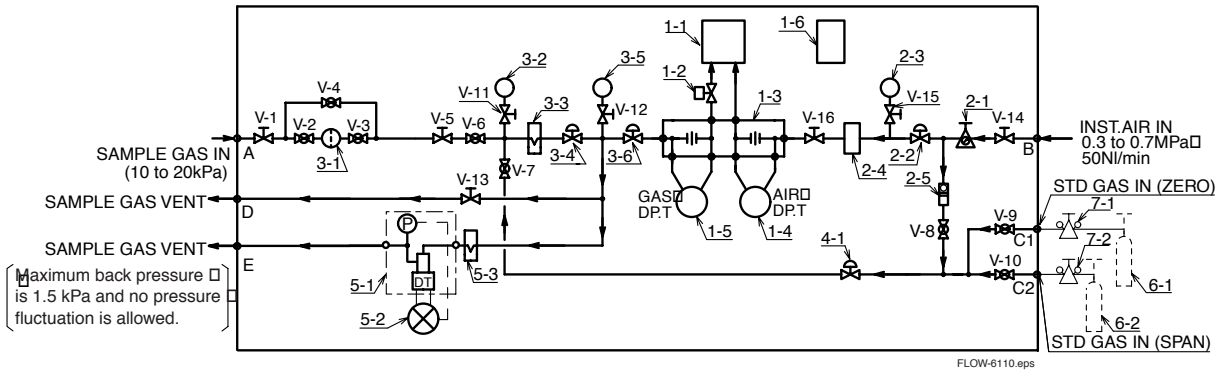


Figure 5.3 Flow Sheet (for Town Gas)

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 babbler□	□5-2□	Density meter converter (when specified)□
□1-3□	Orifice assembly□	□3-3□	Fulflo filter□	□5-3□	Flowmeter for density meter (when specified)□
□1-4□	Differential pressure transmitter (air)□	□3-4□	Pressure regulating unit□	□6-1□	Water Flowmeter□
□1-5□	Differential pressure transmitter (gas)□	□3-5□	Dehumidifier□	□7-1□	Open probe (optional)□
□1-6□	Computing station□	□3-6□	Pressure reducing valve□	□7-2□	Fulflo filter (optional)□
□2-1□	Air set□	□3-7□	Line filter□	□9-1□	Pressure reducing valve for cylinder (optional)□
□2-2□	Pressure reducing valve□	□3-8□	Diaphragm pump (when specified)□	□9-2□	Pressure reducing valve for cylinder (optional)□
□2-3□	Pressure gauge□	□3-9□	Drain pot (when specified)□	□10-1□	Standard gas cylinder (supplied by customer)□
□2-4□	Preheating chamber□	□4-1□	Pressure reducing valve for cylinder□	□10-2□	Standard gas cylinder (supplied by customer)□
□2-5□	One touch coupler	□4-2□	Flowmeter	□11-1□	Drain seal pot (supplied by customer)□
				□ □	
				Ø1...16□	Ball valve, needle valve

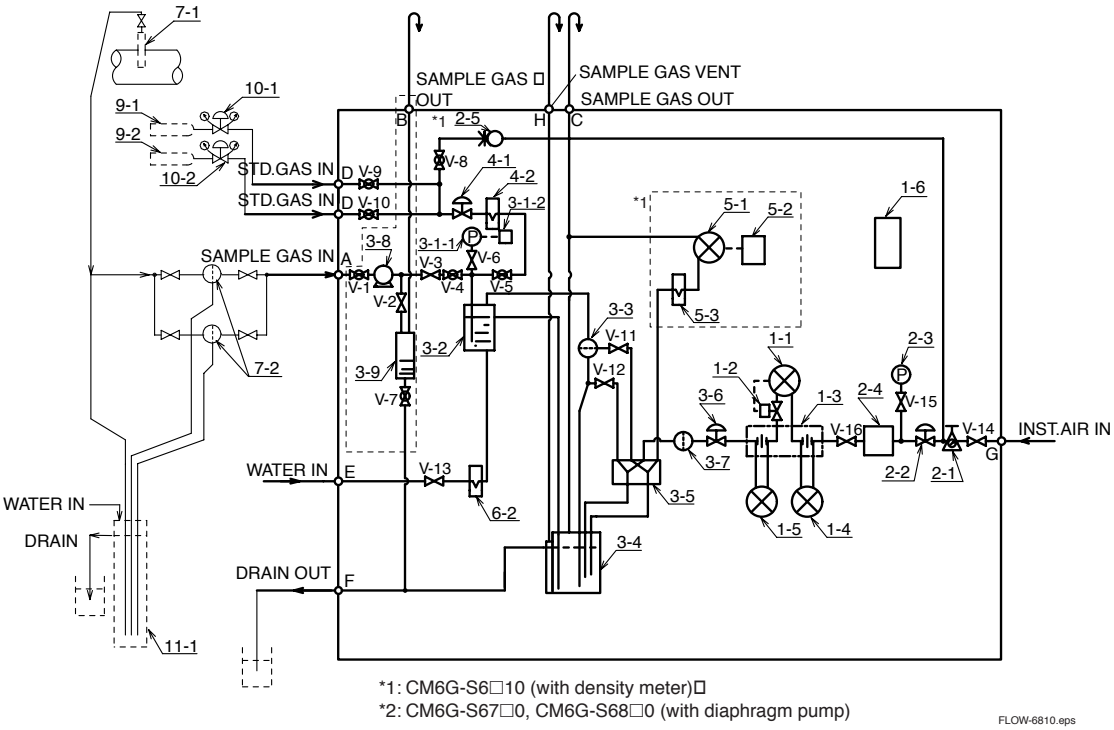


Figure 5.4 Flow Sheet (Steel Mill Use)

5.3 Differential Pressure Detection Part

In order to calculate the differential pressure, take out the flow rate, through orifice, as a differential pressure and by the function of differential pressure transmitter and distributor, convert to an electrical signal.

Orifice is housed in the constant temperature chamber (Orifice assembly) which temperature is kept staying approximately at 50 °C by the function of temperature control system using a noncontact proportional control method, and prevent it from the temperature difference of the actual flow rate.

When the temperature exceed over 90 °C, the safety thermostat operates and intercepts the heater power supply. If the temperature becomes cooler because of the interception of the heater power supply, alarm thermostat operate and obtained the contact signal output (Closed in time of disorder) by the alarm thermostat. (Alarm circuit is optional)

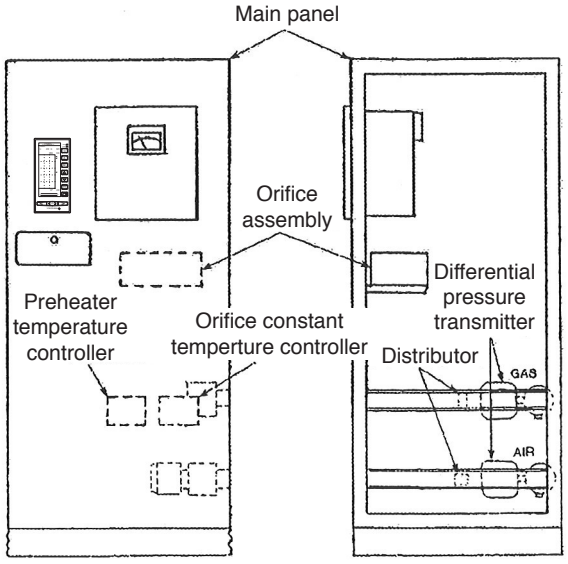
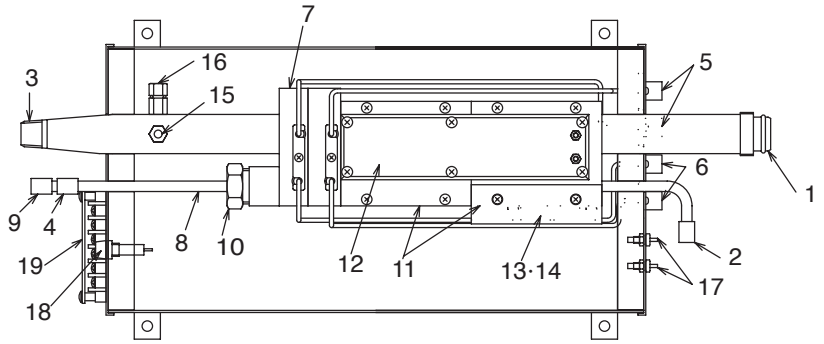


Figure 5.5 Differential Pressure Detection Equipment



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

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Figure 5.6 Orifice Assembly

5.4 Detector

The detector consists of the burner unit which detect the difference of temperature after burning the sample gas, amplification circuit of the detected signal and ignition-and-safety sequence circuit. The detection signal amplified from approx. 4 - 20 mV to 1-5 V DC and transmitted to the computing station. As to the burner extinguishing or over burning contact output of “closed in time of alarm” is obtained.

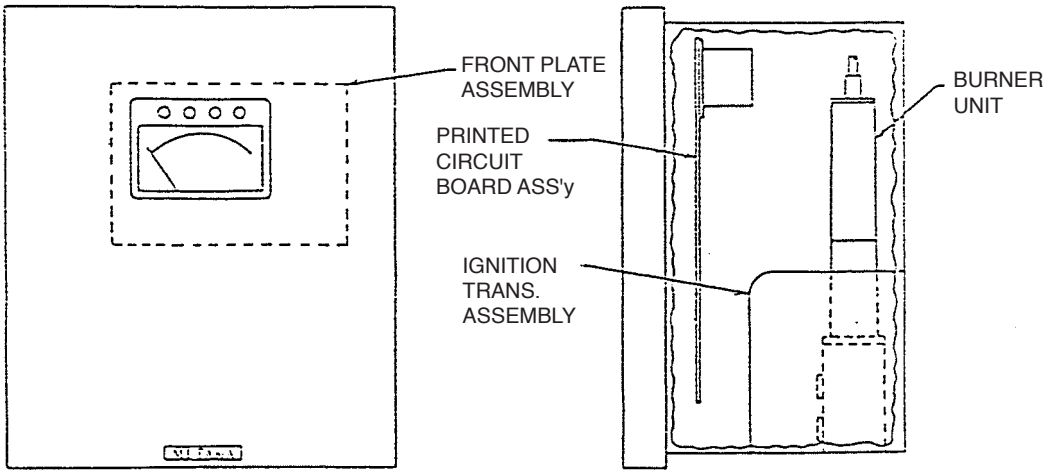


Figure 5.7 Detector

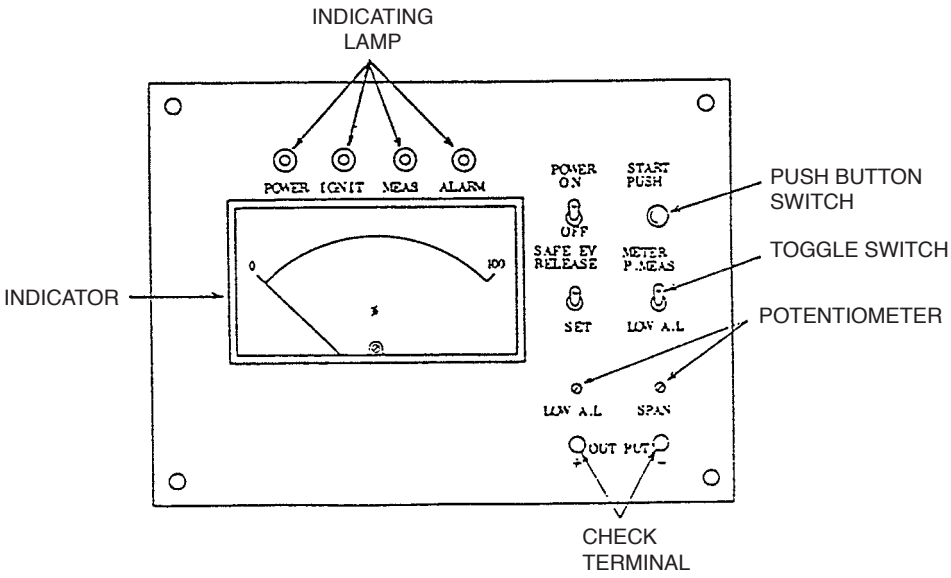


Figure 5.8 Front Panel Assembly

Table 5.2 Function and operation procedure for each switch of the detector

Name	Function and operation procedures
“POWER” switch	• Power supply switch. • Turn to “ON”, power supply is supplied to the detector and at the same time light the lamps, “POWER” and “ALARM”.
“START” switch	• After one push on “START” switch, the gas is supplied to the burner unit and operate the ignition. • On the same time light the lamp “IGNIT”, the lamp “ALARM” is lit off. • If ignit within the preset time, the lamp “IGNIT” is lit off but light the lamp “MEAS”. • If not ignite within the preset time, the lamp “IGNIT” is lit off and light the lamp “ALARM” again.
“SAFE EV” switch	• Normally leave the switch at “SET” portion. • When adjust the differential pressure turn it to “RELEASE”. When the lamp “ALARM” is let off, alarm is released and solenoid valve of the gas line is opened. • If leave the switch position stay at “RELEASE” from “SET” nothing happens, but in such case no alarm signal is given even when extinguishing the burner, so be careful of this matter. • When the switch shows “RELEASE”, it doesn’t start even if the switch “START” be pushed.
“METER” switch	• You can switch the indication of the indicator “P.MEAS” and “LOWA.L” each other. • Such conversion has nothing to do with the final output and the sequence function.
“SPAN” potentiometer	• With this span potentiometer you can adjust the output of the detector to 1 - 5 V DC. • If turn to the right the span point becomes bigger.
“LOW A.L” potentiometer	• The level set for the extinction alarm (lower alarm) is decided by this potentiometer. • If turn to the right the alarm level becomes higher.
“OUTPUT” terminal	• Output checking terminal.
“IGNIT” lamp	• During the lamp is lighting, this is ready to be ignited.
“MEAS” lamp	• During the lamp is lighting, it is under the measurement condition.
“ALARM” lamp	• During the lamp lighting, alarm function is being given.

