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# Instruction Manual

EXA OXY

## In-Situ Type Zirconia Oxygen Analyzer

(Version 2.00)

IM 11M6A2 - 01E

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# INTRODUCTION

The EXAOXY In-Situ Type Zirconia Oxygen Analyzer has been developed for combustion control. This analyzer basically consists of a detector and a converter. The detector comes in one of four styles which can be selected based upon your application.

Optional accessories are also available to improve measurements and automate calibration. An optimal control system can be realized if the proper types of equipment are selected.

This instruction manual refers to almost all of the equipment related to the EXAOXY. You may skip the sections on the equipment which is not included in your system.

Product line included in this manual and described content for each

Model	Name	Description in the manual				
		Specifi- cations	Install- ation	Opera- tion	Mainte- nance	CMPL
ZO21D - L	Standard detector	○	○	○	○	○
ZO21D - H	High-temperature detector	○	○	○	○	○
ZA8C	Converter (Style B)	○	○	○	○	○
ZO21V	Probe supporter	○	○			
ZO21R - L	Probe protector	○	○			
ZO21P - H	High-temperature probe adapter	○	○			○
ZA8F	Flow setting unit	○	○	○		
ZA8H	Flow setting unit	○	○	○	○	
ZA8T	Solenoid valve unit	○	○			
—	High-temperature auxiliary ejector (Part No.: E7046EC, EN)	○	○			○
—	Calibration gas unit case (Part No. E7044KF)	○	○			
—	Check valve (Part No.: E7042VR)	○	○			
—	Dust elimination filter for the detector (Part. No.: E7042UQ)	○	○		○	
ZO21S	Standard gas unit	○		○	○	○

This manual is divided into twelve chapters as follows :

Chapter	Contents	Work item		
		Install- ation	Opera- tion	Mainte- nance
1. General	Gives examples of system configuration.	○	△	○
2. Specifications	Shows external views of equipment together with standard specifications and model codes or part	◎	○	○
3. Installation	Illustrates installation procedure for each type of equipment.	◎		△
4. Piping	Provides piping diagrams for four standard system configurations.	◎		△
5. Wiring	Wiring principles are explained according to the application.	◎		△
6. Names and Functions of Components	Describes the main components of the system.	△	○	○
7. Operation	Describes the operating procedure.		◎	△
8. Converter Key Operation	Details the converter key operation.		○	△
9. Calibration	Describes the calibration procedure required in the course of operation.		○	△
10. Check and Maintenance	Items to be checked are listed along with a description of the replacement procedure for damaged parts.		○	◎
11. Troubleshooting	This chapter describes measures to be taken when an abnormal condition occurs.		△	◎
CMPL (Parts List)	A list of replacement parts is given for each type of equipment.		△	○

◎ : Items which should be read through before starting operation.

○ : Items which should be read before operation and during operation as required.

△ : Items to be read as required.

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# 1. GENERAL

The EXAOXY In-Situ Type Zirconia Oxygen Analyzer is used to monitor and control the oxygen concentration in combustion gases in boilers and other industrial furnaces.

Four types of detectors are available for the analyzer: a standard detector, a detector equipped with a probe supporter, a detector equipped with a probe protector, and a high-temperature detector which can be used in combustion gases at temperatures exceeding 600°C. Choose the detector which best suits your use conditions so that an optimal combustion control system can be obtained. The detector is attached, for example, on the wall of a flue.

The converter is equipped with various functions such as measurement and calculation functions, and maintenance functions, including a self-test as a standard function. Other optional functions are also available such as a digital communication function. Analyzer calibration can also be fully automated, using optional equipment such as a ZA8H flow setting unit.

Some examples of typical system configuration are illustrated below.

## 1.1 System Configuration

The system configuration should be determined by the conditions the system will be under. An example of this would be whether the calibration gas flow should be automated, or what safety measures should be taken toward the generation of combustion gases. The system configuration can be divided into four basic patterns as follows.

### 1.1.1 System 1

This is the simplest system consisting of a detector and converter. This system can be implemented for monitoring oxygen concentration in the combustion gases in the package boiler. No piping is required for the reference gas (air) which is fed in at the installation site. The handy ZO21S standard gas unit is used for calibration.

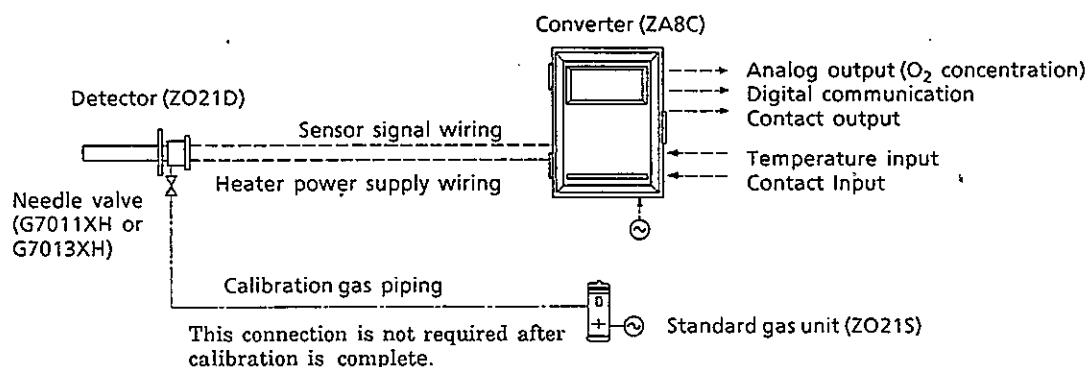


Figure 1.1 System 1

Zero gas from this unit and span gas (air) are sent to the detector through a tube which is connected during calibration. A needle (stop) valve should be connected to the

calibration gas inlet of the detector. The valve should be fully closed unless calibration is in progress.

### 1.1.2 System 2

This system is for monitoring and controlling oxygen concentration in the combustion gases in a large-size boiler or heating furnace. Fresh (dry) air is used as the reference gas and the span gas for calibration. Zero gas is fed in from a cylinder during calibration. The gas flow is controlled by the ZA8F flow setting unit (for manual valve operation).

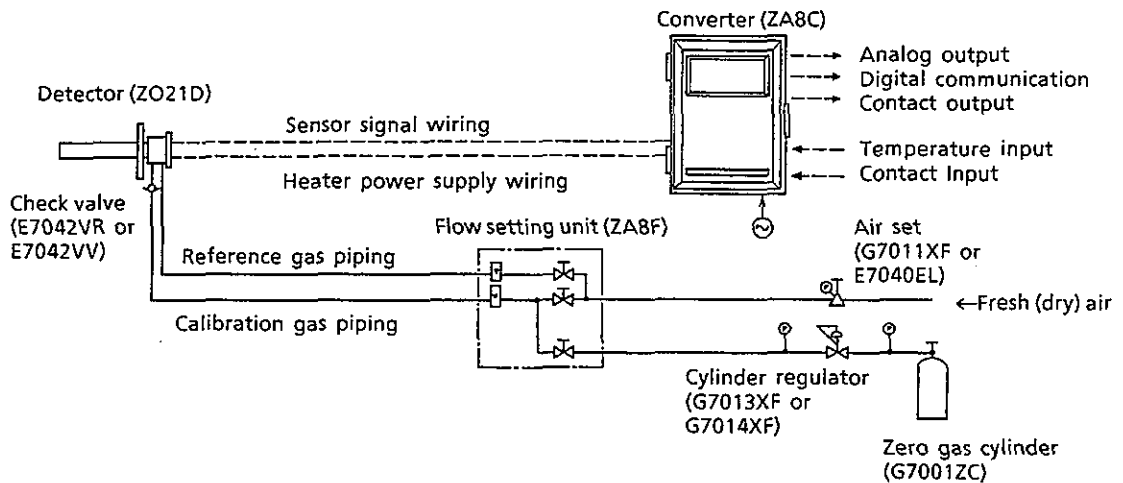


Figure 1.2 System 2

### 1.1.3 System 3

This system is similar to system 3, except that the calibration gas flow is automated using the ZA8H flow setting unit.

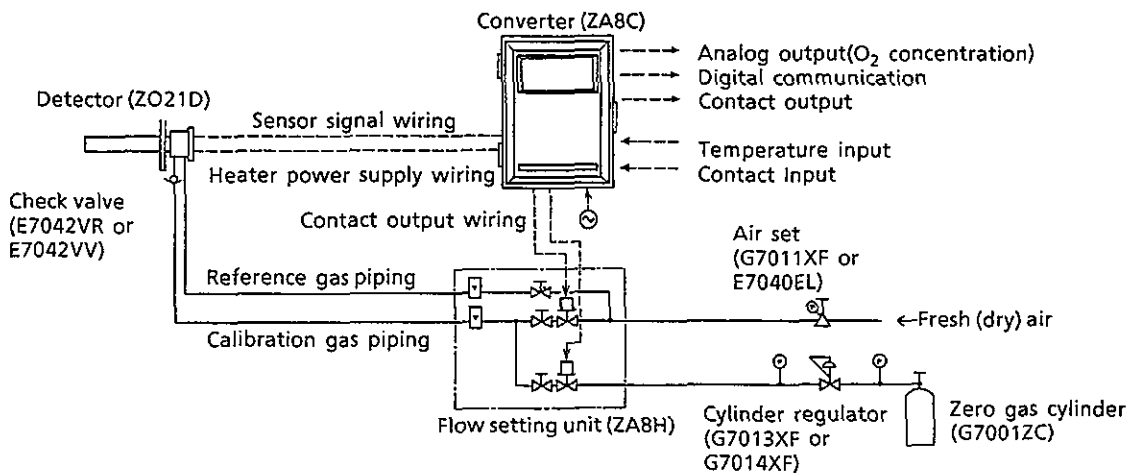


Figure 1.3 System 3

### 1.1.4 System 4

This system is also used for monitoring and controlling oxygen concentration in the combustion gases in large-size boilers and heating furnaces. The difference is that this system is equipped with a safety function to interrupt electric power to the detector heater, and to feed purge gas to the detector sensor when combustible gases are produced. The

flow setting unit ZA8H can be replaced by ZA8F as in system 2. In this case, the calibration gas is fed in by manual operation of the valve.

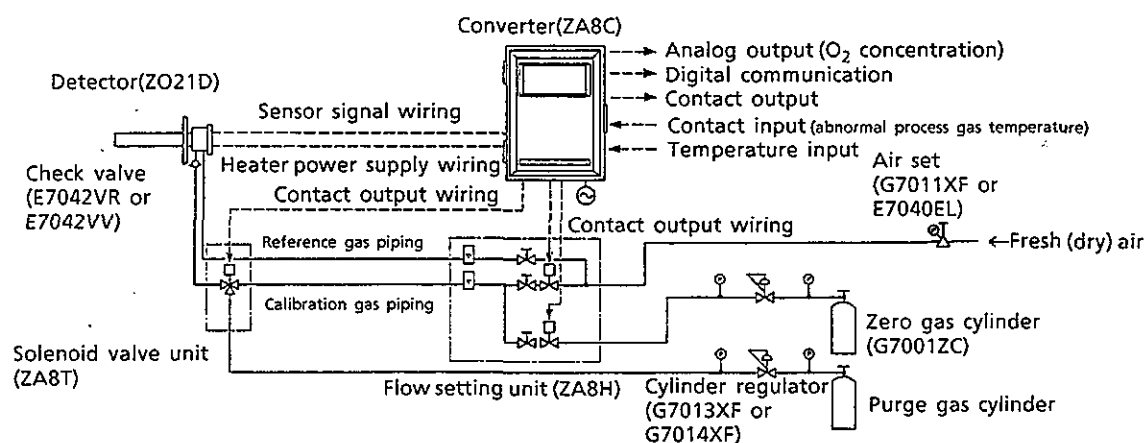


Figure 1.4 System 4

## 1.2 System Components

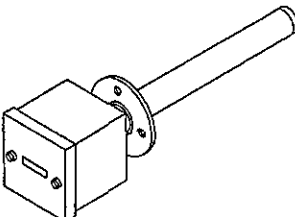
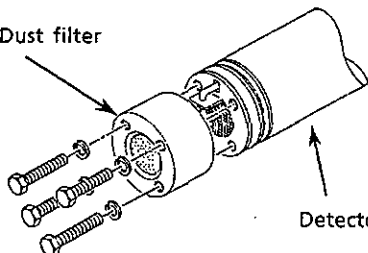
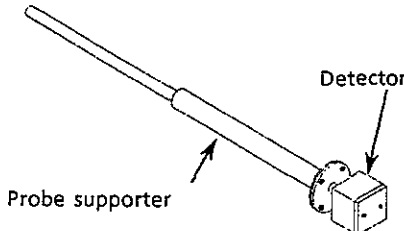
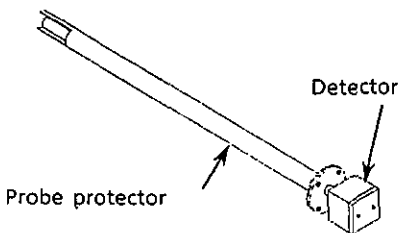
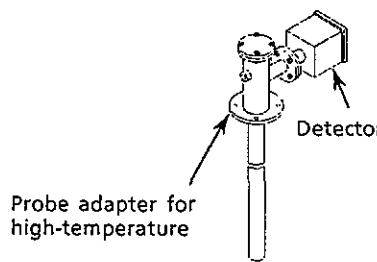
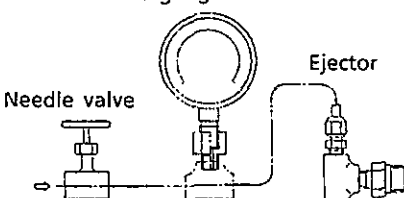
### 1.2.1 Names of the System Components

Model or Part No.	Name	System 1 Manual calibration-gas feed	System 2 Manual calibration-gas feed	System 3 Automatic calibration-gas feed	System 4	
					Manual feed	Auto- matic feed
(See Section 1.2.2)	Detector	○	○	○	○	○
ZA8C (Note 1)	Converter	○	○	○	○	○
ZO21S	Standard gas unit	○				
ZA8F	Flow setting unit		○		○	
ZA8H	Flow setting unit			○		○
G7011XH, G7013XH	Needle valve	○				
E7042VR, E7042VV	Check valve		○	○	○	○
G7011XF, E7040EL	Air set		○	○	○	○
(E7044KF)	(Calibration gas unit case) (Note 3)		(○)	(○)	(○)	(○)
G7001ZC	Zero gas cylinder		○	○	○	○
G7013XF, G7014FX	Zero gas cylinder regulator valve		○	○	○	○
ZA8T	Solenoid valve unit				○	○
(Note 2)	Purge gas cylinder				○	○
(Note 2)	Purge gas cylinder regulator valve				○	○

**Notes:**

- (1) A converter with an automatic calibration function is required for automatic flow of the calibration gas. The converter used in system 4 should be equipped with a contact input processing function.
- (2) The same type of cylinder can be used for zero gas.
- (3) The calibration gas unit case may be dispensed with depending on the conditions.

## 1.2.2 Detectors and Accessories

● Standard detector (temperature: 0 to 600°C)		Accessories (if required)
Standard detector	Model	Dust elimination filter for the detector Part No. : E7042UQ
	ZO21D-L	
	Mounting	
Vertical or horizontal when inserted 0.4 to 2 m. Vertical when inserted 3 m.		
Applications: Boilers, Heating furnaces		
Detector with a probe supporter	Model	
	ZO21D-L and ZO21V	
	Mounting	
Vertical or horizontal (when inserted 3 m)		
Application: Boilers, Heating furnaces		
Detector with a probe protector	Model	
	ZO21D-L and ZO21R-L	
	Mounting	
Vertical or horizontal (when inserted 1 m to 2 m)		
Application: Cement kiln Powdered coal boiler with gas flow over 10 m/s		
● High-temperature detector (temperature: 0 to 1400°C)		Accessories (if required)
	Model	Auxiliary ejector Part No. : E7046EC or E7046EN
	ZO21D-H and ZO21P-H	
	Mounting	
(Probe adapter should be attached) vertical A SUS probe can also be attached horizontally.		
Application: Heating furnaces		

## 2. Specifications

This chapter describes the specifications for the following:

ZO21D-L	Standard detector	(See Section 2.2.1)
ZO21V	Probe supporter	(See Section 2.2.2)
ZO21R-L	Probe protector	(See Section 2.2.3)
ZO21D-H	High-temperature	(See Section 2.3.1)
ZO21P-H	High-temperature probe adapter	(See Section 2.3.2)
ZA8C	Converter	(See Section 2.4)
ZA8F	Flow setting unit	(See Section 2.5.1)
ZA8H	Flow setting unit	(See Section 2.5.2)
ZO21S	Standard gas unit	(See Section 2.6)
ZA8T	Solenoid valve unit	(See Section 2.7)

### 2.1 General Specifications

#### 2.1.1 Standard Specifications

Object to be measured: Oxygen concentration in exhaust gases from combustion,  
and mixed gases (except combustible gases)

Measurement method: Zirconia method

Measurement range: Reading: 0.0 to 100 vol% O<sub>2</sub> (in three digits)

Output: 0 to 5 — 100 vol% O<sub>2</sub> (can be set in intervals of 1 vol% O<sub>2</sub>)

Warm-up time: About 10 minutes

Wiring between detector and the converter:

The electrical resistance of the conductor should be 10  $\Omega$  or less. (Up to  
about 300 m for a 1.25 mm<sup>2</sup> cable core)

Power source: 100, 110, 115, 220 or 240 V AC (−15%, +10%) 50/60 Hz

Power consumption: Approx. 80 VA (for ordinary use)

Maximum 270 VA

#### 2.1.2 Features

Repeatability:  $\pm 0.5\%$  full scale

Linearity:  $\pm 1\%$  full scale (for a maximum range of 0 to 25 vol% O<sub>2</sub>)

Drift:  $\pm 2\%$  Full scale/month for the zero point and span

Response: 90% response within five seconds (measured from the time gas is switched  
on at the detector calibration gas inlet until the analog output signal  
starts to vary)

## 2.2 Standard Detector and Related Equipment

Standard detector ZO21D-L can be used by itself or in combination with probe supporter ZO21V (see Section 2.2.2) or in combination with probe protector ZO21R-L (see Section 2.2.3).

### 2.2.1 ZO21D-L Standard Detector

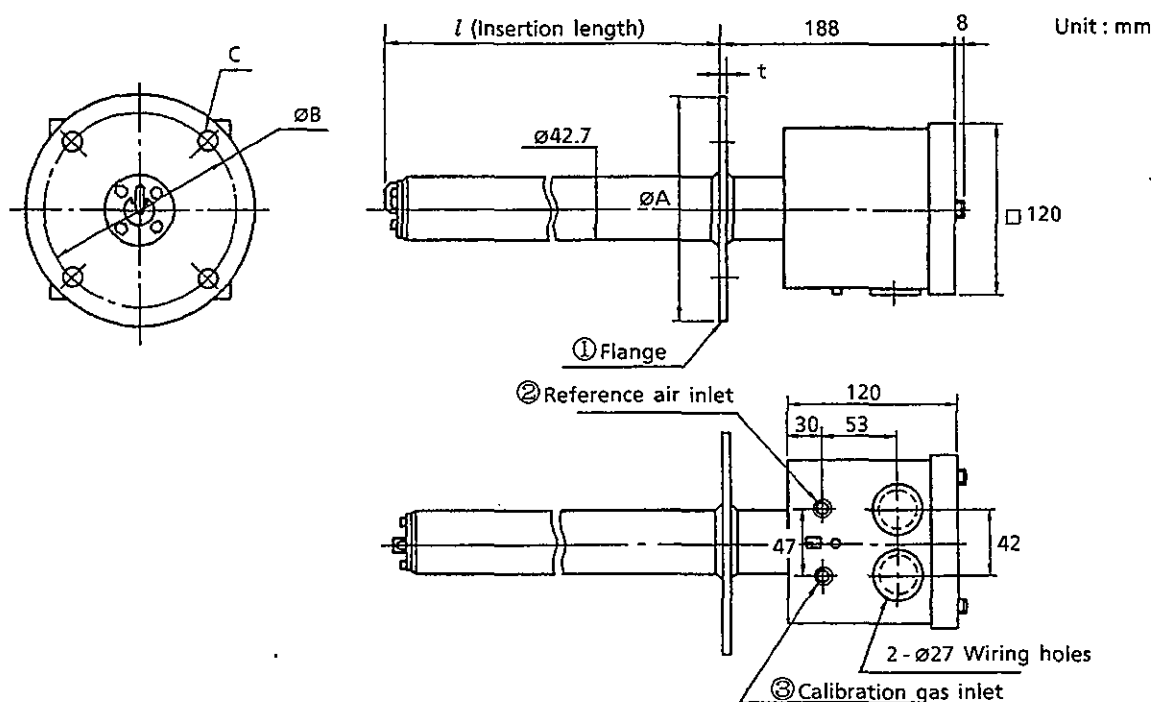
#### • Standard Specifications

Construction:	Water-resistant, non-explosionproof, direct insertion
	Insertion length: 0.4, 1.0, 1.5, 2.0 or 3.0 m
Material:	Terminal box : SUS304
	Probe portion : SUS316 (Probe)
	SUS304 (Flange)
	Zirconia (Sensor)
Weight:	Insertion length 0.4 m: approx. 4 kg (Weight w/JIS flange)
	approx. 8 kg (Weight w/ANSI flange)
	Insertion length 1.0 m: approx. 6 kg (Weight w/JIS flange)
	approx. 9 kg (Weight w/ANSI flange)
	Insertion length 1.5 m: approx. 7 kg (Weight w/JIS flange)
	approx. 10kg (Weight w/ANSI flange)
	Insertion length 2.0 m: approx. 8.5kg (Weight w/JIS flange)
	approx. 11.5kg (Weight w/ANSI flange)
	Insertion length 3.0 m: approx. 10.5kg (Weight w/JIS flange)
	approx. 13.5kg (Weight w/ANSI flange)
Installation:	Flange mounting
	Flange specifications : JIS 5 K 65 FF equivalent (thickness varies)
	ANSI CLASS 150 4B FF equivalent (thickness varies)
	Mounting angle: The probe may be placed vertically with its tip downward or horizontally or at any angle in between.
	A probe supporter is required for a 3-meter insertion detector unless it is mounted vertically.
Reference gas and calibration gas piping outlet:	
	Uses PT 1/8 or 1/8 NPT female screw.
Cable inlet:	Ø27 mm (two locations)
Ambient temperature:	-10 to 80°C
Temperature of measured gas:	0 to 600°C
Pressure of measured gas:	-500 to 500 mm H <sub>2</sub> O

# • Model and Code

Model	Basic specification code	Option code	Specifications
ZO21D	- L .....		Standard detector (for gas temperatures from 0 to 600°C)
Insertion length	- 040 .....		0.4 m
	- 100 .....		1.0 m
	- 150 .....		1.5 m
	- 200 .....		2.0 m
	- 300 .....		3.0 m
Flange connection	- J .....		JIS 5 K 65 FF Equivalent, PT 1/8 Female screw
	- A .....		ANSI CLASS 150 4B FF Equivalent, 1/8 NPT Female screw
Style code	* B .....		Style B
Check valve		/ CV .....	Equipped with a check valve
Needle valve		/ SV .....	Equipped with a needle (stop) valve

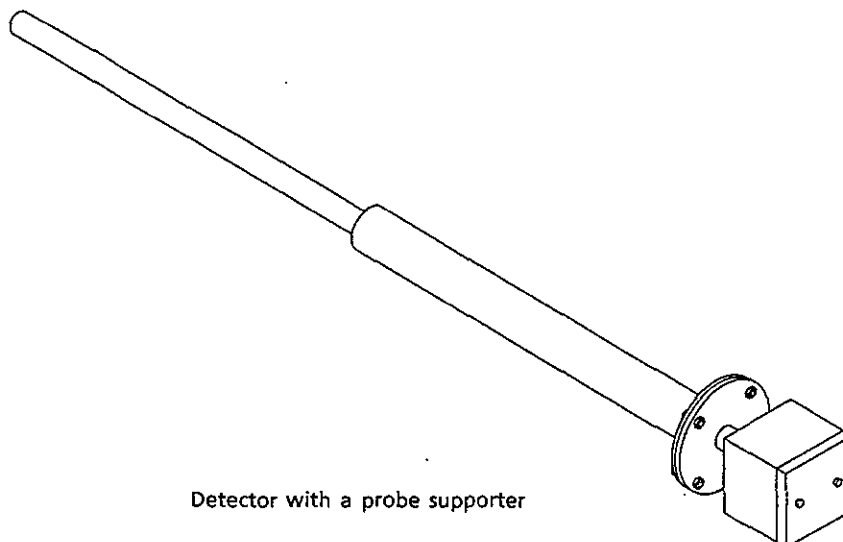
# • External Dimensions



Model	$l$	②, ③ Inlet	① Flange					Weight (kg)
			Standard	A	B	C	t	
ZO21D-L-040-J*B	400	PT 1/8 Femel screw	JIS 5 K 65 FF Equivalent	155	130	4- $\phi 15$	5	Approx. 4
ZO21D-L-100-J*B	1000							Approx. 6
ZO21D-L-150-J*B	1500							Approx. 7
ZO21D-L-200-J*B	2000							Approx. 8.5
ZO21D-L-300-J*B	3000							Approx. 10.5
ZO21D-L-040-A*B	400	1/8 NPT Femel screw	ANSI CLASS 150 4B FF Equivalent	228.2	190.5	8- $\phi 19$	12	Approx. 8
ZO21D-L-100-A*B	1000							Approx. 9
ZO21D-L-150-A*B	1500							Approx. 10
ZO21D-L-200-A*B	2000							Approx. 11.5
ZO21D-L-300-A*B	3000							Approx. 13.5

### 2.2.2 ZO21V Probe Supporter

A probe supporter is required when a standard detector with a 3-meter insertion length is used at an inclination other than vertical.



Detector with a probe supporter

#### • Standard Specifications

Material: SUS316 (Supporter)  
SUS304 (Flange)

Supporter length: 1.5 m

Weight: Approx. 10 kg when JIS flange is used.  
Approx. 13 kg when ANSI flange is used.

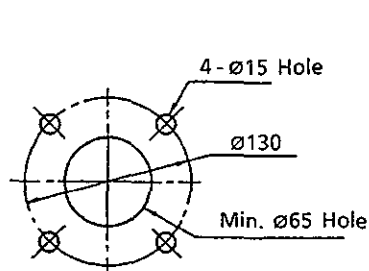
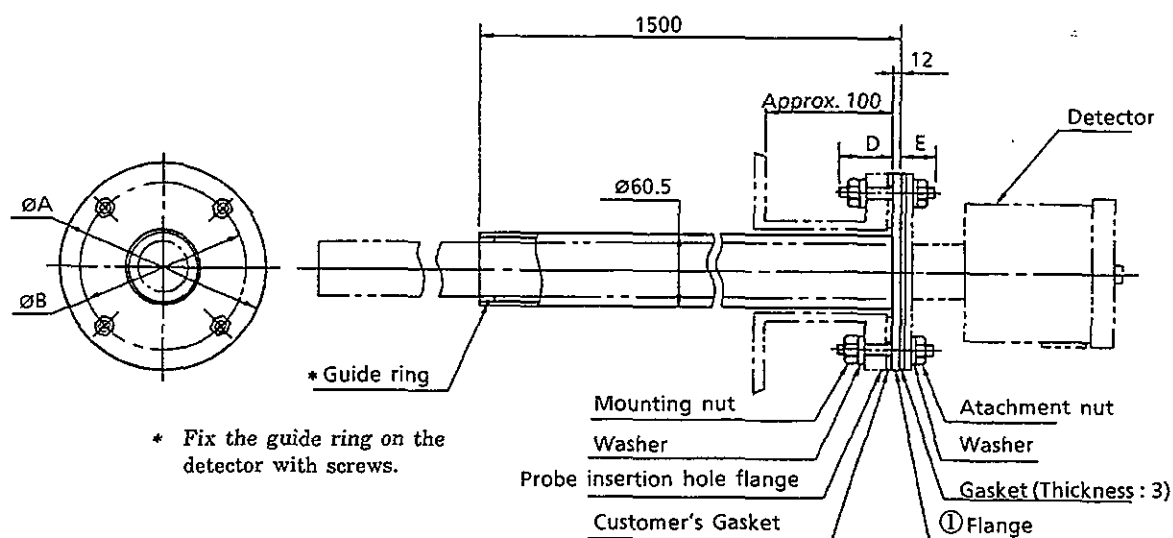
Installation: Flange mounting  
JIS 5 K 65 FF equivalent (thickness varies)  
ANSI CLASS 150 4B FF equivalent (thickness varies)

#### • Model and Code

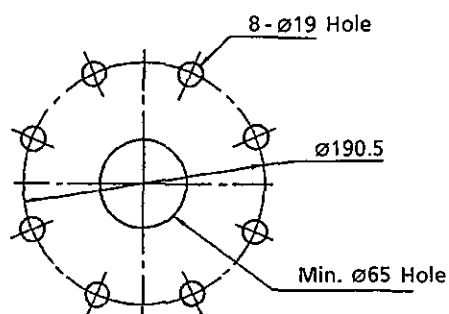
Model	Basic specification code	Option code	Specifications
ZO21V	.....	.....	Probe supporter
Insertion length	- 150 .....	.....	1.5 m (Supporter length) for detector with 3-meter insertion length
Flange	- J .....	.....	JIS 5 K 65 FF equivalent
	- A .....	.....	ANSI CLASS 150 4B FF equivalent
Style code	* B .....	.....	Style B

# • External Dimensions

Unit : mm



When JIS flange



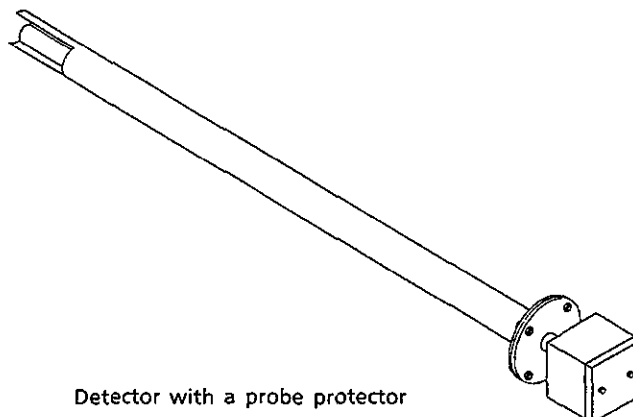
When ANSI flange

## Boring and Drilling Dimensions for Probe Insertion Hole Flange

Model	① Flange					Weight
	Standard	A	B	D	E	
ZO21V-150-J.B	JIS 5 K 65 FF equivalent	155	130	40	40	Approx. 10 kg
ZO21V-150-A*B	ANSI CLASS 150 4B FF equivalent	228.6	190.5	50	50	Approx. 13 kg

### 2.2.3 ZO21R-L Probe Protector

This probe protector is required for the standard detector when it is used for oxygen concentration measurements in powdered coal boilers or in fluidized furnaces to prevent abrasion due to dust particles when gas flow exceeds 10 m/s.



Detector with a probe protector

#### ● Standard Specifications

Material: SUS316 (Protector)

SUS304 (Flange)

Protector length: 1.05, 1.55 or 2.05 m

Weight: Protector length 1.05 m:

Approx. 6 kg (when JIS flange is used)

Approx. 10 kg (when ANSI flange is used)

Protector length 1.55 m:

Approx. 9 kg (when JIS flange is used)

Approx. 13 kg (when ANSI flange is used)

Protector length 2.05 m:

Approx. 12 kg (when JIS flange is used)

Approx. 16 kg (when ANSI flange is used)

Installation: Flange mounting

Flange specification: JIS 5 K 65 FF equivalent (Thickness of the flange varies.)

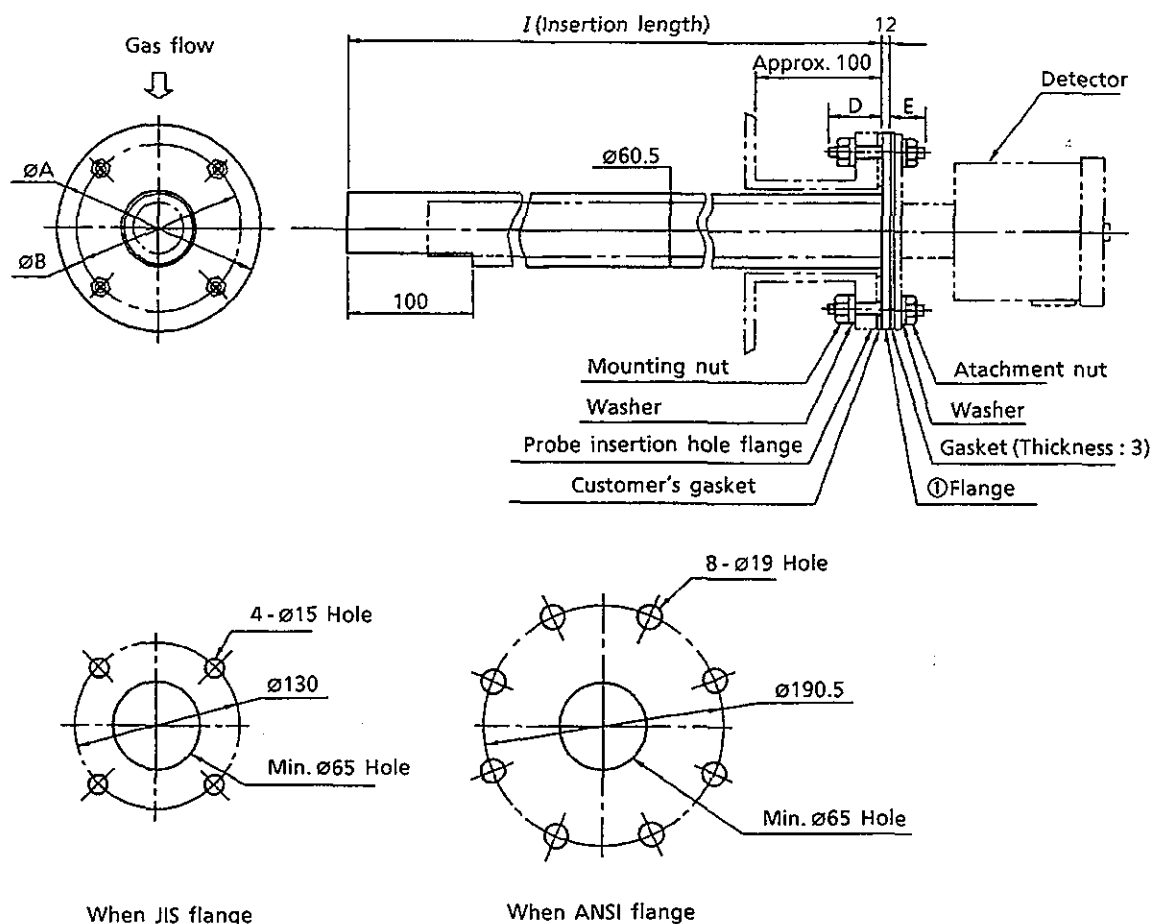
ANSI CLASS 150 4B FF equivalent (Thickness of the flange varies.)

#### ● Model and Code

Model	Basic specification code	Options code	Specifications
ZO21R	- L .....	.....	Probe protector
Insertion length	- 100 .....	.....	1.05 m for a detector of 1.0 m insertion length
	- 150 .....	.....	1.55 m for a detector of 1.5 m insertion length
	- 200 .....	.....	2.05 m for a detector of 2.0 m insertion length
Flange	- J .....	.....	JIS 5 K 65 FF equivalent
	- A .....	.....	ANSI CLASS 150 4B FF equivalent
Style code	* B .....	.....	Style B

- External Dimensions

Unit : mm



### .....Boring and Drilling Dimensions for Probe Insertion Hole Frange

Model	l	① Flange						Weight
		Standard	A	B	t	D	E	
ZO21R-L-100-J*B	1050	JIS 5 K 65 FF equivalent	155	130	5	40	40	Approx. 6 kg
ZO21R-L-150-J*B	1550							Approx. 9 kg
ZO21R-L-200-J*B	2050							Approx. 12 kg
ZO21R-L-100-A*B	1050	ANSI CLASS 150 4B FF equivalent	228.6	190.5	12	50	50	Approx. 10 kg
ZO21R-L-150-A*B	1550							Approx. 13 kg
ZO21R-L-200-A*B	2050							Approx. 16 kg

## 2.3 High-Temperature Detector and Related Equipment

### 2.3.1 ZO21D-H High-Temperature Detector

#### • Standard Specifications

Construction: Water-resistant, non-explosionproof

Probe length: 0.15 m

Terminal box: SUS304

Probe material: SUS316 (Probe), SUS304 (Flange), Zirconia (Sensor)

Weight: Approx. 3 kg

Installation: Flange mounting (The use of high-temperature detector probe adapter ZO21P-H is recommended.)

Flange standard: JIS 5 K 32 FF equivalent (thickness varies)

Mounting angle: Any angle between horizontal and vertical (high-temperature probe is fitted with an adapter)

Reference gas and calibration gas piping connection:

PT 1/8 or 1/8 NPT female screw

Cable inlet: Ø27 mm (two holes)

Ambient temperature: -10 to 150°C

Sample gas temperature:

0 to 600°C when no adapter is used. 0 to 750°C or 0 to 1400°C when the probe adapter for high temperature is used.