5.4.1 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 detector.

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

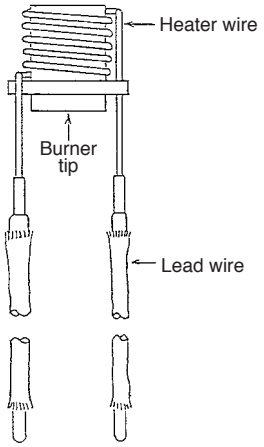
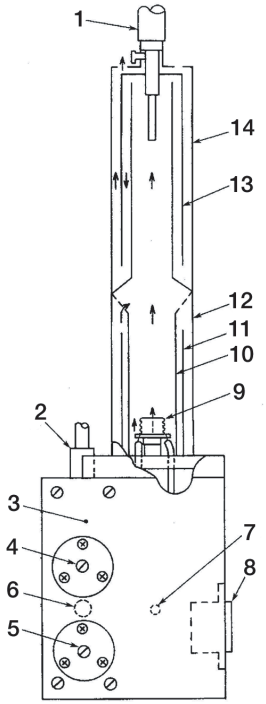


Figure 5.9 Burner Tip Assembly



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 5.10 Burner Unit

5.4.2 Signal Amplification, Ignition and Safety Sequence Circuit.

The thermocouple output (approx. 0 - 20 mV) is pre-amplified, and after span adjustment to 0 - 4 V, converted to 1 - 5 V and generated as the output. The indicator indicates, by “METER” switch, either the amplified signal or the lower level alarm.

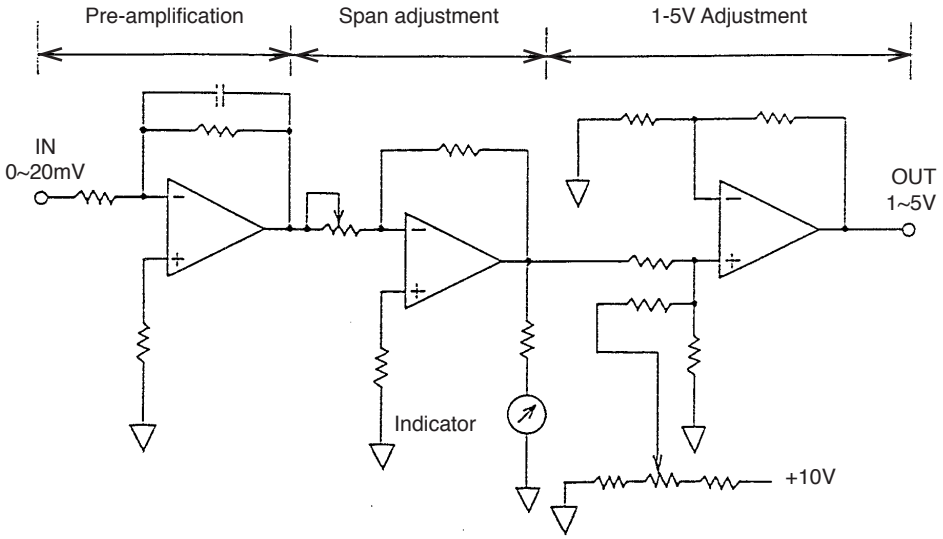


Figure 5.11 Signal Amplification Circuit

In the sequence circuit, each limit of the lower and the higher level is set for the voltage level of the main amplified part in the signal amplification circuit, and the sequence function is exercised. The limit of the higher alarm is the alarm point for the over heat of the burner, and is set at 120% of the span.

The lower alarm is the alarm point for the extinction of the burner and able to change corresponding to each specified range of the measurement by the potentiometer “LOW A.L” mounted on the detector front panel. The above adjustment is duly conducted at our factory in the final adjustment test before shipment. The igniting action gets started when pushing the switch “START” of the detector.

For completing this action, we have to repeat five times of each cycle normally, which one cycle means the total times from the time when the igniting voltage be supplied to the heater (T_1) to the time when it is not supplied (T_2) (In case of low calorie gas, pre-heating voltage is supplied).

The time T_1 and T_2 are set independently with a certain time between 2 to 20 sec. respectively depending on the measuring range and the gas composition. Such time setting stall be made using the potentiometers R211 and R214 on the printed circuit board, but normally no need to move those potentiometers.

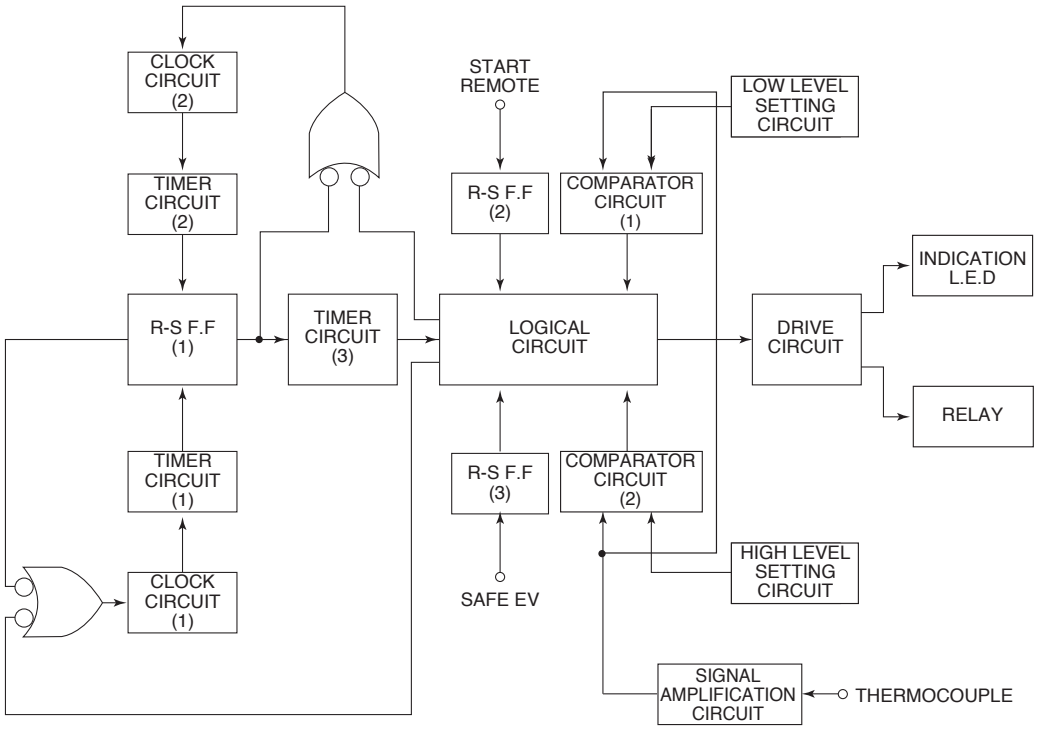


Figure 5.12 Sequence Circuit Block Diagram

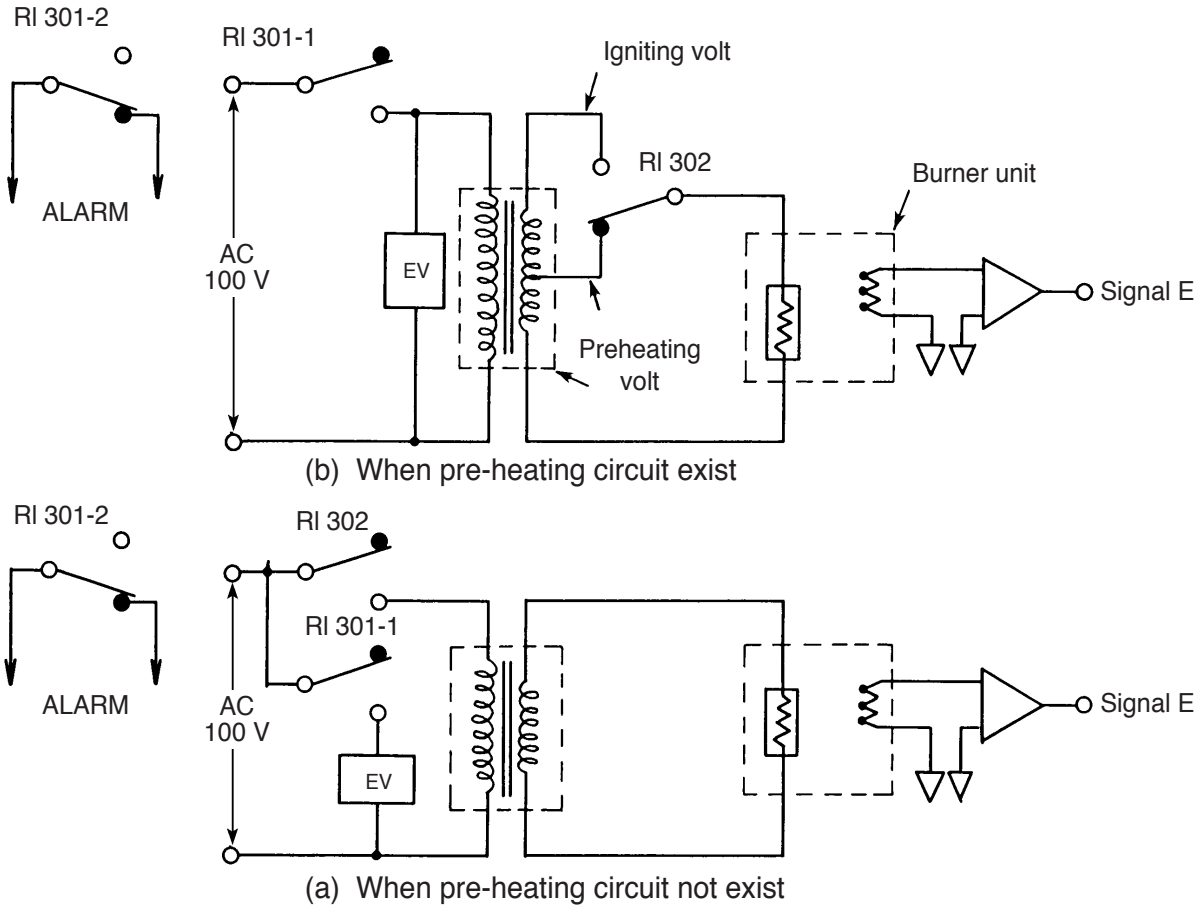


Figure 5.13 Ignition and Safety Circuit

When the amplified signal of the thermocouple exceed the limit of the lower alarm level, the igniting action suspended.

When the ignition is not realized even after being held five times of igniting actions, the igniting action is suspended just after the fifth voltage supplying action. If above case happens, you have to push the switch “START” once more, then, the igniting action shall be started again.

During the measurement, when the burner is extinguished by some reason, the amplified signal of the thermocouple descend below the limit of the lower alarm level, Rl 301 becomes “OFF”. When Rl 301 becomes “OFF”, EV (solenoid valve) is closed and suspend the gas supply on the same time, the alarm signal is energized. Also for the over heating of more than 120% of span, the same action as above (safety alarm action) will be performed.

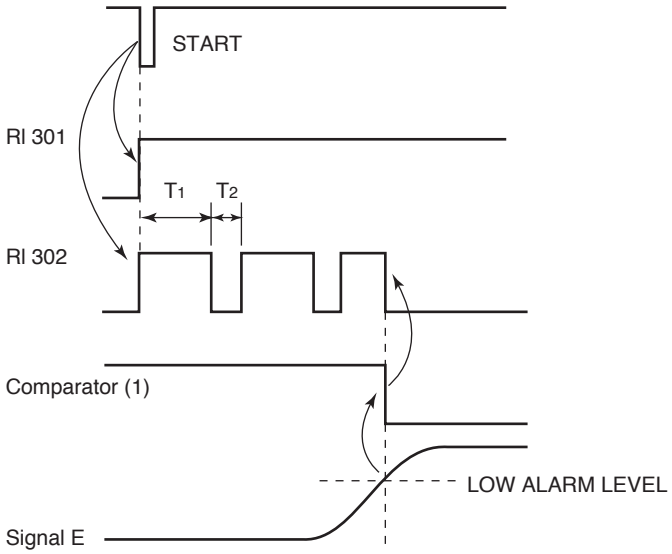


Figure 5.14 Ignition sequence

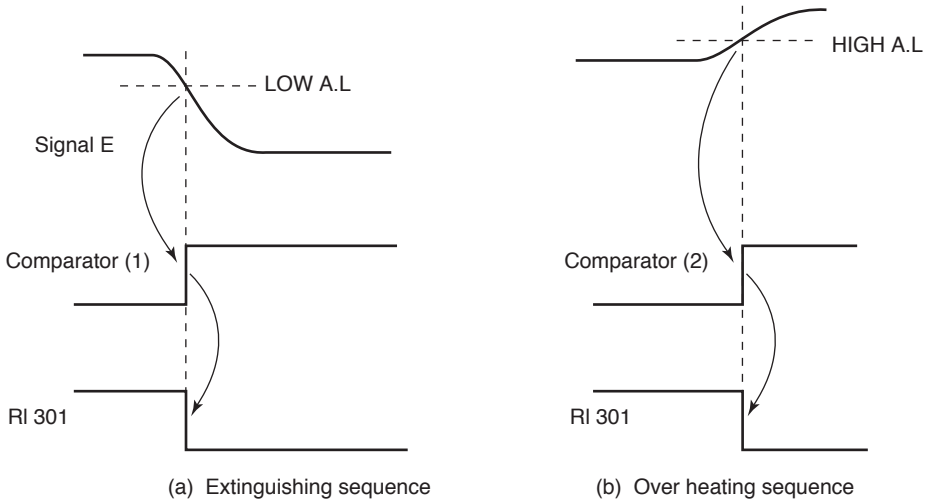


Figure 5.15 Safety-and-alarm Sequence

When the burner extinguished on account of the alarm function, you may push again the switch “START”, after the elimination of the cause of such alarming, and then the igniting action shall be started. Each indication lamp light on or off corresponding to each sequence.

5.5 Computing Station

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

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

5.5.1 Indication Selection

■ Explanation of display indication

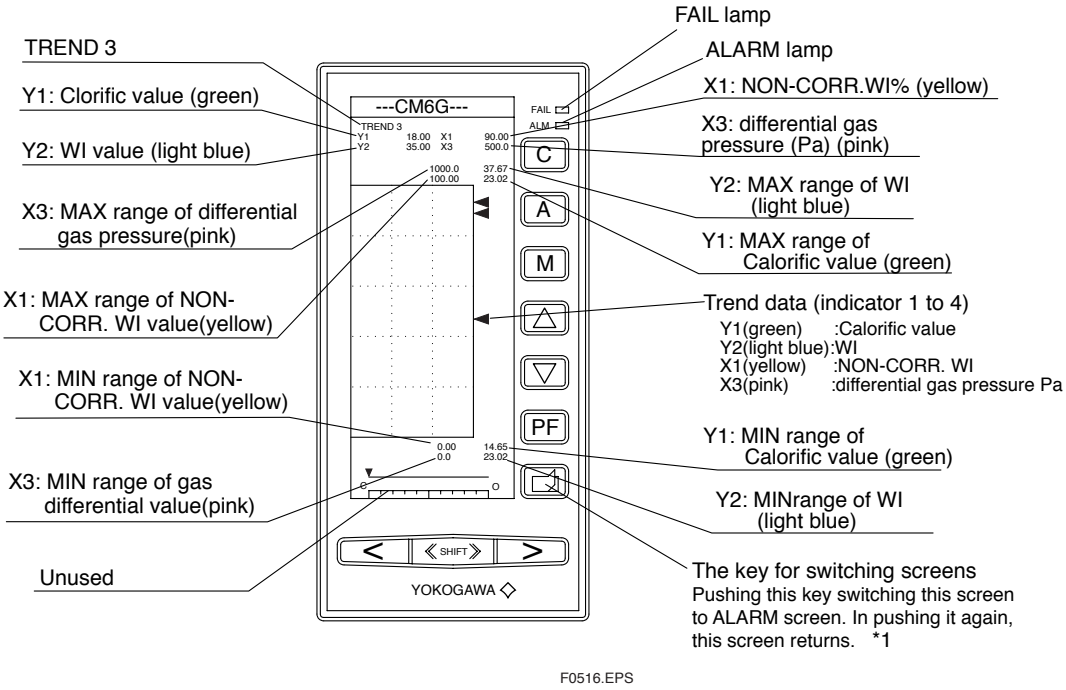


Figure 5.16 Measuring Display

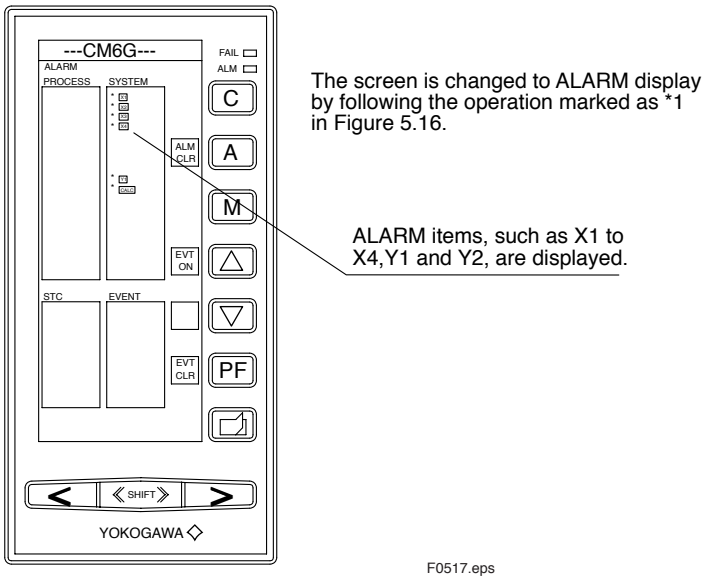
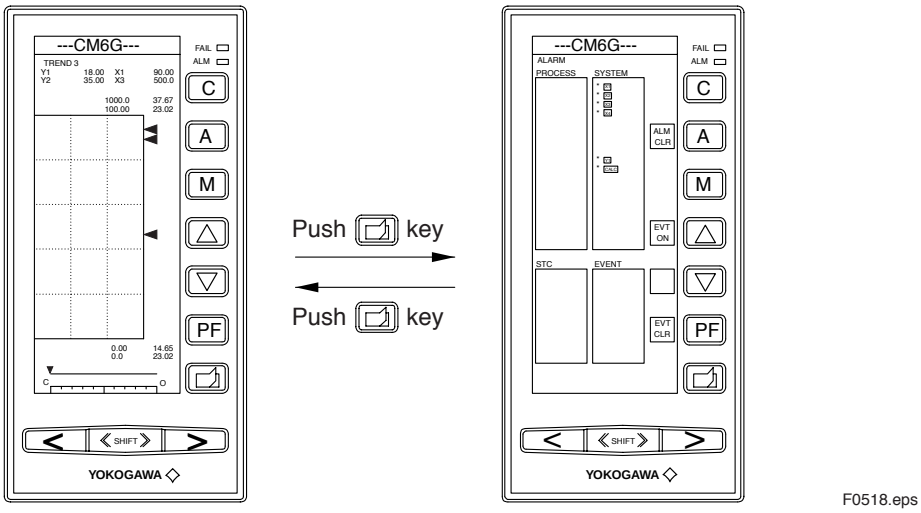


Figure 5.17 Alarm Display

■ Switching to alarm display



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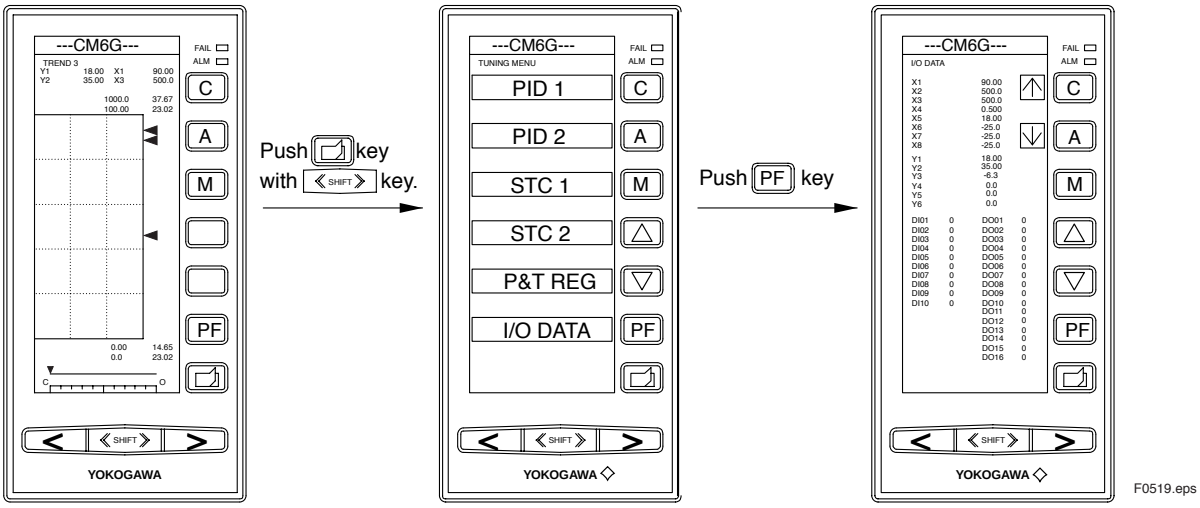
(1) Measuring display (2) Alarm display

Fugure 5.18 Switching operation to alarm display



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

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

Fugure 5.19 Switching operation to Input/output status display

■ Parameter setting

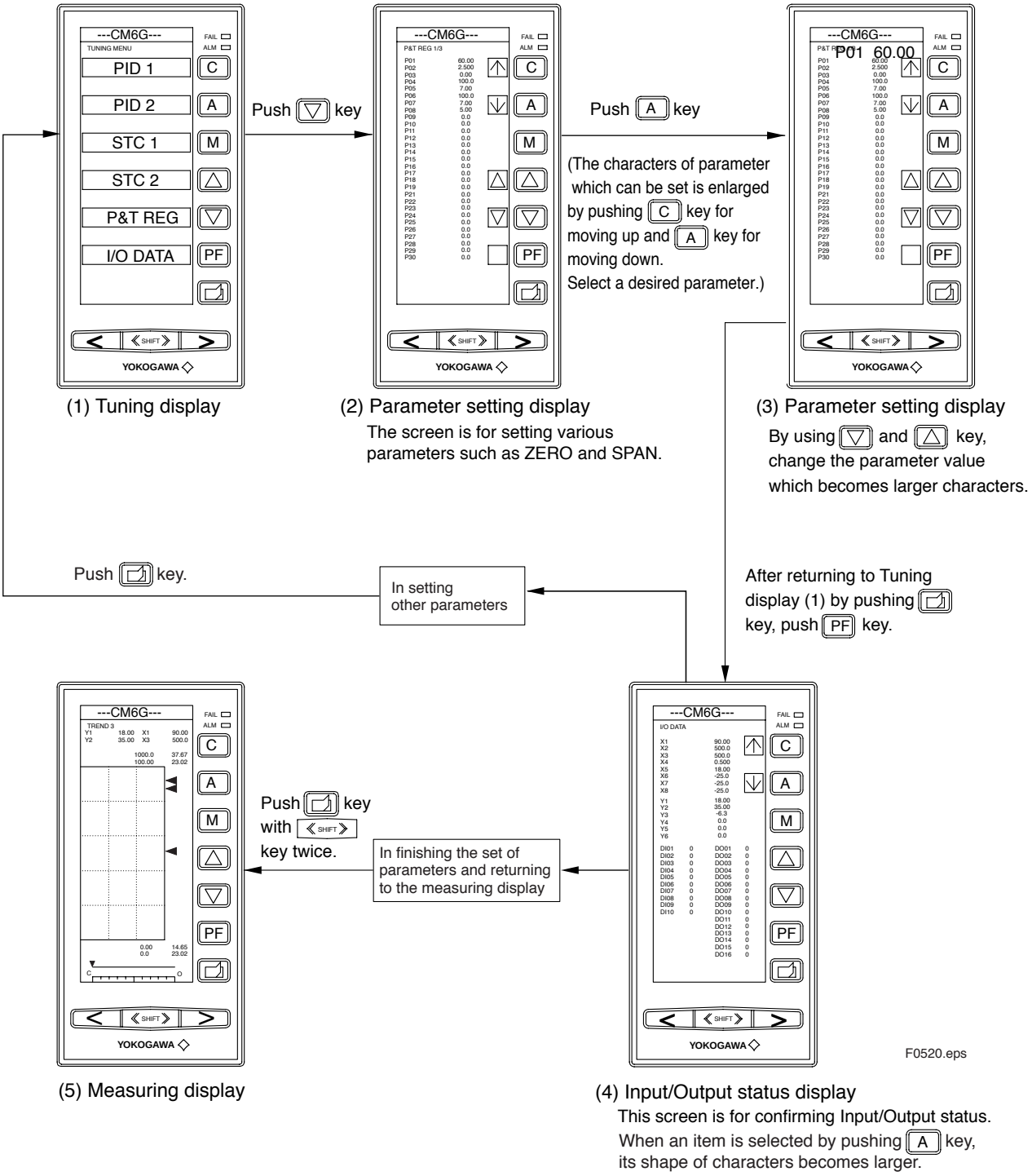

Figure 5.20 Flow Chart of Various Parameter Setting and Confirmation

5.5.2 Contents of the Data Label

Contents of the data label are as follows:

Table 5.3 Contents of the data label

Kind		Data abbreviated		Data contents	Data range
Imput	X1	NON-CORR. WI	%	WI valve before correction	0.0 to 100.0
X_N	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	mV	Thermocouple Electromotive force	0 to 30
	X6 to X8	Unused		————	———
Output	Y1	Cal. MJ/Nm^3		Calorific value	*1
Y_N	Y2	WI		Wobbe index	*1
	Y3	Option		Option	*1
	Y4	BIAS CHECK		Pre-heating check output	0.0 to 100.0
	Y5, Y6	Unused		————	———
Variable	P01	ZERO		Zero adjustment	0.0 to 100.0
data	P02	SPAN		Span adjustment	*1
	P03	BIAS		Pre-heating adjustment	0.0 to 100.0
P_N	P04	A-CORR. RATE	%	Air differential pressure signal computing correstion 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		————	———

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*1: Differs depending on each specification.

The numbers are displayed in four figures.

Example: In case of the range is 3.00 - 6.00 MJ/Nm^3 the abbreviated data becomes as follows:

Abbreviated data	Data range
Cal. MJ/Nm^3	3.00 - 6.00

5.5.3 Correcting Computation

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

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

$$Eo' = Eo \cdot \frac{\sqrt{\Delta Pg}}{\sqrt{\Delta Pa}} \qquad (5.1)$$

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

In the computing program, each differential pressure is extracted of the square root and provide a differential pressure correcting computation. The signal after corrected is range suppressed (ZERO) and to further extended to SPAN. In case when it has a pre-heat circuit deduct the amount of pre-heated 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:

$$K = C(W.I) \cdot \sqrt{\rho g} \qquad (5.2)$$

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

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

$$\Delta\theta = C_1 \cdot \frac{K}{\sqrt{\rho g}} \cdot \frac{\sqrt{\Delta Pg}}{\sqrt{\Delta Pa}} + C_2 \cdot \frac{H}{\sqrt{\Delta Pa}} \qquad (5.3)$$

H : Pre-heat calorie
C_1, C_2 : Constant

If the correction computation of the differential pressure is provided to Δθ in the formula (5.3), it is shown as per the following formula:

$$\Delta\theta \cdot \frac{\sqrt{\Delta Pa}}{\sqrt{\Delta Pg}} = C_1 \cdot \frac{K}{\sqrt{\rho g}} + C_2 \cdot \frac{H}{\sqrt{\Delta Pg}} \qquad (5.4)$$

The second clause of the right part in the formula (5.4) represent the pre-heat calorie, which, as you can see in the formula (5.4), the matters concerning the pre-heating is varied according to the change of differential pressure (ΔPg).