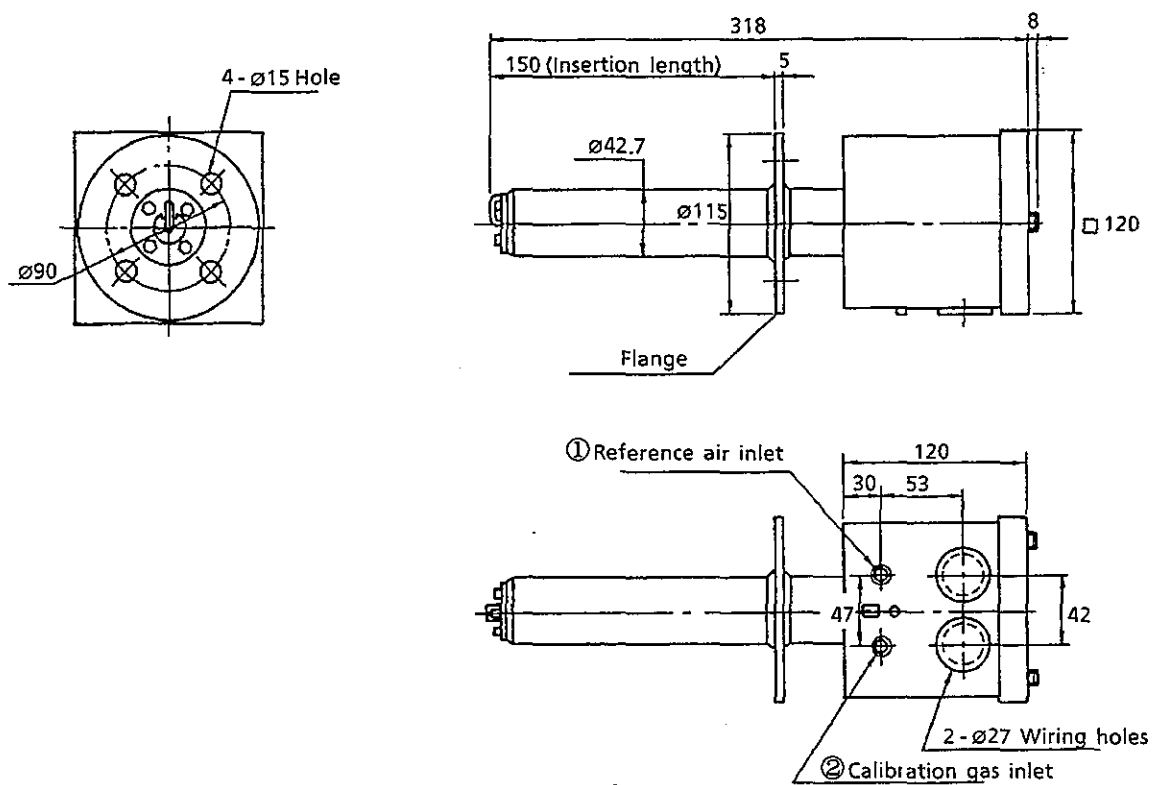
Sample gas pressure: -50 to 500 mm H<sub>2</sub>O

#### • Model and Code

Model	Basic specification code	Option code	Specifications
ZO21D	- H .....		High-temperature detector
Insertion length	- 015 .....		0.15 m
Flange, piping	- J .....		JIS 5 K 32 FF equivalent, PT 1/8 female screw
	- K .....		JIS 5 K 32 FF equivalent, 1/8 NPT female screw
Style code	* A .....		Style A
Check valve		/ CV .....	Equipped with a check valve
Needle valve		/ SV .....	Equipped with a needle (stop) valve

# • External Dimensions

Unit : mm

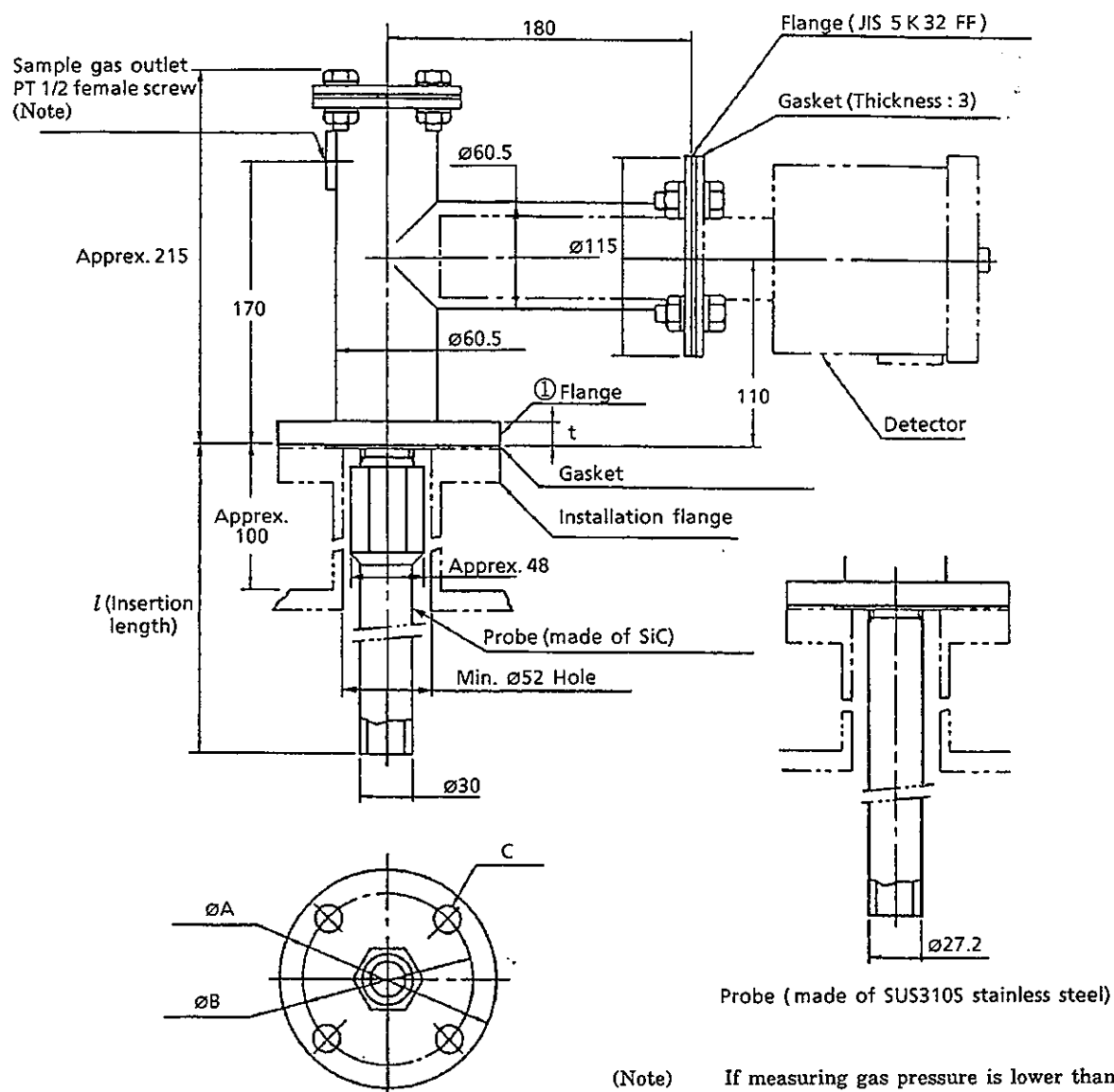


Model	①, ② Inlet
ZO21D-H-015-J*A	PT 1/8 (F)
ZO21D-H-015-K*A	1/8 NPT (F)



# ● External Dimensions

Unit: mm



Model	l	① Flange					Weight
		Standard	A	B	C	t	
ZO21P-H-□-100-J*A	1000	JIS 5 K 50 FF equivalent	130	105	4- $\phi 15$	14	Apprx. 4 kg
ZO21P-H-□-150-J*A	1500						Apprx. 5 kg
ZO21P-H-□-100-A*A	1000	ANSI CLASS 150 4B RF equivalent	228.6	190.5	8- $\phi 19$	23.8	Apprx. 6 kg
ZO21P-H-□-150-A*A	1500						Apprx. 7 kg

## 2.4 ZA8C Converter

### • Standard Specifications

Construction: Dustproof, water-tight (by sealing the wiring port)

Case material: Aluminum alloy

Coating: Epoxy resin, baked finish

Color: Mansell 2.5GY5.0/1.0 equivalent

Installation: Attaches to the pipe, wall, panel

Weight: Approx. 9 kg (100 to 115 V AC )  
Approx. 11 kg (220 to 240 V AC )

Ambient temperature: -20 to 55°C

Storage temperature: -20 to 60°C

Power source: 100, 110, 115, 220 or 240 V AC (-15%, +10%), 50/60 Hz

Display:

Data display: Large-size LED, four digits

Oxygen concentration: 0.0 to 100.0 vol% O<sub>2</sub>

Error code: E- -1 Cell failure

E- -2 Cell temperature is too low.

E- -3 Cell temperature is too high.

E- -4 A/D failure

E- -5 Calibration failure of the zero gas

E- -6 Calibration failure of them span gas

E- -7 Stabilizing time over

E- -8 ROM, RAM failure

□□□□(No display) Digital circuit failure, or power disconnected

Status display: The current mode is identified as follows:

Operation mode: GREEN pilot lamp is ON.

MEAS (Measurement mode)

MAINT (Maintenance, data-setting mode)

Error mode: RED pilot lamp is ON.

ALM (Contact signal of upper or lower limit alarm is output.)

FAIL (An error was detected during the self-test.)

Message display: Dot matrix LCD, 40 characters

Group A (1st level):

A-0 Analog bar-graph, Output range, pre-set alarm output value

A-1 The maximum and minimum oxygen concentration within a specified time interval

A-2 The average oxygen concentration within a specified time interval

A-3 Cell electromotive force in mV

A-4 Cell temperature in °C / Thermocouple electromotive force in mV

A-5 Output current in mA / Output range in vol% O<sub>2</sub>

A-6 Current year, month, date/hour, minute

A-7 Air ratio

## Group B (2nd level)

- B-0 History of the span calibration
- B-1 History of the zero calibration
- B-2 90%-response time in seconds
- B-3 Cell internal resistance in  $\Omega$
- B-4 Cell health status
- B-5 Thermocouple cold contact point temperature in  $^{\circ}\text{C}$
- B-6 Cell heater ON time ratio
- B-7 Dry oxygen concentration/Humidity concentration
- B-8 Exhaust gas temperature, combustion efficiency

## Group C (Calibration)

- C-0 Span gas concentration in vol%  $\text{O}_2$
- C-1 Zero gas concentration in vol%  $\text{O}_2$
- C-2 Calibration mode
- C-3 Stabilizing time in minutes
- C-4 Calibration time in minutes
- C-5 Calibration schedule in days/hours
- C-6 Calibration start time in Month, Day/Hour, Minute
- C-7 Zero point calibration/Span calibration to be omitted or not

## Group D (Output signals)

- D-0 Analog output range 1 in vol%  $\text{O}_2$
- D-1 Analog output range 2 in vol%  $\text{O}_2$
- D-2 Output signal hold or not
- D-3 Analog output signal selection: 4 to 20 mA / 0 to 20 mA
- D-4 Output characteristic selection: Linear/Log
- D-5 Output smoothing constant in seconds
- D-6 Wet oxygen concentration or Dry oxygen concentration is measured.

## Group E (Alarm)

- E-0 Extreme Upper limit value/Upper limit value specification
- E-1 Extreme Lower limit value/Lower limit value specification
- E-2 Contact delay in seconds: hysteresis in vol%  $\text{O}_2$

## Group F (Others)

- F-0 Time Day/Hour, Minute
- F-1 Oxygen concentration averaging time in Hours
- F-2 Maximum/Minimum oxygen concentration monitoring time in Hours
- F-3 Temperature unit specification  $^{\circ}\text{C}$  or  $^{\circ}\text{F}$

Note: See Section 7.1.5 about the display message after F-3.

State messages, Interactive messages, Auxiliary messages

Analog output: One output point

Range: Two ranges can be specified, each within 0 to 5 — 100 vol% O<sub>2</sub>. (Range switching is determined by the contact input.)

Output: 4 to 20 mA DC or 0 to 20 mA DC, Maximum load resistance: 550Ω,  
Input/Output isolated

Output characteristic: Linear or Log(0.1 to 5, 0.1 to 10, 0.1 to 25, or 0.1 to 100 vol% O<sub>2</sub> range)

Contact output: Three output points

Contact capacity: 30 V DC 2A, 250 V AC 2A: Resistance load

Relay status: Normally energized or normally de-energized can be selected. (The contact status is selected with a jumper pin).

Application: The following can be specified for contact outputs #1 to #3.

- Error

- Entry in progress, Range switching instruction answer back, Warming-up progress, Calibration in progress, Solenoid valve unit drive, Blow back, Calibration gas pressure lowered (contact input to be output again), Abnormal process gas temperature (in case the temperature input signal is used).

- Alarm on Extreme lower limit, Lower limit, Upper limit, Extreme upper limit

Output status when default values are specified:

Contact Output #1 --- NC (Relay coil is always existed)

Contact Output #2 --- NO (Relay coil is always non-existed)

Contact Output #3 --- NO (Relay coil is always non-existed)

Digital communication (Optional):

Serial communication using RS-232-C or RS-422-A

Communication Specifications (RS-232-C or RS-422-A):

Transmission Items: Time, O<sub>2</sub> concentration (wet and dry), Cell emf, Cell temperature, Fail code, Alarm code, Status number, Calibration coefficient, Cell resistance, Response time, Cell life, Measuring gas temperature, Average oxygen concentration, Average computing time, Maximum and minimum oxygen concentration, Output current and Calibration start day/time

Communication: Start-stop system, Half-duplex

RS-232-C Two-wire system

RS-422-A Four-wire multi-drop system

Communication Rate: 9600, 4800, or 2400 bps may be selected

Transmission Procedure: Transferable between No Procedure and

Handshaking (No procedure is only for data transmission)

Data Length: 8 bits

Parity: No

Start Bit: 1

Stop Bit: 1

Communication Code: ASCII

Communication Format: (See subsection 5.6.3.)

Triac Output (For solenoid valve) :

Contact capacity : 250 V AC, 1 A

Leak current during OFF : 3 mA or Less

Analog input signal (Optional)

Temperature input (one point): 4 to 20 mA DC (The measurement range is 0 to 3000 °C / °F.)

(Note) This input can be used for the boiler efficiency calculation as well as alarm output.

Contact input (Optional): Two points, Isolated

Input : Contact (Resistor) input or Voltage input

(1) Contact (resistor) input

ON ..... 200  $\Omega$  or below

OFF ..... 100 k $\Omega$  or above

(2) Voltage input

ON ..... -1 to 1 V DC

OFF .... 4.5 to 25 V DC

Application: (One of the following can be specified)

Calibration gas pressure loss alarm

Range switching

Calibration start command

Process gas failure alarm

(Note) When this item is specified, the ON signal input leads to heater power cut-off and the contact output for the solenoid valve unit drive turns ON.

Blow back start command

Self-test: Cell (sensor) failure

Cell temperature is too low.

Cell temperature is too high.

A/D analog circuit failed.

Calibration value was incorrect.

ROM or RAM failed.

Digital circuit failed.

Power supply was switched OFF.

Calibration :

Operation: One-touch calibration, Automatic, Semi-automatic

(1) One-touch calibration

Calibration gas flow and key operation are executed manually according to the message displayed.

(2) Automatic

All the calibration procedures are executed according to the sequence specified.

(3) Semi-automatic

Start should be specified through key operation. Then, calibration is automatically executed according to the sequence specified.

Oxygen concentration of the calibration gas: 0.3 to 100 vol% O<sub>2</sub>

Contact signal for ZA8H flow setting unit:

Each one NO contact for zero gas and span gas

Normally deenergized

Air purge: Possible (Optional)

Piping connection: PT 1/4 female screw or 1/4 NPT female screw

Air qualification: Fresh, dry air

Air consumption: Approx. 5 l/min (when 0.5 kgf/cm<sup>2</sup>)

● Model and Code

Model	Basic specification code	Option code	Specifications
ZA8C	.....	.....	Converter
Dis- play	- S .....	.....	Standard
power source	- 3 .....	.....	220 V AC, 50/60 Hz
	- 4 .....	.....	240 V AC, 50/60 Hz
	- 5 .....	.....	100 V AC, 50/60 Hz
	- 8 .....	.....	110, 115 V AC, 50/60 Hz
Digital communi- cation	- N .....	.....	None
	- A .....	.....	RS-232-C
	- B .....	.....	RS-422-A
Contact input	- 0 .....	.....	None
	- 1 .....	.....	Present (Two points)
Process temperature input	- N .....	.....	None
	- A .....	.....	Present (4 to 20 mA DC)
Automatic calibration	- 0 .....	.....	None
	- 1 .....	.....	Present
Wording on the panel	- J .....	.....	in Japanese
	- E .....	.....	in English
Style code	* B .....	.....	Style B
Panel fixing part		/ P	Panel fixing with bracket
Air purge piping joint		/ AP 1	PT 1/4 female screw
		/ AP 2	1/4 NPT female screw
Cable gland		/ ECG	JIS A20 equivalent



## 2.5 Flow Setting Unit

### 2.5.1 ZA8F Flow Setting Unit

This flow setting unit is applied to the reference gas and the calibration gas in system configuration 2.

#### ● Standard Specifications

Construction: Outdoor installation

Case material: SPCC (JIS)

Coating: Epoxy resin, baked finish

Color: Dark green (Mansell 2.0GY3.1/0.5 equivalent)

Piping connection: PT 1/4 female screw or 1/4 NPT female screw

Weight: Approx. 2 kg

Reference gas: Fresh air with pressure 0.5 to 7 kgf/cm<sup>2</sup>

Reference gas consumption: Approx. 0.9 N l/min

Calibration gas (zero gas, span gas) consumption:

Approx. 0.7 N l/min (During calibration alone)

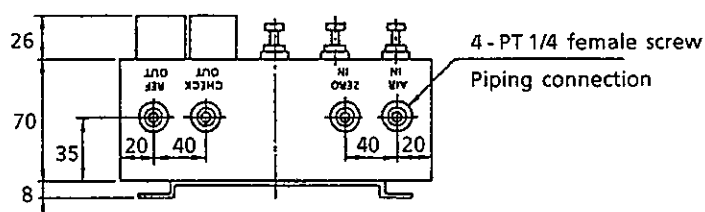
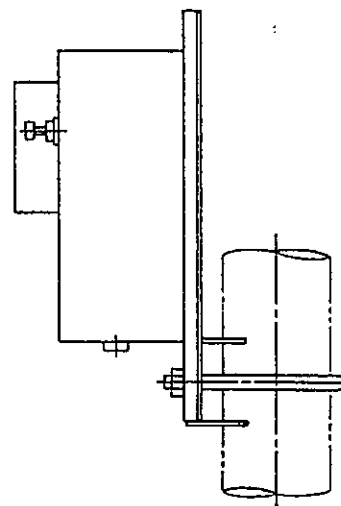
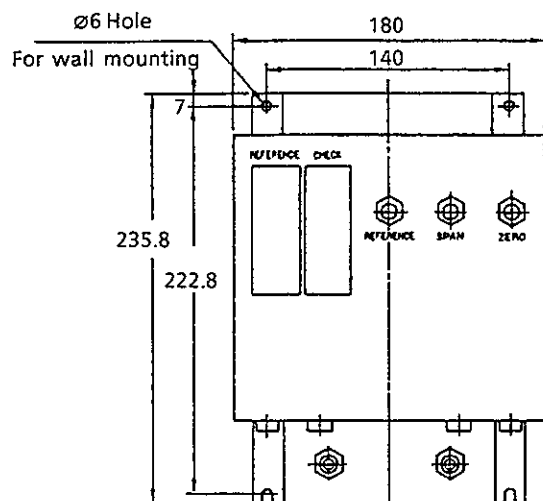
(Note) The air for reference gas is used as the span gas.

#### ● Model and Code

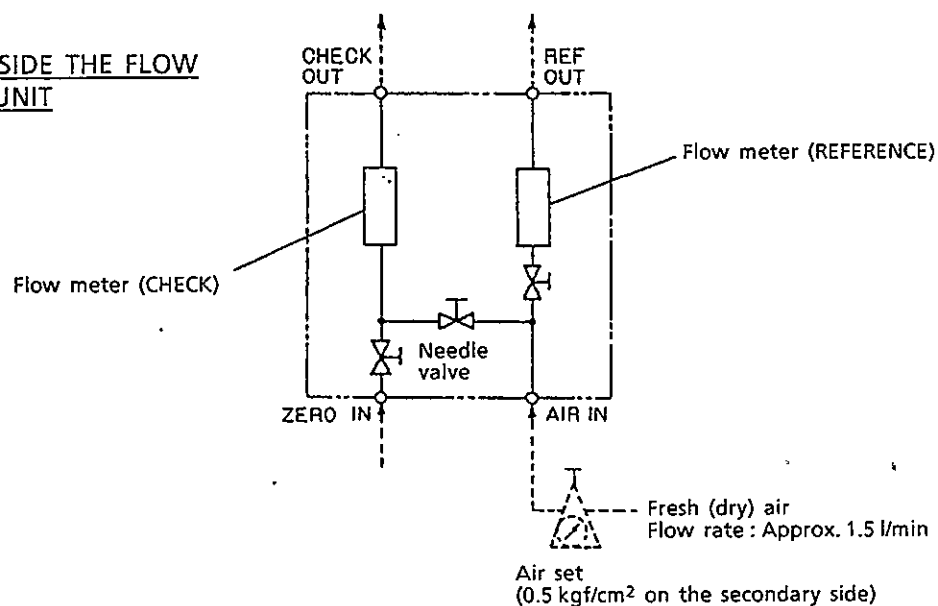
Model	Basic specification code	Option code	Specifications
ZA8F	.....	.....	Flow setting unit
Piping connection	- J .....	.....	PT 1/4 female screw
	- A .....	.....	1/4 NPT female screw (with tapered joint)
Style code	* A .....	.....	Style A

# • External Dimensions

Unit : mm



## PIPING INSIDE THE FLOW SETTING UNIT



### 2.5.2 ZA8H Flow Setting Unit

This flow setting unit is applied to the reference gas and the calibration gas in system configuration based on Example 3.

#### ● Standard Specifications

Construction: Outdoor installation

Case material: SPCC (JIS)

Coating: Epoxy resin, baked finish

Color: Dark green (Mansell 2.0GY3.1/0.5 equivalent)

Piping connection: PT 1/4 female screw or 1/4 NPT female screw

Magnetic valve drive: 100, 110, 115, 200, 220 or 240 V AC 50/60 Hz power source

Weight: Approx. 3.5 kg

Air supply for reference gas:

Fresh air with pressure 0.5 to 7 kgf/cm<sup>2</sup>

Reference gas consumption: Approx. 0.9 N l/min

Calibration gas (Zero gas, Span gas) consumption:

Approx. 0.7 N l/min (During calibration alone)

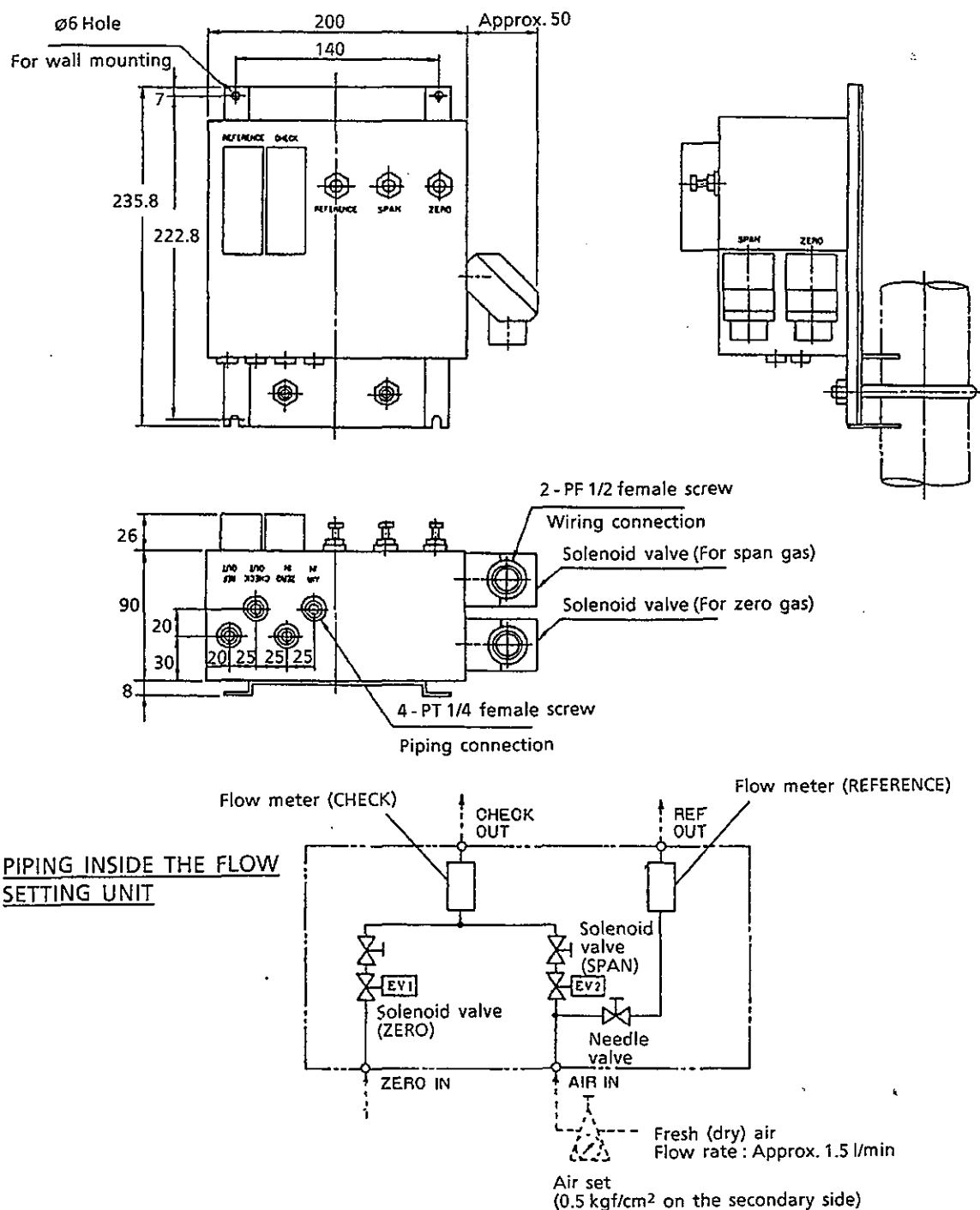
(Note) The air for the reference gas is used as the span gas.

#### ● Model and Code

Model	Basic specification code	Option code	Specifications
ZA8H	.....	.....	Flow setting unit
Power source	- 2 .....	.....	200 V AC, 50/60 Hz
	- 3 .....	.....	220 V AC, 50/60 Hz
	- 4 .....	.....	240 V AC, 50/60 Hz
	- 5 .....	.....	100 V AC, 50/60 Hz
	- 7 .....	.....	110 V AC, 50/60 Hz
	- 8 .....	.....	115 V AC, 50/60 Hz
Piping connection	- J .....	.....	PT 1/4 female screw
	- A .....	.....	1/4 NPT female screw (with tapered joint)
Style code	* A .....	.....	Style A

# • External Dimensions

Unit : mm



## 2.6 ZO21S Standard Gas Unit

This is a handy apparatus to supply zero gas and span gas to the detector in the system configuration based on Example 1. It is used in combination with the detector only during calibration.

### ● Standard Specifications

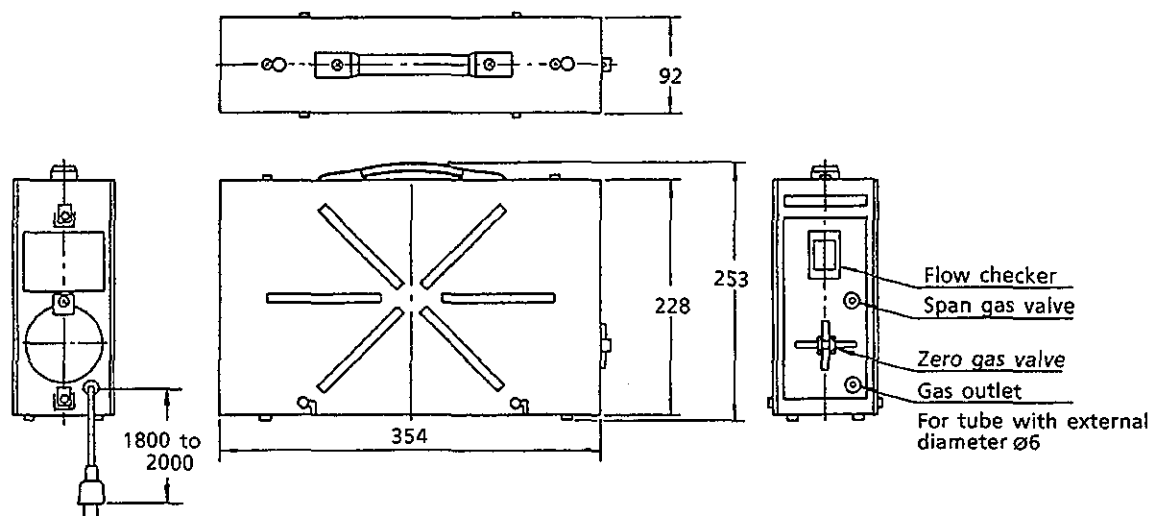
Construction: Handy  
 Case material: SPCC (JIS)  
 Coating: Epoxy resin, baked finish  
 Color: Case : Mansell 2.0GY3.1/0.5 equivalent  
           Cover: Mansell 2.8GY6.4/0.9 equivalent  
 Piping connection: Joint for  $\varnothing 6 \times \varnothing 4$  mm soft tube  
 Weight: Approx. 3 kg  
 Zero gas: Compressed gas in canisters (6 canisters are attached.)  
           Volume: 1 liter  
           Pressure: 7 kgf/cm<sup>2</sup> G (at 35°C)  
           Gas component: 0.95 to 1.0 vol% O<sub>2</sub> + N<sub>2</sub> balance  
 Span gas: Ambient air is taken in through the built-in pump and fed to the detector.  
 Pump drive: 100, 110, 115, 200, 220 or 240 V AC, 50/60 Hz power source  
 Power consumption: 5 VA or below

### ● Model and Code

Model	Basic specification code	Option code	Specifications
ZO21S	.....	.....	Standard gas unit
Power source	-2 .....	.....	200 V AC, 50/60 Hz
	-3 .....	.....	220 V AC, 50/60 Hz
	-4 .....	.....	240 V AC, 50/60 Hz
	-5 .....	.....	100 V AC, 50/60 Hz
	-7 .....	.....	110 V AC, 50/60 Hz
	-8 .....	.....	115 V AC, 50/60 Hz
Wording on the panel	-J .....	.....	in Japanese
	-E .....	.....	in English
Style code	*A .....	.....	Style A

• External Dimensions

Unit : mm



## 2.7 ZA8T Solenoid Valve Unit

This unit is applied to the system configuration based on Example 4. When combustible gases are detected in the gases being analyzed, the signal is sent to the converter, which in return transmits a contact output so that purge gas is fed to the detector.

### • Standard Specifications

Construction: Outdoor type

Installation: On the pipe or wall surface

Fixing plate material: SUS304 (JIS)

Weight: Approx. 0.8 kg

Piping connection: PT 1/4 female screw or 1/4 NPT female screw

Solenoid valve drive: 100, 110, 115, 200, 220 or 240 V AC, 50/60 Hz power source

Wiring connection: PF 1/2 female screw

Purge gas: Gas component: N<sub>2</sub>

Pressure: Approx. 0.5 kgf/cm<sup>2</sup> G

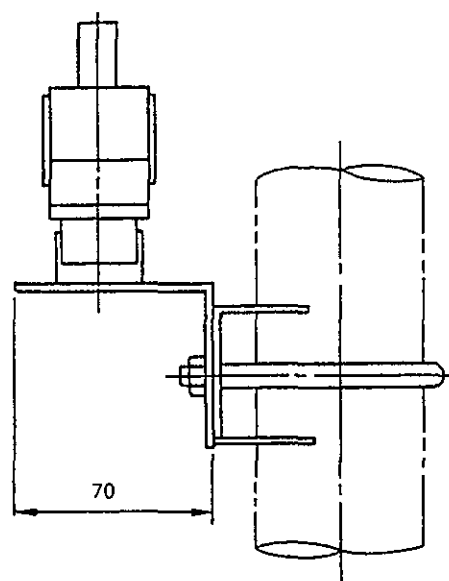
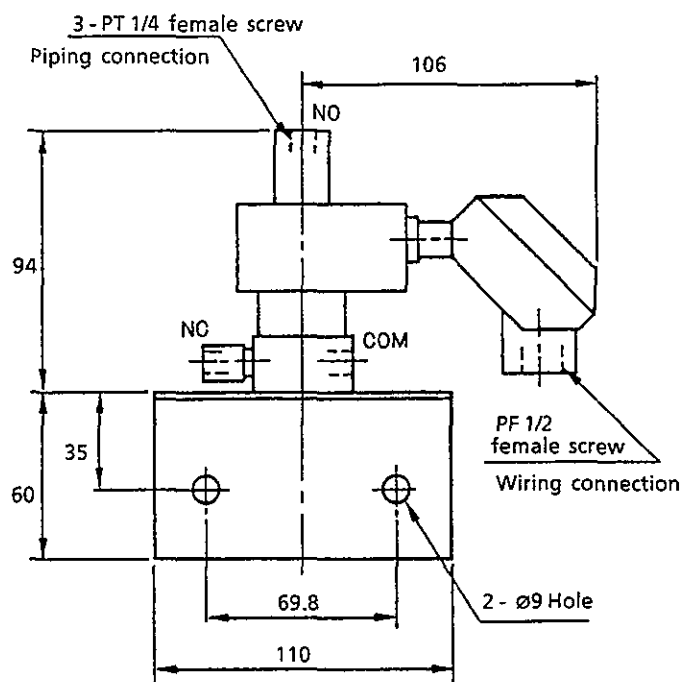
Flow: Approx. 4 l/min

### • Model and Code

Model	Basic specification code	Option code	Specifications
ZA8T	.....	.....	Solenoid valve unit
Power source	- 2 .....	.....	200 V AC, 50/60 Hz
	- 3 .....	.....	220 V AC, 50/60 Hz
	- 4 .....	.....	240 V AC, 50/60 Hz
	- 5 .....	.....	100 V AC, 50/60 Hz
	- 7 .....	.....	110 V AC, 50/60 Hz
	- 8 .....	.....	115 V AC, 50/60 Hz
Piping connection	- J .....	.....	PT 1/4 female screw
	- A .....	.....	1/4 NPT female screw (with tapered joint)
Style code	* A .....	.....	Style A

## ● External Dimensions

Unit : mm



## 2.8 Other Equipment

### 2.8.1 Dust Filter for the Detector (Part No.: E7042UQ)

This filter is used to protect the detector sensor from a corrosive dust component or from a high concentration of dust when the oxygen concentration in utility boilers or cement kilns are to be measured.

#### • Standard Specifications

Application: Standard detector

(The gas flow should almost be at a right angle to the probe axis direction.)

Filter type: Carborundum (SiC), 70 mesh

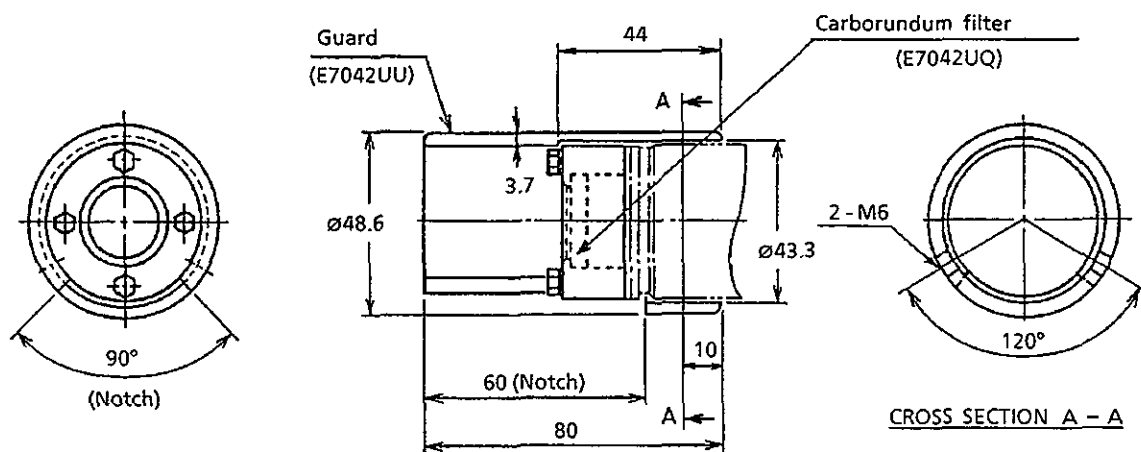
Weight: Approx. 300 g (About 650 g for a model with a guard)

#### • Part No.

Part Name	Part No.	Description
Filter	E7042UQ	The E7042UU guard should be ordered separately.

#### • External Dimensions

Unit: mm



(Note) E7042UU guard should be used only when necessary (see Section 3.1.4).

## 2.8.2 Auxiliary Ejector for High-Temperature Use (Part No.: E7046EC or E7046EN)

This is used with a high-temperature detector when the gas to be analyzed is under negative pressure. The unit consists of an ejector assembly, pressure gauge and needle valve.

### ● Standard Specifications

Ejector assembly :

Material: SUS304 (JIS)

Air supply: 0.3 to 0.7 kgf/cm<sup>2</sup> (at the inlet)

Air consumption: 30 to 40 l/min

Suction gas flow: 3 to 7 l/min

Connection to the high-temperature probe adapter: PT 1/2 male screw

Piping connection: PT 1/4 or 1/4 NPT female screw

Connection tube:  $\varnothing 6 \times \varnothing 4$  mm or 1/4-inch copper or stainless pipe

Pressure gauge:

Type: A1.5 U3/8  $\times$  75 (JIS B7505)

Material in contact with gas: SUS316 (JIS)

Case material: Aluminum alloy (Black coat)

Piping connection: PT 1/4 male screw or NPT 1/4 male screw

Scaling: 0 to 1 kgf/cm<sup>2</sup> G

Ambient temperature: 40°C at maximum

Needle valve:

Piping connection: PT 1/4 or 1/4 NPT female screw

Material: SUS316

### ● Part Number

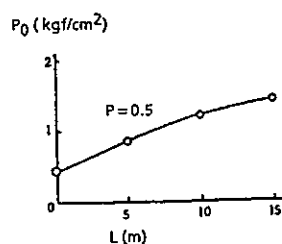
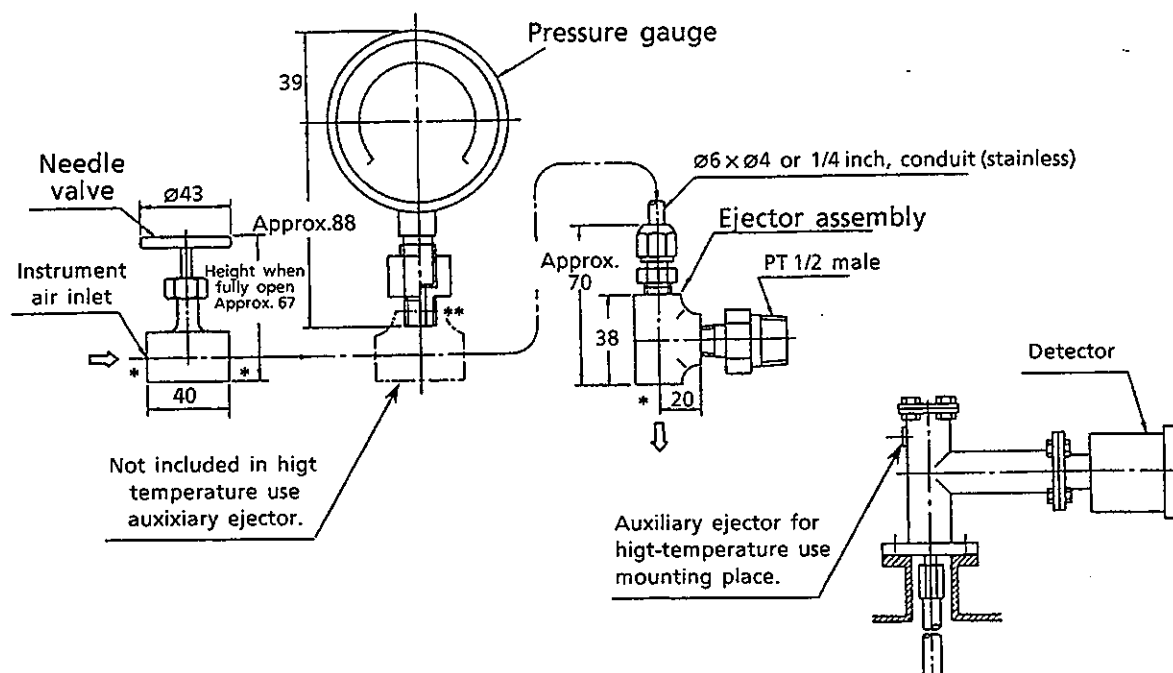
Part No.	Specifications	Construction
E7046EC	Piping connection: PT 1/4 female screw	Ejector, pressure gauge, and needle valve
E7046EN	Piping connection: 1/4 NPT female screw	

# • External Dimensions

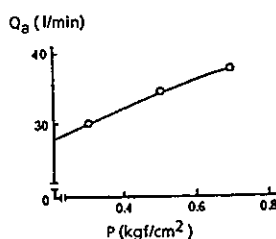
E7046EC : Piping connections, PT 1/4 female (\* part) or PT 1/4 male (\*\* part)

E7046EN : Piping connections, 1/4 NPT female (\* part) or 1/4 NPT male (\*\* part)

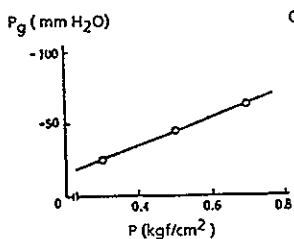
Unit : mm



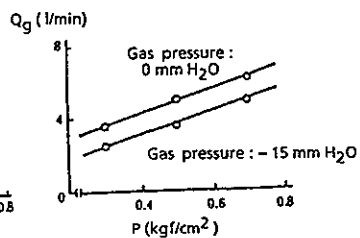
Pressure setting characteristics



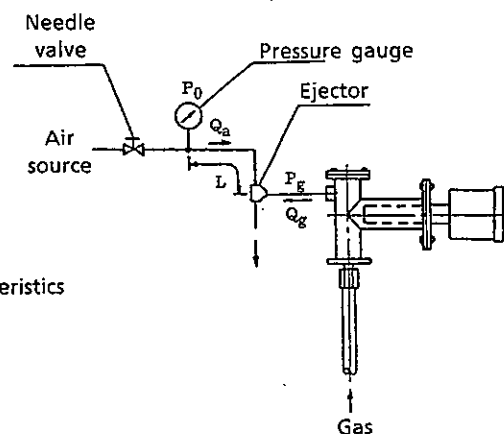
Air consumption characteristics



Suction pressure characteristics



Suction flow characteristics



$P_0$  (kgf/cm<sup>2</sup>): Pressure setting  
 $P$  (kgf/cm<sup>2</sup>): Drive pressure (at the ejector entrance)  
 $P_g$  (mmH<sub>2</sub>O): Suction pressure  
 $Q_a$  (l/min) : Air consumption  
 $Q_g$  (l/min) : Suction flow  
 $L$  (m) : Distance between the ejector and the pressure gauge

### 2.8.3 Needle (Stop) Valve (Part No.: G7011XH or G7013XH)

This valve is mounted on the calibration gas line in the system to allow for one-touch calibration. This is applied to the system corresponding to "System 1".