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

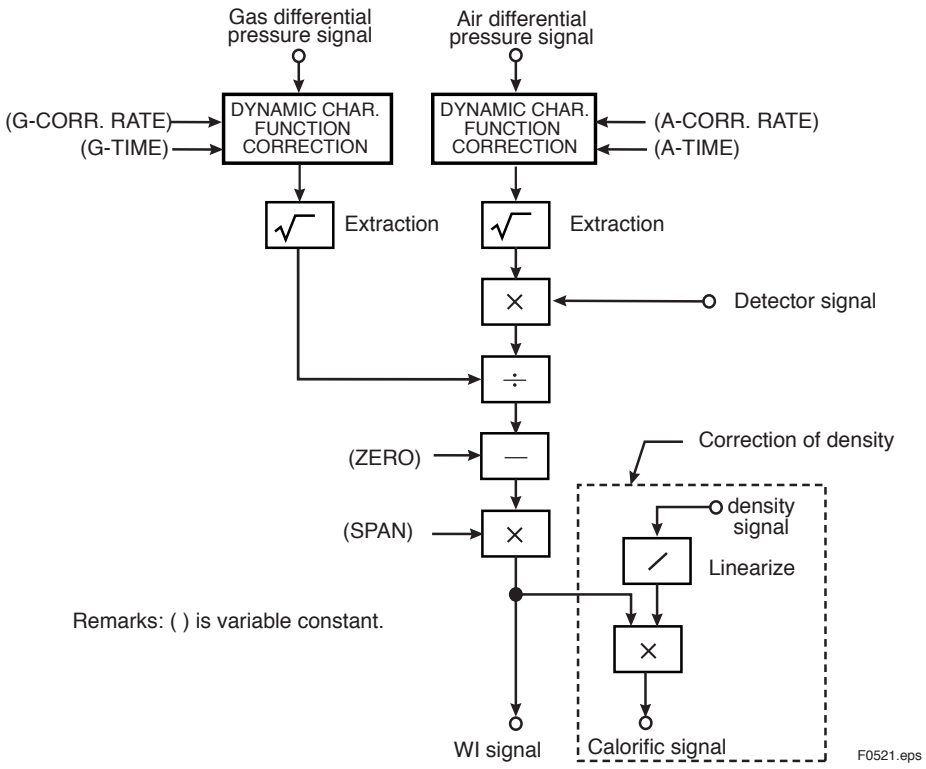

Figure 5.21 Computing Block Diagram (Pre-heating Circuit Does Not Exist)

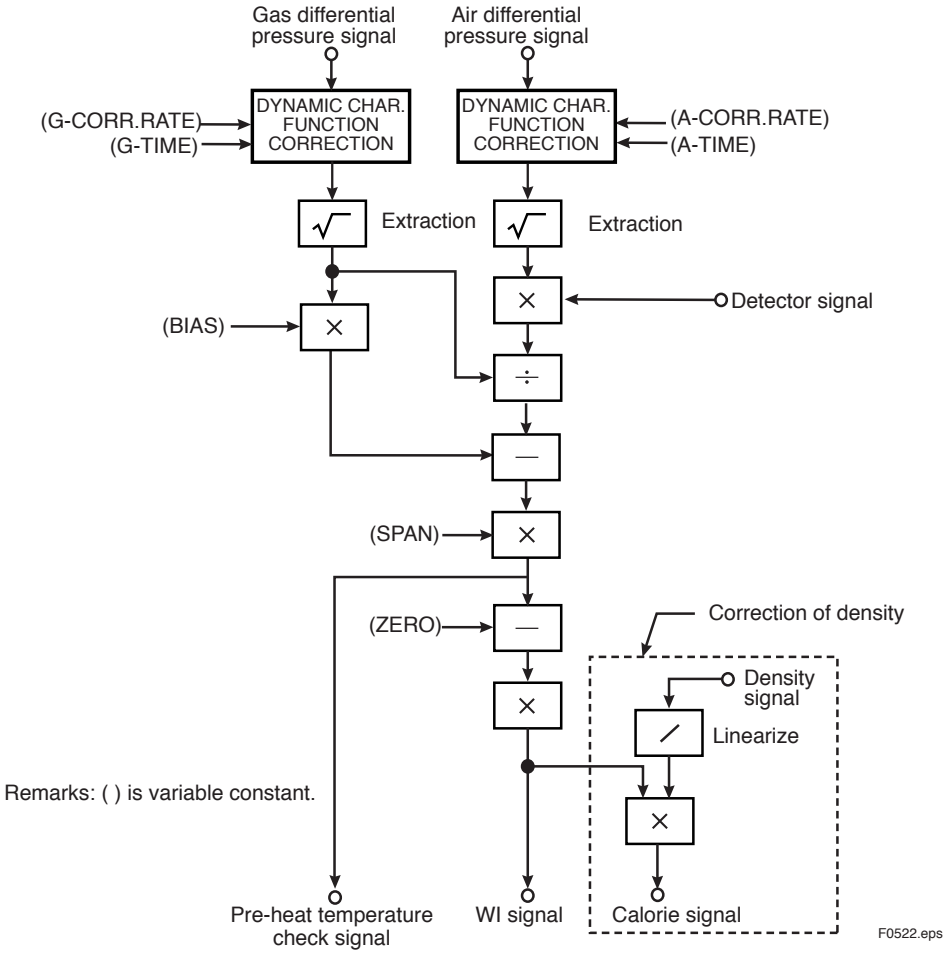

Figure 5.22 Computing Block Diagram (Pre-heating Circuit Exists)

5.6 Density Meter

The GD400 is used for gas density meter.

Regarding GD400, Gas density meter, please refer to attached Instruction Manual IM 11T3B1-01E.

6. Operation and Suspension

Before start operation check outside wirings, pipings and confirm no gas leakage found. Refer to the flow sheet Figure 5.2, Figure 5.3, Figure 5.4.

6.1 Preparation of Operation

6.1.1 Sampling System

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

6.1.2 Valves in the Panel

Please confirm and open or close according to the following table.

For town gas use

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

For steel miss 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	Open	V-15	Open
V-8	Close	V-16	*

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

6.1.3 Water Supply (For Steel Mill Use)

a) Open valve V-13 and supply water until it overflows from the drain exhaust outlet of the washing bubbler and the pressure regulating pot.
b) The flow meter (6-1) indicates the flow rate of 0.2 l/min.

6.1.4 The Zero Adjustment of the Differential Pressure Transmitter

a) Remove the pressure transmission pipes of both transmitters.
b) Turn the circuit breaker of the switch box to ON, then the switch of the distributor to ON.
c) Measure each output of the distributor terminal block by digital voltmeter and adjust it to DC lV by the “zero adjustment knob” of the differential pressure transmitter.
d) After the adjustment connect each transmission pipe with a care not to take place any leakage at the connected parts.

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

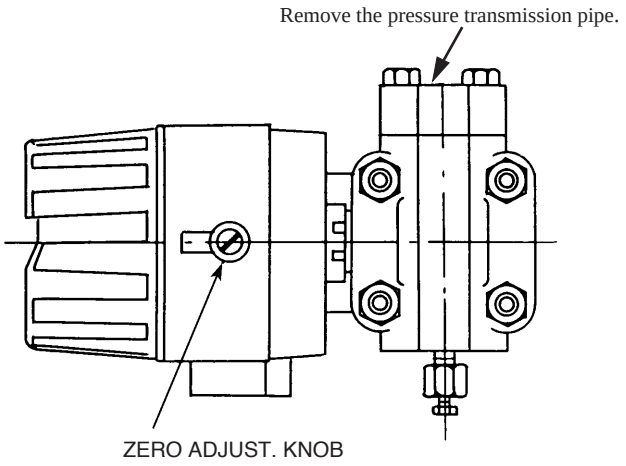

Figure 6.1 Differential Pressure Transmitter

6.1.5 Supply of the Air

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

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

When the pressure is not normal, will you please adjust it by the following procedures?

a) Adjust the pressure gauge of the filter regulator to become approx. 200 kPa, using the valve there-of (2-1). When turn the valve to the right, the pressure becomes higher.
b) Adjust the pressure gauge (2-3) to become about 20 kPa, using the pressure regulator (2-2) and V-16. If turning the valve of the pressure regulator to the right, the pressure becomes higher.

6.1.6 Supply of Power

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

Switch	Position
Power	OFF
SAFE EV	SET
METER	P.MEAS

b) Turn on the switches of the following components in the switch box.
- Orifice Assembly (NFB)
- Pre-heater (NFB)
- Dehumidifier (For steel mill use only)
- Detector
- Computing station
- Den. meter (With density correction)
- Distributor

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

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

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

f) After elapsed for about 30 minutes the lamp of the orifice assembly starts flickering the temperature of the orifice constant chamber become stable.

6.1.7 Air Differential Pressure Adjustment

a) Set the indication of the computing station to Input/Output status display.

b) Adjust V-16 so that the indication “X2” will become “500”.

c) When the indication of the pressure gauge (2-3) differs from 20 kPa, set again by the pressure regulator (2-2) to 20 kPa and conduct the adjustment of b).

6.1.8 Pressure Adjustment of the Gas Line

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

■For town gas use

a) Close V-6 and connect the coupler.

b) Open V-7 and V-8.

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

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

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

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

g) Set the indication of the computing station to Input/Output status display.

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

i) When the adjustment completed, close V-8, V-7, separate the coupler, and open V-6.

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

■For steel mill use

a) Close V-4, connect the coupler and open V-5 and V-8.
b) Set the switch “SAFE EV” of the detector to “RELEASE”, when the solenoid valve of the gas line open and the alarm is released.
c) Adjust the flow rate of the flowmeter (4-2), by using the pressure regulator (4-1), to become about 10 l/min. In this time the pressure gauge (3-1) indicates approx. 6 kPa.
d) When the density meter is attached, adjust the indication of the flow meter (5-3) to 0.5 to 1 l/min by using V-11.
e) Adjust, by using V-12, the number of bubbles come out from the pipe A of the pressure regulating pot (3-4), 3 - 6 pcs/sec. Open V-12 fully, in case of the low calorie instrument, when no bubbles came out.
f) Set the indication of the computing station to Input/Output status display.
g) With the pressure regulator (3-6), Adjust the indication “X3” to become “500”. When the number of bubbles from pipe A be changed, adjust the number of bubbles by using V-12, and then, carry out the adjustment.
h) When complete the adjustment, close V-8 and V-5, separate the coupler, and open V-4.
i) Turn the switch “SAFE EV” of detector to “SET”.

6.2 Start Operation

Confirm the air is supplied before start operation.

6.2.1 Introduction of the Sample Gas

■For town gas use

a) Open V-1 fully.
b) When the pump is attached, turn the power supply switch of the pump to “ON” in this time.
c) When the pressure is 100 to 200 kPa or increased by the pump, adjust, by V-5, so that the indication of the pressure gauge (3-2) become 8 to 18 kPa. While the pressure is reduced by the pressure regulator, adjust the indication of the pressure gauge (3-2) to become 8 to 18 kPa, by the pressure regulator (3-8).

■For steel mill use.

a) In the case that the pressure is above 8 kPa, open V-4, and in the case that the pressure is increased by the pump, open V-1, V-4 respectively.
b) When the pump is attached, turn on the power supply switch of the pump in this time.
c) Adjust the pressure of the pressure gauge (3-1), using V-3 in the case of standard pressure (above 8 kPa), and using V-2, V-3 in the case of the pressure increased by the pump, to become approx. 6 kPa.

6.2.2 Start Operation of the Detector

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

6.2.3 Differential Pressure Readjustment

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

■For town gas use

a) When the pressure indication of the pressure gauge (3-5) differs from approx. 3 kPa, adjust it by the pressure regulator (3-4).
b) When the density meter is attached and the flowmeter (5-3) indicate out of 0.5 to 1 l/min, adjust its indication again.
c) Set the computing station to Input/Output status display (refer to Figure 5.18 (3)). If the indication of “X2” and “X3” is not ”500”, adjust each with the pressure regulator (3-6) and V-16.

■For steel mill use

a) When the density meter is attached, adjust again the indication of the flowmeter (5-3) by V-11.
b) When the number of bubbles coming out from the pipe A is not constant, adjust it by V-12.
c) Set the computing station to Input/Output status display (refer to Figure 5.18 (3)). If the indication of “X2” and “X3” is not ”500”, adjust each with the pressure regulator (3-6) and V-16.

6.3 Suspend Operation

6.3.1 Long Timer Suspension

a) Close V-1. In case of the standard pressure for steel mill use, close V-4. In case of the pressure increased by the pump, switch the pump off at first.
b) When the gas supply suspended and the burner extinguished, the lamp “MEAS” of the detector is lit off and the lamp “ALARM” on.
c) Set the switch of the detector “SAFE EV” to “RELEASE”.
d) In the case of the town gas use, close V-6 and open V-7, V-8. In case of the steel mill use, close V-4 and open V-5, V-8. By such operation the sample gas in the gas line is blown off by the air
e) After continuing the blow for 3 to 5 min., turn off the “POWER” switch of the detector and if the density meter is attached, cut the power supply switch inside the density meter.
f) Turn off all switches of the switch box.
g) Lastly, close V-14 and stop the air supply.