#### • Standard Specifications

Material: Brass

Piping connection: PT 1/8 or 1/8 NPT female screw

Weight: Approx. 80 g

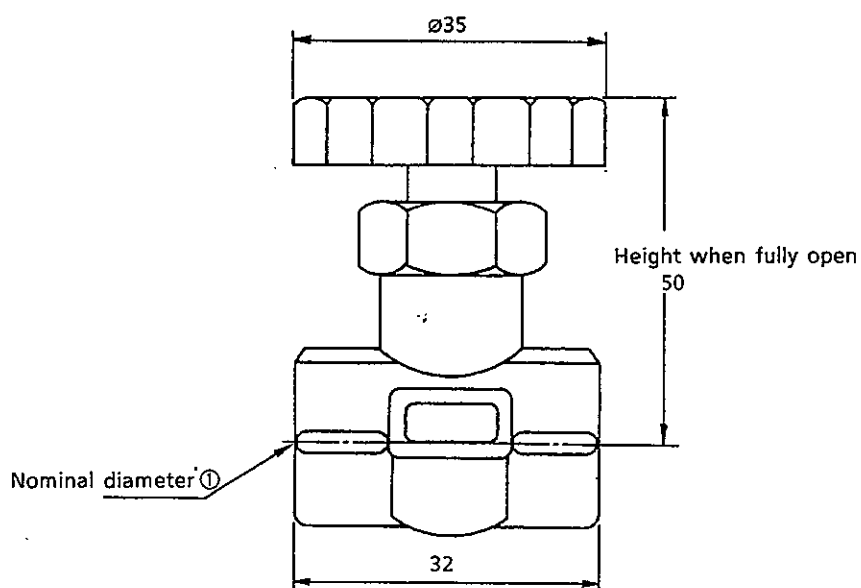
#### • Part Number

Part Name	Part No.	Description
Needle valve	G7011XH	Piping connection: PT 1/8 female screw
	G7013XH	Piping connection: 1/8 NPT female screw

#### • External Dimensions

G7011XH: Nominal dia. ①, PT 1/8 female screw  
G7013XH: Nominal dia. ①, 1/8 NPT female screw

Unit: mm



### 2.8.4 Check Valve (Part No.: E7042VR or E7042VV)

This valve is mounted on the calibration gas line (directly connected to the detector). This is applied to the system corresponding to "System 2 to System 4".

#### ● Standard Specifications

Material: SUS304 (JIS)

Piping connection: PT 1/8 female screw (PT 1/8 male screw available) or 1/8 NPT female screw (1/8 NPT male screw available)

Weight: Approx. 50 g

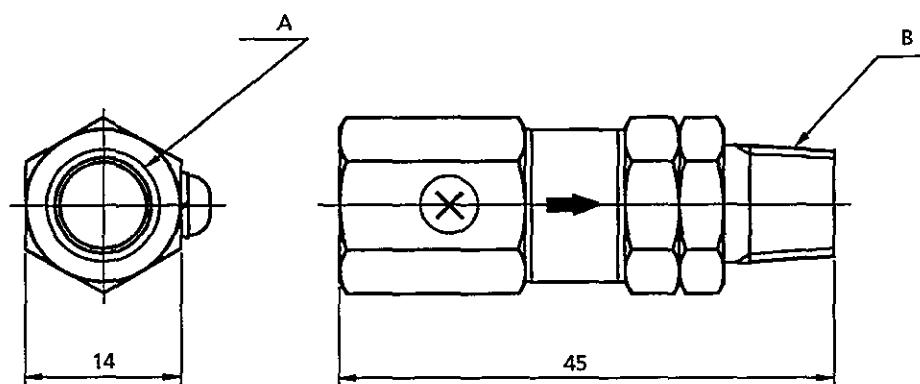
#### ● Part Number

Part Name	Part No.	Description
Check valve	E7042VR	Piping connection: PT 1/8 female screw (A part)
	E7042VV	Piping connection: 1/8 NPT female screw (A part)

#### ● External Dimensions

Unit : mm

E7042VR : PT 1/8 female screw (A part), PT 1/8 male screw (B part)  
E7042VV : 1/8 NPT female screw (A part), 1/8 NPT male screw (B part)



### 2.8.5 Air Set (Part No.: G7011XF or E7040EL)

This set is used to lower the pressure when fresh (dry) air is used as the reference and span gases.

#### ● Standard Specifications

Primary pressure : Max. 20 kgf/cm<sup>2</sup> G

Secondary pressure : 0.1 to 2 kgf/cm<sup>2</sup> G

Piping connection : PT 1/4 or 1/4 NPT female screw

Weight : Approx. 1 kg

#### ● Part Number

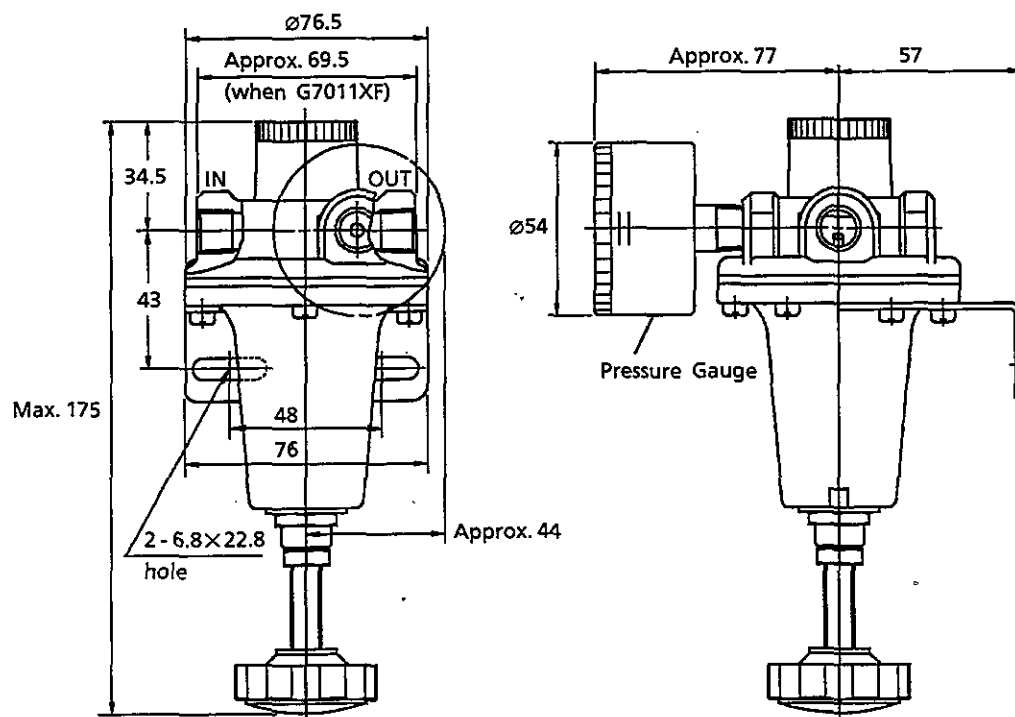
Part Name	Part No.	Description
Air set	G7011XF	Piping connection : PT 1/4 female screw
	E7040EL	Piping connection : 1/4 NPT female screw

#### ● External Dimensions

G7011XF : Piping connection (Primary, Secondary side), PT 1/4 female

E7040EL : Piping connection (Primary, Secondary side), 1/4 NPT female

Unit : mm



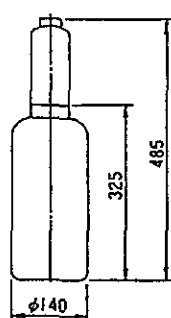
### 2.8.6 Zero Gas Cylinder (Part No.: G7001ZC)

The gas from this cylinder is used as the calibration zero gas and detector purge gas.

#### ● Standard Specifications

Capacity: 3.4 liter  
 Pressure: 100 to 120 kgf/cm<sup>2</sup> G  
 Gas component: 0.95 to 1.0 vol% O<sub>2</sub>; the reset is N<sub>2</sub>

#### ● External Dimensions



Unit: mm

Weight: Approx. 6 kg

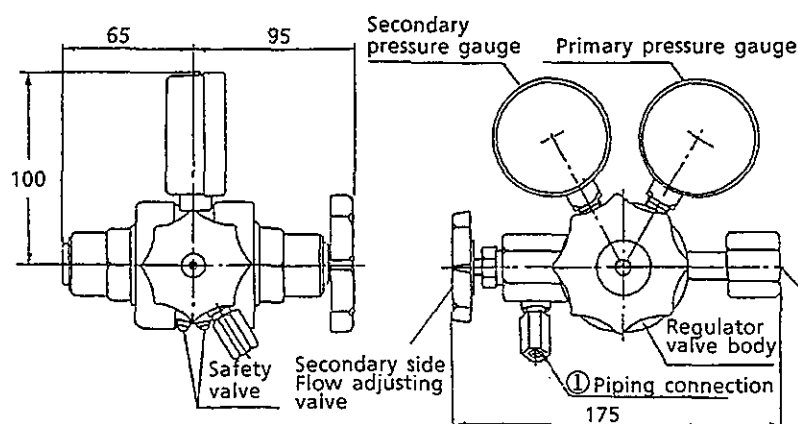
### 2.8.7 Cylinder Regulator Valve (Part No.: G7013XF or G7014XF)

This regulator valve is used with the zero gas cylinder.

#### ● Standard Specifications

Pressure gauge: Primary: 0 to 200 kgf/cm<sup>2</sup> G  
 Secondary: 0 to 5 kgf/cm<sup>2</sup> G  
 Attachment screw: W22 14-thread, clockwise screw  
 Piping connection: PT 1/4 female screw or 1/4 NPT female screw  
 Material: Brass (body)

#### ● External Dimensions



Unit: mm

Part No.	①
G7013XF	PT 1/4 female screw
G7014XF	1/4 NPT female screw

W22 14-thread female screw  
 (JIS B8245)  
 The compressed gas cylinder regulator valve can be mounted onto an A-shaped fixture.

Weight: Approx. 1 kg

### 2.8.8 Calibration Gas Unit Case (Part No.: E7044KF)

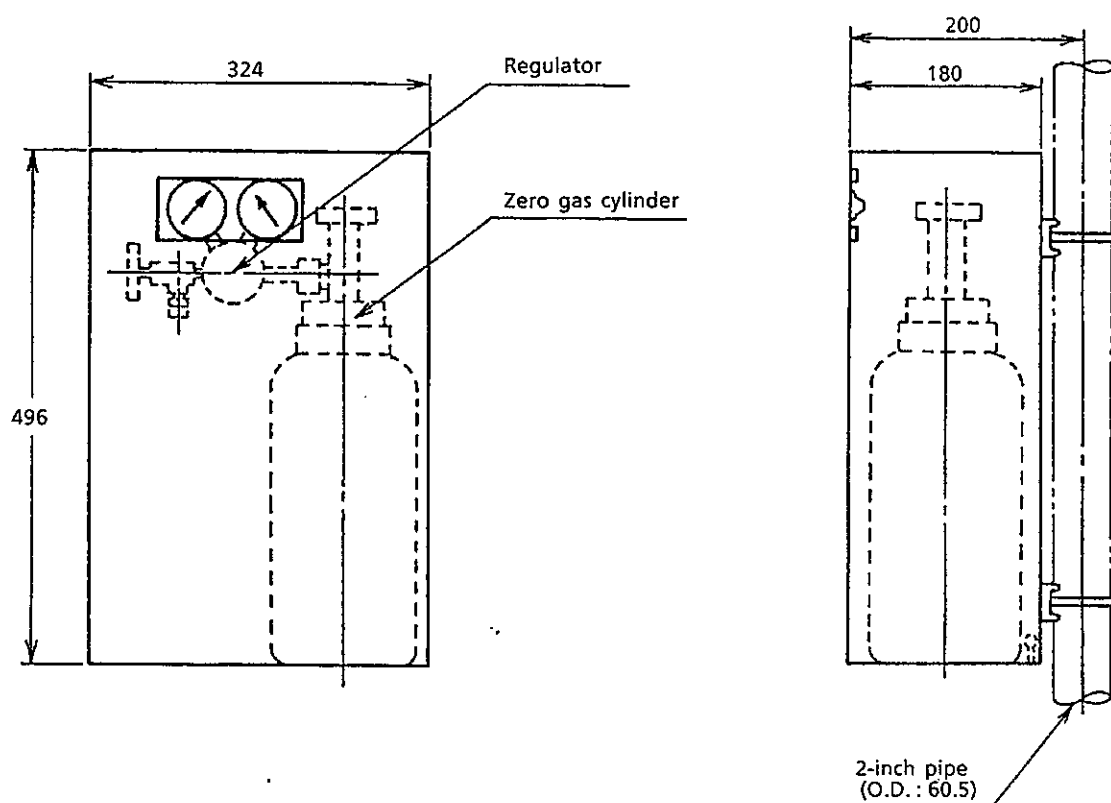
This case is used to store the zero gas cylinder.

#### • Standard Specifications

Installation: Pipe mounting  
 Material: SPCC (JIS)  
 Coating: Epoxy resin, baked finish  
 Color: Mansell 7.5BG4/1.5 equivalent  
 Weight: Approx. 3.6 kg

#### • External Dimensions

Unit: mm



(Note) The zero gas cylinder and the regulator valve are not included in the E7044KF (case assembly).

## 3. INSTALLATION

This chapter describes installation of the following:

- Item 3.1 Standard Detector
- 3.2 High-Temperature Detector Including the Adapter
- 3.3 Converter
- 3.4 Flow Setting Unit
- 3.5 Calibration Gas Unit Case
- 3.6 Solenoid Valve Unit

### 3.1 Installation of the Standard Detector

#### 3.1.1 Installation Site

The following should be taken into consideration when installing the detector:

- (1) Easy access to the detector for checking and maintenance work.
- (2) A location in which the ambient temperature is not too high (below 80°C) and the terminal box is not subject to radiant heat.
- (3) A clean environment without any corrosive gases.
- (4) No vibration.
- (5) The gas to be analyzed satisfies the specification described in Chapter 2.

#### 3.1.2 Probe Insertion Hole

Includes those analyzers equipped with a probe supporter and probe protector.

When preparing the probe insert hole, the following should be taken into consideration:

- (1) The detector probe tip should not be pointed upward.  
 Note: If the probe tip is placed upward, the cell (sensor) in the probe tip may deteriorate due to condensation.
- (2) If the probe length is 3 meters, the detector (without a probe supporter or protector) should be attached almost vertically (no more than a 5° tilt).
- (3) The detector probe should be situated almost at a right angle to the gas flow to be analyzed or, at the very least, the probe tip should be on the downflow side.

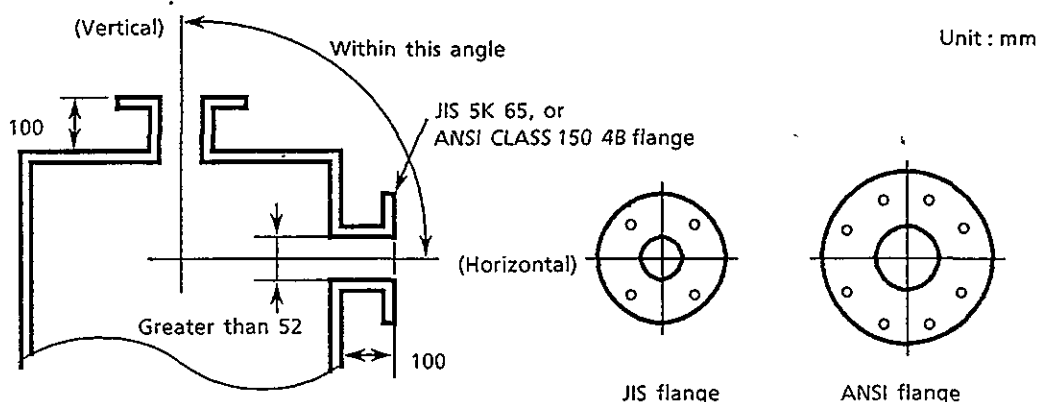


Figure 3.1 Example of probe insertion hole

### 3.1.3 Detector Installation

The cell (sensor) at the tip of the detector is made of ceramic (zirconia). Care should be taken not to allow sudden or violent jarring to the probe such as dropping it.

The gasket should be used on the flange surface to prevent gas leakage. The gasket material should be heatproof and corrosion-proof.

The parts which are necessary for mounting are listed in Table 3.1.

Table 3.1 Mounting parts required of the user

Flange spec.	Part name	Q'ty	Notes
JIS 5 K 65	Gasket	1	The gasket should be heatproof, and corrosion-proof.
	Bolt (M12 × 50)	4	These are required only for the standard detector without a probe supporter or probe protector.
	Nut (M12)	4	
	Washer (for M12)	8	
ANSI CLASS 150 4B	Gasket	1	The gasket should be heatproof, and corrosion-proof.
	Bolt (M16 × 60)	8	These are required only for the standard detector without a probe supporter or probe protector.
	Nut (M16)	8	
	Washer (for M16)	16	

The following should be taken into consideration when mounting the standard detector :

<Standard detector>

- (1) Make sure the cell mounting screws (four pcs.) have not come loose.

If a dust filter (see Section 2.8.1) is used, make sure it is properly attached to the detector. Filter mounting is described in Section 3.1.4.

- (2) In a case where the detector is attached horizontally, the cable lead-in hole should face downward.

### 3.1.4 Dust Filter Installation

The dust filter is used to protect the sensor from a high concentration of dust such as in utility boilers and cement kilns. If a filter is used in combustion systems other than these, it may have an adverse effect. These combustion conditions should be examined carefully before using a filter.

It is recommended that Chapter 10 be read prior to filter mounting, for it is necessary to be familiar with the detector's construction, especially in the sensor assembly. Mount the filter on the detector following this procedure :

- (1) Remove the attachment bolts (four) together with the spring washers from the sensor (cell) assembly of the detector probe.

These bolts are not used with filter mounting, but it is recommended that they be stored since operation without a filter may be required in the future.

- (2) Mount the dust filter as follows :

Apply the heat-resistant coating (see Note) to the threaded portion of the four bolts (M5 screw, length 30 mm). Put the bolts through the washers into the filter holes and screw them into the probe threads. Tighten each bolt with 60 kg.cm torque.

Note: As the detector is heated to 750°C, it is recommended that "Never Seeds Nickel Special" (distributed through the Kyokuto Trading Co.) be used to prevent melting.

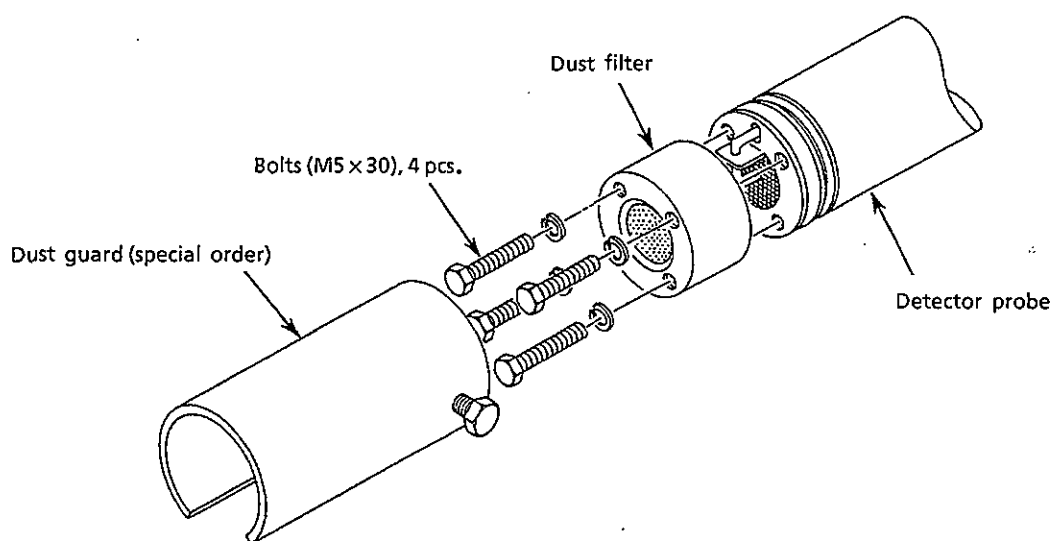


Figure 3.2 Dust filter mounting

- (3) If dust concentration is extremely high and gas flow exceeds 10 m/s, a dust guard (specially ordered) may be required to prevent the filter from clogging. Attach the dust guard with the notch downward and affix it to the detector probe with two screws. Tighten the screws, matching them with the probe grooves.

<Detector with a probe supporter>

- (1) Attach the guide ring of the probe supporter to the detector 1.5 m from the probe base, and affix it with two screws. Tighten the screws firmly.
- (2) Insert the gasket supplied by the user between the flange surfaces and mount the probe supporter (in any direction).
- (3) Make sure that the probe cell fixing screws (four) are not loose.
- (4) In the case where the detector is mounted horizontally, the cable lead-in hole should be at the bottom.

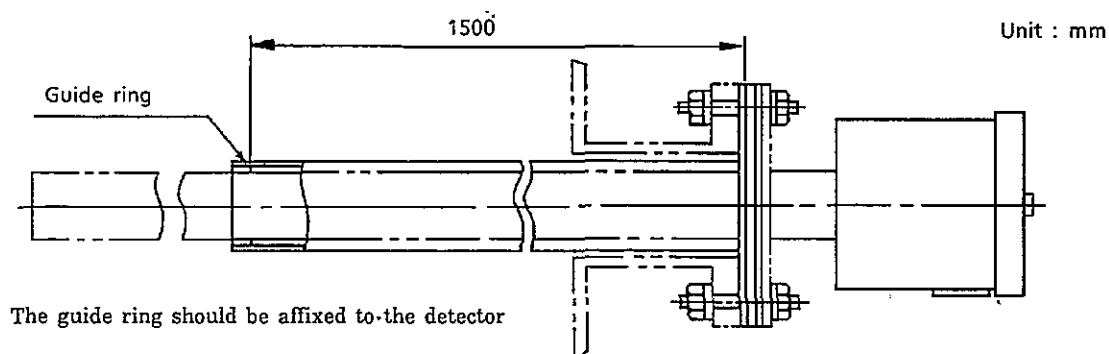


Figure 3.3 Mounting the detector with a probe supporter

## &lt;Detector with a probe protector&gt;

- (1) Insert the gasket between the flange surfaces, and mount the probe protector so that the notch at the tip is located on the downstream side of the gas to be analyzed.
- (2) Make sure that the cell attachment screws (four) at the probe tip are not loose.
- (3) Mount the detector so that the cable lead-in hole is located at the bottom.

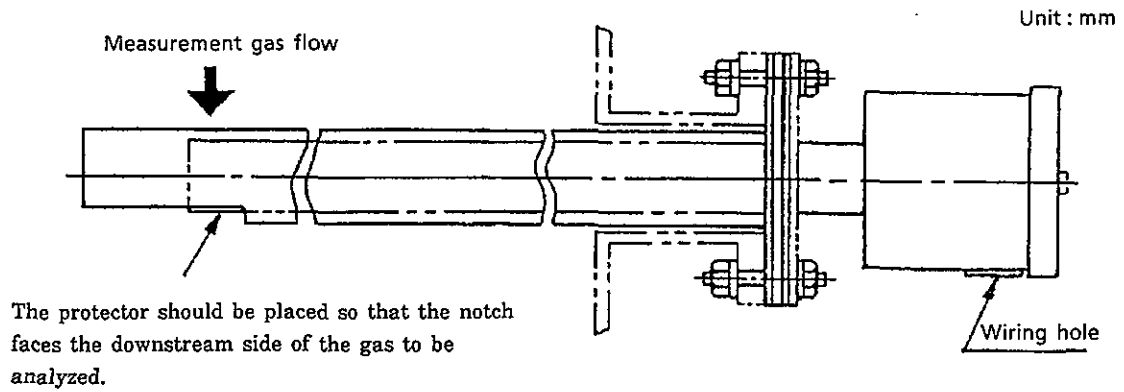


Figure 3.4 Mounting the detector with a probe protector

## 3.2 Installation of the High-Temperature Detector

### 3.2.1 Installation Site

The following should be taken into consideration:

- (1) Easy access to the detector for inspection and maintenance work.
- (2) The ambient temperature should not be too high (below 150°C) and the terminal box should not be subjected to radiant heat.
- (3) No corrosive gas should be allowed.
- (4) No vibration should be allowed.
- (5) The gas should satisfy the conditions described in Chapter 2.

### 3.2.2 Probe Insertion Hole

A high-temperature detector consists of a detector ZO21D-H and high-temperature probe adapter ZO21P-H.

The probe insertion hole should be prepared as follows:

- (1) If the probe is made of silicon carbide (SiC), the probe hole should be prepared so that the probe is placed vertically (no more than a 5 tilt).
- (2) In the case where the probe is made of stainless steel and the probe adapter is to be placed horizontally, the probe hole should be prepared so that the probe tip is not higher than the probe base.

Figure 3.5 illustrates preparation of the probe insertion hole.

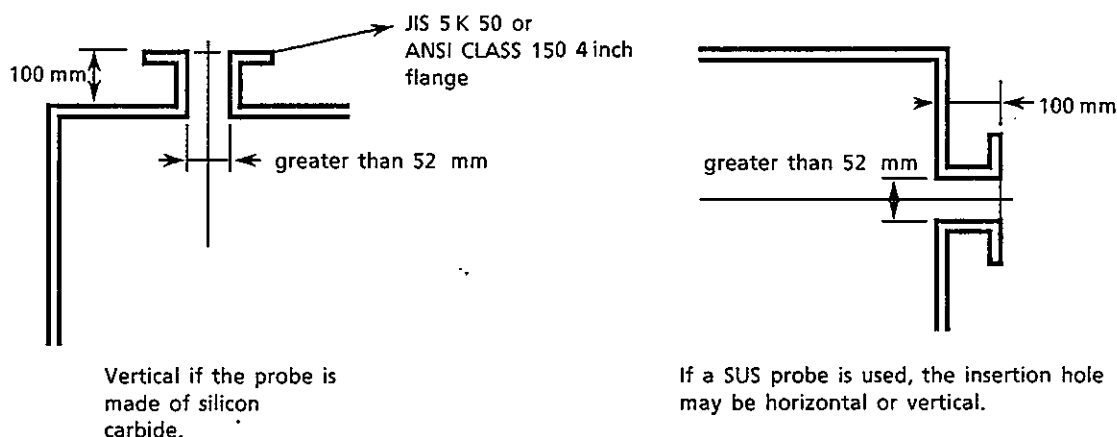


Figure 3.5 Probe insertion hole

### 3.2.3 Mounting the High-Temperature Detector

Ceramic (zirconia) is used in the sensor (cell) portion on the detector probe tip. Care should be taken not to drop the detector during installation. The same applies to a probe made of silicon carbide (SiC).

A gasket should be used on the flange surface to prevent gas leakage. The gasket material should be selected depending on the characteristics of the gas to be analyzed. It should be heatproof and corrosion-proof. The parts which should be supplied by the user are listed in Table 3.2.

Table 3.2 Mounting parts to be supplied by the user

Mounting flange spec.	Part name	Q' ty	Description
JIS 5 K 50 FF	Gasket	1	Heatproof, corrosion - proof
	Bolt (M12×50)	4	
	Nut (M12)	4	
	Washer (for M12)	8	
ANSI CLASS 150 4B RF	Gasket	1	Heatproof, corrosion - proof
	Bolt (M16×60)	8	
	Nut (M16)	8	
	Washer (for M16)	16	

A high-temperature detector should be mounted as follows:

- (1) It is recommended that the detector be mounted vertically. However, if it is impossible due to the physical arrangements and the detector is mounted horizontally, do not place the probe facing upward.
- (2) When mounting a high-temperature probe adapter, be sure to insert a gasket between the flange surfaces to prevent gas leakage. Special care should be taken toward air-tightness in case the pressure in the furnace is negative.
- (3) When mounting the detector in a position other than vertical, the cable lead-in port should face downward.

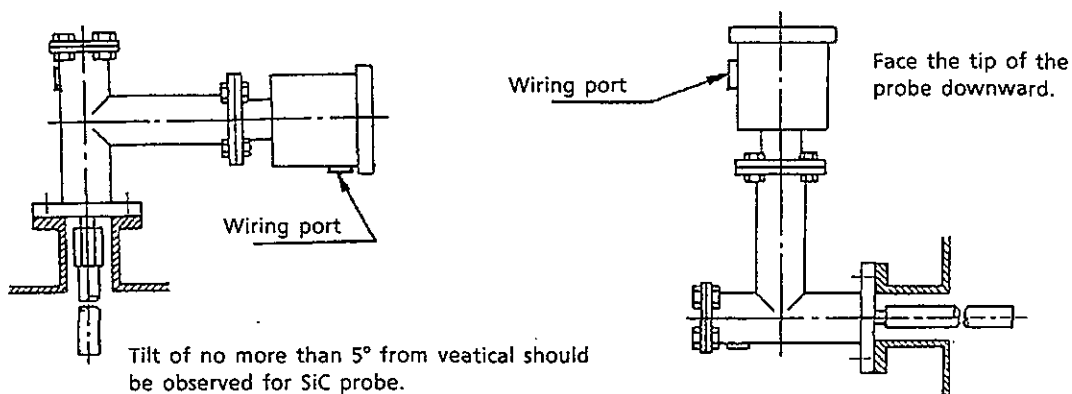


Figure 3.6 Mounting the high-temperature detector

## 3.3 Installation of the Converter

### 3.3.1 Location

Install the converter in such a place as shown below.

- (1) Where indicated oxygen concentrations and messages can be read easily and key can be readily operated.
- (2) Where maintenance and inspection are easily carried out.
- (3) Where ambient temperature is not too high (max. 55°C) and temperature varies little (recommended to be within 15°C of difference between days).
- (4) Where humidity is moderate (40 to 75% RH is recommended) and no corrosive gases is present.

Note: If the ambient atmosphere contains corrosive gases, carry out air purging. The air-purge tube fittings are attached only when required.

- (5) Where vibration is little.
- (6) Where the detector is installed relatively near.

Note: However, if digital communication is implemented (optionally), the maximum transmission distance must be taken into consideration.

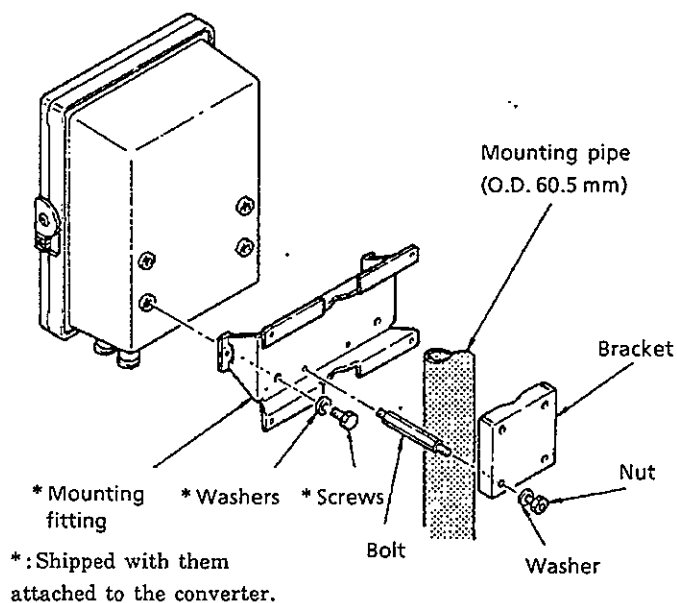
### 3.3.2 Mounting of Converter

The converter can be mounted to the pipe (nominal 50A : O.D. 60.5 mm), on a wall or a panel. But, it is recommended, as a rule, to install it on a vertical face.

Mount the converter in the following procedures.

#### <Pipe Mounting>

- (1) Provide a vertical pipe of sufficient strength (nominal 50A : O.D. 60.5 mm) for mounting the converter.
- (2) Mount the converter to the pipe. Fix it firmly to the pipe in the procedure described in Figure 3.7.



1. Screw four bolts into the mounting bracket.
2. Hold the pipe between the bracket and mounting fitting, passing bolts through the bracket holes.
3. Clamp the mounting fitting to the pipe. Set washers onto the bolts and fully fasten the nuts.

Figure 3.7 Pipe Mounting Procedure

## &lt;Wall Mounting&gt;

- (1) Drill the mounting holes through the wall as shown in Figure 3.8.

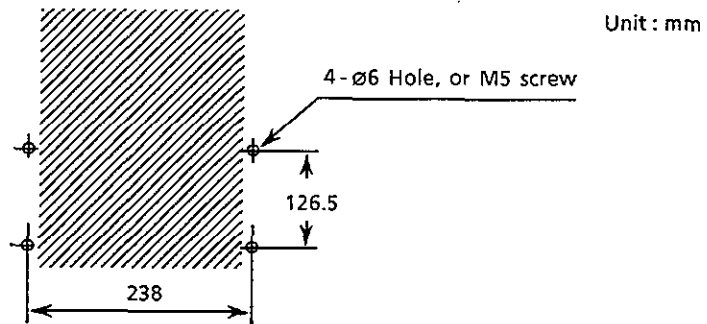


Figure 3.8 Drilling Mounting Holes

- (2) Mount the converter. Secure the converter on the wall using four screws.

Note: For wall mounting, the bracket and bolts are not used.

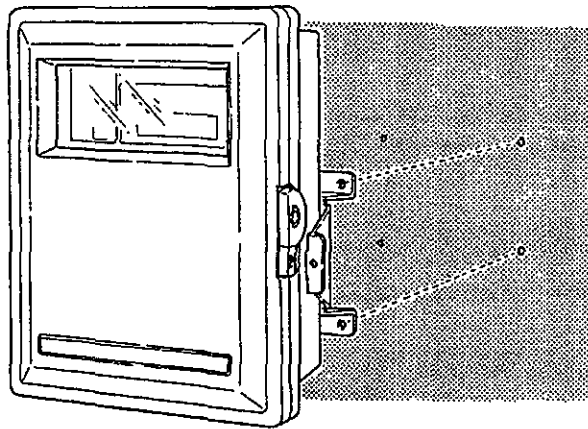


Figure 3.9 Mounting Procedure to the Wall

## &lt;Panel Mounting&gt;

- (1) Cut out the panel according to Figure 3.10.

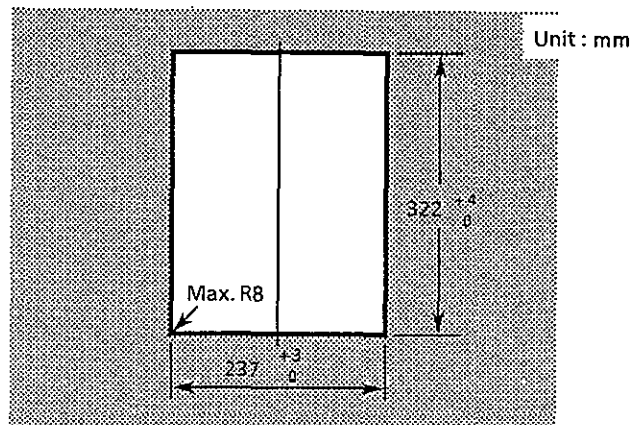


Figure 3.10 Panel Cut Dimensions

- (2) Remove the mounting fitting from the converter by loosening four screws.
- (3) Insert the converter case into the cutout hole of the panel.
- (4) Attach the mounting fitting once removed in step (2) again to the converter.
- (5) Firmly fix the converter to the panel. Fully screw two clamp screws to hold the panel with the fitting.

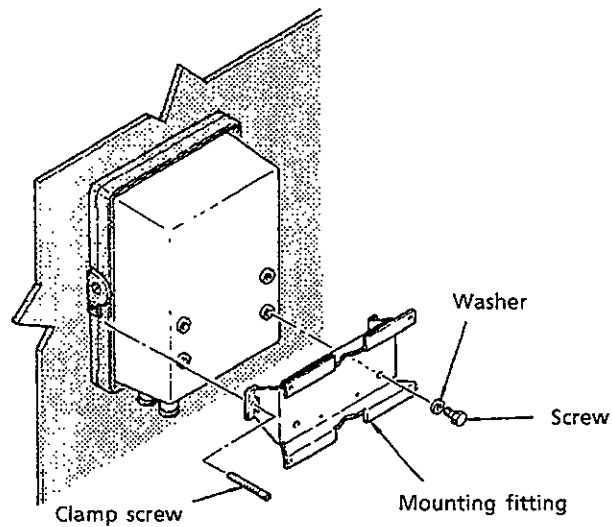


Figure 3.11 Mounting Procedure to the Panel

## 3.4 Installation of the Flow Setting Unit

When using a ZA8F or ZA8H flow setting unit, read the following:

### 3.4.1 Installation Site

The following should be taken into consideration:

- (1) Easy access for inspection and maintenance
- (2) Proximity to the detector and the converter
- (3) No corrosive gas.
- (4) An ambient temperature of not more than 80°C and little fluctuation.
- (5) No vibration.

### 3.4.2 Mounting the Flow Setting Unit

The flow setting unit can be mounted either on a pipe (nominal 50 A) or on a wall. It should be positioned vertically so that the flow meter functions correctly.

#### <Mounting on a pipe>

- (1) Attach the mounting pipe (nominal 50A : O.D. 60.5 mm) vertically so that it has sufficient strength.
- (2) Mount the flow setting unit on the pipe, using a nut to tighten the U-bolt so that the metal fixture is firmly attached to the pipe.

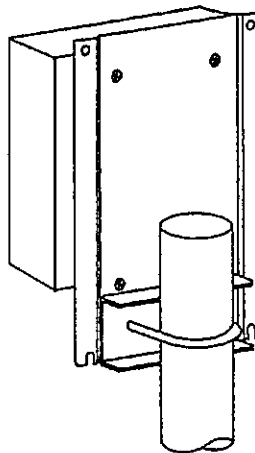


Figure 3.12 Mounting on a pipe

## &lt;Mounting on the wall&gt;

- (1) Make a hole in the wall as illustrated in Figure 3.13.

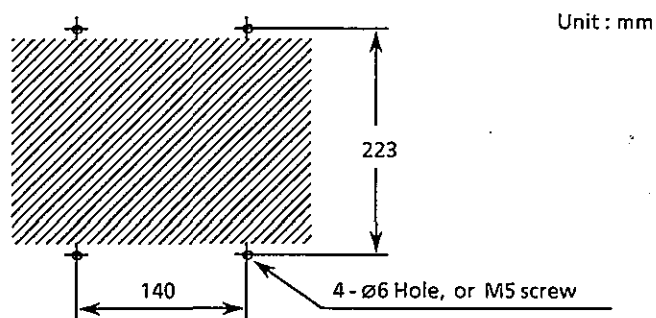


Figure 3.13 Mounting hole

- (2) Mount the flow setting unit. Remove the pipe mounting parts from the mount fittings of the flow setting unit and attach the unit securely on the wall with four screws.

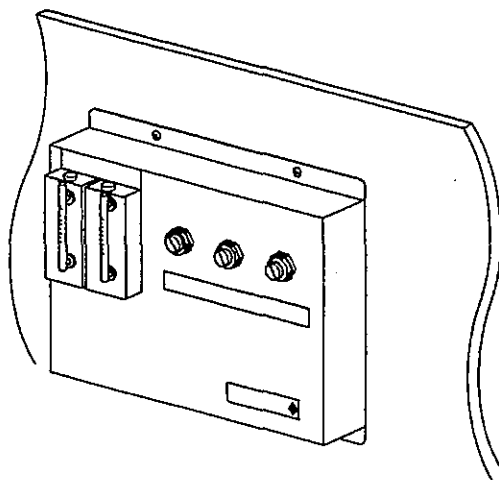


Figure 3.14 A flow setting unit attached to a wall

## 3.5 Installation of the Calibration Gas Unit Case

The calibration gas unit case is used to store the G7001ZC zero gas cylinder.

### 3.5.1 Installation Site

The following should be taken into consideration:

- (1) Easy access for cylinder replacement
- (2) Easy access for inspection
- (3) Proximity to the detector and converter as well as the flow setting unit.
- (4) No vibration.

### 3.5.2 Mounting

Mount the calibration gas unit case on a pipe (nominal 50 A) as follows:

- (1) Attach the mounting pipe (nominal 50 A : O.D. 60.5 mm) vertically so that it has sufficient strength.
- (2) Attach the calibration gas unit case on the pipe, using nuts (four) to tighten the U-bolts so that the case is firmly attached to the pipe.

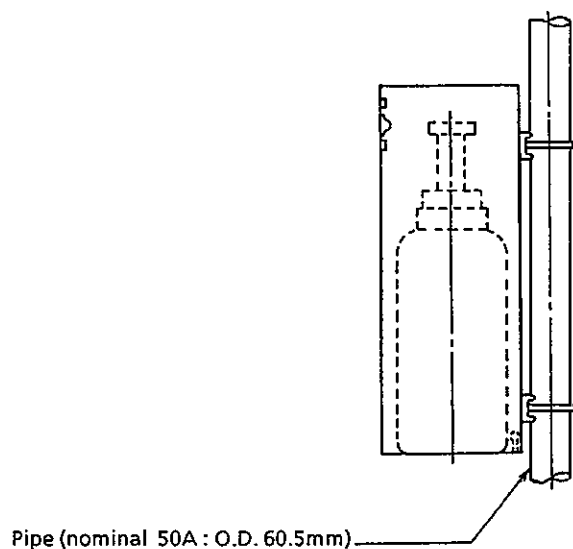


Figure 3.15 Mounting on a pipe

## 3.6 Installation of the Magnetic Valve Unit

The magnetic valve unit is used in the system configuration illustrated in Example 4.

### 3.6.1 Installation Site

The following should be taken into consideration:

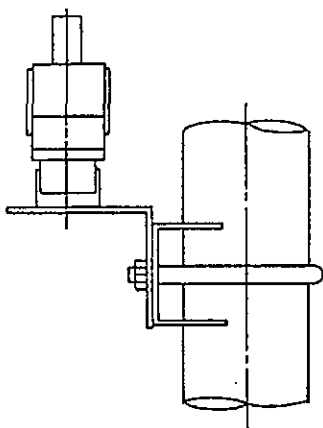
- (1) Easy access for cylinder replacement (of purge gas)
- (2) Easy access for inspection
- (3) Proximity to the flow setting unit
- (4) An ambient temperature of not more than 80°C.

### 3.6.2 Mounting

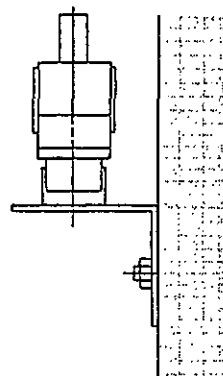
The magnetic valve unit can be mounted either on a pipe (nominal 50 A : O.D. 60.5 mm) or on a wall as follows :

- (1) If a flow setting unit has been mounted on a pipe, the magnetic valve unit can also be mounted on this pipe. Tighten the nut to the U-bolt so that the valve unit is firmly attached to the pipe.

If the valve unit is to be mounted on a wall, remove the pipe mounting metal fixture and attach the unit with two screws.



Mounting on a pipe



Mounting on a wall

Figure 3.16 Mounting the magnetic valve unit

## 4. Piping

This chapter describes piping based on system configurations 1 to 4.

### 4.1 Piping for System 1

The piping in System 1 is illustrated in Figure 4.1.

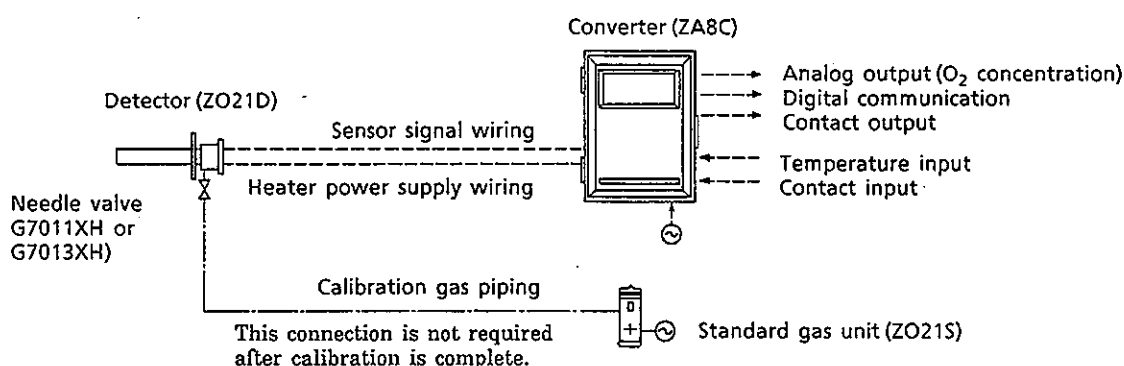


Figure 4.1 Piping for System 1

Piping in System 1 is as follows :

- Place a needle valve through a nipple at the calibration gas inlet of the detector, and mount a joint for a  $\varnothing 6 \times \varnothing 4$  mm soft tube at the needle valve connection hole of the inlet side (see Section 4.1.2). The tube is to be connected to this joint only during calibration.
- (Note) The needle valve should be connected directly to the detector. If any piping is present between the detector and the needle valve, condensed water may be produced in the pipe, which may cause damage to the sensor by rapid cooling, when the calibration gas is introduced.
- If a high-temperature detector is used, piping for the reference gas is required. In other cases, piping is required if the air around the detector is not clean (see Section 4.1.2).
- (Note) The reference gas should have an oxygen concentration identical to that of fresh air (20.9%). When a high-temperature detector is used, the sample gas is vented into the surrounding air. Therefore, the oxygen concentration required may not be obtained unless an exhaust pipe is installed.
- If a high-temperature detector is used and no piping can be installed for the reference gas, place piping in the exhaust hole for the sample gas on the high-temperature probe adapter so that the sample gas is carried away from the vicinity of the detector (see Section 4.1.4, Figure 4.6).
- If a high-temperature detector is used and the gas to be analyzed is under negative pressure, connect the auxiliary ejector to the sample gas exhaust hole of the high-temperature probe adapter (see Section 4.1.4, Figure 4.3).
- If a high-temperature detector is used and the pressure of the gas to be analyzed is above 50 mm H<sub>2</sub>O, it is recommended that a needle valve (throttle) be used in the sample gas exhaust of the high-temperature probe adapter (see Section 4.1.4, Figure 4.4).

(Note) This is for lowering the sample gas temperature below 600°C. If the gas temperature is high and the pressure is also significantly high, the sampled gas temperature may not decline below 600°C when reaching the detector.

On the other hand, if the sample gas temperature is lowered too much, condensation may form in the high-temperature probe adapter. During winter time, it is recommended that the probe adapter be protected with an adiabatic material to prevent condensation.

#### 4.1.1 Parts Required for Piping in System 1

Check that the parts listed in Table 4.1 are ready.

Table 4.1 Parts requiredd for piping

Detector	Piping section	Parts required	Description	
Low-temp. detector	At the calibration gas inlet	Needle valve	Recommended by YOKOGAWA (G7011XH or G7013XH)	
		* Nipple	PT 1/8 or 1/8 NPT	On the open market
		Tube connecting joint	PT 1/8 (1/8 NPT) — $\varnothing 6 \times \varnothing 4$ mm soft tube	On the open market
	At the reference gas inlet	(Closed)	(See Section 4.1.3 if piping is required)	
High-temp. detector	At the calibration gas inlet	Needle valve	Recommended by YOKOGAWA (G7011XH or G7013XH)	
		* Nipple	PT 1/8 or 1/8 NPT	On the open market
		Tube connecting joint	PT 1/8 (or 1/8 NPT) — $\varnothing 6 \times \varnothing 4$ mm soft tube joint	
	At the reference gas inlet	(Closed)	(See Section 4.1.3 if piping is required)	
	At the sample gas exhaust	* Auxiliary ejector * T-shaped joint of identical diameter, piping joint	Recommended by YOKOGAWA (E7046EC or E7046EN)	
			PT 1/4 or 1/4 NPT	On the open market
		* Needle valve * Tapered nipple	PT 1/4 or 1/4 NPT	On the open market
			PT 1/2 — PT 1/4 or PT 1/2 — 1/4 NPT	On the open market

Note: The parts with an asterisk(\*) may not be required.

#### 4.1.2 Connection to the Calibration Gas Inlet

When carrying out calibration, connect the piping ( $\varnothing 6 \times \varnothing 4$  mm tube) from the standard gas unit to the calibration gas inlet of the detector. When the calibration is finished, mount the needle valve (of a quality specified by YOKOGAWA) through a nipple (found on the open market) as illustrated in Figure 4.2, and mount a piping joint (also found on the open market) at the needle valve tip. (The needle valve may be mounted on the detector when the detector is shipped.)

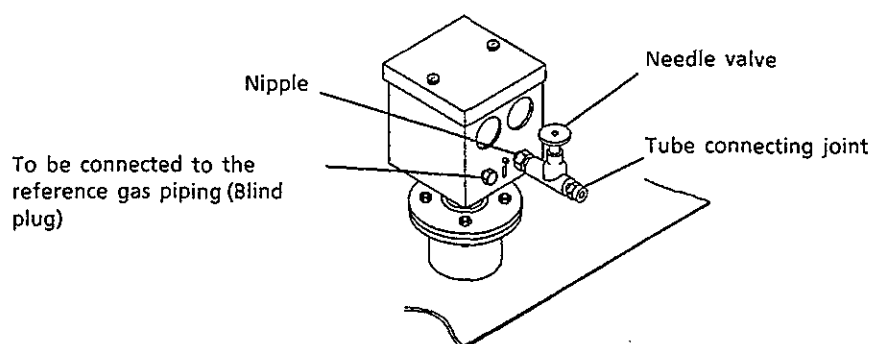


Figure 4.2 Connection to the calibration gas inlet

#### 4.1.3 Connection to the Reference Gas Inlet

Normally, no piping is required for the reference gas inlet. Leave the plug as it is. However, if the air around the detector is polluted and the necessary oxygen concentration cannot be obtained, prepare piping the same as in System 2.

#### 4.1.4 Piping to the High-Temperature Probe Adapter

The gas to be analyzed should be at a temperature below 600°C before reaching the detector sensor. If the gas is under negative pressure, it should be fed to the detector by way of forced suction. These are the reasons for piping to the high-temperature detector probe adapter.

If the gas to be analyzed is under negative pressure, connect the auxiliary ejector as illustrated in Figure 4.3. Mount the pressure gauge in the vicinity of the auxiliary ejector. However, if the ambient temperature is too high, mount it in a location with a temperature below 40°C.

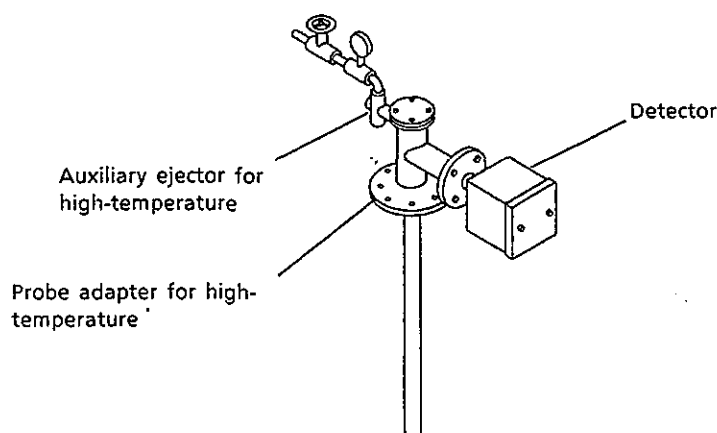


Figure 4.3 Connecting the Auxiliary Ejector

If the temperature of the gas to be analyzed exceeds the specified value and its pressure exceeds 50 mm H<sub>2</sub>O, the sample gas temperature may not be below 600°C at the detector. In such a case, connect a needle valve (found on the open market) through a nipple (also found on the open market) to the probe adapter sample gas exhaust (PT 1/2 female screw) so that the sample gas exhaust volume is minimal.

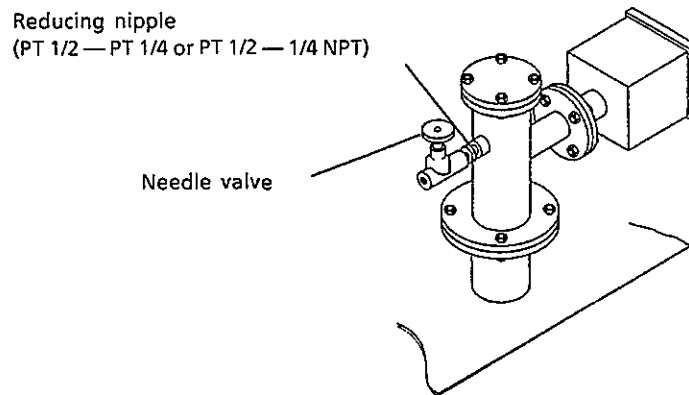


Figure 4.4 Connecting the needle valve for adjusting the sample gas exhaust volume

In the case where condensation is likely to occur in the probe adapter when the sample gas is cooled, protect the probe adapter with an adiabatic material as illustrated in Figure 4.5.

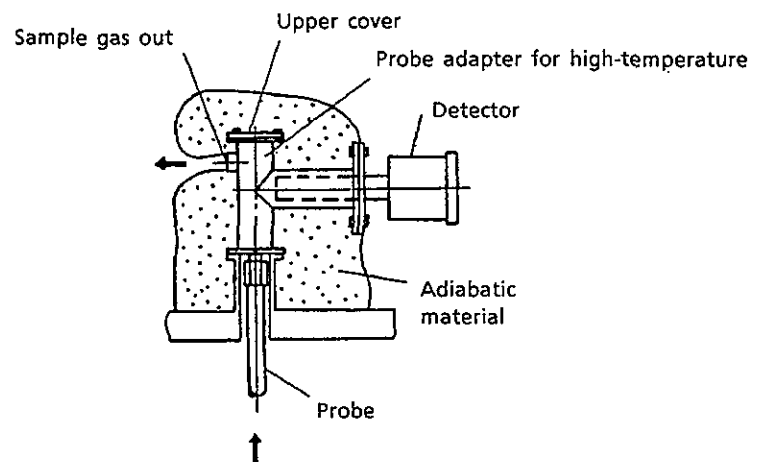


Figure 4.5 Countermeasures against condensation

If the sample gas is to be vented at a distance from the detector because no reference gas piping can be provided, the exhaust pipe should be installed as illustrated in Figure 4.6.

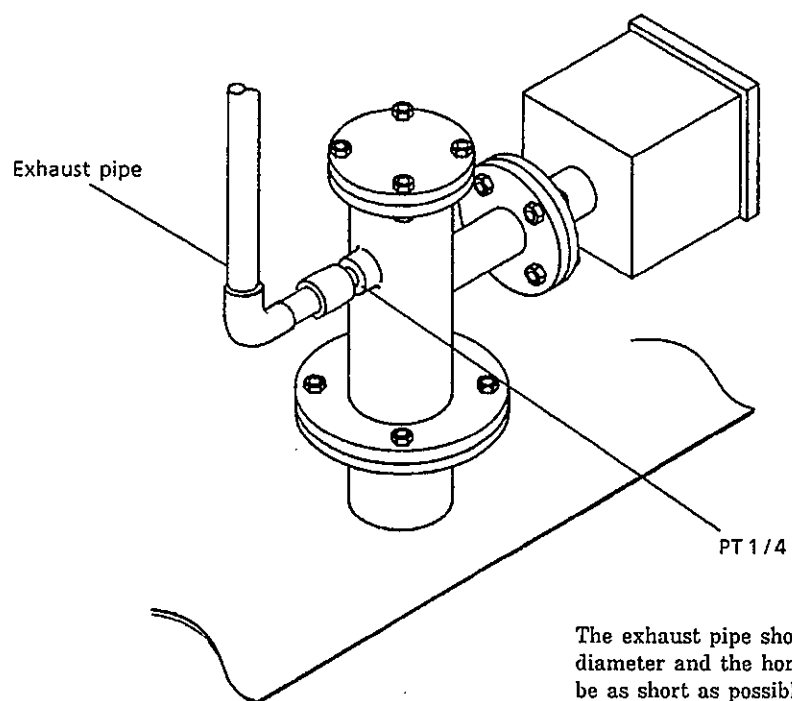


Figure 4.6 Installing the exhaust pipe

## 4.2 Piping for System 2

Piping in System 2 is illustrated in Figure 4.7.

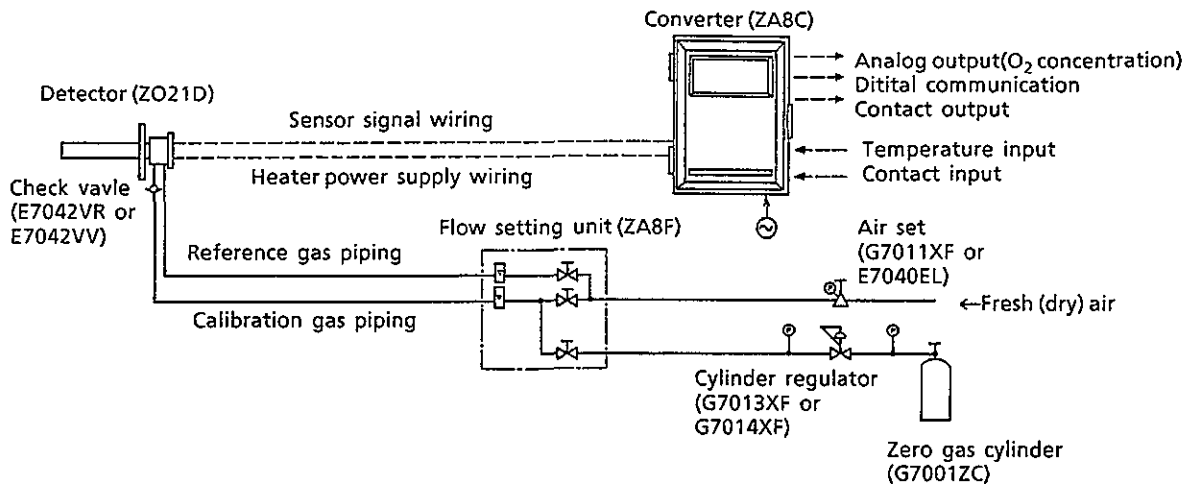


Figure 4.7 Piping for System 2

System 2 illustrated in Figure 4.7 requires piping as follows:

- Mount the check valve through a nipple to the reference gas inlet of the detector.
- If a high-temperature detector is used and the sample gas is under negative pressure, connect the auxiliary ejector to the sample gas exhaust hole of the high-temperature probe adapter (see Section 4.1.4, Figure 4.3).
- If a high-temperature detector is used and the sample gas pressure exceeds 50 mm H<sub>2</sub>O, "throttle" with the needle valve is required at the sample gas exhaust hole of the high-temperature probe adapter (see Section 4.1.4, Figure 4.4).

(Note) This is for lowering the sample gas temperature below 600°C. If the gas temperature is high and the pressure is also significantly high, the sampled gas temperature may not be below 600°C upon reaching the detector.

On the other hand, if the sample gas temperature is lowered too much, condensation may form in the high-temperature probe adapter. During winter time, it is recommended that the probe adapter be protected with an adiabatic material to prevent condensation.

- If the dust sticking to the interior of the high-temperature probe adapter is to be eliminated by blow back while using the high-temperature detector, the air feed for blow back should also be taken into consideration.

(Note) The probe is easily clogged if too much dust is contained in the sample gas such as in a recovery boiler or cement kiln. To get rid of the dust with compressed air, the piping from the air source is connected only during cleaning. Blow back piping can be installed for dust cleaning as illustrated in Section 4.3.1.

### 4.2.1 Piping Parts for System 2

Check that the parts listed in Table 4.2 are ready.

Table 4.2 Piping parts

Detector	Piping section	Parts required	Description
Low-temp. detector	Calibration gas piping	Check valve	Recommended by YOKOGAWA (E7042VR or E7042VV)
		* Nipple	PT 1/8 or 1/8 NPT On the open market
		Zero gas cylinder	Recommended by YOKOGAWA (G7001ZC)
		Regulator valve	Recommended by YOKOGAWA (G7013XF or G7014XF)
		Piping joining	PT 1/8 or 1/8 NPT On the open market
	At the reference gas inlet	Air set	Recommended by YOKOGAWA (G7011XF or E7040EL)
		Piping joint	PT 1/8 or 1/8 NPT On the open market
High-temp. detector	At the calibration gas inlet	Check valve	Recommended by YOKOGAWA (E7042VR or E7042VV)
		* Nipple	PT 1/8 or 1/8 NPT On the open market
		Zero gas cylinder	Recommended by YOKOGAWA (G7001ZC)
		Regulator valve	Recommended by YOKOGAWA (G7013XF or G7014XF)
		Piping joining	PT 1/8 or 1/8 NPT On the open market
	At the reference gas inlet	Air set	Recommended by YOKOGAWA (G7011XF or E7040EL)
		Piping joining	PT 1/8 or 1/8 NPT On the open market
	At the sample gas exhaust	* Auxiliary ejector * T-shaped joint with identical diameter, piping joint	Recommended by YOKOGAWA (E7046EC or E7046EN) PT 1/4 or 1/4 NPT On the open market
		* Needle valve	PT 1/4 or 1/4 NPT On the open market
		* Tapered nipple	PT 1/2 — PT 1/4 or PT 1/2 — 1/4 NPT On the open market

Note: The parts with an asterisk (\*) may not be required.

### 4.2.2 Piping for the Calibration Gas

This piping is to be installed between the zero gas cylinder and the flow setting unit, and between the flow setting unit and the detector.

The cylinder should be placed in a calibration gas unit case so as not to subject it to direct sunlight. Mount the regulator valve (specified by YOKOGAWA) on the cylinder.

Mount the check valve (recommended by YOKOGAWA) through the nipple (found on the open market) at the detector calibration gas inlet as illustrated in Figure 4.8. (The check valve may have been mounted on the detector when shipped.) Connect the flow setting unit and the detector with a stainless steel pipe  $\varnothing 6 \times \varnothing 4$  mm (or nominal size 1/4 inch).

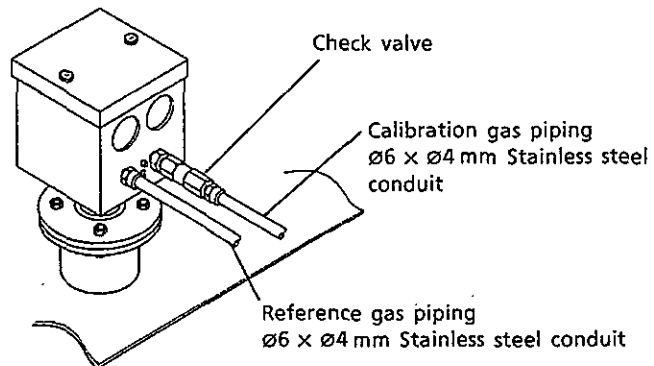


Figure 4.8 Check the valve connection to the calibration gas inlet

### 4.2.3 Piping for the Reference Gas

Reference gas piping is required between the air source (fresh air) and the flow setting unit and between the flow setting unit and the detector.

Insert the air set next to the flow setting unit in the piping between the air source and the flow setting unit.

Use a  $\varnothing 6 \times \varnothing 4$  mm (or nominal size 1/4 inch) stainless steel pipe between the flow setting unit and the detector.

### 4.2.4 Piping to the High-Temperature Probe Adapter

See Section 4.1.4.

## 4.3 Piping for System 3

Piping in System 3 is illustrated in Figure 4.9. In System 3, calibration is automated but the piping is basically the same as that of System 2. See Section 4.2.

If contact input to the converter is used for the blow back function, prepare blow back piping according to Section 4.3.1.

(Note) Blow back function means the function to get rid of dust inside a high-temperature probe adapter using compressed air when a high-temperature detector is used.

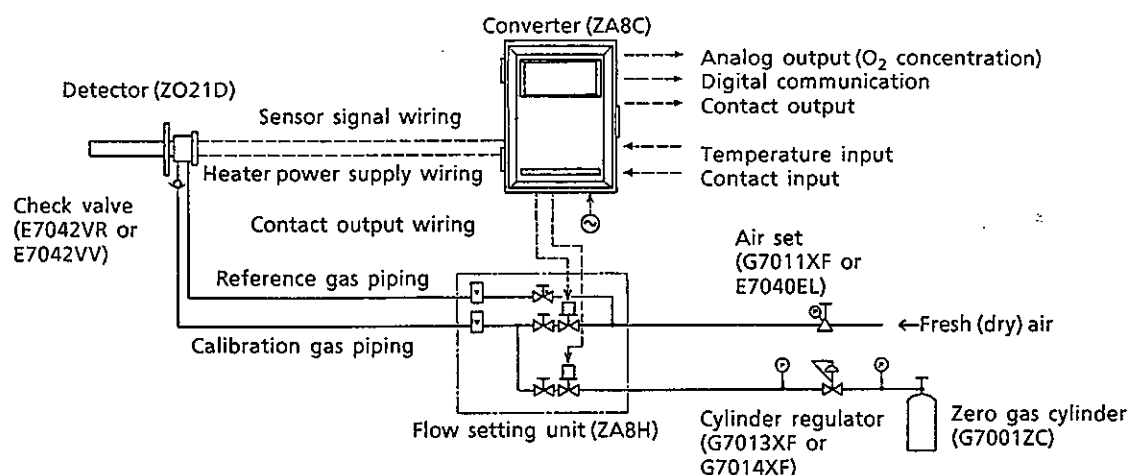


Figure 4.9 Piping for System 3

### 4.3.1 Piping for the Blow Back Function

This piping is required when the blow back function is carried out. The piping described below provides automatic blow back operation when the "blow back start" command is entered to the converter.

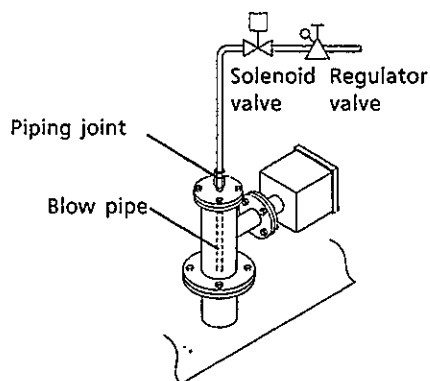


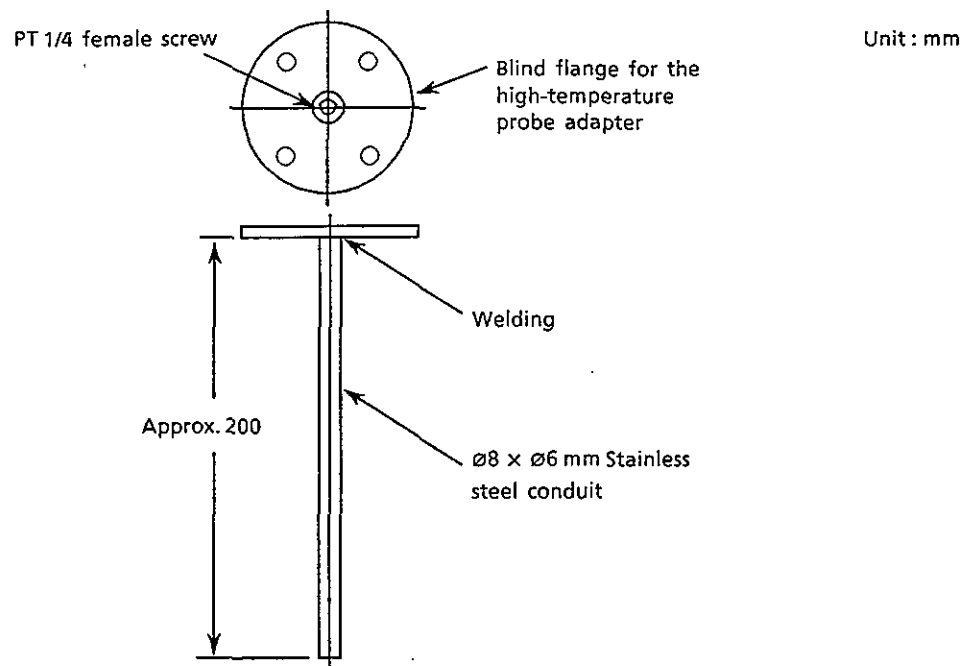
Figure 4.10 Blow back piping

The following parts are required for blow back piping.

- Blow pipe (to be prepared as illustrated in Figure 4.11.)
- Two-way solenoid valve: "Open" when electric current is on. (Found on the open market)
- Air set (recommended by YOKOGAWA, G7011XF or E7040EL)

#### <Blow pipe installation>

Install the blow pipe as illustrated in Figure 4.11, and mount it on the high-temperature blow adapter.

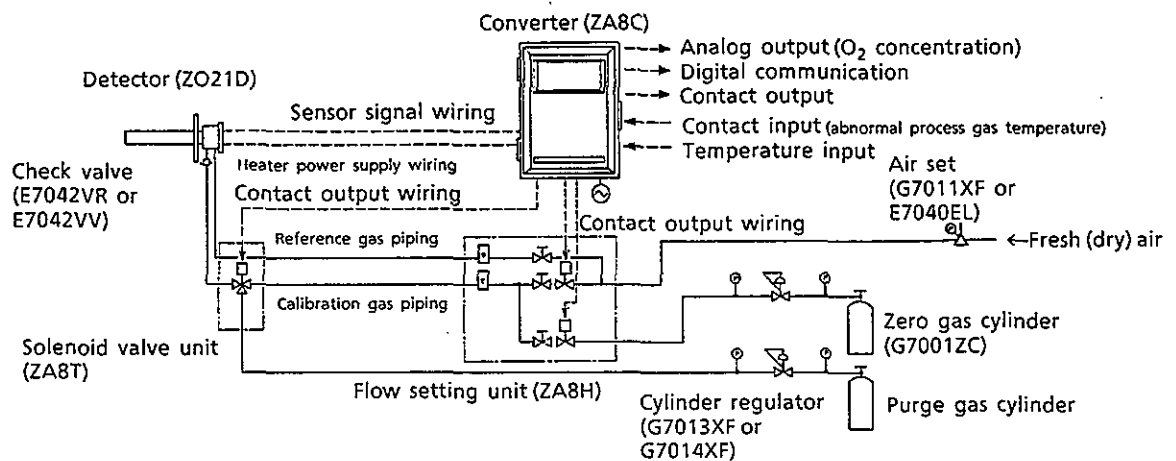


**Figure 4.11 Blow pipe**

#### 4.4 Piping for System 4

Piping in System 4 is illustrated in Figure 4.12. The piping in this system is basically identical to that of System 2 or System 3. The difference is that piping in System 4 includes additional piping to introduce purge gas to the detector when combustible gases are produced. If the contact input to the converter is used for the blow back function, the corresponding piping is also required.

(Note) Blow back function means the function to get rid of dust inside a high-temperature probe adapter using compressed air when a high-temperature detector is used.



**Figure 4.12 Piping for System 4**

Prepare the piping in this system as follows :

- Mount the check valve through a nipple at the calibration gas inlet of the detector.
- If the sample gas is under negative pressure when using a high-temperature detector, connect an auxiliary ejector at the sample gas exhaust hole of the high-temperature probe adapter (see Section 4.1.4).
- If the pressure of the gas to be analyzed is over 50 mm H<sub>2</sub>O when using a high-temperature detector, "throttle" such as that obtained by the needle valve is required at the sample gas exhaust hole of a high-temperature probe adapter (see Section 4.1.4, Figure 4.4).

(Note) This is for lowering the sample gas temperature below 600°C. If the gas temperature is high and the pressure is also significantly high, the sampled gas temperature may not be below 600°C upon reaching the detector.

On the other hand, if the sample gas temperature is lowered too much, condensation may form in the high-temperature probe adapter. During winter time, it is recommended that the probe adapter be protected with an adiabatic material to prevent condensation.

- If dust sticking to the interior of a high-temperature probe adapter is to be eliminated by blow back while using the high-temperature detector, the air feed for blow back should also be taken into consideration.

(Note) The probe is easily clogged if too much dust is contained in the sample gas such as in a utility boiler or cement kiln. To get rid of the dust with compressed air, the piping from the air source is connected only during the cleaning. Blow back piping can be installed for dust cleaning as illustrated in Section 4.3.1.

#### 4.4.1 Piping Parts for System 4

Check that the piping parts listed on Table 4.3 are ready.

Table 4.3 Piping parts

Detector	Piping section	Parts required	Description
Low-temp. detector	Calibration gas and purge gas	Check valve	Recommended by YOKOGAWA (E7042VR or E7042VV)
		* Nipple	PT 1/8 or 1/8 NPT On the open market
		Zero gas cylinder	Recommended by YOKOGAWA (G7013XF)
		Cylinder regulator valve	Recommended by YOKOGAWA (G7014XF or G7001ZC)
		Piping joining	PT 1/4 or 1/4 NPT On the open market
		Purge gas cylinder	Recommended by YOKOGAWA (G7001ZC)
		Regulator valve (purge gas)	Recommended by YOKOGAWA (G7013XF or G7014XF)
	At the reference gas inlet	Air set	Recommended by YOKOGAWA (G7011XF or E7040EL)
		Piping joint	PT 1/8 or 1/8 NPT On the open market
High-temp. detector	Calibration gas inlet and purge gas	Check valve	Recommended by YOKOGAWA (E7042VR or E7042VV)
		* Nipple	PT 1/8 or 1/8 NPT On the open market
		Zero gas cylinder	Recommended by YOKOGAWA (G7001ZC)
		Cylinder regulator valve	Recommended by YOKOGAWA (G7013XF or G7014XF)
		Piping joining	PT 1/4 or 1/4 NPT On the open market
		Purge gas cylinder	Recommended by YOKOGAWA (G7013XF)
		Regulator valve (purge gas)	Recommended by YOKOGAWA (G7014XF or G7001ZC)
	At the reference gas inlet	Air set	Recommended by YOKOGAWA (G7011XF or E7040EL)
		Piping joint	PT 1/8 or 1/8 NPT On the open market
	At the sample gas exhaust	* Auxiliary ejector * T-shaped joint with identical diameter, piping joint	Recommended by YOKOGAWA (E7046EC or E7046EN) PT 1/4 or 1/4 NPT On the open market
		* Needle valve	PT 1/4 or 1/4 NPT On the open market
		* Tapered nipple	PT 1/2 — PT 1/4 or PT 1/2 — 1/4 NPT On the open market

Note: The parts with an asterisk (\*) may not be required.

#### 4.4.2 Piping for the Calibration Gas

Calibration gas piping is required between the zero gas cylinder and the flow setting unit, between the flow setting unit and the solenoid valve unit, and between the solenoid valve unit and the detector.

The cylinder should be protected from direct sunlight by storing it in the calibration gas unit case or in another way. Mount the regulator valve (recommended by YOKOGAWA) on the cylinder.

Mount the check valve (recommended by YOKOGAWA) through a nipple (found on the open market) at the detector calibration gas inlet as illustrated in Figure 4.13. (The check valve may have been mounted on the detector when shipped.)

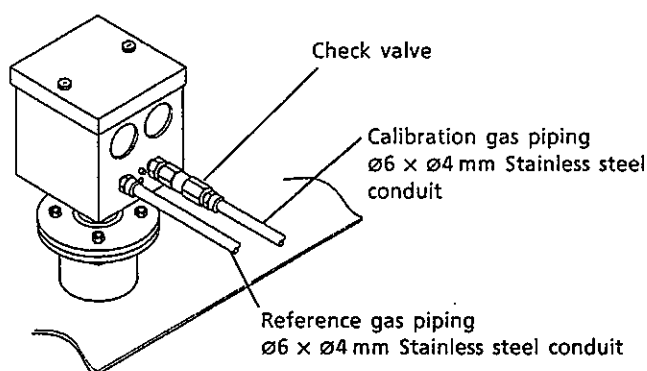


Figure 4.13 Check valve connection to the calibration gas inlet

Piping from the flow setting unit is to be connected to the solenoid valve unit connection hole NO.