6.3.2 Short Time Suspension

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

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

(Page Blamk below)

7. Calibration

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

7.1 Supply of the Check Gas

7.1.1 For Town Gas Use

See Also

Refer to Flow sheet in Figure 5.2 and 5.3.

a) Close V-6 and open V-7. In this time the burner is extinguished. But if the pump is attached, close V-6 and open V-7, after turn off the power supply of the pump.
b) Adjust the secondary pressure of the pressure regulator for check gas cylinder, to become approx. 200 kPa.
c) Open V-9 or V-10 and introduce the check gas.
d) Adjust the indication of the flowmeter (3-3), by the pressure regulator (4-1), to become about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.
e) Push the “START” switch of the detector to ignite.
f) Set the computing station to Input/Output display screen (refer to Figure 5.18 (3)). If the indication of “X2” and “X3” is not ”500”, adjust each with the pressure regulator (3-6) and V-16.
g) In the case of the density meter being attached, please confirm and re-adjust (if necessary) the indication of the flowmeter.
h) When the calibration is completed, close V-9, V-10, V-7, and open V-6. In the case of the pump being attached, supply the power supply of the pump as the next step.
i) Push the “START” switch of the detector to ignite.
j) Confirm and readjust (if necessary) the gas differential pressure and the flow rate to the density meter.
k) Please don’t forget to close the root valve of the check gas cylinder.

7.1.2 For Steel Mill Use

See Also

Refer to Flow sheet in Figure 5.2 and 5.3.

a) Close V-4 and open V-5. The burner is extinguished. However, if the pump being attached, turn off the power supply of it in advance.
b) Set the secondary pressure of the pressure regulator for check gas cylinder to approx. 200 kPa.
c) Open V-9 or V-10 and introduce the check gas.
d) Using the pressure regulator (4-1), adjust the indication of the flowmeter (4-2) to become about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.
e) Push the “START” switch of the detector to ignite.
f) Set the computing station to Input/Output status display (refer to Figure 5.18 (3)). If the indication of “X3” is not ”500”, adjust “X3” with the pressure regulator (3-6). In the case of the density meter being attached, confirm and re-adjust the flow rate.
g) Confirm “X2” in Input/Output status display. Adjust “X2” to “500” by using V-16.
h) When completed the calibration close V-9, V-10, V-5 and open V-4. In the case of the pump being attached supply the power supply of the pump as the next step.
i) Push the “START” switch of the detector to ignite.
j) Re-adjust both the gas differential pressure and the flow rate to the density meter.
k) Don’t forget to close the root valve of the check gas cylinder.

7.2 Span Adjustment of the Detector

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

7.2.1 When no Pre-heating Circuit Exist

a) Set the computing station to Input/Output status display.
b) Introduce the span check gas and after ignition, wait until the indication “X1” becomes stable.
c) Adjust the indication, using the “SPAN” potentiometer on the front side of the detector, to become the specified value (x%). WI is used to find out the x value.

Example:
WI value of the span check gas = 7960 WI
WI value of the range at the highest level = 8000 WI

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

7.2.2 When Pre-heating Circuit Exists

a) Suspend the supply of the sample gas.
b) Same as the gas line pressure adjustment explained in paragraph 6.1.8), introduce the air to the gas line.
c) Set the “SAFE-EV” switch of the detector to “RELEASE”, when the pre-heating voltage is applied to the ignition heater of the burner unit, by which the increased temperature with an effect of the pre-heating is detected by the thermocouple.
d) Measure with digital voltmeter 2(+) - 1 (-) on the terminal board at the back side of the detector, and when the indication becomes stable record the value (Eo mV).
e) Set the “SAFE-EV” switch of the detector to “SET”.
f) Suspend the air supply to the gas line, and supply the span check gas and ignite.
g) Measure with digital voltmeter 2(+) - 1(-) on the terminal board of the detector, and after confirming the indication becomes stable, record the value (Ec mV).
h) Set the computing station to Input/Output status display and adjust the “SPAN” potentiometer of the detector so that “X1” will show the specified value (x%). WI is to be used to find out the value of x.

For example:
Range the highest level WI value = 1200 WI
Span check gas WI value = 1190 WI
Eo = 4 mV Ec = 19 mV

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

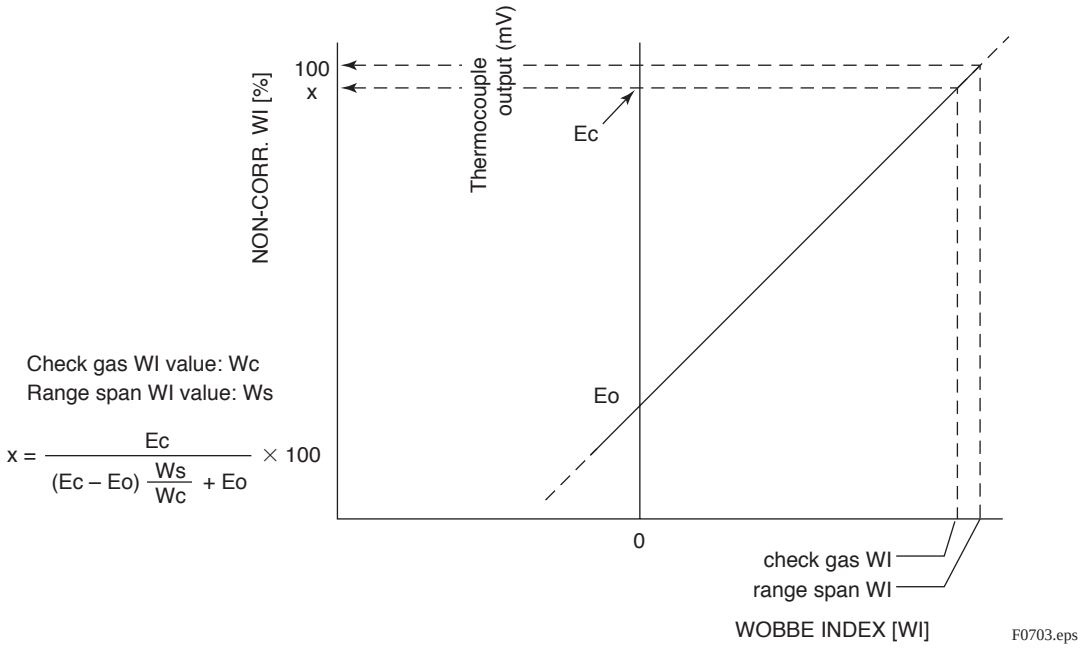

Figure 7.1 How to Find Out x When Pre-heating Circuit Exists

7.3 Calibration of the Computing Station

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

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

In case of existing the pre-heating, the bias adjustment is carried out firstly.

7.3.1 Bias Adjustment

This adjustment is carried out only when the pre-heating circuit exists.

a) Suspend the supply of the sample gas, and introduce the air to the gas line.
b) Set the “SAFE EV” switch of the detector to “RELEASE”.
c) Refer to Figure 5.19. Set the computing station to Input/Output status display. After the indication Y4 (BIAS CHECK) become stable (20 to 30 minutes), change to parameter setting display. Adjust the P03 (BIAS) Potentio of the computing station so that the (Y4) value will become [0.0]

by the data setting key,

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

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

7.3.2 Zero Span Adjustment

a) Introduce the zero check gas and ignite.
b) Set the computing station to Input/Output status display. Adjust, with the “P01” potentiometer of the operator, to be the “Y2” or “Y1” (WI value or the calorific value of the check gas).
c) Change from zero check gas to span check gas, when, if let the span check gas start flowing before the zero check gas valve is not completely closed, the burner is not extinguished. Same in the case of the other way. If burner is extinguished, please ignite.
d) Set the indication of the computing station to Input/Output status display. After the indication “Y2” or “Y1” becomes stable, adjust, with the “P02” potentiometer of the operator, to become WI value or the calorific value of the check gas. (Display P02, adjust by the data setting key). (Confirm the result of the adjustment after displaying it as WI or CAL).
e) Repeat 2 or 3 times the above adjustments.
f) When complete the adjustment suspend the supply of the check gas.

7.3.3 Other Adjustment

The adjustment of P04 (A-CORR, RATE), P06 (G-CORR, RATE) and P05 (A-TIME), P07 (G-TIME) is usually unnecessary.

(Reserve the record of the data in the initial stage). But when replacing the thermocouple, the regular adjustment for the specific characteristic is performed, but such adjustment, please consult to our service personnel.

7.4 Calibration of the Density Meter

Regarding GD400 Gas density meter, please refer to attached Instruction Manual IM 11T3B1-01E.

8. Maintenance

8.1 Daily Check

8.1.1 Air, Gas Differential Pressure Adjustment

Confirm and adjust the air or gas differential pressure to the “500”. The way how to adjust shall be carried out according to the paragraph 6.1.

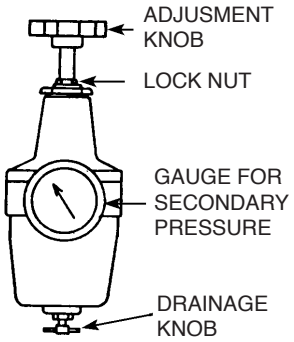

Figure 8.1 Filter Regulator

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

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

8.1.3 Take Out the Drain from the Filter Regulator

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

8.2 Regular Check

8.2.1 Cleaning of the Gas Orifice Plate and Replacement of O-ring

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

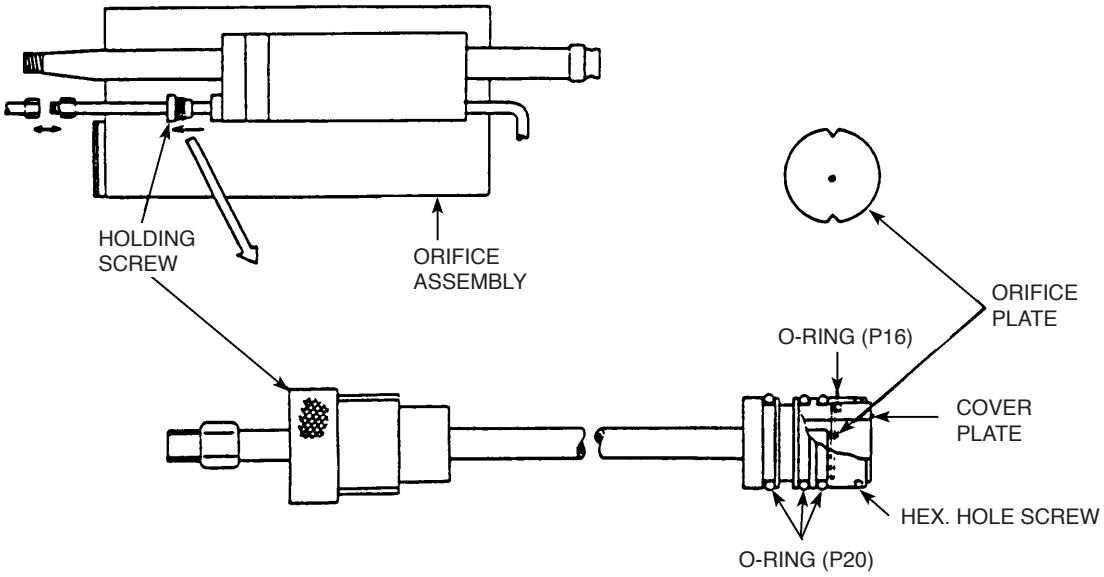

Figure 8.2 Gas Orifice System

a) Suspend the supply of the sample gas, then blow the gas line with the air.
b) Remove the crotchet joint.
c) Turn the holding screw and take out.
d) Pull out slowly to the direction as shown on Figure 8.2.
e) Loosen the set screw by using the hexagonal wrench attached there-to and take out the orifice plate together with the cover plate.
f) For the cleaning please use something like a supersonic cleaner and never insert into the orifice holes anthing like a stick or rod.
g) When the O-rings are worn out replace them with the spare parts.
h) When the cleaning and replacement completed, assemble the parts according to the order contrary to above mentioned.

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

8.2.2 Temperature Setting of the Orifice Constant Temperature Chamber

Measure the terminal “TEMP CHECK” of the orifice assembly by using digital voltmeter and the resistance value is 3.6 to 4.2 kΩ that means the temperature setting was correct.

When the resistance value is out of the above range, remove the cover of the temperature controller of the orifice assembly and adjust the valve by turning the potentiometer R13 on the base plate.

Adjustment shall be carried out firstly measure the resistance value by using digital voltmeter, then, turn the potentiometer slowly confirming the indication being kept stable. If turn the potentiometer to the left, the resistance value becomes smaller and the setting temperature higher.

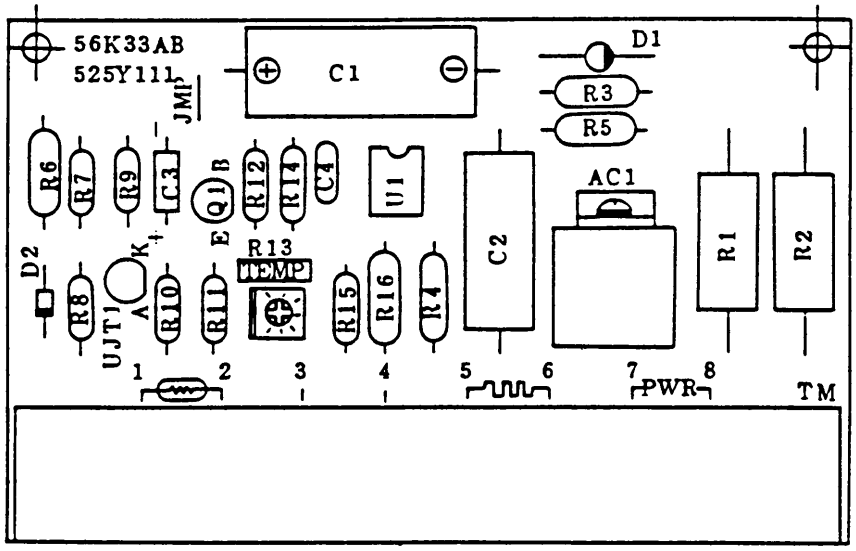

Figure 8.3 Temperature Controller of the Orifice Constant Temperature Chamber Print Circuit Board.