Use stainless steel pipe between the solenoid valve unit (connection hole : COM) and the detector.

#### 4.4.3 Piping for the Purge Gas

Install the piping to connect the purge gas cylinder with the flow setting unit.

The cylinder should be protected from direct sunlight by storing it in the calibration gas unit case, for example. Mount the regulator valve (recommended by YOKOGAWA) on the cylinder.

The piping from the cylinder should be connected to the solenoid valve unit connecting hole NC.

#### 4.4.4 Piping for the Reference Gas

Reference gas piping is required between the air source (fresh air) and the flow setting unit, and between the flow setting unit and the detector.

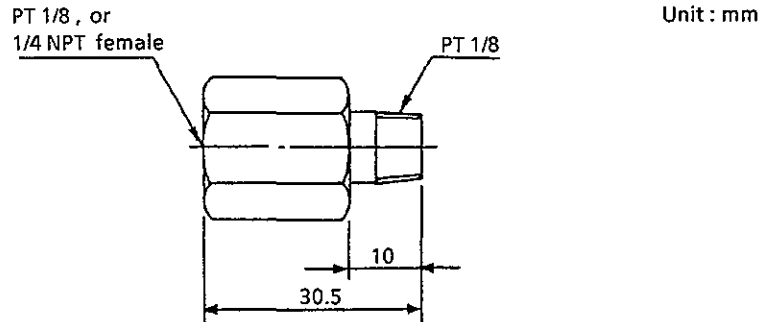
In the piping between the air source and the flow setting unit, insert the air set adjacent to the flow setting unit. The piping between the flow setting unit and the detector should be installed using Ø6 x Ø4 mm (or nominal size 1/4 inch) stainless steel pipe.

#### 4.4.5 Piping to the High-Temperature Probe Adapter

The same as in system configuration 1. See Section 4.1.4.

## 4.5 Air Purge Tubing in the Converter

It is recommended that air purging is employed when the converter is to be installed in a place whose atmospheric gas is corrosive. If specified, the converter is delivered with air purge joint (each one for air supply and venting ports) attached. Connect tubings in the following procedure.



(Note) The air supply joint has a different diameter for air hole from that of the air venting joint. Be sure to use the joint having the  $\varnothing 0.5$  mm dia. hole for the air supply port.

Figure 4.14 Air Purge Joint

### 4.5.1 Air Supply for Air Purge

Air purge should be implemented using clean and dry air. Employ instrument air or the like as the source of purge air. Air consumption is approximately 5 l/min when the supply air pressure is 0.5 kgf/cm<sup>2</sup>.

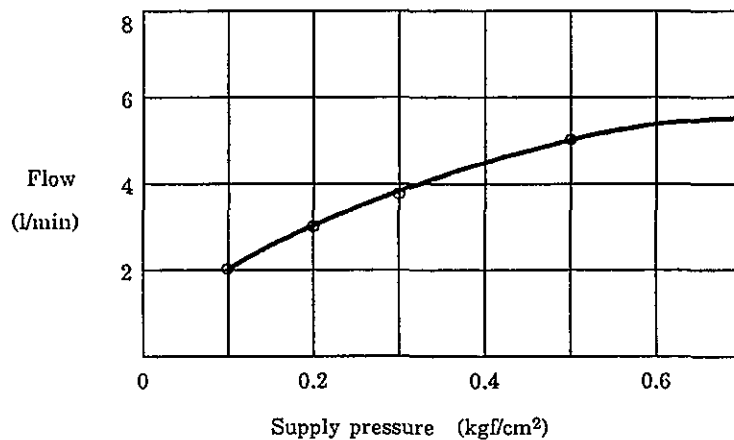


Figure 4.15 Flow Characteristics of Air Supply Joint

### 4.5.2 Tubing Procedure

Remove each tapered plug with hexagon socket attached to two air purge joint connections at the bottom of the converter case, and connect the attached joints. Connect an air supply to the air purge supply port with a copper tube of  $\varnothing 6$  mm O.D.  $\times$   $\varnothing 4$  mm I.D. (or nominal size 1/4" tube) through a pressure regulator. Normally, a tubing is not necessary to connect for the venting joint (may be connected if purging air is supplied to another instrument).

## 5. WIRING

In this Chapter, the wiring necessary for connection to the Model ZA8C converter is described.

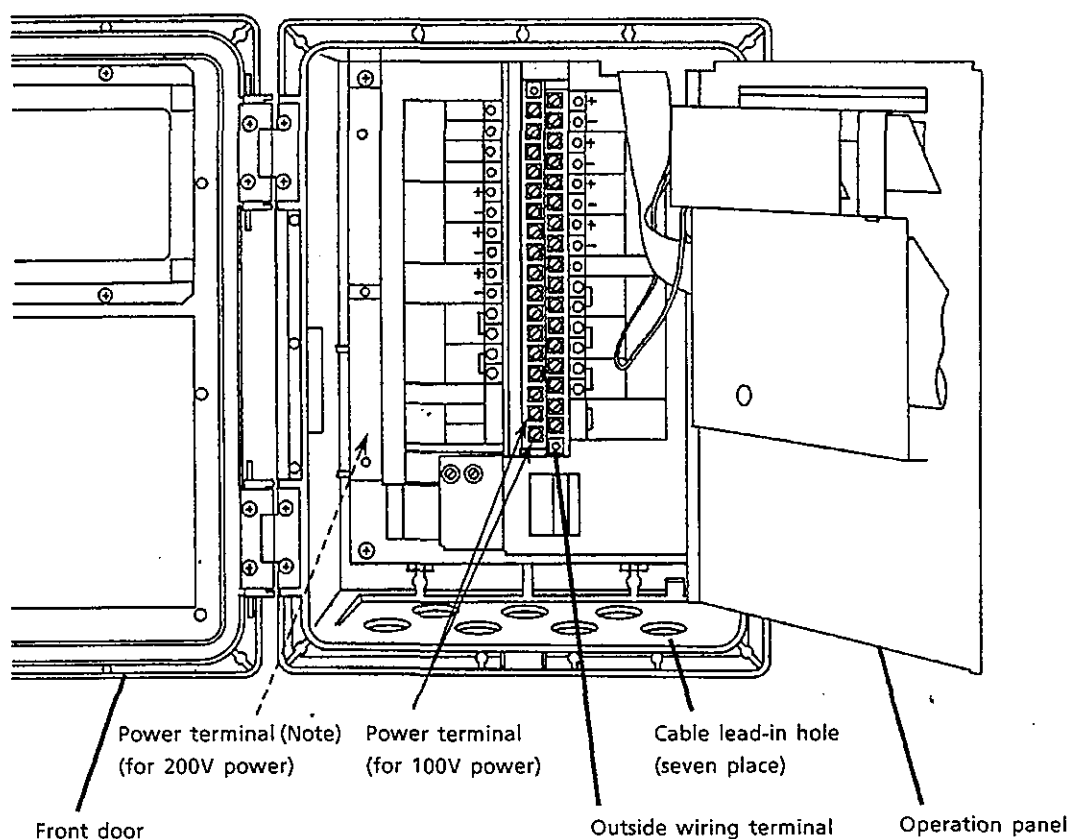
### 5.1 General

#### 5.1.1 Safety Precaution During Wiring

Never supply current to the converter or any other device constituting a power circuit in combination with the converter, until all wiring is completed. Otherwise, electric shock may occur even if the main switch in the converter is OFF, as some terminals are still energized.

#### 5.1.2 Outer wiring terminals of the Converter

Outer wiring terminals can be seen, when the front door and further the operation panel are opened. The positions of terminals are a little different between converter for 100V power and converter for 200V power.



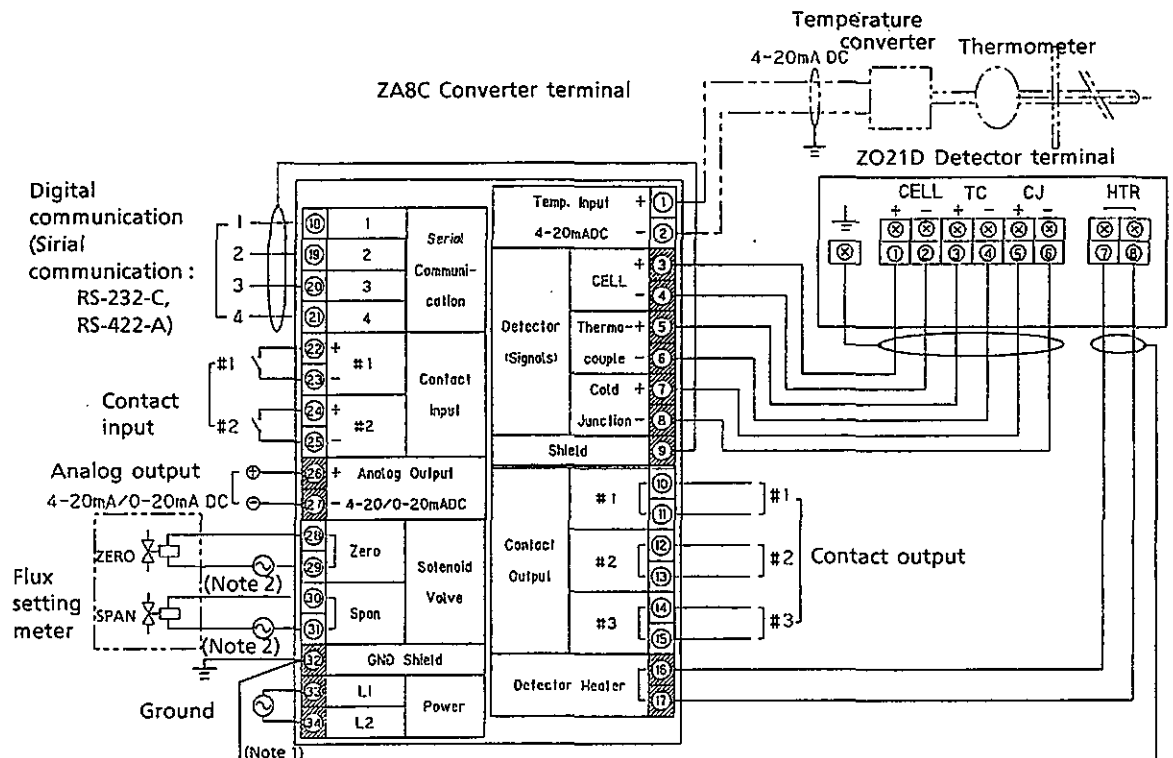
(Note) In case of converters for 220 V or 240 V AC power, an exclusive terminal is prepared at the left corner inside.

Figure 5.1 Outer wiring terminals of the Converter

### 5.1.3 Types of Wiring

Wiring for the following purposes can be connected to the converter. There can be up to 9 wiring channels. However, there are only 7 cable wiring ports. If wiring channels exceeding the number of cable wiring ports are to be used, and if waterproofness is required, decrease the number of cables to seven by arranging for similar wiring channels (e.g., application-selecting contact output and flow setting unit solenoid valve-driving contact output) to be connected to one cable.

- (1) Detector output wiring (connects the converter with the detector.)
- (2) Detector heater power wiring (connects the converter with the detector.)
- (3) Analog output signal wiring
- (4) Power and ground wiring
- (5) Digital communication (optional)
- (6) Contact output wiring (optional)
- (7) Flow rate setting unit solenoid valve drive wiring (optional)
- (8) Contact input wiring (optional)
- (9) Measurement gas temperature input signal (optional)



(Note 1) Converter power supply: 100, 115, 220, 240 V AC 50/60 Hz  
(In case of 220 or 240 V AC, the terminals 32, 33 and 34 are separated from the terminal block in this diagram and put on another independent terminal block.)

(Note 2) Flow setting unit power supply: 100, 110, 115, 200, 220, 240 V AC

Figure 5.2 Output Wiring for Converter

### 5.1.4 Mounting of Cable Gland

A cable gland (nominal size : A20), available on the open market, is mounted to the cable bushing of the converter, except that wire conduit work is done. Install the cable gland by attaching it to the case with a nut. The cable gland (equivalent to nominal size A20, plastic) is attached as an accessory to the converter only when required.

- (1) Remove the nut from the cable gland as prepared and set the nut in the keyway inside the cable bushing.
- (2) Screw the gland onto the nut of (1), from the outside. At that time, be sure to use a gasket to seal completely the space between the case hole and the gland.

## 5.2 Wiring for Detector Output

This wiring enables the converter to receive cell output from the detector, output from a thermocouple and a signal for compensating the cold contact. Install wires that allow for  $10\Omega$  of loop resistance or less. Install these wires apart from the power wiring.

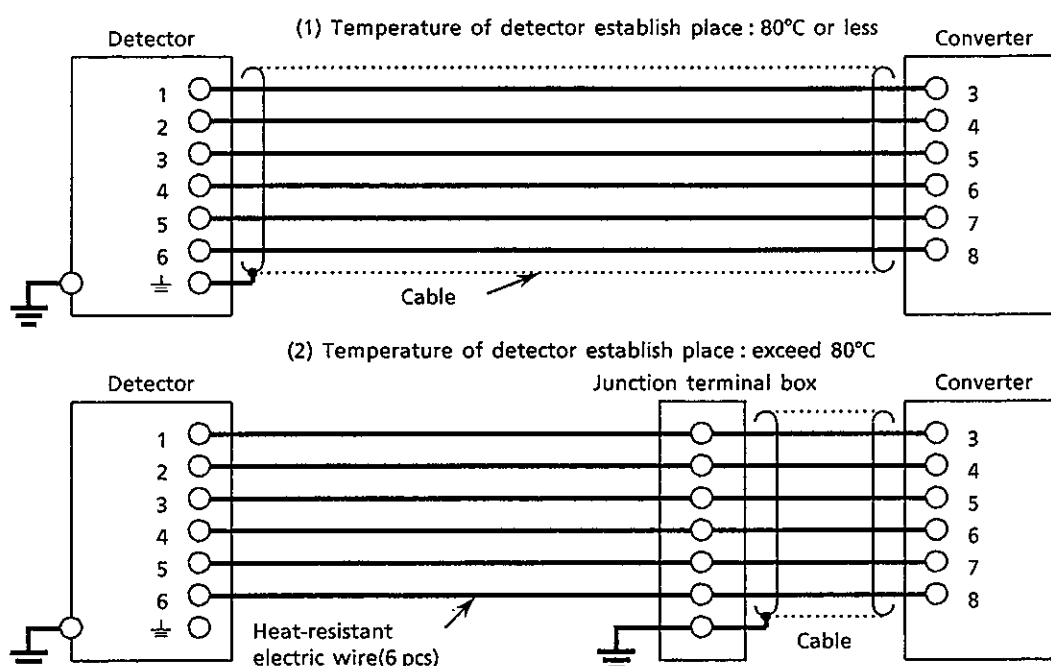


Figure 5.3 Output Wiring for Detector

### 5.2.1 Cable Specifications

For this wiring, a shield cable with an outside diameter of  $\varnothing 11$  to  $\varnothing 14$  mm is used. On the detector side, select any of the following cables depending on the ambient temperature at the installation site of the detector.

- Ambient temperature of 60°C or less : PVC insulated PVC sheathed control cable (6 cores)
- Ambient temperature of 60 to 80°C : PVC insulated PVC sheathed control cable (heat-resistant, 6 cores)
- Ambient temperature of 80 to 150°C : 600 V silicon rubber insulated glass braided wire  $\times$  6 pcs.

### 5.2.2 Connection to Detector

To connect a cable to a detector, be careful of the following:

- (1) The diameter of the cable bushing hole in the detector is  $\varnothing 27$  mm. Protect the cable by using a flexible wire conduit of a nominal diameter of 19 mm. The detector may need to be removed in the future for maintenance, so be sure to allow a sufficient cable length.
- (2) If the ambient temperature at the wire installation site is 80 to 150°C, be sure to use a flexible metallic wire conduit. If a non-shielded "600 V silicon rubber insulated glass braided wire" is used, avoid picking up external noise by separating the wire from noise sources.
- (3) Figure 5.4 shows the layout of the detector terminals.

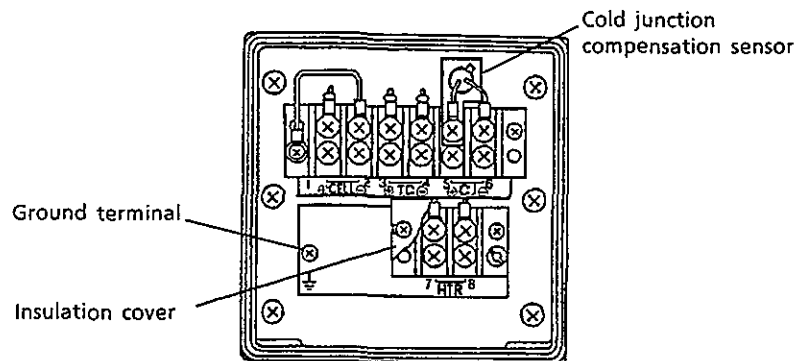


Figure 5.4 Layout of Detector Terminals

The sizes of the terminal screw threads are M4 and M3 for general and high-temperature detectors, respectively. So, use a crimp terminal\*1 conforming to your cable terminals.

\*1 If the ambient temperature at the detector installation site exceeds 60°C, use a "bare crimp terminal".

- (4) Except when a "600 V silicon rubber insulated glass braided wire" is used, connect the cable shield to the ground terminal.

Note: With a "600 V silicon rubber insulated glass braided wire" in use, ground the system on the converter side.

### 5.2.3 Connection to Converter

To connect the wiring to the converter, be careful of the following:

- (1) The size of terminal screw threads for the converter is M4. Use a crimp terminal conforming to this size for connecting the cable.
- (2) With silicon rubber insulated glass braided wire used for wiring to the detector, it is a general rule to use a cable, e.g. PVC insulated PVC sheathed control cable, via the junction terminal box from this terminal box to the converter.

Note: This is intended to prevent moisture or corrosive gas from entering the converter and to ground the detector completely.

- (3) Do not connect the ground wiring for the terminals in the detector, to the ground terminal in the converter in redundancy. Also, see 5.4 for grounding.

## 5.3 Wiring for Power to the Detector Heater

This wiring provides electric power from the converter to the heater for heating the sensor in the detector.

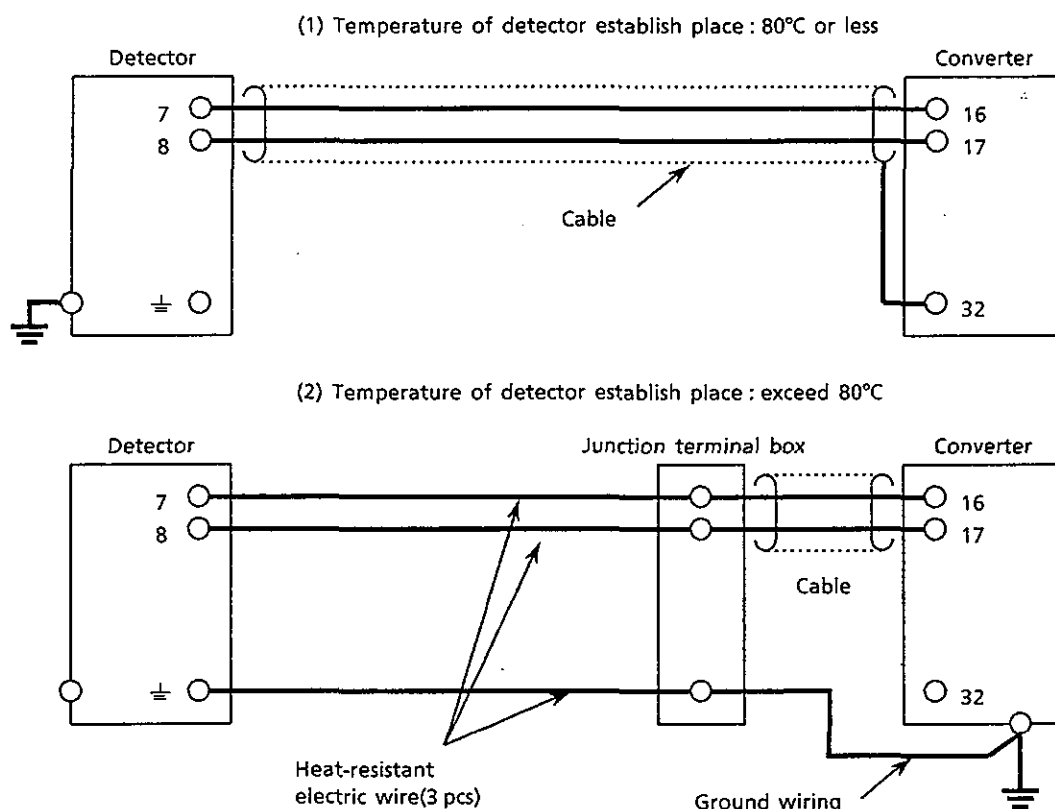


Figure 5.5 Wiring for Detector Heater Power

### 5.3.1 Cable Specifications

For this wiring, it is a general rule to use a shield cable with an outside diameter of  $\varnothing 8$  to  $\varnothing 11$  mm. On the detector side, select any of the following types of cables depending on the ambient temperature at the detector installation site.

- Ambient temperature of 60°C or less : PVC insulated PVC sheathed control cable (2 cores)
- Ambient temperature of 60 to 80°C : PVC insulated PVC sheathed control cable (heat-resistant, 2 cores)
- Ambient temperature of 80 to 150°C : 600 V silicon rubber insulated glass braided wire  $\times 3$  pcs.

Note: A wire with 3 pcs. is used for grounding.

### 5.3.2 Connection to Detector

Be careful of the following for connecting the cable to the detector:

- (1) The outside diameter of the cable bushing in the detector is  $\varnothing 27$  mm. Use a flexible wire conduit of a nominal size of 19 for protecting the cable. Allow for sufficient cable length because the detector may be removed in the future for maintenance.
- (2) If the ambient temperature at the wiring installation site is 80 to 150°C, be sure to use a flexible metallic wire conduit.
- (3) The sizes of the terminal screw threads are M4 and M3 for general and high-temperature detectors, respectively. So, use a crimp terminal\*1 conforming to the terminals of your cable.

\*1: If the ambient temperature at your detector installation site exceeds 60°C, use a "bare crimp terminal".

- (4) Don't connect the cable shield to the ground terminal in the detector. If a "600 V silicon rubber insulated glass braided wire" is used for wiring, connect the ground wire to the ground terminals in the devices as shown in Figure 5.5.

### 5.3.3 Connection to Converter

For connecting a cable to a converter, be careful of the following:

- (1) The size of terminal screw threads in the converter is M4. Use a crimp terminal conforming to this size for connecting your cable.
- (2) When the silicon rubber insulated glass braided wire is used for wiring to the detector, it is a general rule to use a cable, e.g. PVC insulated PVC sheathed control cable, via the junction terminal box from this terminal to the converter.

(Note) This is intended to prevent moisture or corrosive gas from entering the converter. If the atmosphere around the detector and the converter is good, you may lead the wiring from the detector directly to the converter by protecting it with a wire conduit.

## 5.4 Wiring for Analog Output

This wiring is for transmitting 4 to 20 mA DC or 0 to 20 mA DC output signals to a device, e.g. recorder. Maintain the load resistance at 550  $\Omega$  or less.

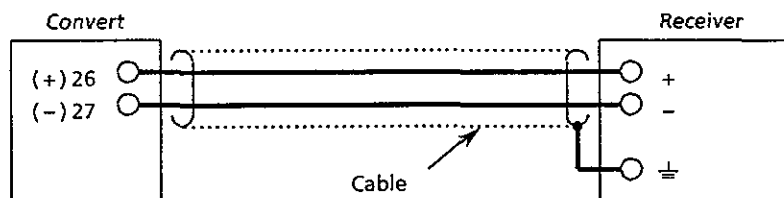


Figure 5.6 Wiring for Analog Output

#### 5.4.1 Cable Specifications

For this wiring, use a 2-core shielded cable with an outside diameter of  $\varnothing 8$  to  $\varnothing 11$  mm.

#### 5.4.2 Wiring Methods

- (1) The size of the converter terminal screw threads is M4. Use a crimp terminal conforming to this size for connecting your cable. Connect the shield of the cable generally on the side of the device to be connected.
- (2) Be sure to connect "+" and "-" polarities correctly.

## 5.5 Power and Ground Wiring

These wirings provide the converter with driving power and ground the converter.

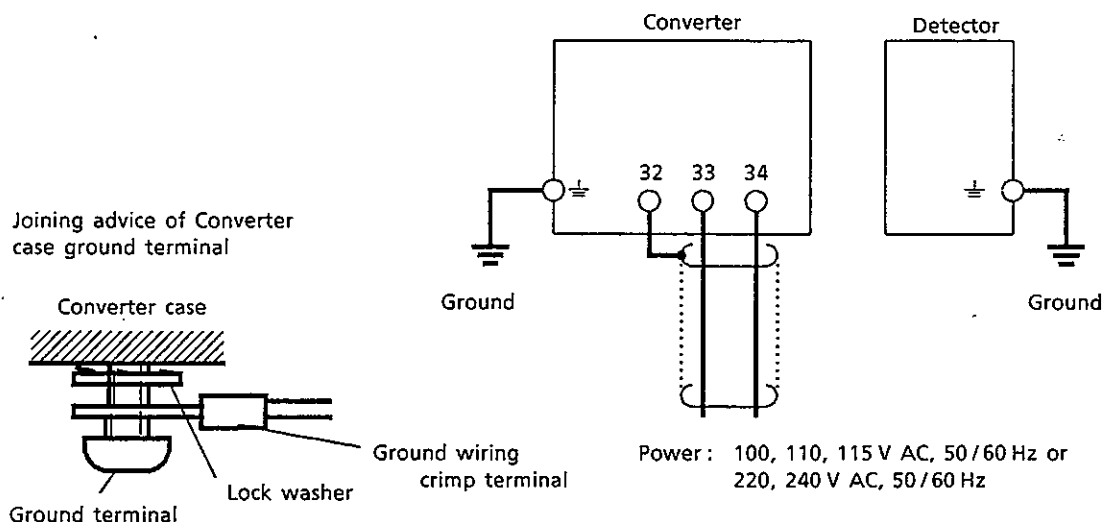


Figure 5.7 Power and Ground Wiring

### 5.5.1 Power Wiring

Connect the power wiring to the terminals of the converter. Be careful of the following when installing the wiring:

- (1) Use a 2-core shielded cable with an outside diameter of  $\varnothing 8$  to  $\varnothing 11$  mm.
- (2) The size of converter terminal screw threads is M4. Use a crimp terminal conforming to this size for connecting your cable.

### 5.5.2 Ground Wiring

For the ground wiring, it is a general rule that wires should be installed from the ground terminal of the detector case or the converter case. Be careful of the following when wiring:

- (1) Keep ground resistance less than  $100 \Omega$  (JIS Grade 3 grounding).
- (2) When the ambient temperature at your wiring installation site is 80 to 150°C for the detector, use wiring material with satisfactory heat resistance.
- (3) When silicon rubber insulated glass braided wire is used because of a higher ambient temperature, connect the wiring from the ground terminal in the detector to the ground terminal in the converter case as shown in Figure 5.5.
- (4) Connect the cable to the converter case ground terminal so that the lock washer makes contact with the case (see Figure 5.7).

## 5.6 Digital Communication Wiring (Optional)

If communications via RS-232-C or RS-422-A interface is to be intended, connect the converter to a computer such as your personal computer.

In this section, communications specifications of ZA8C converter is also described as well as communication wiring procedure.

### 5.6.1 Wiring with RS-232-C Communication Cable

Figure 5.8 shows terminal connections of RS-232-C communication cable. RS-232-C communications are carried out by connecting only one converter to one computer.

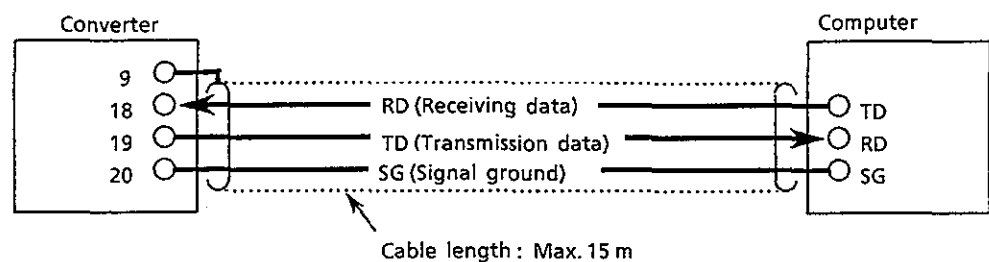


Figure 5.8 Wiring of RS-232-C Communication Cable

#### <Specifications for Communication Cable and Maximum Length>

Use a three-conductor — (nominal cross section: 0.2 mm<sup>2</sup>) or two twisted pair (24 AWG or thicker) — shielded cable for RS-232-C communication wiring. In addition, the cable length is limited up to 15 m.

In end-treating the cable, attach crimping type solderless terminal lugs matching M4 (4 mm) screws to the cable end to be connected to the converter terminals.

### 5.6.2 Wiring with RS-422-A Communication Cable

RS-422-A communication can be carried out by connecting up to eight converters to one computer. In the ZA8C converter, communication I/O signals are not isolated. If the computer is distant (communication cable length is 15 m or more as a guideline) from the converter and thus their ground potentials cannot be equalized, use a computer having I/O signal isolating type interface.

Figure 5.9 shows terminal connections of RS-422-A communication cable.

#### <Notices in Making Wiring>

- (1) Lay communication cables away from power cables which may become noise sources. In addition, lay cables so that adjacent cables are not in parallel with each other.
- (2) If more than one converter is to be connected to a computer, ground wiring should be such that the ground potentials of each converter are equal.

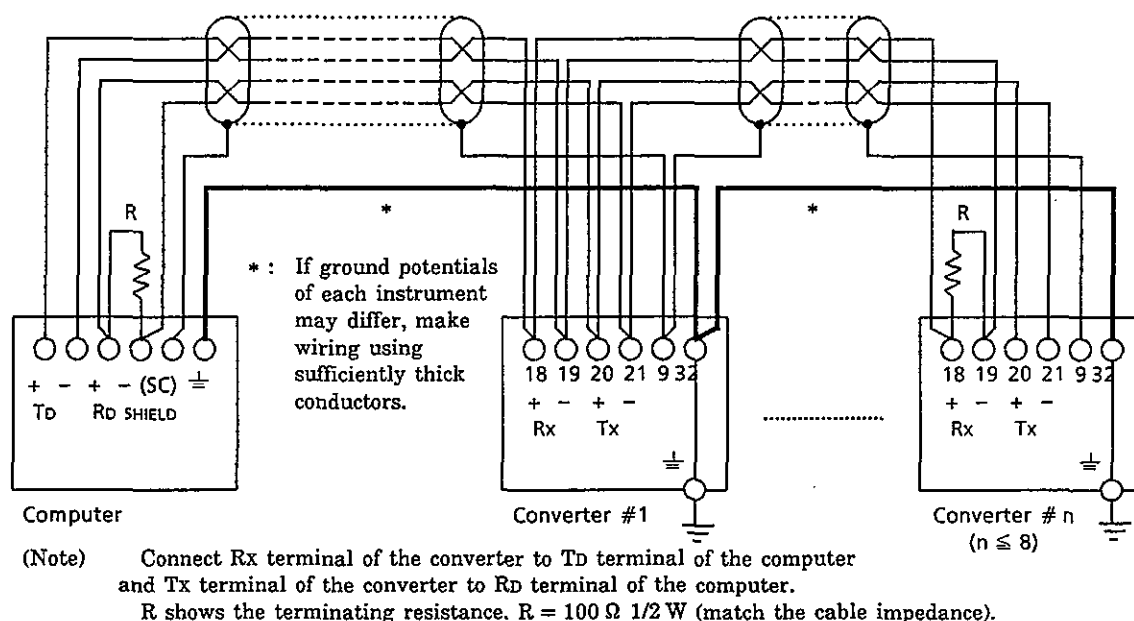


Figure 5.9 Connections for RS-422-A Communications

## &lt;Specifications for Communication Cable and Maximum Length&gt;

For RS-232-C communication cable, use two twisted pair (24 AWG or thicker) shielded cables of  $\varnothing 8$  to  $\varnothing 11$  mm O.D. so that the cable impedance is  $100\ \Omega$  and cable capacitance is  $50\ \text{pF/m}$  or less. It is recommended that the cable length be within 15 m to balance ground potentials. However, if a computer having I/O signal isolating interface is used, the cable length may be extended up to 500 m. In this case, the ground system wiring should be made in a procedure shown in Figure 5.10.

As end treatment of the cable, attach the crimping type solderless terminal lugs matching M4 (4 mm) screws to the end of the cable to be connected to the converter terminals. Expose the conductors from the cable shield as short as possible.

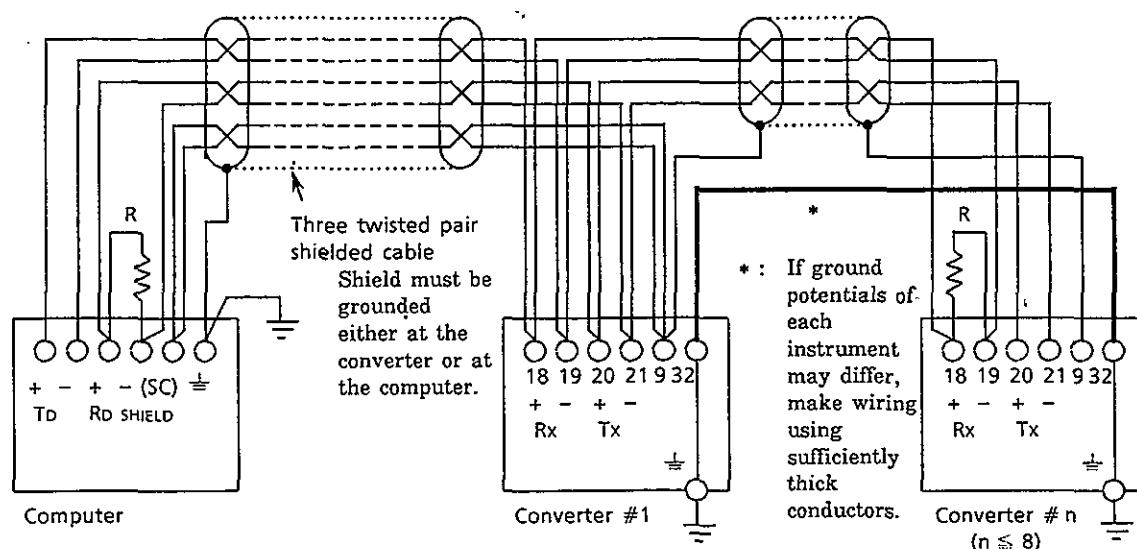


Figure 5.10 Connections for RS-422-A Communications (when using an I/O isolating computer)

### 5.6.3 Specifications for ZA8C Converter Communications (RS-232-C or RS-422-A)

● Communication Specifications

Classification	Item	Description
Specifications	Signal level	Conforming to EIA RS-232-C or RS-422-A standards I/O signal not isolated
	Communication system	Start-stop system, Half duplex RS-232-C: Two wire system RS-422-A: Four wire system, multidrop connection Number of computer: converters = 1 : N (N = 1 to 8)
	Communication distance	RS-232-C: Up to 15 m RS-422-A: Up to 500 m (between I/O isolated computer and ZA8C converter)
	Communication rate	2400, 4800, 9600 bps switching
	Transmission procedure	No procedure, handshaking transfer In the case of 'no procedure' data transmission only (transmission period: 10 seconds)
	Data length	8 bits
	Parity	None
	Start bit	1
	Stop bit	1
	Communication code	ASCII code
Contents	Reception	(1) Zero and span calibration request, Calibration abort request (2) Analog output range selection signal
	Transmission	Time, O <sub>2</sub> concentration (wet and dry), cell emf, cell temperature, error codes, alarm number, status number, calibration coefficient, cell resistance, response time, cell life, exhaust gas temperature, O <sub>2</sub> average value, O <sub>2</sub> averaging time, max. and min. O <sub>2</sub> concentration, and output current, Date and time of calibration start

● Command Interpretation

(1) RC (Request Calibration)

Function	"Zero, span calibration start request" signal or "Calibration abort" signal (Note) Set the ZA8C converter calibration mode to "Auto" or "Semi-auto".																																				
Data structure	<p>(1) Received data</p> <table border="1"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr> <td>R</td><td>C</td><td></td><td>1</td><td>,</td><td>0</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr> </table> <p> </p> <p>(2) Transmitted data</p> <table border="1"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr> <td>R</td><td>C</td><td></td><td>1</td><td>,</td><td>0</td><td>,</td><td>0</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr> </table> <p> </p>	1	2	3	4	5	6	7	8	R	C		1	,	0	C <sub>R</sub>	L <sub>F</sub>	1	2	3	4	5	6	7	8	9	10	R	C		1	,	0	,	0	C <sub>R</sub>	L <sub>F</sub>
1	2	3	4	5	6	7	8																														
R	C		1	,	0	C <sub>R</sub>	L <sub>F</sub>																														
1	2	3	4	5	6	7	8	9	10																												
R	C		1	,	0	,	0	C <sub>R</sub>	L <sub>F</sub>																												

(2) CR (Change Range)

Function	"Analog output range selection" signal (Note) The ZA8C converter contact input signal has priority.																																
Data structure	<p>(1) Received data</p> <table border="1"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr> <td>C</td><td>R</td><td></td><td>1</td><td>,</td><td>1</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr> </table> <p> </p> <p>(2) Transmitted data</p> <table border="1"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr> <td>C</td><td>R</td><td></td><td>1</td><td>,</td><td>1</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr> </table> <p>(Same as received data)</p>	1	2	3	4	5	6	7	8	C	R		1	,	1	C <sub>R</sub>	L <sub>F</sub>	1	2	3	4	5	6	7	8	C	R		1	,	1	C <sub>R</sub>	L <sub>F</sub>
1	2	3	4	5	6	7	8																										
C	R		1	,	1	C <sub>R</sub>	L <sub>F</sub>																										
1	2	3	4	5	6	7	8																										
C	R		1	,	1	C <sub>R</sub>	L <sub>F</sub>																										

## (3) DT (Data Trigger)

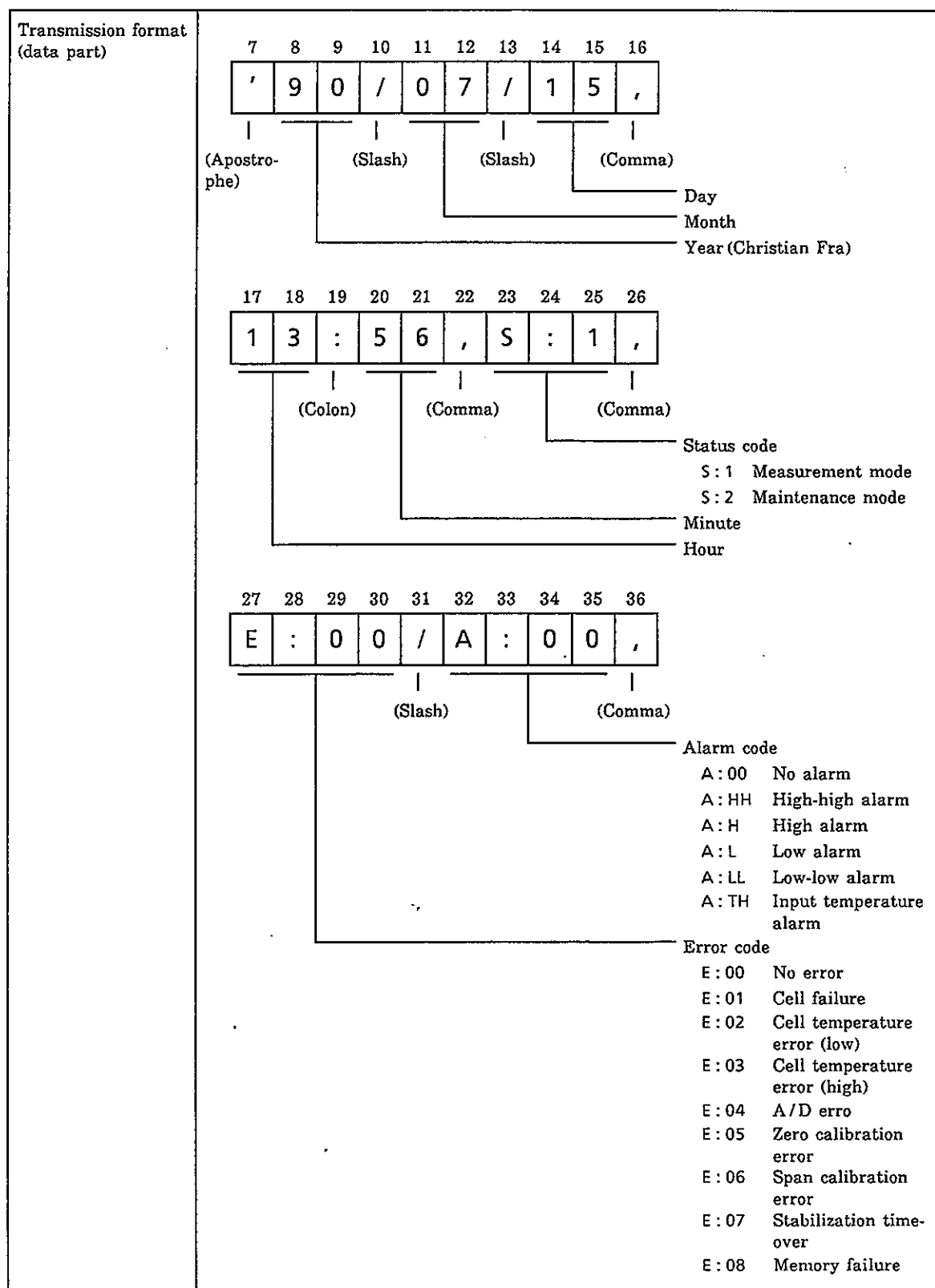
Function		Latest measured data and date and time are taken into the communication memory inside the ZA8C converter.													
Data structure		<p>(1) Received data</p> <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>D</td><td>T</td><td></td><td>1</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr></table> <p>Delimiter ZA8C converter channel number, No.1 to No.8 (Note 1) (Space) Command</p> <p>(Note 1) When channel No. is [0], all the converters take the measuring simultaneously. (Note 2) Data retained with DT command is transmitted to the computer by DR command. (Note 3) When a "DT 0 C<sub>R</sub> L<sub>F</sub>" command is sent from the computer to the converter, allow a one-second interval or longer until the next command (as for example, a DR command) is sent.</p>		1	2	3	4	5	6	D	T		1	C <sub>R</sub>	L <sub>F</sub>
1	2	3	4	5	6										
D	T		1	C <sub>R</sub>	L <sub>F</sub>										
Receivin g format	In setting	DT 1 C <sub>R</sub> L <sub>F</sub>													
	In read- ing	None													
Transmitting format		DT 1 C <sub>R</sub> L <sub>F</sub>													

## (4) DR (Data Read)

Function		This command can make ZA8C converter transmit date and time and measured data.																														
Data Structure		<p>(1) Received data</p> <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>D</td><td>R</td><td></td><td>1</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr></table> <p>Delimiter ZA8C converter channel number, No.1 to No.8 (Space) Command</p> <p>(2) Transmitted data</p> <table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7.....226</td><td>227</td><td>228</td></tr><tr><td>D</td><td>R</td><td></td><td>0</td><td>1</td><td>,</td><td>Data</td><td>C<sub>R</sub></td><td>L<sub>F</sub></td></tr></table> <p>Data (For format, see page 13 and later.) (Comma) ZA8C converter channel number, No.1 to No.8 (Space) Command</p>	1	2	3	4	5	6	D	R		1	C <sub>R</sub>	L <sub>F</sub>	1	2	3	4	5	6	7.....226	227	228	D	R		0	1	,	Data	C <sub>R</sub>	L <sub>F</sub>
1	2	3	4	5	6																											
D	R		1	C <sub>R</sub>	L <sub>F</sub>																											
1	2	3	4	5	6	7.....226	227	228																								
D	R		0	1	,	Data	C <sub>R</sub>	L <sub>F</sub>																								
Receivin g format	In setting	None																														
	In read- ing	D R 1 C <sub>R</sub> L <sub>F</sub>																														

Note Answer-back signals for commands other than the "DT 0 C<sub>R</sub> L<sub>F</sub>" command may be sent by placing them after two undecided characters.

## Data Part Format for DR Command Communication (Transmission) (1)



## Data Part Format for DR Command Communication (Transmission) (2)

Transmission format  
(data part)

37	38	39	40	41	42	43	44	45	46
W	E	0	1	0	.	0		%	,

(Comma)

Unit

Oxygen concentration value

 $O_2 \geq 10.0 \rightarrow 010.0$  $O_2 < 10.0 \rightarrow 009.9$ Wet concentration/dry  
concentration

WE: Wet concentration

DY: Dry concentration

47	48	49	50	51	52	53	54	55	56
A	V	0	2	1	.	0	0	%	,

(Comma)

Unit

Oxygen concentration value

(000.00 to 100.00)

Average oxygen

57	58	59	60	61	62	63	64	65	66
A	T	0	2	4	H				,

(Space)

(Comma)

Unit (time)

Calculation time (000 to 999)

Oxygen concentration  
average value calculation

67	68	69	70	71	72	73	74	75	76
M	X	0	2	5	.	0	0	%	,

(Comma)

Unit

Oxygen concentration value

(000.00 to 100.00)

Maximum oxygen  
concentration

77	78	79	80	81	82	83	84	85	86
M	I	0	2	5	.	0	0	%	,

(Comma)

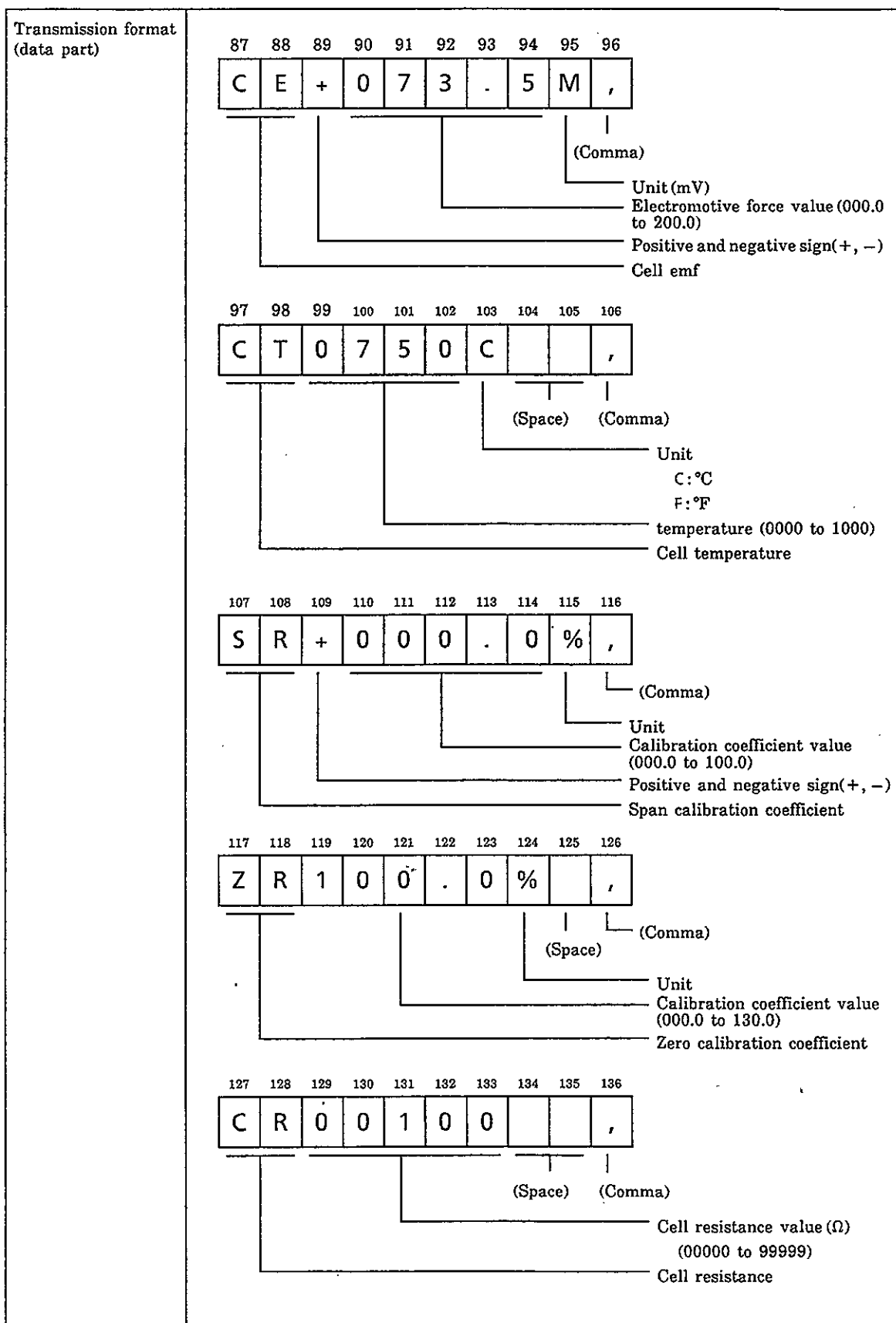
Unit

Oxygen concentration value

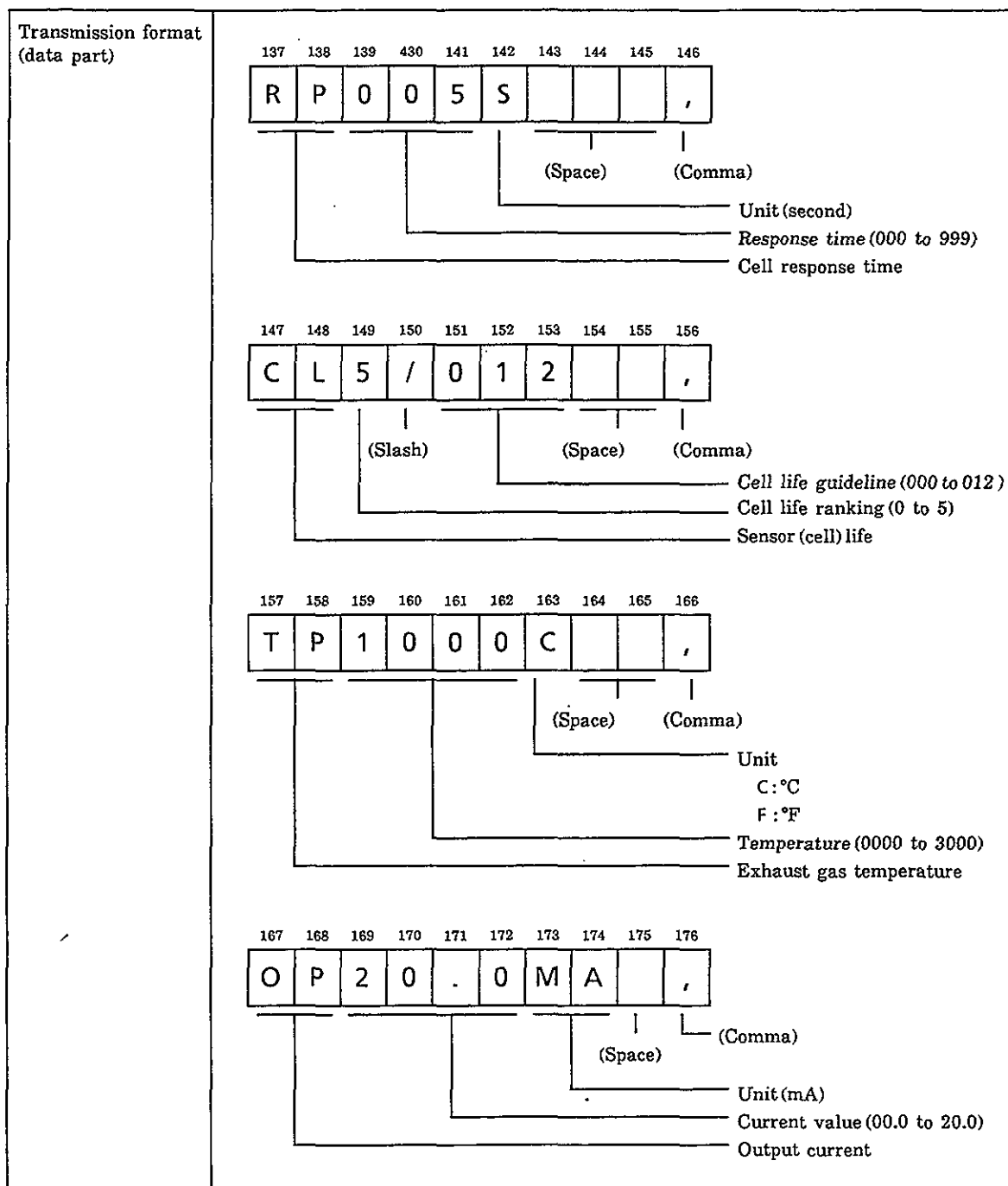
(000.00 to 100.00)

Minimum oxygen

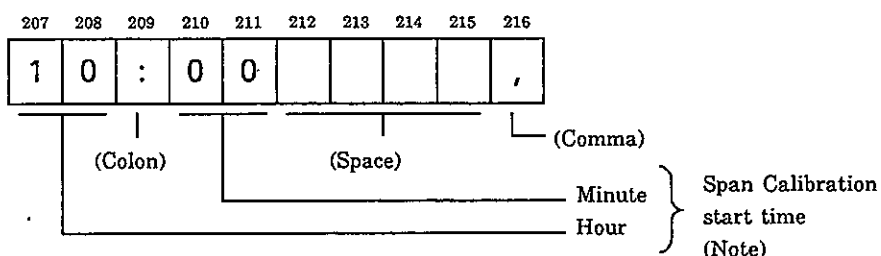
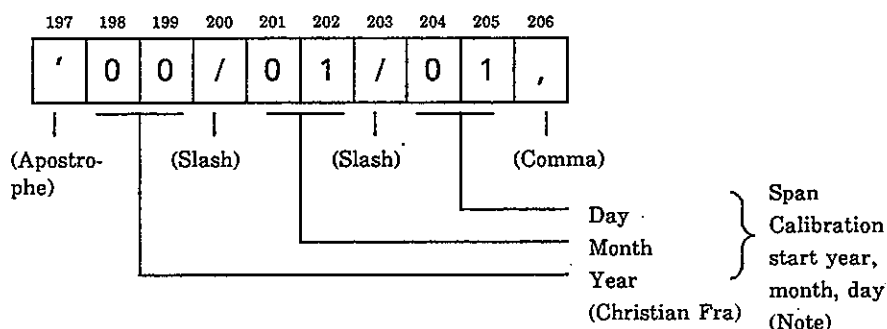
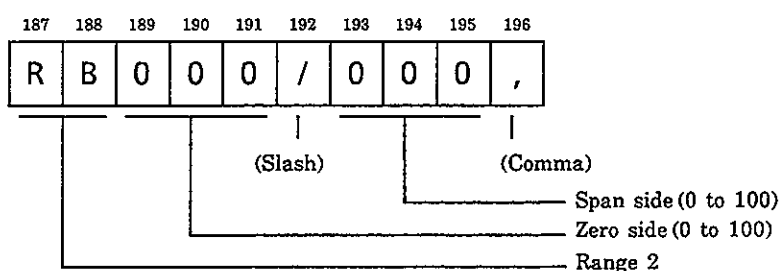
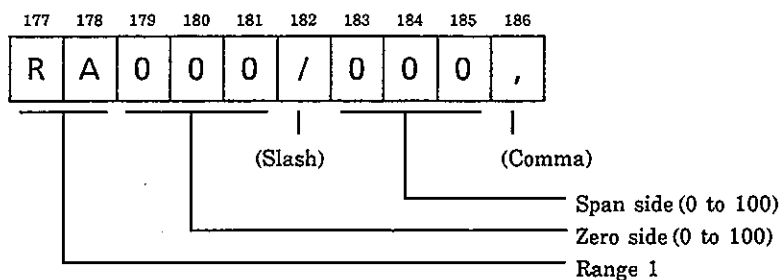
## Data Part Format for DR Command Communication (Transmission) (3)



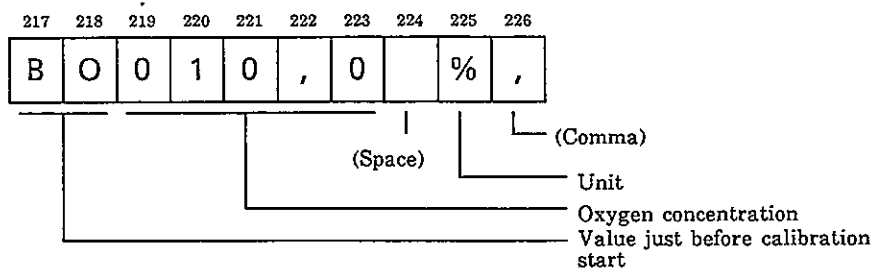
## Data Part Format for DR Command Communication (Transmission) (4)



## Data Part Format for DR Command Communication (Transmission) (5)

Transmission format  
(data part)

(Note) If omission of span calibration is set by C7, Zero calibration start time is displayed.



## 5.7 Contact Output Wiring

The converter can output a maximum of 3 contact signals. You can use these contact outputs after you select (e.g., "low-limit alarm" or "high-limit alarm") from out of the 13 different applications (see 2.4).

When using these contact outputs, install the wiring as follows:

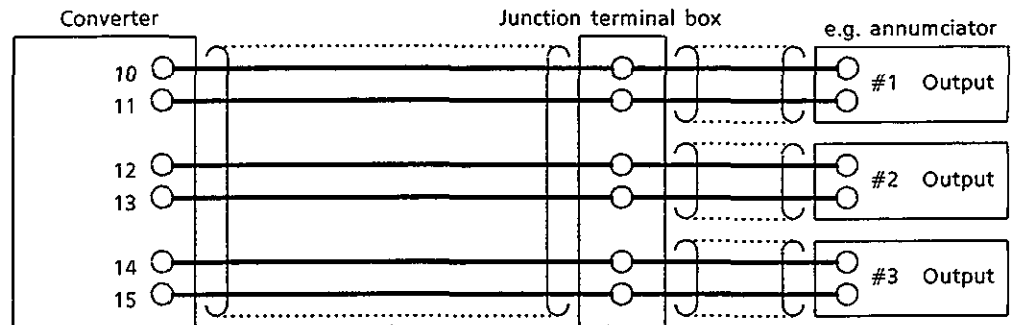


Figure 5.9 Contact Output Wiring

### 5.7.1 Cable Specifications

Use a cable with an outside diameter of Ø8 to Ø11 mm (2 or 4 cores) or one with an outside diameter of Ø11 to Ø14 mm (6 cores), for this wiring.

### 5.7.2 Wiring Advice

- (1) The size of the converter terminal screw threads is M4. Use a crimp terminal conforming to this size for connecting your cable.
- (2) The capacities of contact output relay contacts are 30 V DC 2 A and 250 V AC 2 A. Connect a load (e.g. pilot lamp and annunciator) satisfying these values.

## 5.8 Flow Setting Unit Solenoid Valve Wiring (Optional)

This wiring is used for driving the solenoid valve for the zero gas and span gas in the ZA8H flow setting unit in a system where the flow rate of the calibration gas is automatically controlled (e.g., system configuration 3).

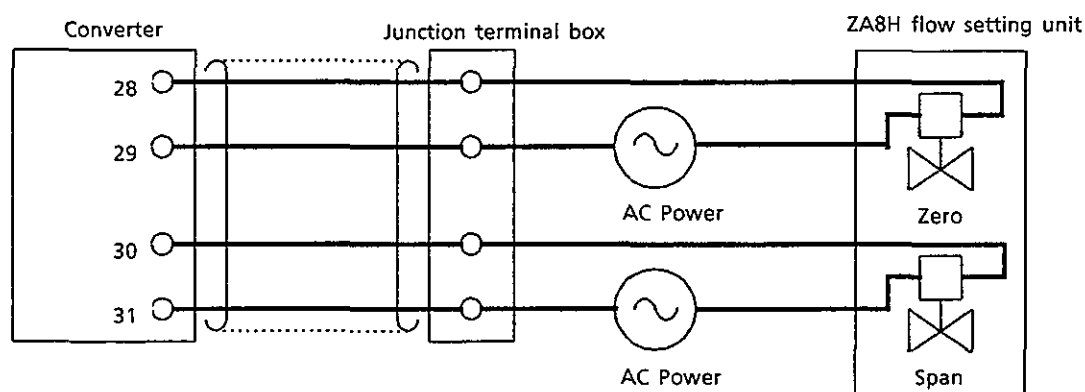


Figure 5.10 Wiring for Flow-Setting Solenoid Valve

### 5.8.1 Cable Specifications

Use a 4-core cable with an outside diameter of  $\varnothing 8$  to  $\varnothing 11$  mm for this wiring.

### 5.8.2 Wiring Advice

- (1) The size of the converter terminal screw threads is M4. Use a crimp terminal conforming to this size for connecting your cable. The size of the solenoid valve terminal screw threads is M3.
- (2) The converter supplies the solenoid valve with power. So, you have to install wiring only between the converter and the flow setting unit. For confirmation before wiring, make sure that the power requirements of the ZA8H flow setting unit conforms to the power requirements of your converter in use.

## 5.9 Contact Input Wiring (Optional)

The converter can respond to a maximum of 2 types of contact signals received (e.g., a "range changeover command" or "calibration gas under pressure alarm") out of 5 types of signals.

To use these contact signals, install the wiring according to the following methods:

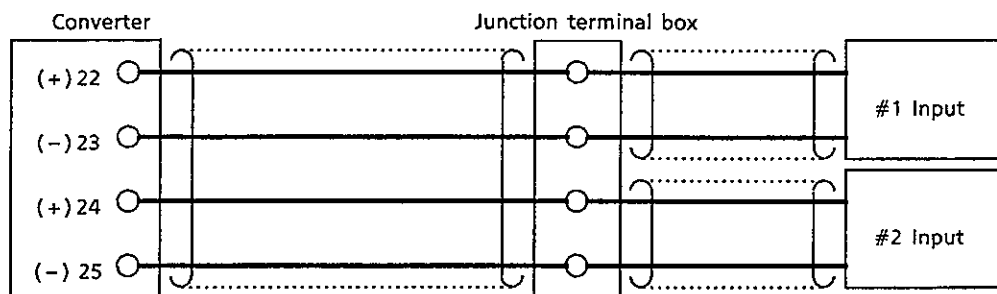


Figure 5.11 Contact Input Wiring

### 5.9.1 Cable Specifications

Use a 2-core (1-contact input) or 4-core (2-contact input) with an outside diameter of Ø8 to Ø11 mm for this wiring.

### 5.9.2 Wiring Advice

- (1) The size of the converter terminal screw threads is M4. Use a crimp terminal conforming to this size for connecting your cable.
- (2) The ON/OFF level of this contact input is identified by resistance or voltage. You have to connect a device which satisfies the following conditions:

Table 5.1 Contact Input ON/OFF Identification

	ON	OFF
Resistance (contact)	less than 200 $\Omega$	more than 100 k $\Omega$
Voltage	-1 to 1 V DC	4.5 to 25 V DC

## 5.10 Measurement Gas Temperature Input Signal Wiring (Optional)

The converter has a function where, after receiving the temperature signal of the measurement gas, boiler efficiency is calculated or an alarm is issued. To use this function, install the wiring according to the following. Measurement gas input signals have a standard level of 4 to 20 mA DC corresponding to the range of the thermometer.

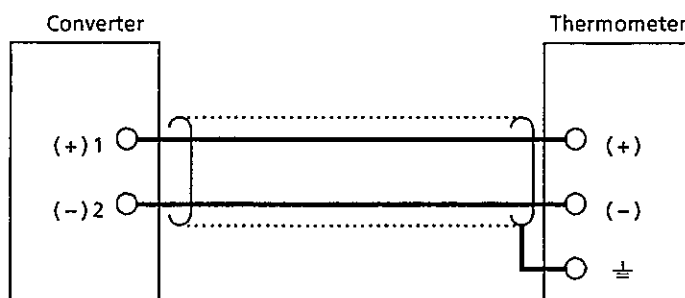


Figure 5.12 Measurement Gas Temperature Input Signal Wiring

### 5.10.1 Cable Specifications

Use a 2-core shielded cable with an outside diameter of Ø8 to Ø11 mm for this wiring.

### 5.10.2 Wiring Advice

- (1) The size of the converter terminal screw threads is M4. Use a crimp-on lug (solderless terminal) conforming to this size for connecting your cable.
- (2) Ground the cable shield generally on the side of the device to be connected.

## 6. Name and Function of Components

In this Chapter, the name and function of components are described for the major equipment of the EXAOXY In-Situ Type Zirconia oxygen analyzer.

### 6.1 Detector

#### 6.1.1 General-Purpose Detector (Standard)

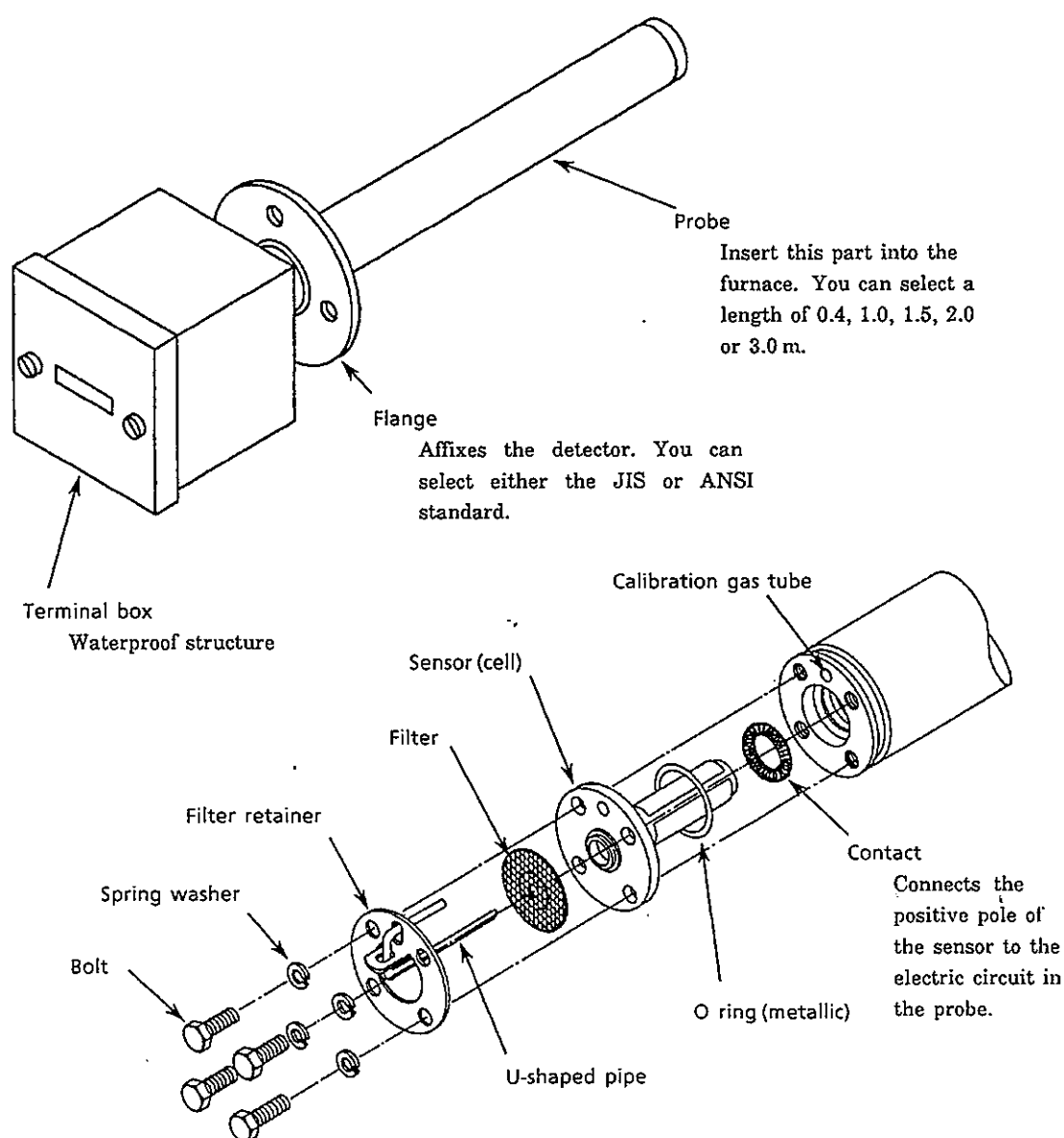


Figure 6.1 Name and Function of Each Component in a General-Purpose Detector (Standard)

### 6.1.2 High-Temperature Detector (with a High-Temperature Probe Adapter)

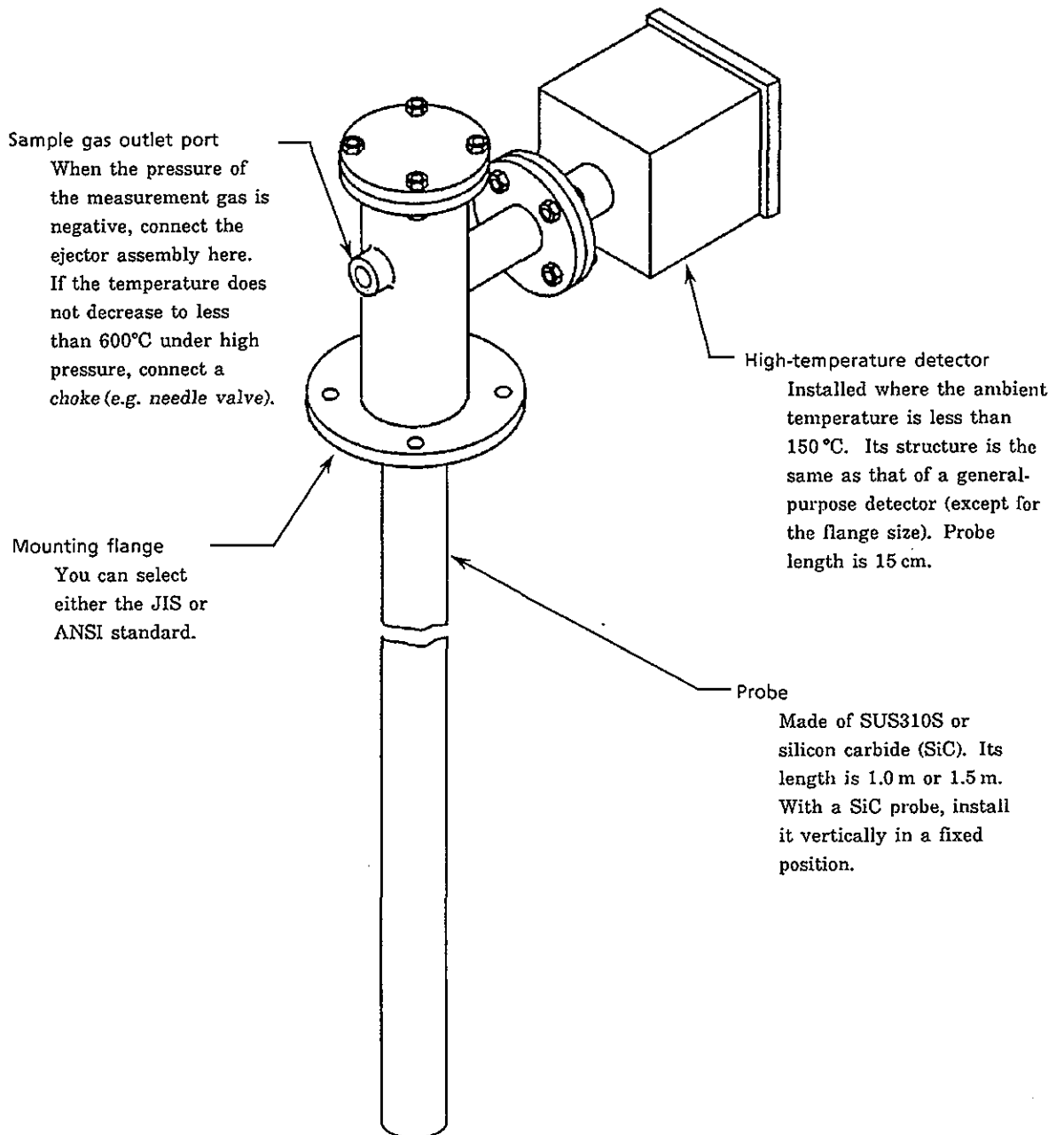


Figure 6.2 Name and Function of Each Part in a High-Temperature Detector

## 6.2 Converter

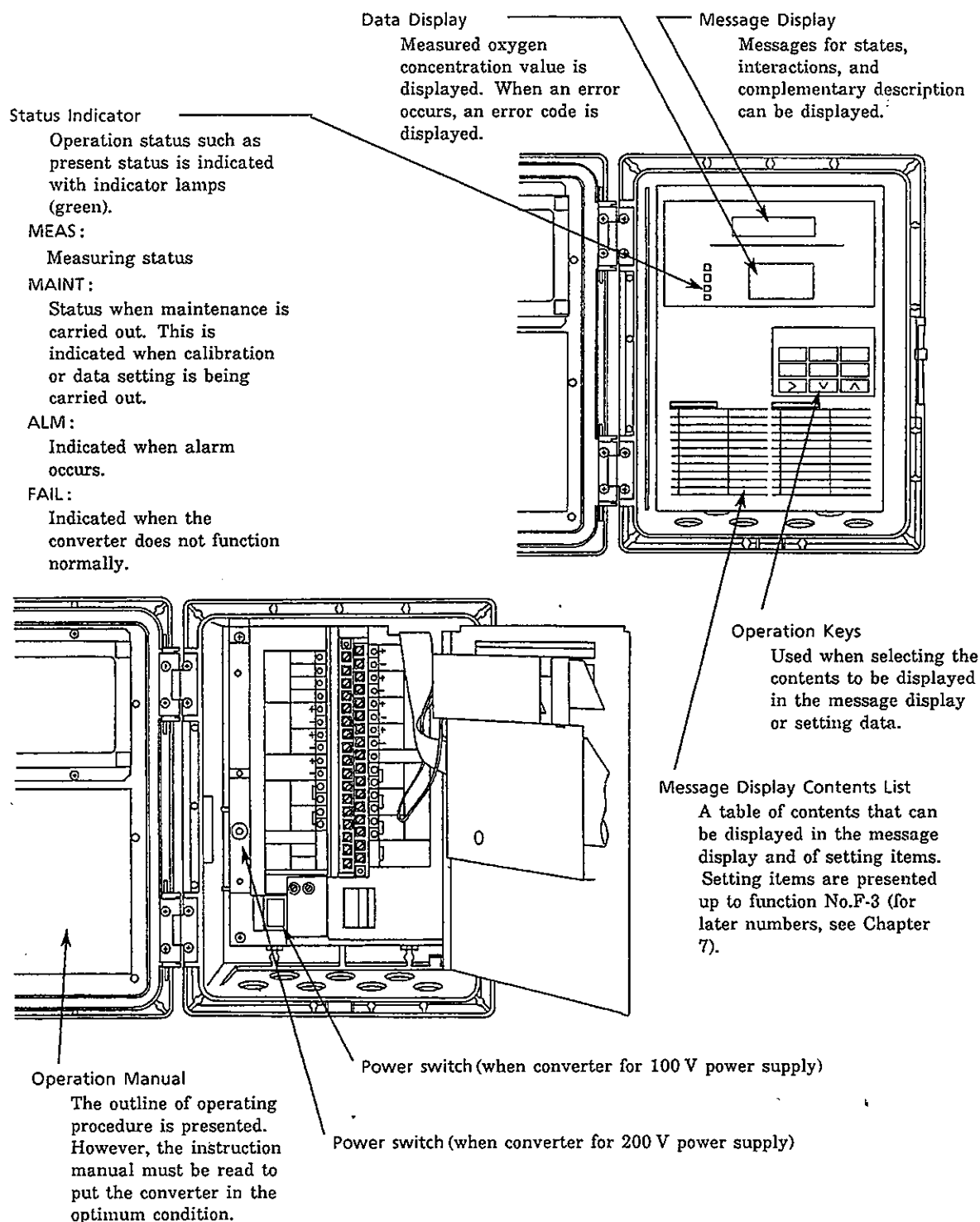


Figure6.3 Name and Function of Converter Components

## 6.3 Flow Setting Unit

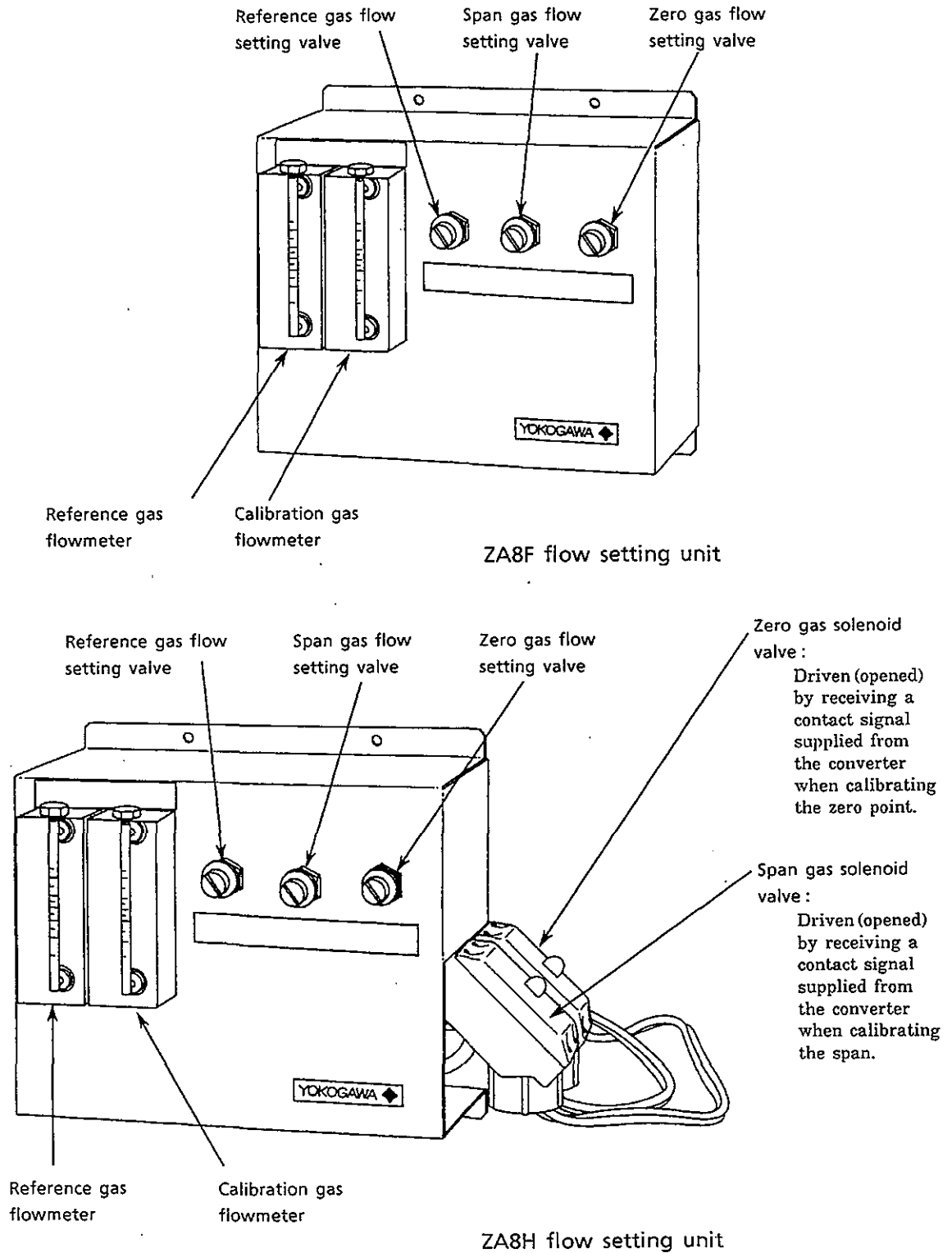


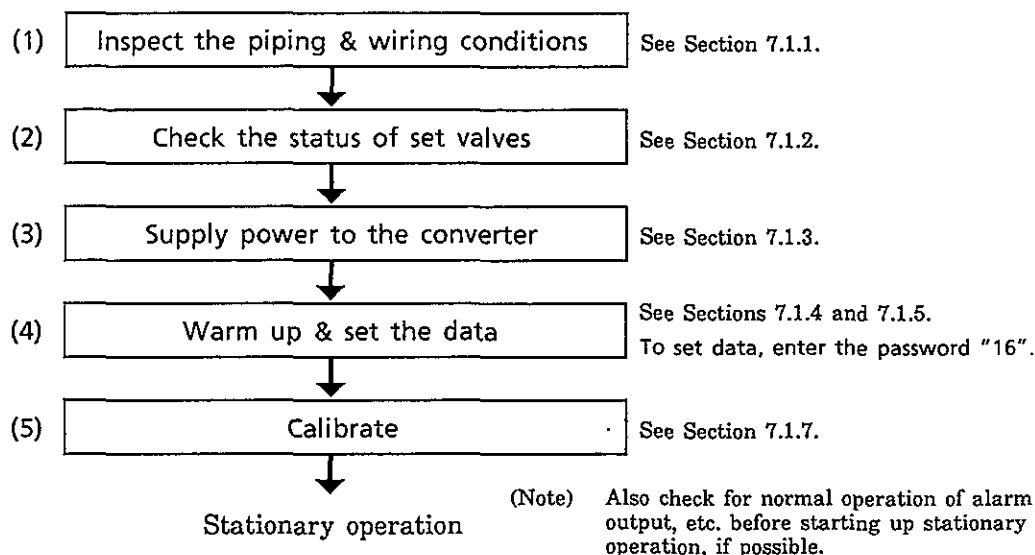
Figure 6.4 Name and Function of Each Part in a Flow Setting Unit

## 7. Operation

In this Chapter, the basic operation methods for the EXAOXY In-Situ Type Zirconia Oxygen Analyzer are described.