8.2.3 Fulflo Filter (For Steel Mill Use)

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

a) Turn the nut and remove the cover.
b) Pull out the element and clean or replace.
c) Assembly is carried out in contrary order to above.
d) When the packing or gasket is worn out, replace it.

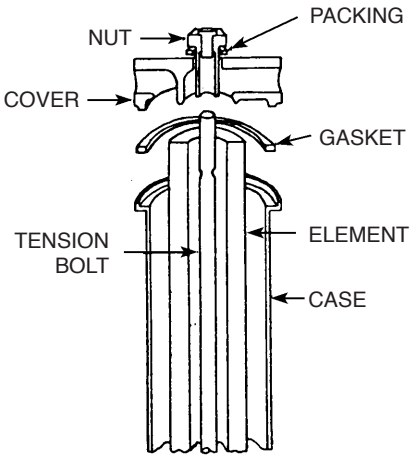

Figure 8.4 Fulflo Filter

8.2.4 Line Filter (For Town Gas Use)

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

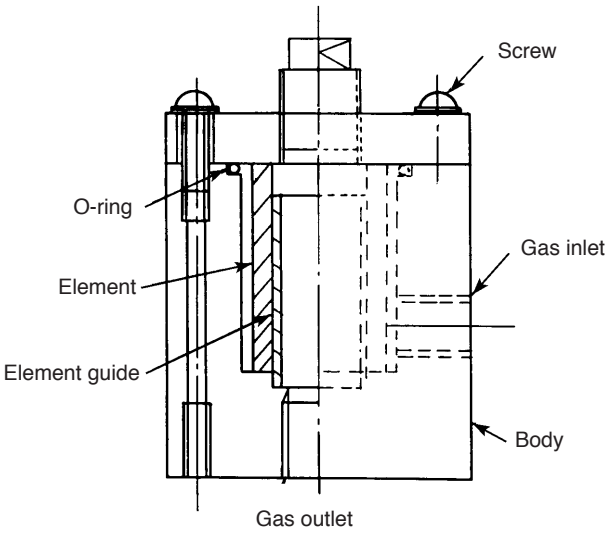

Figure 8.5 Line Filter

8.2.5 Pressure Regulating Pot or Water Washing Bubbler

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

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

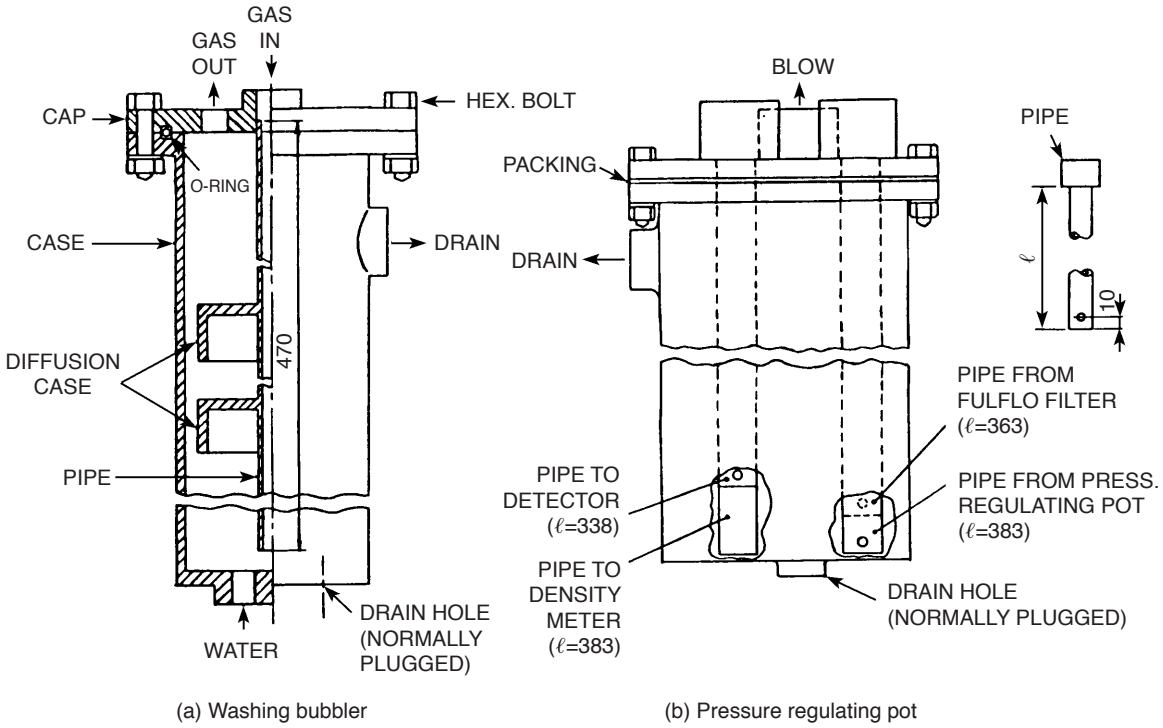

Figure 8.6 Washing Bubbler and Pressure Regulating Pot

8.2.6 Dehumidifier (For Steel Mill Use)

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

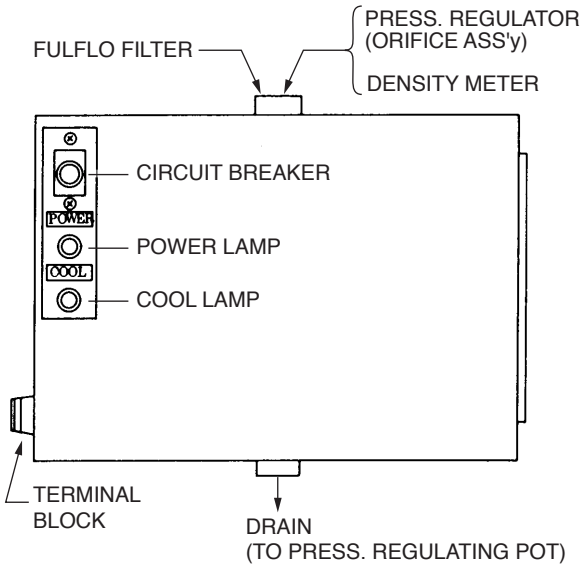

Figure 8.7 Dehumidifier

8.2.7 Density Meter

Regarding GD400, Gas density meter, please refer to attached Instruction Manual IM 11T3B1-01E.

8.3 Check at the Regular Service

8.3.1 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 8.13 - (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 8.13 - (B), flickering and when the secondary air is not sufficient, the flame outline is the same.
- When the primary air is not sufficient the color of the flame is clear yellow and sometimes soots come out.
- When there is any blockade or leakage is the air line, the flame becomes like the shape as shown in Figure 8.13 - (D).

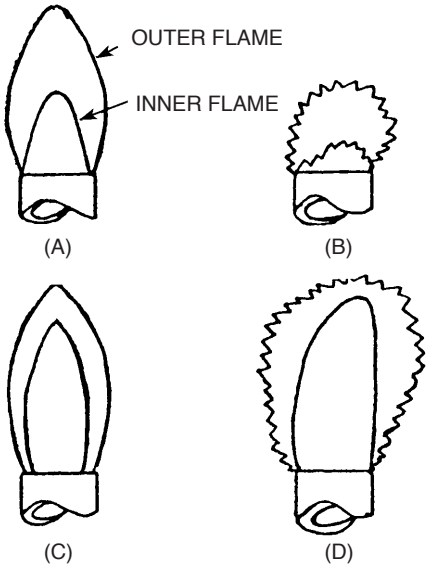

Figure 8.13 Burner Flames

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

a) Remove the screw (4 pcs) fixing the outside pipe, then remove the connectors to the terminal of the hot junction detecting point.
b) Disassemble the outside pipe and take out the jet plate by pulling upward. (The direction to pull for removal is shown in Figure 8.14 by the sign of arrow).
c) Insert the attached mirror herewith into the ventilator.
d) When ignite, the flame reflected on the above mirror can be observed from slanting upside.
e) Assembly shall be conducted in the contrary way to the above procedures.

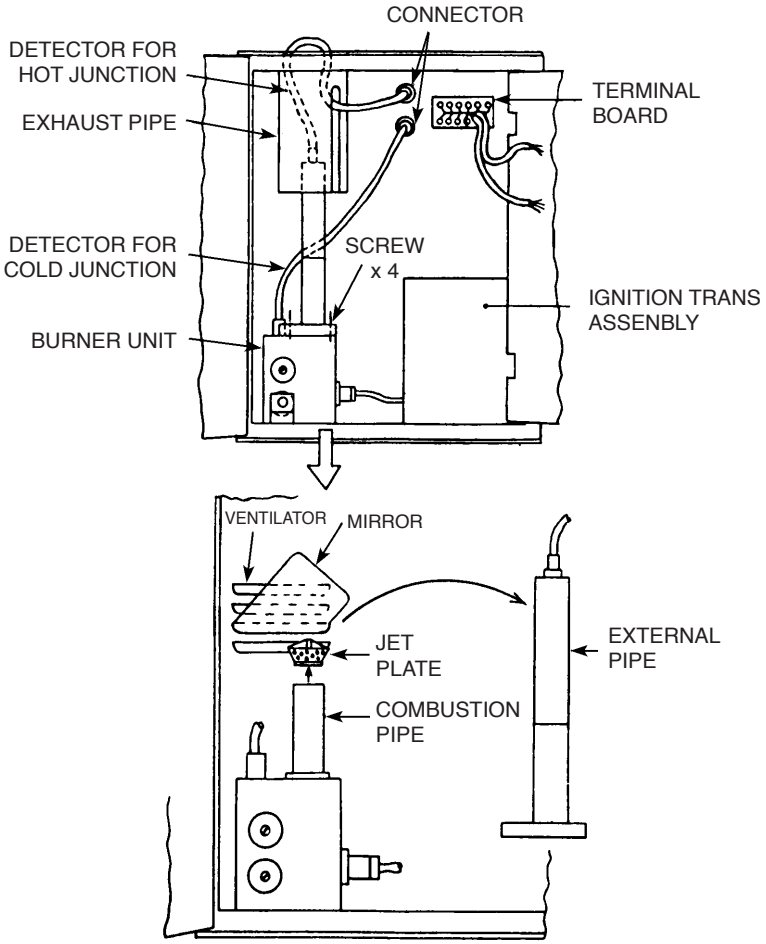

Figure 8.14 Flame Checking

8.3.2 Zero Adjustment of the Differential Pressure Transmitter

Please adjust according to the procedure described in paragraph 6.1.4.

8.3.3 Others

If necessary, conduct each regular check mentioned in paragraph 8.2.

9. Troubleshooting

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

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

9.1 Gas Sampling Pressure Regulating Section

Please refer to the flow sheet Figure 5.2, 5.3 and 5.4.

9.1.1 For Town Gas Use

1) Check if any blockade or leakage exist in the sampling line up to the panel.
   → If any blockade found, blow the sampling line by air.
2) Check the filter element of the line filter.
   → According to the paragraph 8.2.4, clean or replace.
3) If above is normal, the pressure gauge (3-2) indicates 8 to 18 kPa.
   → When the pump is attached and if the indication does not indicate normal value even after open V-5 fully, the decrease of the suction ability of the pump might be a cause of trouble.
   → If the pressure regulator is attached, and the indication of the pressure gauge (3-2) does not change even after the operation of the pressure regulator (3-8), the pressure regulator may be defective.
4) When introducing the check gas, confirm the indication of the flowmeter (3-3) is about 10 l/min. In case of only indication check, its adjustment of approximately 2 to 3 l/min is permissible.
   → If the flow rate can not be satisfactorily set by the pressure regulator (4-1), it is due to the defect of the pressure regulator.
5) Confirm the pressure gauge (3-5) indicate approx. 3 kPa.
   → If the pressure cannot be satisfactorily set by the pressure regulator (3-4), it may be defective.
6) When the density meter is attached, confirm the indication of the flowmeter (5-4) is 0.5 to 1 l/min.
   → If no indication appeared on the flowmeter, the trouble is considered to be due to the clogging of the gas pipe inside the density meter.
7) Confirm the indication of the computing station is about “500”, after set the indication to “X3”.
   → When the differential pressure setting is impossible with the pressure regulator (3-6), it is due to the defect of the pressure regulator.
8) For all gas lines, check any leakage at each joint connection.

9.1.2 For Steel Mill Use

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

1) Check if the water level of the drain pot equipped outside the panel is higher than 15 kPa.
2) Check for any findings of clogging, accumulation of drain or leakage in the pipings, between the probe and the fulflo filter equipped outside.
   →When found any clogging, blow by the air.
   →When the piping has any U bending, the drain is likely to be accumulated there, so in such case give a slope to the piping.
3) Check the element of the outside fulflo filter.
   →When found clogged, clean or replace as according to the paragraph 8.2.3.
4) Check the indication of the pressure gauge (3-1) is approx. 6 kPa.
   →If there is no water accumulated in the washing bubbler, no indication appeared on the pressure gauge, in such case please supply water to the washing bubbler.
   →If the pump is attached, and its suction ability decreased, the case might happen that the pressure gauge does not indicate the normal value after the adjustment by only V-2 and V-3.
5) Check the indication of the flowmeter (4-2) is approx. 10 l/min.
   →When cannot be adjusted by the pressure regulator (4-1), it is likely that the pressure regulator is defective.
6) Check the element of the fulflo filter (3-3).
   →If it is clogged, clean or replace as according to the paragraph 8.2.3.
7) Check the water level of the pressure regulating pot.
   →If necessary, supply water or clean.
8) Check if the bubbles are coming out 3 - 6 pcs/sec from the pipe A of the pressure regulating pot.
   →Even after using V-11, V-12 fail to adjust, clean the piping inside the dehumidifier as according to the paragraph 8.2.6.
   Please note no bubbles are coming out, however, in case of low calorie gas.
9) When the density meter is attached, check if the indication of the flowmeter (5-3) is 0.5 to 1 l/min.
10) Check if the indication of the computing station is “500” when setting the indication of “X3”.
    →When the adjustment is impossible even by using the pressure regulator (3-6), it is likely the pressure regulator is defective.
11) For all gas lines, check the leakage at each joint connection.