### 7.1 Start-Up

The general procedures for starting up are as follows:



#### 7.1.1 Inspection of Piping and Wiring Conditions

In referring to Chapters 4 and 5, inspect the piping and wiring to see that they are correctly installed.

#### 7.1.2 Checking of Set Valves

Inspect the valves as follows depending on your system:

- (1) If a needle valve is mounted at the calibration gas inlet of the detector, completely open this valve beforehand.
- (2) When instrument air is used as the reference gas, set the secondary pressure of the air so that the air pressure becomes 0.5 to 1 kgf/cm<sup>2</sup>. In addition, to set the opening, rotate the shaft of the reference gas flow adjust valve "REFERENCE" in the flow setting unit so that the flow rate changes to about 0.8 l/min. Flow rate increases by rotating the valve screw counterclockwise.

Before rotating the screw, loosen the lock nut. After the completion of the setting, be sure to tighten the lock nut again.

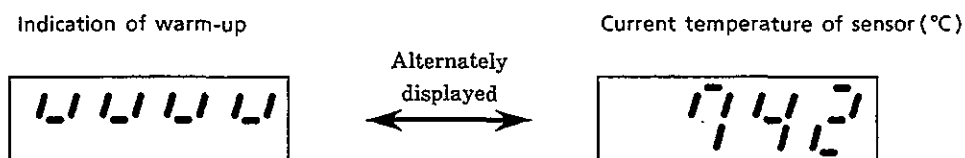
(Note) The setting of the calibration gas flow will be performed later. Keep the relevant needle valve in the flow setting unit fully close.

### 7.1.3 Supplying Power to Converter

Check that the supplied voltage meets the specifications of your converter (see 2.4) and then turn on the power to the converter. In addition, turn ON the main switch on the converter (on the left side of the external wire terminals). At that time, the converter will begin to operate. However, measurement will not take effect for about 10 minutes because the sensor of the detector will not have reached the specified temperature.

All of the set parameters, etc. will also be in a default state, so enter data as required (see 7.1.5).

The display will be as shown in Figure 7.1 immediately after the power is turned ON.



(Note) The message display indicates the message for the next operation.

Example: [SET PRESENT TIME ENTER TO CODE (F0)]

Figure 7.1 Readout Upon Turning ON Power and During Warm-Up (Data Display)

### 7.1.4 During Warming-Up

The warm-up period before measurement can begin (i.e., until the detector sensor reaches the specified temperature) is about 10 minutes from the time the power is turned ON. Since measuring operations are suspended during this time, you can take this opportunity to set the data. The analog output signal during the warm-up period reads an O<sub>2</sub> value of 0%. (However, this indicates a default. When Function No. D-2 is adjusted to "PRESET", the preset value is set.)

After completion of the warm-up period, the data display indicates the measured oxygen concentration.

### 7.1.5 Data Setting (To set data, enter the password "16")

With the EXAOXY In-Situ Type Zirconia Oxygen Analyzer, you can have the most suitable operation and measurement functions for your individual processes by setting the various data.

Basic data, e.g., parameters required for operation, are stored in EEP-ROM in the converter. Temporary data, as set forth individually, are stored in the RAM. The temporary data, read in the RAM, are preserved through the backup of an electric double-layer capacitor for a short time even if the main power supply fails. After that, however, the data in the RAM is lost while the stored data in the converter changes to a default state.

Also upon shipment, the data read and loaded into the converter are in the default state. Thus, upon commencement of operation, set the data to match each operation. Table 7.1 shows the setting items and their default values. Refer to it when setting data. In addition, to enter the password 16 or key operations when data is set, see Chapter 8.

Table 7.1 Settable Items and Their Defaults

Group	No.	Setting range or default details		Default	LCD display	Setting
Calibration	C-0	Span gas concentration: 4.5 to 100 vol% O <sub>2</sub>		21.00 % O <sub>2</sub>	21.0	
	C-1	Zero gas concentration: 0.3 to 100 vol% O <sub>2</sub>		1.00 % O <sub>2</sub>	1.00	
	C-2	Mode: One-touch(TCH) / Semi-Auto(SEMI) / Auto(AT)		TCH	2: TCH	
	C-3	Stabilizing time: 0 to 10 minutes		3.0 min	3.0 minutes	
	C-4	Calibration time: 0 to 10 minutes		3.0 min	3.0 minutes	
	C-5	Calibration schedule: 0 to 255 day or 0 to 23 hours		1 day	1 day	
	C-6	Calibration start time: Month, Day, Hour, Minute				
	C-7	Skip: None (0), Span (1), Zero (2)		0: NONE	0: NONE	
Analog output	D-0	Range 1: (0 to 5) to (0 to 100) vol% O <sub>2</sub>		0 to 10 % O <sub>2</sub>	000—010 % O <sub>2</sub>	
	D-1	Range 2: (0 to 5) to (0 to 100) vol% O <sub>2</sub>		0 to 25 % O <sub>2</sub>	000—025 % O <sub>2</sub>	
	D-2	Hold: None(N), HLD, P-HLD		HOLD	1: HLD	
	D-3	Selection: 4 to 20 mA or 0 to 20 mA		4 to 20 mA DC	0: 4—20 mA	
	D-4	Output characteristic selection: Linear/Log		Linear	0: Linear	
	D-5	Smoothing constant: 0 to 255 sec.		0 sec.	000 sec	
	D-6	Wet gas O <sub>2</sub> / Dry gas O <sub>2</sub>		Wet gas O <sub>2</sub>	0: WET	
Alarm	E-0	Extreme Upper limit / Upper limit: 0 to 100.0 % O <sub>2</sub>		Both 0 (none)	HH=0, HI=0	
	E-1	Extreme Lower limit / Lower limit: 0 to 100.0 % O <sub>2</sub>		Both 0 (none)	LL=0, LO=0	
	E-2	Contact delay: sec., Hysteresis: % O <sub>2</sub>		3 sec, 0.1 % O <sub>2</sub>	3 sec, 0.1 % O <sub>2</sub>	
Time matching, temperature unit assigning, etc.	F-0	Hour-meter setting: Day / Hour, Minute				
	F-1	O <sub>2</sub> concentration averaging time: 1 to 255 hour		1 hour	1 hr	
	F-2	Max./Min. O <sub>2</sub> averaging time: 1 to 255 hour		24 hour	24 hr	
	F-3	Temperature unit specification: °C, °F		°C	0: °C	
	F-4	Input temperature range: 0 to 3000 °C/°F		None (Note1)		
	F-5	High-limit alarm value of the input temperature		0°C (none)	0°C	
Contact output	G-0	Contact output 1	(See Page 7-11)	NE / F		
	G-1	Contact output 2		NDE / E + C + W		
	G-2	Contact output 3		NDE / H + L		
Contact input	G-3	Contact input 1	P: Process gas error alarm, B: Instructions for start of blow-back	R	1: R	
	G-4	Contact input 2	G: Calibration gas under pressure alarm, R: Instructions for change in measurement range, C: Instructions for start of calibration	R	1: R	
Communication	H-0	Communication mode: freewheel/handshake		handshake	handshake	
	H-1	Baud rate: 9600 b/s, 4800 b/s, 2400 b/s		4800 bps	1: 48	
Fuel, calculation data	J-0	Types of fuels				
	J-1	Moisture content in exhaust gas: 0 to 5 m <sup>3</sup> /kg(m <sup>3</sup> )				
	J-2	Theoretical air quantity: 1 to 20 m <sup>3</sup> /kg(m <sup>3</sup> )				
	J-3	Net calorific value: 0 to 15000 kcal/kg(m <sup>3</sup> )				
	J-4	X value (X = a + b · H <sub>i</sub> )				
	J-5	Absolute humidity of atmosphere: 0 to 1 kg/kg				
	J-6	Temperature of exhaust gas: 0 to 2000 °C				
	J-7	Temperature of atmosphere: -50 to 60 °C				

Note 1: Set the measuring range of the thermometer. Input signal is 4 to 20 mA.

## &lt;Details about Selecting Set Data&gt;

## C-0 Span gas concentration

You can set the oxygen concentration for your span gas used for calibration. If the air at the detector installation site is taken in or the instrument air is used as a span gas, set the value at 21 vol% O<sub>2</sub> (i.e., nearly the same oxygen concentration of clean air) by entering "021.00".

If the air at the installation site is to be taken in but is obviously polluted, check the actual oxygen concentration using a portable oxygen analyzer, etc.

Readout on the message  
display (Example)

C 0	CAL GAS CONC (% O <sub>2</sub> )
	SPAN = 0 2 1 . 0 0

## C-1 Zero gas concentration

You can set the oxygen concentration for the zero gas used for calibration. Set it for the gas charged in the cylinder you are using at present. If the concentration is 1 vol% O<sub>2</sub>, for example, then enter "001.00".

Readout on the message  
display (Example)

C 1	CAL GAS CONC (% O <sub>2</sub> )
	ZERO = 0 0 1 . 0 0

## C-2 Calibration mode

Select your mode from AUTO (AT), SEMI-AUTO (SEMI) and ONE-TOUCH (TCH). Set the cursor to the corresponding number. The calibration mode presently set is expressed with the number displayed under the function number.

For more details on the operation of each mode, see "7.1.7 Calibration".

Readout on the message  
display (Ex.)

C 2	CALIBRATION MODE
2	0 : AT 1 : SEMI 2 : TCH

Number of mode presently set.

## C-3 Stabilizing time

You can set a waiting period for the time from the completion of the calibration to the beginning of measurements again, in minute units. Set an interval for the time between stopping the flow of the calibration gas and completing the replacement of the calibration gas around the detector sensor with measurement gas. If it is 3 minutes 30 seconds, for example, enter 03.5".

The operation mode, switched to the maintenance mode (MAINT) during calibration operations, will return to the measurement mode (MEAS).

Readout on the message  
display (Ex.)

C 3	STABILIZING TIME
	0 3 . 5 m i n u t e s

## C-4 Calibration time

You can set a time at which the converter reads the oxygen concentration of a calibration gas (span gas or zero gas). In automatic or semi-automatic calibration mode, set a time (in minutes) from which the converter outputs solenoid valve driving signals (power supply) which causes the calibration gas to flow out. In one-touch calibration, set a

permissible maximum interval for the time between when you enter a positive answer (by pressing the key "YES") in reply to the message "Span (or Zero) valve open Y?" shown in the message display, and when the calibration value is completely read, also in minutes. If it is 5 minutes, for example, enter "05.0". When you calibrate a system where no solenoid valve is used for the calibration gas, you have to operate a valve to get rid of the gas in the meantime, and so on. Take this into account when setting the data.

Upon the completion of the calibration time interval, you will see the message, "Span (or Zero) cal good" on the display.

Readout on the message  
display (Ex.)

C 4	CALIBRATION TIME
	05 . 0 m i n u t e s

#### C-5 Calibration frequency

You can set the interval from the time of starting a calibration to the time of starting the next calibration in automatic calibration. Set in days or hours, the calibration frequency differs according to your process conditions. However, it is normally recommended that intervals of 1 to 3 months (30 to 90 days) be used. If a calibration interval of 60 days is to be set, select "0" from the settable-item selection messages thereby displaying the day-setting message and set 60 days by entering "060". If you want to set 12 hours, for example, select "1" from the settable-item selection messages and, after the time setting request message is shown, enter 12 hours with "12".

Readout on the message  
display (Ex.)

C 5	CAL INTERVAL
0	0 : d a y      1 : h r

└─ When "0" is selected from

C 5	CAL INTERVAL
( 0 )	0 6 0 d a y

└─ When "1" is selected from

C 5	CAL INTERVAL
( 1 )	1 2 h r

#### C-6 Calibration start time

You can set the date and time at which the first automatic calibration is to start. If it is 4:30 pm, July 15, 1990, for example, set the date by entering "90/07/15 16:30".

Readout on the message  
display (Ex.)

C 6	CAL START TIME
	9 0 / 0 7 / 1 5    1 6 : 3 0

#### C-7 Skip

Calibration is normally performed for both zero and span points. However, either of them may be omitted (but both zero and span points should be calibrated once). In this section, the assignment of this omission is described. If you do not want to omit them any longer, select "0". For omitting span or zero point, select "1" or "2", respectively.

These assignments are effective for semi-automatic and automatic calibrations. You cannot omit them in one-touch calibration.

Readout on the message  
display (Ex.)

C 7	SKIP		
0	0 : NONE	1 : SPN	2 : ZR

#### D-0 Output range 1

You can set the range of oxygen concentration to correspond to the analog output signal (4 to 20 mA or 0 to 20 mA DC). You can set a free range from 0 to 5 vol% O<sub>2</sub> to 0 to 100 vol% O<sub>2</sub>. Also, a partial range is selectable provided the minimum value in the range is 6 vol% O<sub>2</sub>, under the condition that the ratio of "maximum : minimum" is "1.3 : 1" or greater.

(Note) If the output mode is set to "Logarithm" in function No. D-4, the minimum value of the output range is always "0.1" regardless of this setting.

Readout on the message  
display (Ex.)

D 0	OUTPUT RANGE		1
	0 0 0 -	0 5 0	% O 2

#### D-1 Output range 2

Output range 2 can be output only when the converter has the functions of "contact input" or "digital communication" by the "range change command". Similar to output range 1, set the oxygen concentration range correspondent to the analog output signal (4 to 20 mA DC or 0 to 20 mA DC). Any range from 0 to 5 vol% O<sub>2</sub> up to 0 to 100 vol% O<sub>2</sub> can be set. If the minimum value of a range is 6 vol% O<sub>2</sub> or more, a partial range can be set under conditions where the ratio of the "maximum value to the minimum value" is "1.3 to 1" or more. If selecting a partial range of 10 to 25 vol% O<sub>2</sub>, set "010 — 025".

In addition, if the "range selection command" is to be made with a contact input, select Change in measurement range in function Nos. G-3 or G-4. However, if the command is made via digital communications, do not select Change in measurement range. If selected, a command via digital communications cannot be received.

Readout on the message  
display (Ex.)

D 1	OUTPUT RANGE		2
	0 1 0 -	0 2 5	% O 2

#### D-2 Output signal hold

You assign whether or not analog output signals are in a mode other than measurement mode as, for example, maintenance mode in which calibration or data setting is performed. Assign "0", "1" or "2" for directly outputting the measured value without holding it, outputting the measured value after having held it until immediately before entering a mode other than the measurement mode, or outputting the preset value, respectively.

When "2" is selected, a message for setting a preset value is then displayed, so enter your value from the keyboard. Preset values are in O<sub>2</sub> vol% units. If, for example, you desire 0% (corresponding to 4 mA DC in the case of 4 to 20 mA), select "000".

(Note) The output signal in a state other than normal operation, such as in data setting mode or during warming up, shows the value either for holding the preceding value or for preset holding (where "2" is set), even if "0" is set. If the preset value is not set in the preset hold mode, the preceding value holds.

Readout on the message  
display (Ex.)

D 2	OUTPUT HOLD		
2	0 : N	1 : HLD	2 : P - HLD

When "2" is assigned

D 2	OUTPUT HOLD		
( 2 )	PRESET HOLD	= 0 0 0 %	

### D-3 Types of output signals

You assign the analog output signals conforming to the specifications of the receiving meter in use. Enter "0" or "1" for 4 to 20 mA DC or 0 to 20 mA DC, respectively.

Readout on the message  
display (Ex.)

D 3	CURRENT OUTPUT		
0	0 : 4 - 2 0 m A	1 : 0 - 2 0 m A	

### D-4 Output signal characteristics

The relationship between the 4 to 20 mA DC or 0 to 20 mA DC analog output signal and oxygen concentration is normally linear. However, you can modify it to logarithmic.

You can set either. For a linear or logarithmic relationship, assign "0" or "1", respectively.

(Note) For the "relationship between the output current and oxygen concentration" when selecting "log" see the description of function No. A-5 mentioned in subsection 8.2.3.

Readout on the message  
display (Ex.)

D 4	OUTPUT SCALE		
0	0 : Linear	1 : Log	

### D-5 Output smoothing constant

If the oxygen concentration of the measurement gas changes suddenly, and you use these measured values directly to control operations, problems (e.g., frequent turning ON / OFF of operations) might occur. To avoid such situations, you introduce a modified time constant into the operation in order to smooth out the signal variations. You can set a time constant of up to 255 seconds, so enter a suitable value from the keyboard. If it is 30 seconds, enter "030".

Readout on the message  
display (Ex.)

D 5	SIGNAL DAMPING		
	0 3 0	s e c	

### D-6 Moisture base in measurement gas

Combustion gases contain moisture created by burning hydrogen in the fuel. If this moisture is removed, the oxygen concentration after removal might be higher than before. You can select whether the oxygen concentration in a wet gas is measured directly, or compensated to a dry-gas value before use. For wet or dry conditions, assign "0" or "1", respectively.

You can set the moisture content required for the calculation according to Function No. J-1 through J-7.

Readout on the message  
display (Ex.)

D 6	WET / DRY O 2 SELECT		
0	0 : WET	1 : DRY	

## E-0 Setting of extreme high-limit/high-limit alarms

You can set the level(s) of contact output signals for the extreme high-limit and/or high-limit alarms. If, for instance, you want to have an alarm set at an oxygen high-limit of 7.5 vol% O<sub>2</sub> but deactivate the extreme high-limit alarm, enter "000.0" for the extreme high-limit alarm (HH=) and "007.5" for the high-limit alarm (HI=).

You can set these settings related to contact output with Function Nos. G-0 through G-2.

(Note) For alarm value display, see 8.2.2 "Function No. A-0, Analog Bargraph Display".

Readout on the message  
display (Ex.)

E 0	ALARM SET PT (% O <sub>2</sub> )
	HH = 0 0 0 . 0 , HI = 0 0 7 . 5

## E-1 Setting of extreme low-limit/low-limit alarms

You can set the level(s) of contact output signals for the extreme low-limit and/or low-limit alarms. If, for instance you want to have an alarm set at an oxygen extreme low limit of 2.5% and activate a low-limit alarm of 4.9%, enter "002.5" for the extreme low-limit alarm (LL=) and "004.9" for the low-limit alarm (LO=).

You can set these settings related to contact output with Function Nos. G-0 through G-2.

(Note) For alarm value display, see 8.2.2 "Function No. A-0, Analog Bar-graph Display".

Readout on the message  
display (Ex.)

E 1	ALARM SET PT (% O <sub>2</sub> )
	LL = 0 0 2 . 5 , LO = 0 0 4 . 9

## E-2 Contact operation of alarm output

When measured values return to a stationary range after leaving the alarm range, it is sometimes desirable for existing alarm output to be reset conditionally instead of being reset immediately. You can set such conditions, i.e., operation delay and hysteresis. The operation delay, once set here, is effective even after measured values shift from the stationary range to the alarm range. Set the operation delay (in "seconds") and the hysteresis in the oxygen concentration (vol% O<sub>2</sub>), respectively.

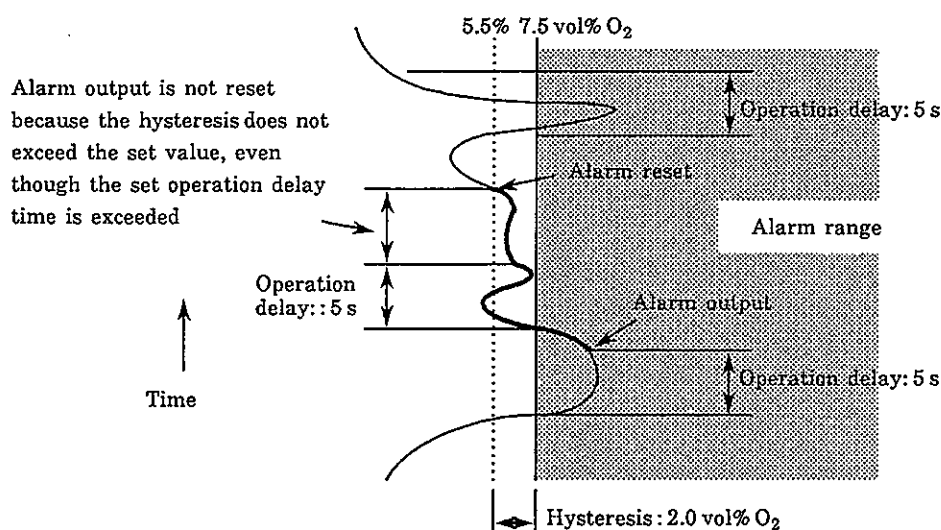
For instance, to set an operation delay of 5 seconds and a hysteresis in the oxygen concentration of 2.0 vol% O<sub>2</sub>, enter "005" and "2.0" on the keyboard.

(Note) The operation delay set here is applied to all contact signals selected with function numbers G-0 to G-2.

Readout on the message  
display (Ex.)

E 2	RL DELAY = 0 0 5 s e c
	RL HYS = 2 . 0 % O <sub>2</sub>

The alarm output for the example above becomes as follows:



#### F-0 Adjustment of date and time

Set the clock in this instrument to the present date and time. If the present date/time is April 26, 1990/6:45 pm for instance, enter "90/04/26 18:45" and press the "ENTER" key to activate the date and time.

Readout on the message display (Ex.)

F 0	CLOCK ENTRY
90 / 04 / 26	18 : 45

#### F-1 Mean O<sub>2</sub> concentration calculation time

You can set the time for collecting measured data in order to calculate the mean oxygen concentration (indicated when you access Function No. A-2). Measured data are collected and summarized in 60second intervals, while averages are calculated every time a datum is collected. And, after the set time expires, the calculated mean value is reset, and the operation of calculating a new mean value begins all over again. If you want to update accumulated data every 24 hours, set this function at "024". Accumulation of data begins from the time you press the entry key.

(Note) The calculation of the mean value is activated every time a datum is collected. So, the longer the calculation time is extended, the more data which are used in averaging are collected. If you use mean data periodically, you should take notice of this.

Readout on the message display (Ex.)

F 1	AVERAGE INTERVAL
024	h r

#### F-2 Time interval for monitoring maximum/minimum O<sub>2</sub>

The converter stores the maximum and minimum values of measured oxygen concentrations within a set time period. You can see these values on the message display by accessing Function No. A-1.

You can set the time period for storing these maximum and minimum values. If you want to store them for a week, enter "168" (hr). The storage of data begins when you press the entry key. Stored maximum and minimum values are updated by comparing them with the new data periodically. When the set time expires, the stored values are reset, and new maximum and minimum value storage begins all over again.

Readout on the message  
display (Ex.)

F 2	MAX, MIN INTERVAL
1 6 8	h r

### F-3 Selecting input temperature scale (°C/°F)

To calculate boiler efficiency, etc., you enter the temperature of the process gas by an analog signal of 4 to 20 mA. You can set here whether the temperature scale is to be °C or °F. If the analog signal of 4 to 20 mA DC is to correspond to a temperature from 0 to 1000°F, enter "1".

Readout on the message  
display (Ex.)

F 3	TEMPERATURE UNIT
1	0 : ° C                      1 : ° F

### F-4 Input temperature range

You assign the temperature range of the process gas, corresponding to the analog input signal of 4 to 20 mA DC. If your range is 0 to 1000°F, enter "1000". At that time, check the temperature scale readout on the message display (the scale as assigned in Function No. F-3 will be indicated). The maximum setting value is 3000 (degrees) regardless of the temperature scale.

(Note) The minimum input temperature is 0 (°C or °F). Therefore, when a temperature decreases below 0, ALM lamp is lit. Similarly, if the input signal decreases to 4 mA or less for some reasons, ALM lamp is also lit.

Readout on the message  
display (Ex.)

F 4	FLUE GAS TEMP SPN
1 0 0 0	° F

### F-5 High-limit alarm value of the input temperature

You can set the high-limit temperature of the process gas. Set a desired temperature within the measurement range. If the alarm value is 600°C, set "0600" (°C). If no high-limit alarm is required, enter "000".

Readout on the message  
display (Ex.)

F 5	FLUE GAS TEMP HI
ALM SET =	0 6 0 0 ° C

This alarm output is available as a contact output when you select the "process gas temperature high-limit alarm setting" in Function Nos. G-0, G-1 or G-2.

## G-0, G-1, G-2 Contact outputs 1, 2, 3

this instrument can freely output any contact signal selected out of 13 specified types. You select this together with the assignment of the relay contact operation (normally energized or deenergized) in Function Nos. G-0, G-1 and G-2.

In the default state, the operation of the relay contact in Function No. G-0 is "normally energized" while that in No. G-1 is "normally energized". In this state, the contact signals "in entry", "in calibration" and "in warm-up" are output. At that time, the operation of the relay in Function No. G-2 is "normally deenergized" and outputs the contact signals "high-limit alarm" and "low-limit alarm".

Readout on the message  
display (Ex.)

G	0	R	Y	1	C	O	N	T	.	O	U	T	P	U	T	
				1	0	0	0	0	0	0	0	0	0	0	1	0
				:	1	2	3	4	5	6	7	8	9	10	11	12

(Note 1)

Digit No. 1 : Relay Operation Setting,

Digit Nos. 2 to 14 : Section of contact signal to be used (to use = 1, Don't use = 0)

- Digit No. 1) Relay Operation : Relay operation is selected whether it is normally energized or deenergized.  
0 : Normally energized(NE)  
1 : Normally deenergized(NDE)
- Digit No. 2) Error Occurrence : Relay operates when an error (code "E--1" to "E--8") occurs.
- Digit No. 3) High-high alarm(HH) : Relay operates when the high-high limit setpoint set with function No. E-0 is reached. (Note 2)
- Digit No. 4) High Alarm(H) : Relay operates when the high limit setpoint set with function No. E-0 is reached. (Note 2)
- Digit No. 5) Low Alarm(L) : Relay operates when the low limit setpoint set with function No. E-1 is reached. (Note 2)
- Digit No. 6) Low-low Alarm(LL) : Relay operates when the low-low limit setpoint set with function No. E-1 is reached. (Note 2)
- Digit No. 7) Entry(E) : Relay operates when the setting mode is set.
- Digit No. 8) In Calibration(C) : Relay operates when calibration action is selected.
- Digit No. 9) Range selection Answerback(R) : Relay operates when the selection command is input in a state where the range selection command (R) is set in function No. G-3 or No. 14
- Digit No. 10) In Warming-up(W) : Relay operates when the detector is warmed up.
- Digit No. 11) Calibration Gas Pressure Reduction (G) : Relay operates when the pressure reduction alarm is input in a state where the calibration gas pressure reduction alarm (G) is set in function No. G-3 or G-4.
- Digit No. 12) Process Gas Temperature High Alarm(T) : Relay operates when process gas rises above the input temperature high limit alarm setpoint set with function No. F-5.
- Digit No. 13) Solenoid Valve Assembly Drive(P) : Relay operates when the process gas failure alarm is input in the state where the process gas failure alarm input (P) is set with function No. G-3. (Note 3)
- Digit No. 14) Blowback(B) : Relay operates when blowback state command is input in the state where the blowback state command (B) is set with function No. G-3.

(Note 1)

When a function is to be used, it is specified by setting the corresponding digit to 1. The default status is those shown below.

G-0 : (0) 1 0 0 0 0 0 0 0 0 0 0 0 0 0  
G-1 : (1) 0 0 0 0 0 1 1 0 1 0 0 0 0  
G-2 : (1) 0 0 1 1 0 0 0 0 0 0 0 0 0 0

(Note 2)

The relay is energized corresponding to the operation delay and hysteresis valve set in function No. E-2.

(Note 3)

"Solenoid valve assembly drive" is a function for driving a solenoid valve which supplies purge gas to the detector when gases not yet burned are mixed into the measuring gas. This function can also be applied to the cases where a sensor breakage accident due to condensed water should be prevented by purging the calibration gas tubing at the restart of operation.

On shipment, relay contacts for contact output relays are set as shown below.

Function No. G-0 (Contact output # 1) relay contacts : "Break contact" (closed when de-energized)

Function No. G-1 (Contact output #2) relay contacts : "Make contact"

Function No. G-2 (Contact output #3) relay contacts : "Make contact"

The contact type can be changed by re-setting the jumper connector positions on the

PCB. If "Break contact" (open when energized) is necessary, change it referring to subsection 7.1.6.

### G-3 Contact point input 1

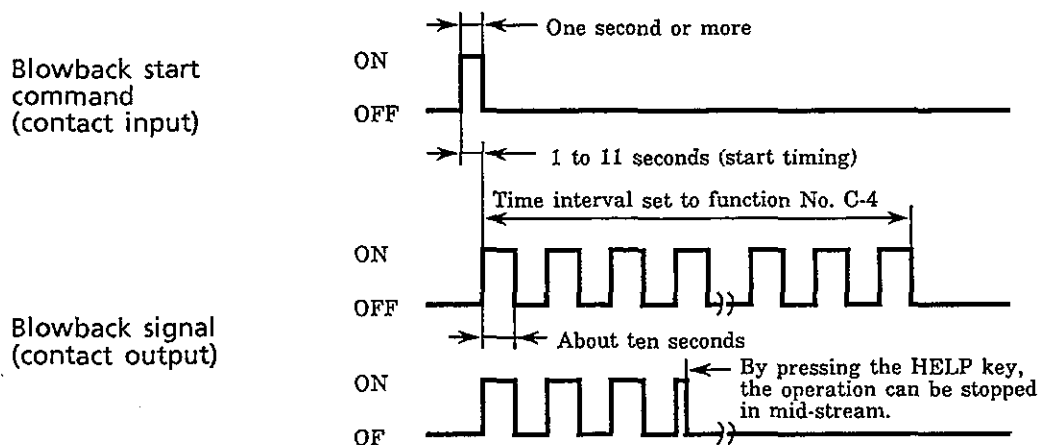
The instrument can accept a total of 2 contact inputs assigned in Functions Nos. G-3 and G-4. You select them from the following 5 types in Function G-3:

(Note 1) Contact input 1 is optional. For a converter without this function, do not specify it.

- 0: Calibration gas under pressure alarm (G)
- 1: Instructions for change in measurement range (R)
- 2: Instructions for start of calibration (C)
- 3: Process gas error alarm (P)
- 4: Instructions for start of blow-back (B) "see Note 2"

If the process gas error alarm is selected, move the cursor to "3" with the keys. If this error alarm is assigned, the power circuit supplying the detector with power from the converter is turned OFF when the contact signal is received. At the same time, the contact signal for driving the solenoid assembly is output.

(Note 2) The Blowback start command is valid when blowback is specified for function No. G-0 (or G-1 or G-2). Take the blowback start command contact input for more than one second. When the converter receives the blowback start command, it outputs a contact signal which turns ON and OFF about every ten seconds for an interval the same as the "calibration time" set for function No. C-4, starting at 1 to 11 seconds after receiving the command.



- (1) Blowback can be stopped with the HELP key.
- (2) Blowback is not started during calibration because the calibration-start commands (AUTO, SEMI-AUTO, ONR TOUCH) and calibrating action have priority.
- (3) The "blowback signal" time does not include the stabilizing time set for function No. C-3.
- (4) The analog output at the blowback operation becomes the mode specified for function No. D-2 (Non-Hold, Hold, or Preset Hold).

Readout on the message display (Ex.)

G 3	RY 1	CONT INPUT			
3 0 : G	1 : R	2 : C	3 : P	4 : B	

#### G-4 Contact input 2

In Function No. G-4, select the contact input signal from the following 3 types:

(Note) Contact input 1 is optional. For a converter without this function, do not specify it.

- 0: Calibration gas under pressure alarm (G)
- 1: Instructions for change in measurement range (R)
- 2: Instructions for start of calibration (C)

If the measurement range change instruction is assigned, move the cursor with the keys to "2".

Readout on the message  
display (Ex.)

G 4	R Y 2 C O N T I N U T		
2	0 : G	1 : R	2 : C

#### H-0 Communication mode

The communication mode should be specified only when digital communications are achieved. When "1" is specified, the message "Set ZA8C converter channel number (CH=)" appears. So enter channel numbers 1 through 8 for the individual converters.

(Note) When an RS-422-A communication interface is used, up to 8 converters can be connected to one computer.

Channel numbers are used to distinguish them from converters, so set channel numbers which are different from the converter numbers.

Readout on the message  
display (Ex.)

H 0	C O M M M O D E	
0	0 : F R E E	1 : H A N D

When "1" is assigned

H 0	C O M M M O D E	
( 0 )	H A N D S H A K E : C H = 3	

#### H-1 Baud rate (data communication rate) assignment

You assign here operating digital communications. For a data communication rate of 9600 bps or 4800 bps, enter "0" or "1", respectively. For 2400 bps, select "2" from the keyboard.

Readout on the message  
display (Ex.)

H 1	B A U D R A T E ( b p s )		
1	0 : 9 6	1 : 4 8	2 : 2 4

(Note) DISP Key

H 1	B A U D R A T E	
( 0 )	9 6 0 0 B i t s / s e c	

#### J-0 Types of fuels

You can select a type of fuel, for obtaining combustion efficiency, etc. Select and assign in Function No. J-0 what fuel you are using from the following 5 types:

- 0: Heavy oil A (A)
- 1: Heavy oil B (B)
- 2: Heavy oil C (C)
- 3: Gas (G)
- 4: Coal (X)

If your oil in use is heavy oil C, move the cursor to "2" with the keys.

Readout on the message  
display (Ex.)

J 0	FUEL GRADE
2 0 : A	1 : B 2 : C 3 : G 4 : X

#### J-1 Moisture content in exhaust gas

You can set the amount of moisture contained in the combustion exhaust gas of the fuel used in the measurement process (in terms of  $N \text{ m}^3/\text{kg}$  or  $\text{m}^3/\text{m}^3$  in proportion to the unit volume of the fuel). Look up the setting value from Table 7.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on pages 7-16.

If the moisture content is  $1.27 N \text{ m}^3/\text{kg}$ , for example, enter "01.27".

Readout on the message  
display (Ex.)

J 1	H2O IN FUEL
0 1 . 2 7	$\text{m}^3 / \text{kg} (\text{m}^3)$

#### J-2 Theoretical air quantity

You can set the theoretical air quantity required for the fuel used in the measurement process to ignite ( $N \text{ m}^3/\text{kg}$  or  $\text{m}^3/\text{m}^3$ ). Look up the setting value from Table 7.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 7-16.

If the theoretical air quantity is  $10.7 N \text{ m}^3/\text{kg}$ , enter "10.70".

Readout on the message  
display (Ex.)

J 2	THEORITICAL AIR
1 0 . 7 0	$\text{m}^3 / \text{kg} (\text{m}^3)$

#### J-3 Net calorific value

You can set the net calorific value of the fuel used in the measurement process (in  $\text{kcal}/\text{kg}$  or  $\text{kcal}/\text{m}^3$ ). Look up the setting value from Table 7.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 7-16.

If the net calorific value is  $9860 \text{ kcal}/\text{kg}$ , enter "09860".

Readout on the message  
display (Ex.)

J 3	NET CALORIFIC VAL
0 9 8 6 0	$\text{kcal} / \text{kg} (\text{m}^3)$

#### J-4 X value ( $X = a + b \cdot H_1$ )

The X value ( $N \text{ m}^3/\text{kg}$  or  $\text{m}^3/\text{m}^3$ ) is the coefficient provided with each fuel. Look up the x value of the fuel used from Table 7.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 7-16.