9.2 Air Pressure Adjustment Section

1) Check the secondary pressure gauge of the filter regulator (2-1) is about 200 kPa
   →When the adjustment of the filter regulator is impossible even when the primary pressure of the instrument air is normal, it is likely the filter regulator is defective.
2) Check the pressure gauge (2-3) indicates approx. 20 kPa.
   →We cannot adjust it when even using the pressure regulator (2-2), it is likely the pressure regulator is defective.
3) If the above are found normal, we can adjust by using V-16 the differential air pressure to “500”.

9.3 Differential Pressure Converting Section

1) Check the gas orifice section of the orifice assembly.
   →When the orifice plate is contaminated clean it as according to the paragraph 8.2.1.
2) Check any leakage in the pressure transmission pipe of each differential pressure transmitter.
3) Check the temperature setting of orifice assembly.
   →When the resistance value is not 3.6 to 4.2 kΩ, please reset as according to the paragraph 8.2.2.

9.4 Signal Section

Measure the output of each components by using digital voltmeter.

1) Measure 2 (+) - 1 (-) on the terminal board of the detector.
   The normal output, when no pre-heating exist, approx. 0 to 20 mV is almost in proportion to 0 - (WI value of the highest level in the measuring range). If pre-heating exist, approx. 4 to 20 mV is almost in proportion to 0 - (the highest level WI value in the measuring range).

For example:

When the WI value of the highest level in the measuring range is 10000 WI, if the sample gas is 8000 WI, the output voltage is about 16 mV (when no preheating circuit).

In spite of both the gas pressure control section and the differential pressure being normal, the output is widely different, it is likely to be some blockade in the air flow distribution line of the burner unit.

If such case happens, please check the burner flame as mentioned in paragraph 8.3.1.

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

2) Measure 3 (+) - 4 (-) on the terminal board of the detector, which normal output, when preheating circuit does not exist, is 1 to 5 V almost in proportion to 0 - (The highest level WI value in the measurement range). If pre-heating circuit exist, approx. 1.8 to 5 V is almost in proportion to 0 - (The highest level of WI value in the measurement range).
3) Measure 5 (+) - 3 (-) on the terminal board of the distributor. The normal value is 24 V ±0.5%.
   →If difficult to obtain the normal value, it is due to the defect of the distributor.
4) Measure 1 (+) - 2 (-) on the terminal board of the distributor. The normal value is 3 V ±0.2 V.
   →If the measured value is widely different in spite of the air pressure control section being normal, it is likely the differential pressure transmitter is defective.
5) Measure 1 (+) - 2 (-) on the terminal board of the distributor. The normal value is 3 V ±0.2 V.
   →If the measured value varied very much in spite of the gas pressure control section being normal, it is likely the differential pressure transmitter considered to be defective.
6) When the density meter is attached, measure 1 (+) - 2 (-) of the terminal of the converter.
   Regarding GD400, Gas density meter, please refer to attached Instruction Manual IM 11T3B1-01E.

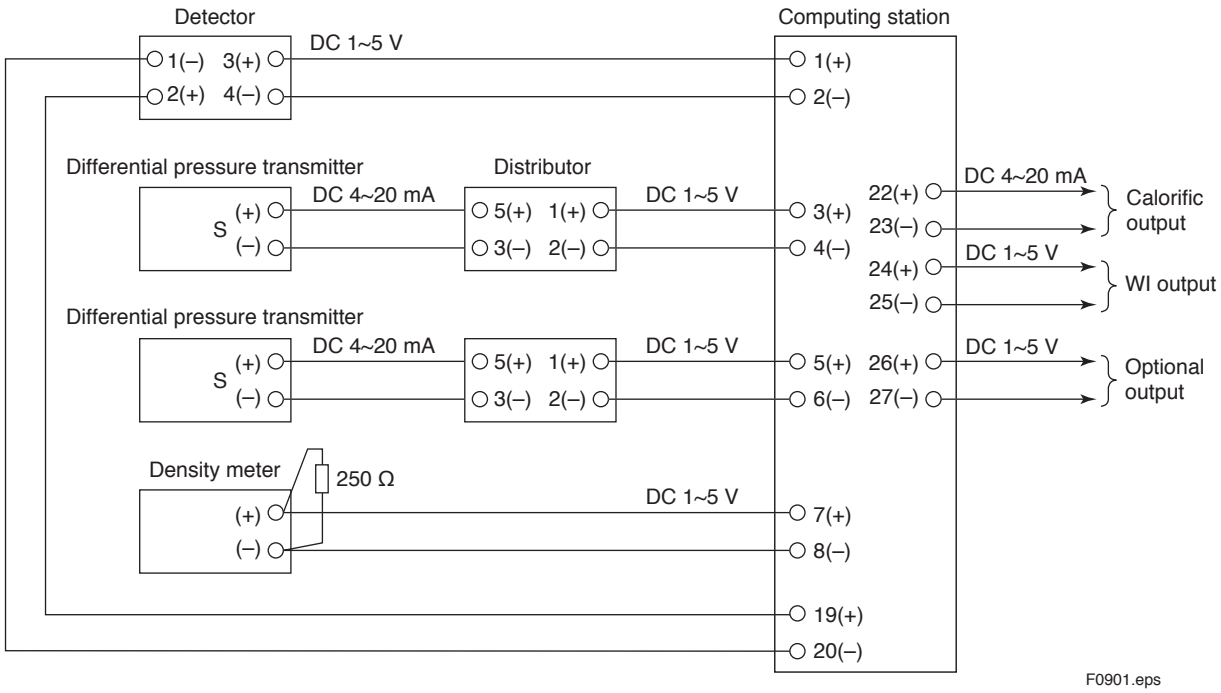

Figure 9.1 Signal Circuit Diagram

9.5 Computing Station

If the value of the above 9.1 - 9.4 is all normal, each input of the computing station shows the following normal values in the table.

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

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

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

1) Lighting of the alarm lamp. (Yellow color)
It lights when the input or output signal is cut off. But in this case, the computing inside the station is kept working. Change to Alarm display (refer to Figure 5.17), and examine the cause of the alarm lamp lighting.
2) Lighting of the fail display lamp (Red color)
The lighting of the fail lamp means an occurence of an abnormal trouble produced inside the instrument. When a fail occures, the analog output and status output reserve the value just before the occurrence of the failure. Such preservation power has a tendencying of decreasing gradually along with the lopse of the time.
Also, the alarm lamp lights when the operation of the pressure adjustment for the gas, air line, but the lighting when other than under the time of measurement is not abnormal.

9.6 Other Troubleshooting

Please check and deal with measures mentioned in paragraph 9.1 to 9.6. As to the trouble not mentioned in this manual please contact to our service personnel. The replacement parts shall be ready for your service as per details mentioned in the “Replacement parts list” in next paragraph 10.

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10. Replacement Parts

10.1 Replacement Parts for Each Component

10.1.1 Detector E7023AB (66K46A)

a) Burner unit E7023BU (66K10)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Hot Junction Detection Terminal	1	E7023BV	62K12	
2	Cold Junction Detection Terminal	1	E7023DR	62K13	
3	Burner Tip Assembly	1	E7023DL	9K30C	
4	O-Ring	1	Y9132XB	-	Viton
5	O-Ring	1	Y9104XB	-	Viton
6	O-Ring	1	Y9119XB	-	Viton
7	O-Ring	1	Y9120XB	-	Viton
8	O-Ring	1	Y9107XB	-	Viton
9	O-Ring	2	Y9110XB	-	Viton
10	Coil Spring	2	E7023DQ	262Y37	
11	Spring	1	E7023DZ	262Y10	
12	Receptacle	1	G7011JC		

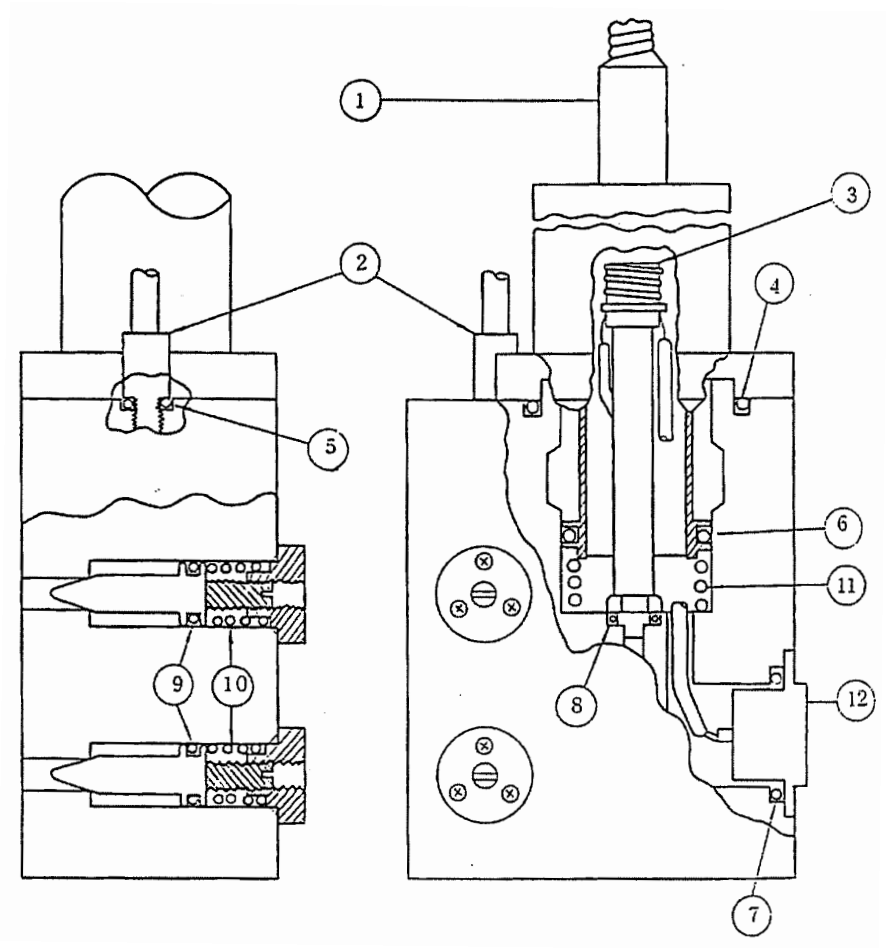

Figure 10.1 Burner Unit

b) Print circuit board assembly E7023BK (59K62A)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Printed Circuit Board Assembly	1	E7023BK	59K62A	-
2	Relay	1	G7210MR	-	MY2, DC24V OMRON
3	Fuse	1	A1192EF	-	3A
4	Fuse	1	G7012EF	-	0.5A

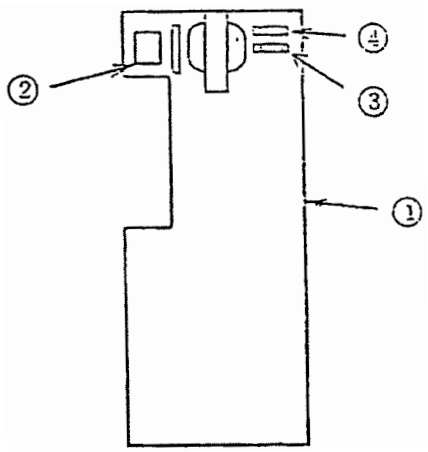

Figure 10.2 Print Circuit Board Assembly

c) Ignition transformer assembly E7023EA (57K29)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Constant Votage Power Supply Converter	1	G7318MT	573G03	
2	Relay	1	G7215MR	-	

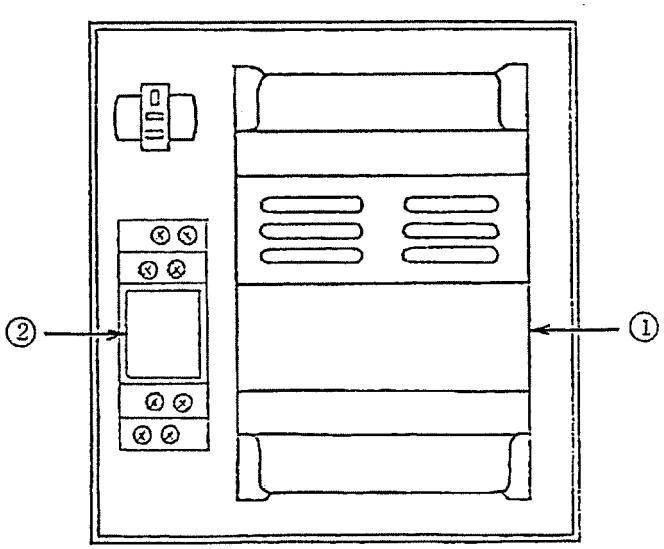

Figure 10.3 Ignition Trans Assembly

d) Front panel assembly E7023BH (12K70)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Meter	1	G7028EA	761G36A	
2	L.E.D	4	G7012PE	-	
3	Toggle Switch	1	G7318ST	-	
4	Toggle Switch	2	G7303ST	-	
5	Push Button Switch	1	G7004SB	-	
6	Potentiometer	1	G7210RV	-	2 kΩ
7	Potentiometer	1	G7209RV	-	20 kΩ

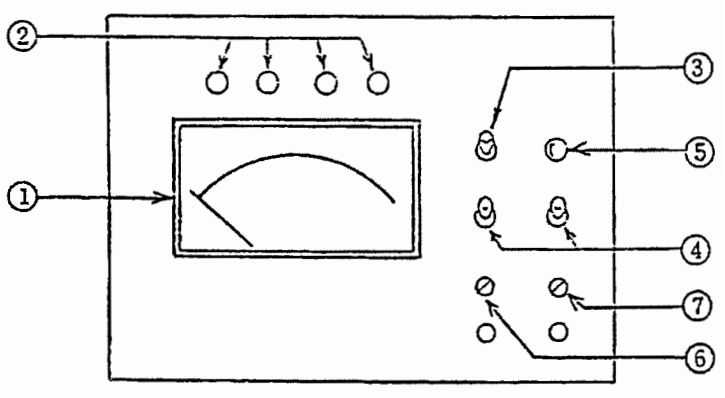

Figure 10.4 Front Panel Assembly

e) Others

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	O-ring	2	Y9110XB	-	Viton
2	Packing	1	E7023FB	431Y68	

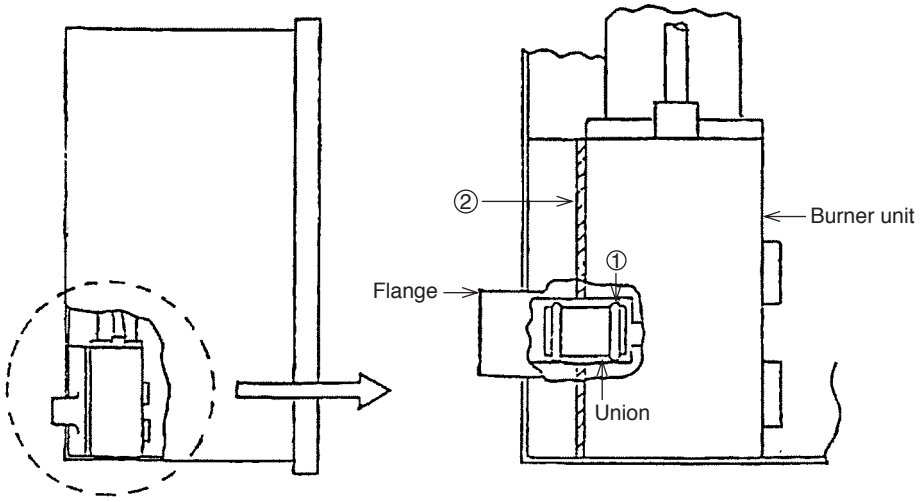

Figure 10.5 Flange Section of the Detector Transmitter

10.1.2 Orifice Assembly E7023NA

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Heater Plate	2	G7003RH	641G13	
2	Thermostat	1	E7023NS	-	
3	Thermostat	1	E7023NT	-	
4	Neon Lamp	1	G7007EP	-	
5	Temperature Detect Thermistor	2	E7023GY	66K44	
6	Orifice	1	E7023GH	682Y12	
7	Orifice Plate	1	*	482Y21A - I	
8	O-Ring	2	Y9105XB	-	Viton
9	O-Ring	1	Y9119XB	-	Viton
10	O-Ring	2	Y9133XB	-	Viton
11	O-Ring	1	Y9114XB	-	Viton
12	O-Ring	3	L9817MT	-	Viton

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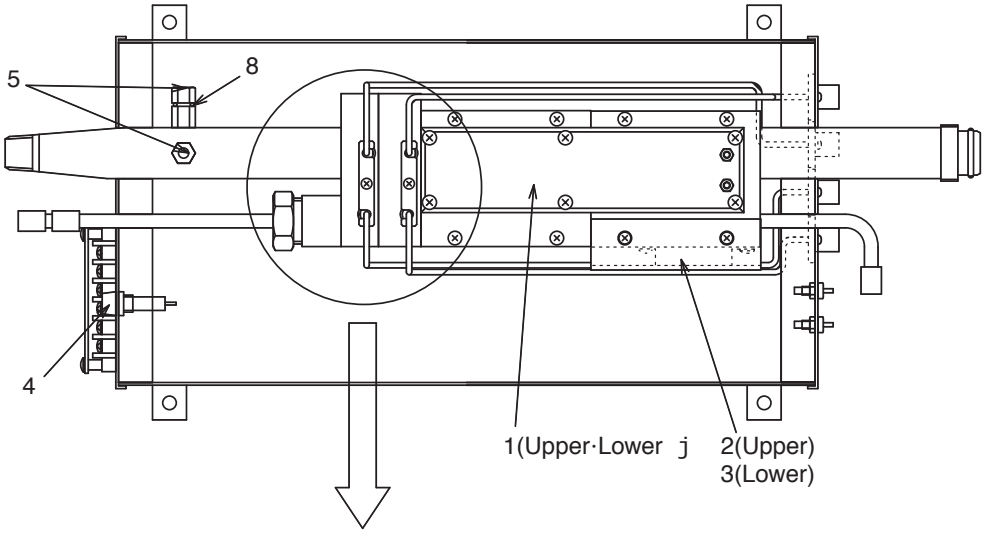

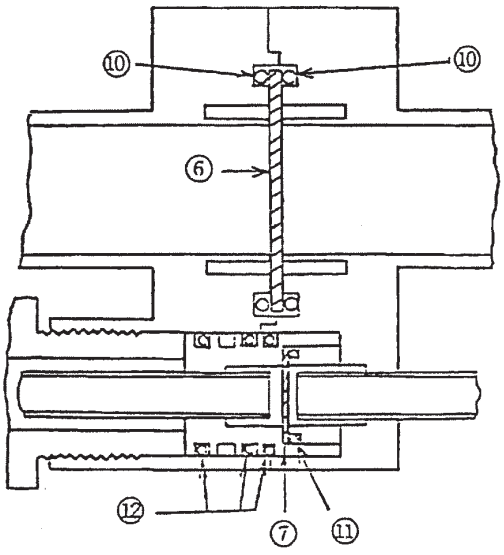

Orifice Hole (ϕ)	Part No.
0.35	G7025XJ
0.40	G7026XJ
0.45	G7027XJ
0.50	G7028XJ
0.55	G7029XJ
0.60	G7030XJ
0.65	G7031XJ
0.70	G7032XJ
0.75	G7033XJ
0.80	G7034XJ
0.85	G7035XJ
0.90	G7036XJ
1.0	G7037XJ
1.1	G7038XJ
1.2	G7039XJ
1.3	G7040XJ
1.4	G7041XJ
1.5	G7042XJ

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Figure 10.6 Orifice Assembly

10.1.3 Pre-heater E7023NG

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Sensor	1	E7023JM	-	Thermistor
2	Heater	1	E7023NR	64K13	
3	Packing	1	E7023JD	431Y70	
4	Temp. Controller Ass'y	1	E7023JL	56K27C	
5	Thermostat	1	E7023NU		

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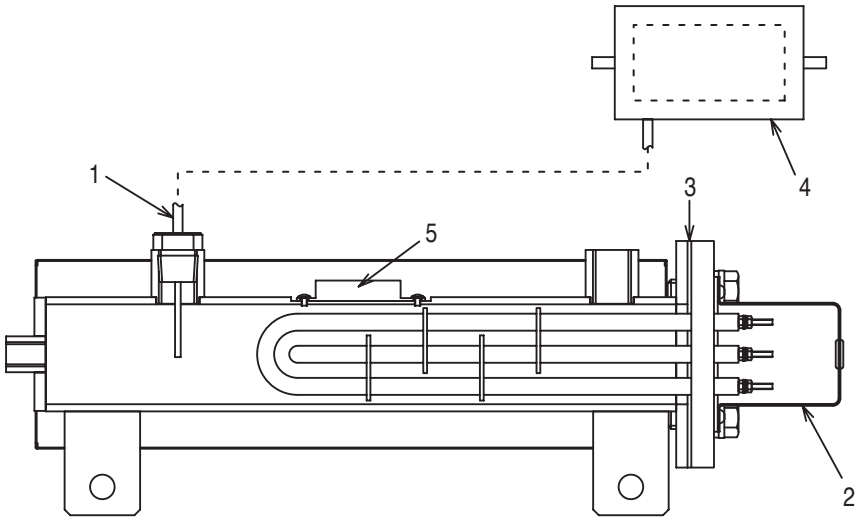

Figure 10.7 Pre-heater

10.1.4 Fulflo Filter

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Element	1	G7054XJ G7057XJ	-	10 μm 50 μm
2	Packing	1	G7086XL	-	
3	Packing	1		-	
4	Packing	1		-	
5	Gasket	1		-	
6	O-ring	1		-	

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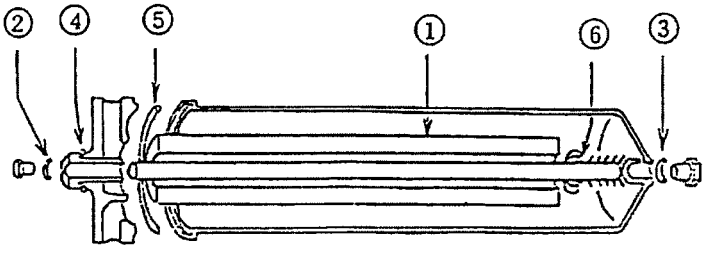

Figure 10.8 Fulflo Filter

10.1.5 Line Filter H7800EC (47K42A)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Element	1	G7005XJ	471G64C	
2	O-Ring	1	Y9116XB	G9303SR	Viton

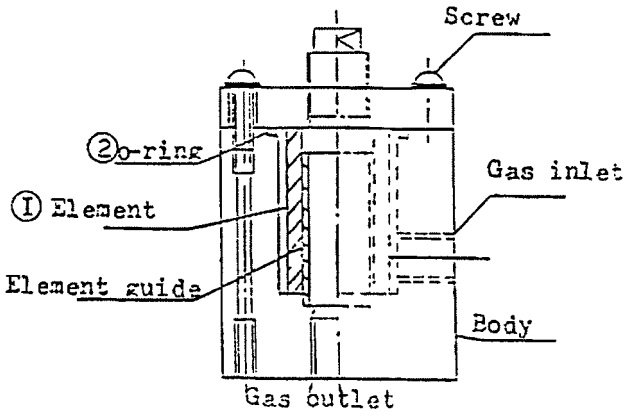

Figure 10.9 Line Filter

10.1.6 Switch Box H7800HV (14K25A)

Name	Q'ty	Part No.	Old Part No.	Remarks
Toggle Switch	1	G7321ST	-	
Fuse	1	G7022EF	-	3A, for Detector
Fuse	1	G7022EF	-	3A, for Pump
Fuse	1	G7022EF	-	3A, for Dehumidifier
Fuse	1	G7013EF	-	1A, for Comp. Station
Fuse	1	G7013EF	-	1A, for Distributor
Fuse (TIME LAG)	1	G7009EF	-	2A, for Density Meter

10.1.7 Probe H7800HA, H7800HB, H7800HC (49K47)

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

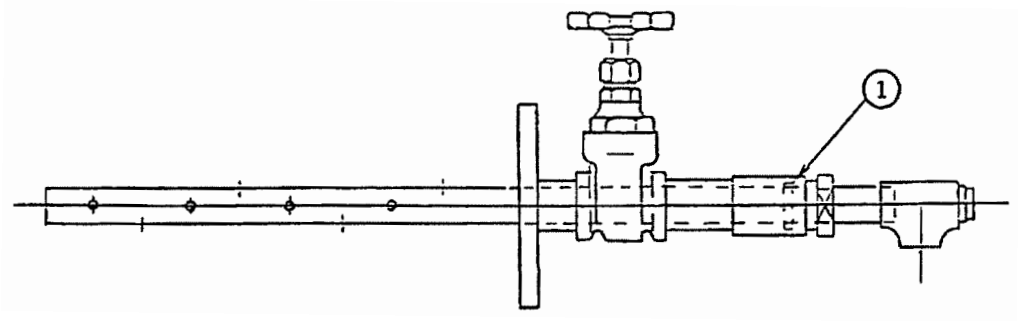

Figure 10.10 Probe

10.1.8 Temperature Controller for Orifice Ass'y E7023JE (56K27A)

No.	Name	Q'ty	Part No.	Old Part No.	Remarks
1	Controller Unit	1	E7023JE	56K27A	With Resistor 1 kΩ

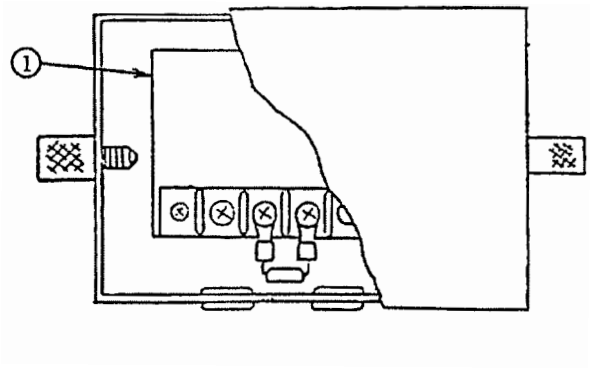

Figure 10.11 Temperature Controller for Orifice Assembly

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Revision Record

Manual Title : Model CM6G Gas Calorimeter
Manual Number : IM 11R2A1-02E

Edition	Date	Remark (s)
1st	**Dec. 1999**	**Newly published**
2nd	**Aug. 2007**	**All over revised**
3rd	**Nov. 2008**	**Revised with the change of style code *B**

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

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

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

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

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

Chapter 9
- Explanation about computing station operation is revised in subsection 9.1.1 (7) and 9.1.2 (10).
- Range of flow rate is expanded (0.5-1 l/min) in subsection 9.1.1 (6) and 9.1.2 (9).
- Description about "indication check" is added to 9.1.1 (4).
- Subsection 9.1.2: Unit "Pa" is corrected to "kPa".
- Section 9.4: In item 2), The value "200" is corrected to "20"
- Section 9.4: In Figure 9.1, alphabet marks of the computing station terminal are corrected to number marks. No.19(+) and No.20(-) are written in the station terminal, and connected to No.1 and No.2 of the detector, respectively. Terminal Numbers of distoributor are revised in the body and Figure 9.1.
- Section 9.5: Item 1) is revised. 2) is deleted. 3) is partially changed and printed as item 2).

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