If the X value is  $0.773 (\text{m}^3/\text{kg})$ , for instance, round off the value to the second decimal place and enter "00.77".

Readout on the message  
display (Ex.)

J 4	VALUE OF X
0 0 . 7 7	$\text{m}^3 / \text{kg} (\text{m}^3)$

## J-5 Absolute humidity of atmosphere

You can set the absolute humidity of the atmosphere used in igniting (moisture: kg/dry air: kg). If the absolute humidity is 0.021 kg/kg, enter "0.021".

For your reference, a graph for determining absolute humidity by the temperature indications of a psychrometer is shown in Figure 7.2. It is a little inferior in accuracy. If the exact humidity is required, determine the value by referring to References such as JIS B8222, "Heat Balancing of Boilers for Land Use."

Readout on the message  
display (Ex.)

J 5	ABS	HMD	OF	AIR
0	.	0	2	1 0
			kg	/ kg

## J-6 Temperature of exhaust gas

You can set the temperature of the exhaust gas in the actual combustion process (°C). If the temperature of the exhaust gas is 450°C, enter "0450".

Readout on the message  
display (Ex.)

J 6	FUEL	GAS	TEMP
0	4	5	0 ° C

## J-7 Temperature of atmosphere

You can set the temperature of the atmosphere taken in for igniting (°C). Measure the temperature of the atmosphere at a place as close to the air intake port as possible.

If the temperature is minus 1°C, for instance, enter "--001". You can alternately display plus and minus signs by pressing the increase key.

Readout on the message  
display (Ex.)

J 7	AMB	AIR	TEMP
-	0	0	1 ° C

Table 7.2 Various Values of Fuels

## ● Liquid fuels

J-2: Theoretical air qty

J-4: X value

Fuel properties Type			Specific weight kg/l	Chemical components (% by weight)							Heat value kcal/kg		Theore- tical combustion N m <sup>3</sup> /kg	Combustion gas qty N m <sup>3</sup> /kg					X value
				C	<i>h</i>	O	N	S	<i>w</i>	Ash	High	Low		CO <sub>2</sub>	H <sub>2</sub> O	SO <sub>2</sub>	N <sub>2</sub>	Total	
Kerosene			0.78~ 0.83	85.7	14.0	—	—	0.5	0.0	0.0	11100	10400	11.4	1.59	1.56	0.00	9.02	12.17	0.96
Light oil			0.81~ 0.84	85.6	13.2	—	—	1.2	0.0	0.0	10960	10280	11.2	1.59	1.47	0.00	8.87	11.93	0.91
A	Heavy oil class 1	No. 1	0.85~ 0.88	85.9	12.0	0.7	0.5	0.5	0.3	0.05	10880	10210	10.9	1.60	1.34	0.00	8.61	11.55	0.89
		No. 2	0.83~ 0.89	84.6	11.8	0.7	0.5	2.0	0.3	0.05	10780	10110	10.8	1.58	1.32	0.01	8.53	11.44	0.86
B	Heavy oil class 2		0.90~ 0.93	84.5	11.3	0.4	0.4	3.0	0.4	0.05	10470	9860	10.7	1.58	1.27	0.02	8.44	11.31	0.77
C	Heavy oil class 2	No. 1	0.93~ 0.95	86.1	10.9	0.5	0.4	1.5	0.5	0.1	10500	9900	10.7	1.61	1.22	0.01	8.43	11.27	0.79
		No. 2	0.94~ 0.96	84.4	10.7	0.5	0.4	3.5	0.5	0.1	10300	9710	10.5	1.58	1.20	0.02	8.32	11.12	0.72
		No. 3	0.92~ 1.00	86.1	10.9	0.5	0.4	1.5	0.6	0.1	10430	9840	10.7	1.61	1.22	0.01	8.43	11.27	0.77
		No. 4	0.94~ 0.97	83.0	10.5	0.5	0.4	3.5	2.0	0.1	10280	9700	10.3	1.55	1.18	0.02	8.18	10.93	0.72

J-3: Net calorific value of fuel in use

J-1: Moisture content  
in exhaust gas

## ● Gas fuels

J-2: Theoretical air qty

J-4: X value

Type	Fuel properties	Specific weight kg/Nm <sup>3</sup>	Chemical components (% by weight)							Heat value kcal/N m <sup>3</sup>		Theore- tical combustion N m <sup>3</sup> /m <sup>3</sup>	Combustion gas qty N m <sup>3</sup> /m <sup>3</sup>					X value
	CO		H <sub>2</sub>	CO <sub>2</sub>	CH <sub>4</sub>	C <sub>m</sub> H <sub>n</sub>	O <sub>2</sub>	N <sub>2</sub>	High	Low	CO <sub>2</sub>		H <sub>2</sub> O		N <sub>2</sub>	Total		
Coke oven gas		0.544	9.0	50.5	2.6	25.9	3.9	0.1	8.0	4880	4350	4.455	0.45	1.10		3.60	5.15	0.46
Blast furnace gas		1.369	25.0	2.0	20.0	—	—	—	53.0	810	800	0.603	0.45	0.02		1.01	1.48	0.08
Natural gas		0.796	—	—	2.0	88.4	3.2	1.6	4.2	9050	8140	9.015	0.98	1.88		7.17	10.03	0.86
Propane		2.030	C <sub>3</sub> H <sub>8</sub> 90%, C <sub>4</sub> H <sub>10</sub> 10%							24380	22450	24.63	3.10	4.10		19.5	26.7	2.36
Butane		2.530	C <sub>3</sub> H <sub>8</sub> 10%, C <sub>4</sub> H <sub>10</sub> 90%							29980	27680	30.37	3.90	4.90		24.0	32.8	2.91
(Gases)			(Molecular Formula)															
Oxygen		1.43	O <sub>2</sub>							—	—	—	—	—		—	—	—
Nitrogen		1.25	N <sub>2</sub>							—	—	—	—	—		—	—	—
Hydrogen		0.09	H <sub>2</sub>							3050	2570	2.390	—	1.0		1.89	2.89	0.27
Carbon monoxide		1.25	CO							3020	3020	2.390	1.0	—		1.89	2.89	0.32
Carbon dioxide		1.96	CO <sub>2</sub>							—	—	—	—	—		—	—	—
Methane		0.72	CH <sub>4</sub>							9496	8557	9.570	1.0	2.0		7.57	10.6	0.90
Ethane		1.34	C <sub>2</sub> H <sub>6</sub>							16636	15228	16.74	2.0	3.0		13.2	18.2	1.60
Ethylene		1.25	C <sub>2</sub> H <sub>4</sub>							15048	14109	14.35	2.0	2.0		11.4	15.4	1.48
Propane		1.97	C <sub>3</sub> H <sub>8</sub>							23667	21800	23.91	3.0	4.0		18.9	25.9	2.29
Butane		2.59	C <sub>4</sub> H <sub>10</sub>							30685	28338	31.09	4.0	5.0		24.6	33.6	2.98

J-3: Net calorific value of fuel in use

J-1: Moisture content  
in exhaust gas

## &lt;Calculation Formulae&gt;

If you use a fuel not described in Table 7.2, calculate the set values for Function Nos. J - 1 to J - 4 using the following formulae:

## ● Liquid fuels

$$\text{Moisture content in exhaust gas} = 1/100 \{ 1.24 (9h + w) \} \quad [\text{m}^3/\text{kg}]$$

$$\text{Theoretical air quantity} = 12.38/10000 \times H_1 - 1.36 \quad [\text{m}^3/\text{kg}]$$

$$\text{Net calorific value} = H_1$$

$$\text{X value} = 3.37/10000 \times H_x - 2.55 \quad [\text{m}^3/\text{kg}]$$

Where,  $H_1$ : Net calorific value of fuel

$h$ : Hydrogen in fuel (% by weight)

$w$ : Moisture content in fuel (% by weight)

$H_x$ : Same as  $H_1$

## ● Gas fuels

$$\text{Moisture content in exhaust gas} = 1/100 \{ (h_2) + 1/2 \sum y (C_x h_y) + w \} \quad [\text{m}^3/\text{m}^3]$$

$$\text{Theoretical air quantity} = 11.2 \times H_1/10000 \quad [\text{m}^3/\text{m}^3]$$

$$\text{Net calorific value} = H_1$$

$$\text{X value} = 1.05/10000 \times H_x \quad [\text{m}^3/\text{m}^3]$$

Where,  $H_1$ : Net calorific value of fuel

$h$ : Hydrogen in fuel (% by weight)

$w$ : Moisture content in fuel (% by weight)

$H_x$ : Same as  $H_1$

## ● Solid fuels

$$\text{Moisture content in exhaust gas} = 1/100 \{ 1.24 (9h + w) \} \quad [\text{m}^3/\text{kg}]$$

$$\text{Theoretical air quantity} = 1.01 \times H_1/1000 + 0.56 \quad [\text{m}^3/\text{kg}]$$

$$\text{Net calorific value} = H_1 = H_h - 5.9 (9h + w) \quad [\text{kcal/kg}]$$

$$\text{X value} = 1.11 - (0.106/1000) \times H_x \quad [\text{m}^3/\text{m}^3]$$

Where,  $w$ : Total moisture content during use (% by weight)

$h$ : Hydrogen content (% by weight)

Mean hydrogen content of domestic coa (moisture-/ash-free) is 5.7 %.

Therefore,  $h$  is approximated by the following formula:

$$h = 5.7 \times [ \{ 100 - (w + \alpha) \} / 100 ] \times (100 - w) / (100 - w_1)$$

Where,  $\alpha$ : Ash content [%]

$w_1$ : Moisture content based on industrial analyses (constant-humidity base) [%]

$H_h$ : High heat value of fuel [kcal/kg]

$H_1$ : Low heat value of fuel [kcal/kg]

$H_x$ : Same as  $H_1$

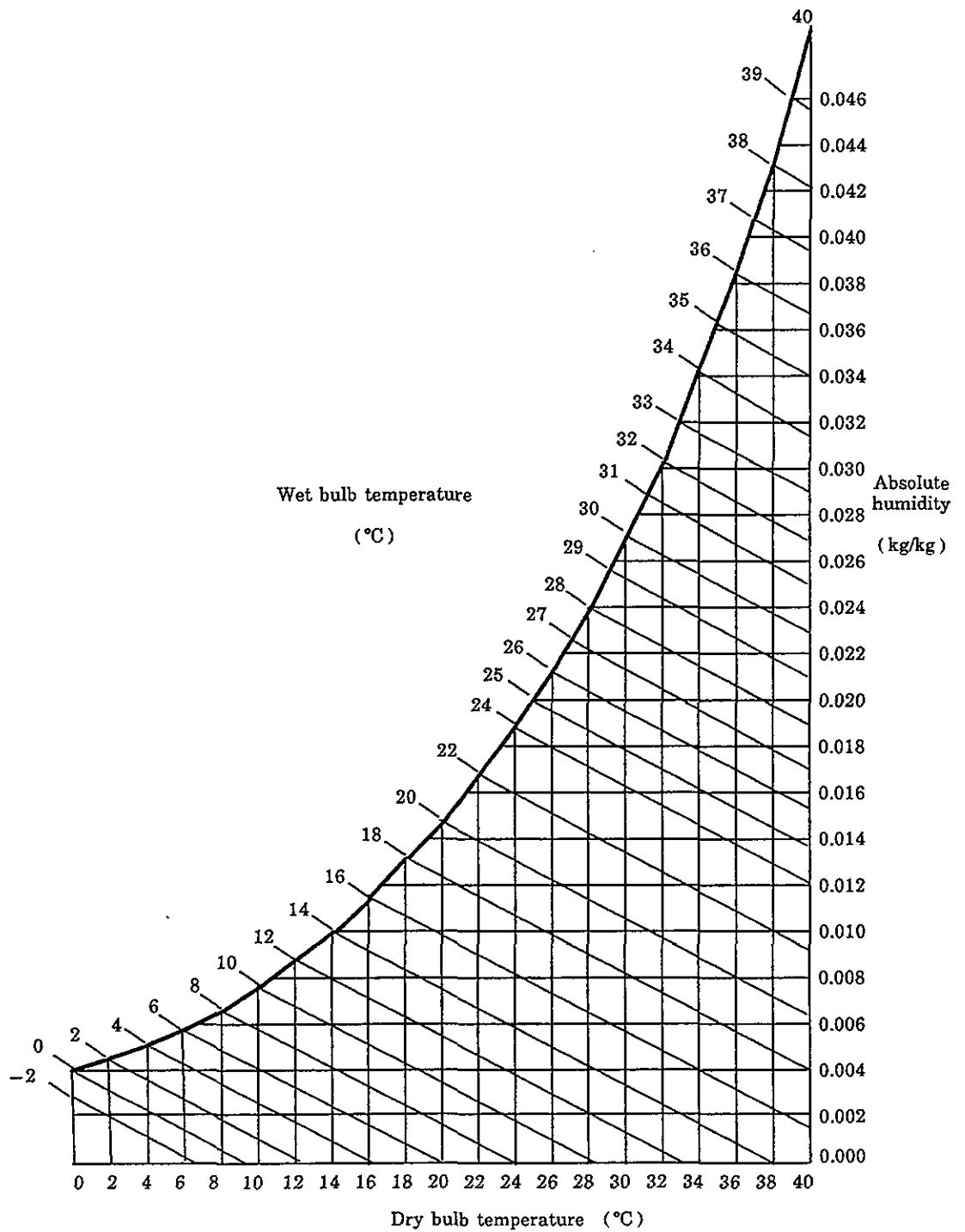


Figure 7.2 Absolute Humidity of Air

### 7.1.6 Changing Relay Contacts for Contact Output

Contact status (Normally Open or Normally Closed) of the contact outputs selecting applications with function No. G-0, G-1 or G-2 is determined by the selected relay operation (normally energized or de-energized) and types of relay contact ("make" contact or "break" contact).

(Note) NO of the contact status means the contact operating status where the contact is "closed" when a contact signal is output (NC is its inversion). "Make" contact in the types of relay contact means the contact which is closed when the relay coil is energized.

Table 7.3 Contact States Classified with Relay Operation and Types of Contact

Relay operation	Type of relay contacts	Contact status		
		When contact signal	Normal condition	Power OFF
Normally energized	Break contact (shortcircuiting jumpers 1 and 2)	[ Closed ]	[ Open ]	[ Closed ]
	Make contact (shortcircuiting jumpers 2 and 3)	[ Open ]	[ Closed ]	[ Open ]
Normally de-energized	Break contact (shortcircuiting jumpers 1 and 2)	[ Open ]	[ Closed ]	[ Closed ]
	Make contact (shortcircuiting jumpers 2 and 3)	[ Closed ]	[ Open ]	[ Open ]

On shipment, the relays are set as shown below.

Function No. G-0 (Contact output #1, Contact status NO): Normally energized,  
Break contact

Function No. G-1 (Contact output #2, Contact status NO): Normally de-energized,  
Make contact

Function No. G-2 (Contact output #3, Contact status NO): Normally de-energized,  
Make contact

If the type of contact is necessary to be changed, do it in the following procedure. The relay operation can be set to function No. G-0, No. G-1, or No. G-2 with key operation.

- (1) Turn off the power switch in the converter.
- (2) Open the operating panel and remove the PCB cover. Remove a screw ① in Figure 7.3 and also loosen screws ② and ③.
- (3) Set the corresponding jumper connector position again and change the type of contact. For obtaining a make contact, set the jumper connector to pins 2 and 3, while for obtaining a break contact, set the jumper connector to pins 1 and 2. When the set work has been done, restore the PCB cover and turn on the power switch.

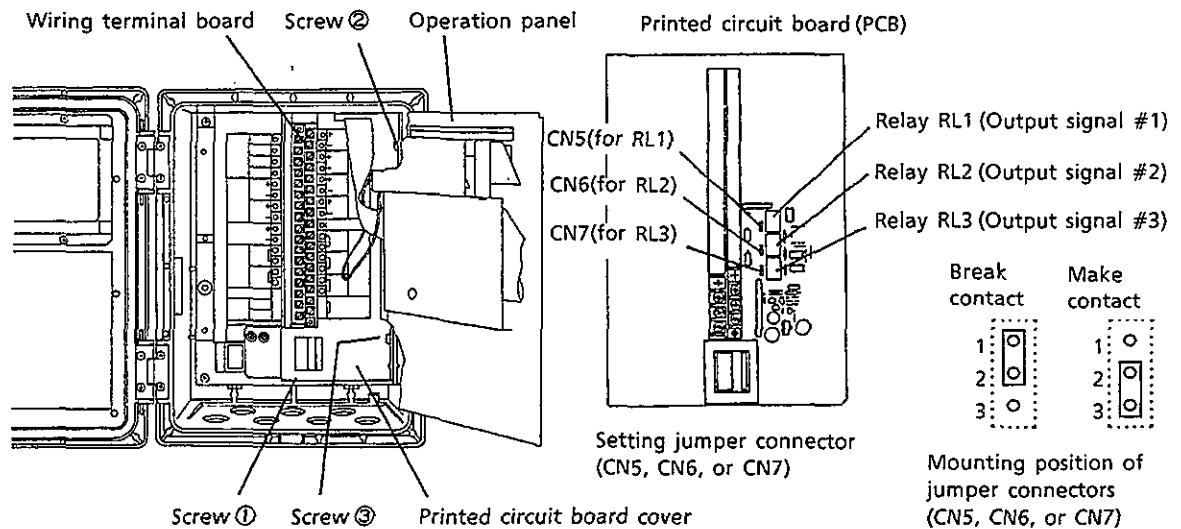


Figure 7.3 Setting Position of Jumper Connector and Setting Method

### 7.1.7 Calibration

The calibration of this instrument is carried out by matching either the zero gas or the span gas, or either the oxygen concentration of the zero gas or of the span gas with the measured value of the relevant calibration gas. The reference oxygen concentration at that time is already read into the memory in the converter. The converter detects the deviation of the measured result from this value and automatically corrects it.

The following 3 methods of calibration are available; further calibrations can be carried out periodically or occasionally, and the calibration gas for these later calibrations can be automatically or manually introduced. You can select any of these methods by registering it in the converter.

#### (1) Automatic calibration

A calibration operation begins when you set the calibration start time and the calibration frequency, and then press the key (or enter an external contact signal) to begin. All operations related to calibration (e.g., calibration time, opening/closing of the solenoid valve and sequence) are automatically activated based on the data set in the converter.

Automatic calibration is applicable to a system corresponding to System 3 or 4.

#### (2) Semi-automatic calibration

In this mode, calibration begins only when the converter is operated with the keys or receives starting instructions from a contact signal through an external circuit. The other details are the same as those for "automatic calibration".

This mode is applicable also to a system corresponding to System 3 or 4.

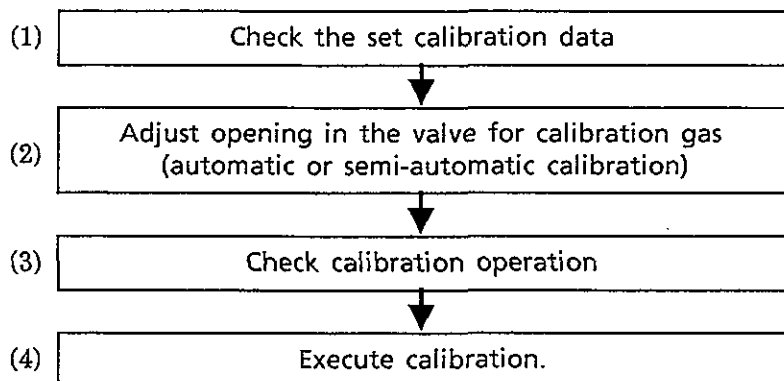
#### (3) One-touch calibration

In this mode, operate keys to send the calibration gas or for other procedures depending on the readout on the message display on the converter after you have given the calibration start instructions (in the same way as for semi-automatic calibration). Other calibration operations are automatically processed by the converter.

One-touch calibration is applicable to a system corresponding to System 1 or 2.

You can begin calibration as described above. For more details on calibration, see Chapter 9 "Calibration". The following description mainly explains how to prepare for calibration.

• Preparation for calibration



<Checking the set calibration data>

Sequentially display the data from Codes C-0 to C-7 on the message display of the converter and check for errors in the set data (e.g., the selected calibration method and the concentration of calibration gas).

<Adjusting the opening on the valve for the calibration gas>

This adjustment is applicable to a system using the ZA8H flow setting unit, e.g., System 3. Two solenoid valves are in the ZA8H flow setting unit and become "open" when electric power is supplied from the converter upon calibration. Adjustments at that time should be made with the solenoid valves open, so connect temporary wiring to the terminals of the solenoid valves (disconnect the wiring from the converter beforehand) and supply power. At that time, also check that the regulator for the zero gas cylinder is fully close.

(Note) If the ZA8F flow setting unit is used, adjust the flow rate before calibration.

Adjust the flow rate as follows:

- (1) Adjust the opening of the span gas flow setting valve "SPAN" which is in the ZA8H flow setting unit. Loosen the lock nut and rotate the valve shaft counterclockwise and adjust it so that the indication, "CHECK", on the flow meter becomes approximately 600 ml/min. After completing the adjustment, retighten the lock nut.
- (2) Disconnect the temporary wiring from the solenoid valves for the span gas in the flow setting unit and close the valves.
- (3) Open the regulator valve for the zero gas cylinder so that the secondary pressure becomes 0.5 to 1 kg/cm<sup>2</sup>. Then, adjust the opening of the valve "ZERO" which is in the ZA8H flow setting unit in order to set the zero gas flow. Loosen the lock nut and rotate the valve shaft counterclockwise and adjust it so that the indication "CHECK", on the flow meter becomes approximately 600 ml/min. After completing the adjustment, retighten the lock nut.
- (4) Disconnect the temporary wiring from the solenoid valves for the zero gas in the flow setting unit and close the valves. In addition, reconnect the wiring from the converter back in place and close the terminal box cover.

## &lt;Checking the calibration operation&gt;

Carry out calibration and check for normal operation. Begin calibration by pressing the key "CAL" on the converter. For the operation procedures of one-touch calibration, see Chapter 9.

If you have trouble when you monitor serial operations to the end of calibration, immediately remedy the problem by, for example, changing set data, etc.

(Note) If the error code "E - - 5" or "E - - 6" is shown in the data display, make the correction according to Chapter 11.

## &lt;Executing calibration&gt;

If you changed set data previously (in checking the calibration operation), you have to calibrate once again by checking for normal operation. Before beginning automatic calibration, check that the correct time is set in the converter and, after stationary operation (see section 7.2) begins, set the time for the first execution.

**7.1.8 Checking Functional Operations**

If you have some ongoing instrument operations which need to be checked before beginning stationary operation, check these operations according to the method suited to individual processes. It is recommended that you check safety functions, e.g., the process gas error alarm, for normal operation beforehand.

**7.2 Stationary Operation****7.2.1 Collection of Control Data**

You can display "maximum/minimum O<sub>2</sub> concentration" of function No. A-1 or "mean O<sub>2</sub> concentration" of A-2 on the message display. However, you cannot use it as an output signal. If you have to control them, read the value at a time as constant as possible for recording.

**7.2.2 Troubleshooting**

If an error occurs:

- (1) A "FAIL" lamp on the converter status display lights up;
- (2) An error code appears in the data display area;
- and,
- (3) Error messages appear in the message display area.

Every time an error occurs, immediately correct it according to the instructions in Chapter 11. The following error codes are operable:

Table 7.3 Error Codes, Details and Status

Error code	Error detail	Error status
E -- 1	Sensor (cell) error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E -- 2	Sensor temp "LOW"	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E -- 3	Sensor temp "HIGH"	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E -- 4	A/D (Analog circuit) error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E -- 5	Calibration value "ZERO"	(Displayed during calibration) the present zero point calibration value is not effected.
E -- 6	Calibration value "SPAN"	(Displayed during calibration) the present span calibration value is not effected.
E -- 7	Start power stability time over	(Displayed during calibration) the present calibration value is not effected.
E -- 8	ROM, RAM error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
□□□□ (Display erased)	Digital circuit error power failure	Goes into fail mode, automatically turning OFF the power supply to the detector heater. (Displayed upon restart after remedying the power failure) Data values default

(Note) E--5, E--6, or E--7 is displayed alternately with the O<sub>2</sub> concentration.

### 7.2.3 Checking Operating Conditions

In order to maintain normal operating conditions, determine which items are to be inspected periodically, and check them regularly for errors.

Items recommended for periodic inspections are as follows for your reference. For maintaining or recovering performance, see Chapter 10.

Table 7.4 Example of Items for Periodic Inspection

Inspection item	Purpose & detail of inspection	Inspection interval	System 1	System 2	System 3	System 4
Complete closing of calibration gas inlet	To prevent condensation which may break sensor. Check for a complete closing of needle valve.	1 to 7 days	○			
Set flow rate of flow setting unit	Check that flow is about 600 ml/min. for both the reference & calibration gases, for correctly measured and calibrated values.	1 to 7 days		○	○	○
Cell voltage (Function No. A-3)	To know the extent of deterioration of the sensor (cell). Compare the displayed value with theoretical one.	1 to 2 weeks	○	○	○	○
Pressure in the calibration gas cylinder	To determine the intervals between replacement of calibration gas (zero gas) cylinders. Specify min. pressure and check for higher pressure.	1 to 2 weeks		○	○	○
Set value of oxygen conc. for calibration gas (zero)	To obtain a correct calibrated value. Check for complete setting of oxygen conc. in the calibration gas (zero) in use.	Upon replacement,	○	○	○	○
Digital circuit error power failure	To determine the intervals between replacement of purge gas cylinders. Determine min. pressure and check for higher pressure.	1 to 2 weeks				○

## 7.2.4 Stopping and Restarting Operations

### <Operation stoppage>

Before stopping operations, it is important for you not to make the detector sensor inoperable.

If you stop the operation of the zirconia oxygen analyzer at the same time as the boiler or furnace, etc., condensation forms in the sensor and dust adheres to it. If you restart operations with the sensor in this state, as it heats up to 750°C, it causes dust to accumulate which significantly deteriorates its performance. In an extreme case with a lot of condensation, the analyzer may break. To prevent such an occurrence, you have to take the following steps to stop the equipment:

- (1) Keep the power supply to the analyzer ON as long as possible. If this is impossible, remove the detector.
- (2) If both of the above are impossible, keep air flowing into the calibration gas piping at a rate of about 600 ml/min.

### <Operation restart>

If none of the above precautions for stopping operations can be done, supply air into the calibration gas piping for 5 - 10 minutes at a rate of about 600 ml/min.

After stopping operations for a long period of time, set the necessary data again (see@ Table 7.1).

## 8. OPERATING KEYS AND DISPLAY UNIT OF CONVERTER

In this Chapter, the operating keys on the operation panel of the converter and the indication on the display unit are described.

### 8.1 Operating Keys

#### 8.1.1 Types and Functions of Operating Keys

There are 9 set keys on the operation panel of the converter. You can select an operation mode (measurement mode or maintenance mode), register temporary data, display various measurements or calculated data using these 9 keys. To operate the keys, press the center of each key.

(Note)

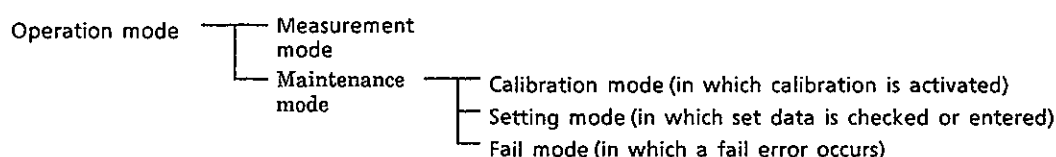


Table 8.1 Types, Functions and Applications of Operating Keys

Key	Name	Functions, applications
YES	Interactive key (yes)	Used for replying "yes" to an inquiry (Y/N ?).
NO	Interactive key (no)	Used for replying "no" to an inquiry (Y/N ?).
HELP	Sub-message display key Calibration stop key	Used for displaying sub-messages. Used for suspending calibration.
CAL	Calibration start key	Used for issuing start instructions in one-touch or semi-automatic calibration.
DISP	Measurement mode select key. Calibration data display key.	Used for returning the mode from the setting mode, etc. to an analog bar display (measurement mode). Used for monitoring various data during calibration.
ENTER	Entry key Setting-mode select key	Used for registering data in setting mode. Used for changing from the measurement mode to the setting mode.
>	Cursor key Message COS key	Used for moving the cursor to the number or letter to be changed or registered. Used for the display continuation of a message on 2 or more screens.
^	Number increase key No. forward key	Used for increasing a number on the cursor. Used for changing from one Function No. to the next
∨	Number decrease key No. backward key	Used for decreasing a number on the cursor. Used for returning to one Function No. from another.

### 8.1.2 Examples of Applications of the Operating Keys

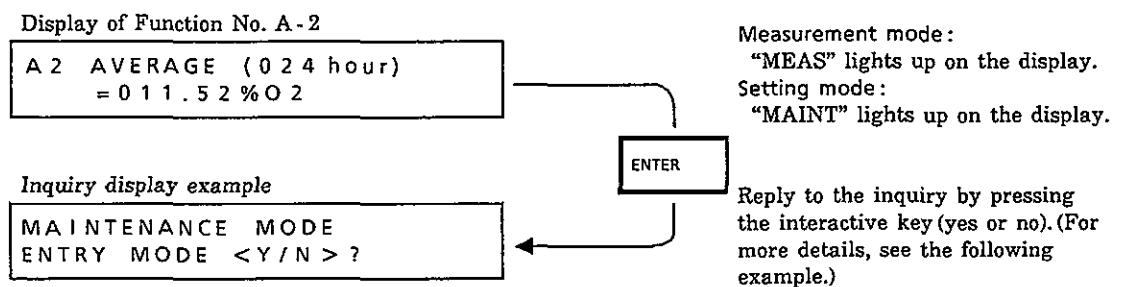
This section describes how to operate the keys with the following examples of operations. For displays, see 8.2.

- (1) Changeover from the measurement mode to the setting mode
- (2) Reply to inquiry
- (3) Entering the password
- (4) Selection of Function No. (Selection of number)
- (5) Selection of Function No. (Selection of group symbol)
- (6) Entering the setting data (Selection of setting details)
- (7) Entering the setting data (Input of data values)
- (8) Changeover from the setting mode to the measurement mode
- (9) Changing displayed data
- (10) Calibration start or suspension instructions
- (11) Displaying the data values in the calibration mode

(1) Changeover from the measurement mode to the setting mode

Used as the setting mode selection key (entry key).

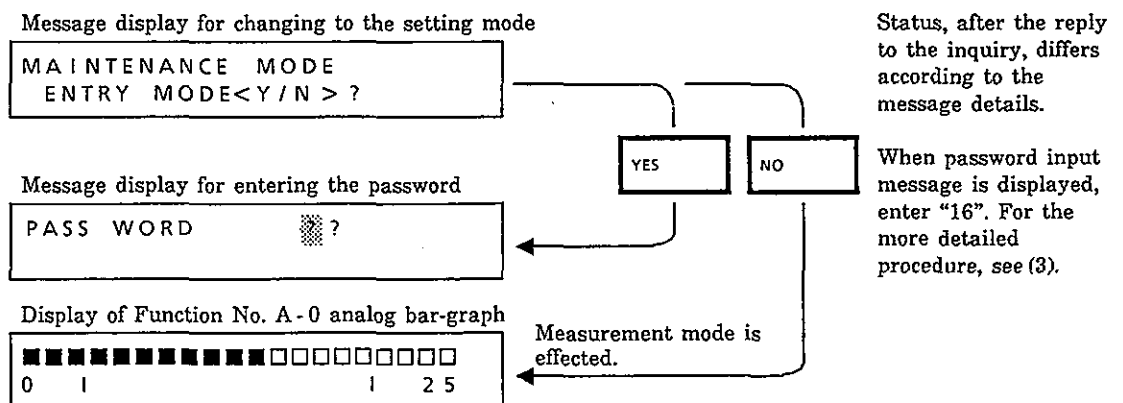
- Exanoke for changing over from the display of Function No. A-2 to the setting mode



(2) Reply to inquiry

Use an interactive key ("YES" or "NO" key).

- Example of replying to the message when changing to the setting mode

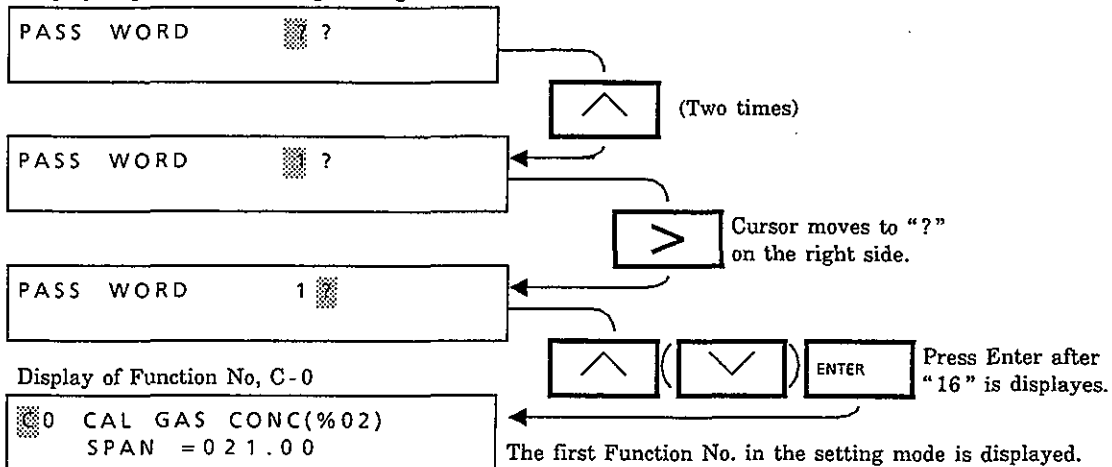


(3) Entering the password (16)

To assign a function in the setting mode, you have to enter the password. The password is "16", so enter this number. To do so, use the number increase/decrease key, cursor movement key, and the entry key.

● Entering the password for setting (checking) temporary data

Display of password - entering message

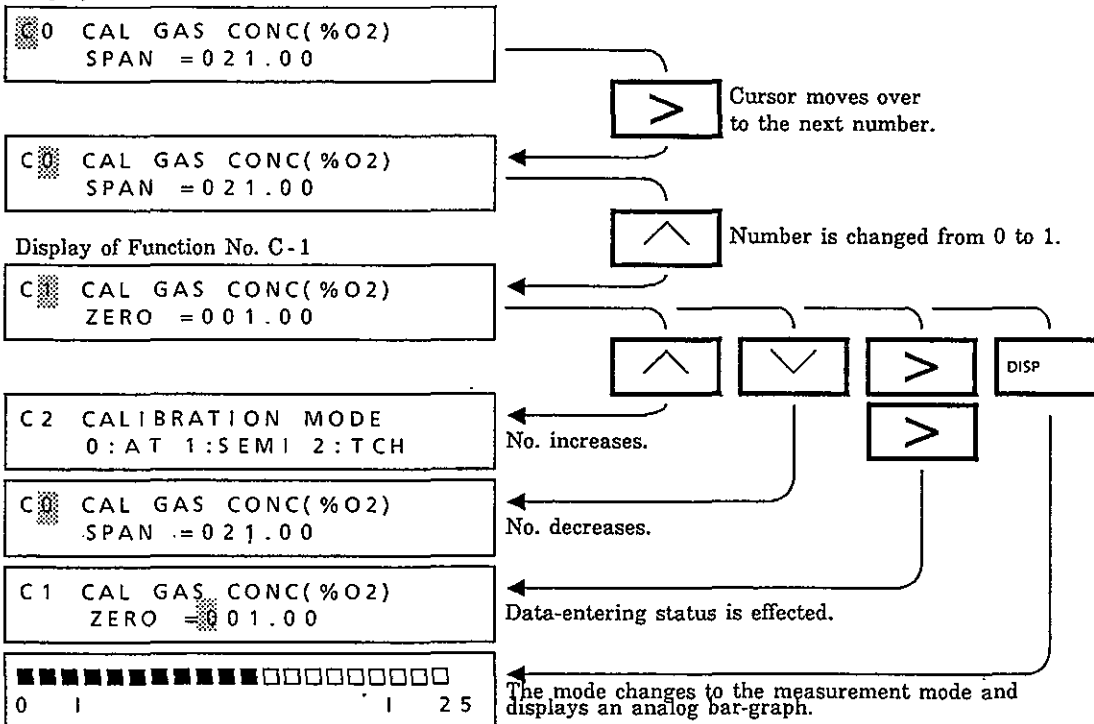


(4) Selection of Function No. (selection of number)

The number increase key, number decrease key and the cursor key are used.

● Display of Function No. C-0

Display of Function No. C-0



(Note 1)

If the entry key "ENTER" is pressed when the cursor resides in a function No. position, note that "0:AT (automatic calibration)" is automatically set as the calibration mode.

(5) Selection of Function No. (selection of group symbol)

Use the number increase key, number decrease key, entry key, etc. Which keys you use depend on the present state you are in (i.e., the operation mode and the position of the cursor).

● Selecting Function No. D-0 when already in Function No. C-1

Display of Function No. C-1

C 1 CAL GAS CONC( %O2)  
ZERO = 001.00

ENTER

The displayed data are registered and the cursor moves to the upper left.

C 1 CAL GAS CONC( %O2)  
ZERO = 001.00

^

The function group changes from Group C to D.

Display of Function No. D-1

D 1 OUTPUT RANGE 2  
000 - 025 %O2

>

The cursor moves over to the No.

D 1 OUTPUT RANGE 2  
000 - 025 %O2

✓

the no. decreases.

Display of Function No. D-0

D 0 OUTPUT RANGE 1  
000 - 050 %O2

(6) Entering the setting data (Selection of setting details)

Use the number increase key, number decrease key, cursor key, entry key, etc. Which keys you use depend on the present state you are in (i. e., the operation mode and the position of the cursor).

● Selecting hold (HLD) in Function No. D-2 when already in Function No. D-0

Display of Function No. D-0

D 0 OUTPUT RANGE 1  
000 - 050 %O2

ENTER

The displayed data are registered and the cursor moves to the upper left.

D 0 OUTPUT RANGE 1  
000 - 050 %O2

>

The cursor moves over to the No.

Display of Function No. D-0

D 0 OUTPUT RANGE 1  
000 - 050 %O2

^

^

2 Press this key twice (D-1 comes up if you press this key only once).

Display of Function No. D-2 (Note)

D 2 OUTPUT HOLD  
0 0 : N 1 : HLD 2 : P - HLD

>

>

Press this key twice. The cursor moves over to "1".

Display of Function No. D-0

D 2 OUTPUT HOLD  
0 0 : N 1 : HLD 2 : P - HLD

ENTER

Registered.

(Note) Presently set item is displayed by the number of left side in the lower line.

### (7) Entering the setting data (Input of data values)

Use the number increase key, number decrease key, cursor key, entry key, etc. Which keys you use depend on the present state you are in (i. e., the operation mode and the position of the cursor).

- When span gas concentration is to be changed from 21.00 vol% O<sub>2</sub> to 20.00 vol% O<sub>2</sub> in Function No. C

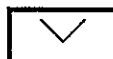
Display of Function No. C-0

0 CAL GAS CONC(%O<sub>2</sub>)  
SPAN = 021.00

Press the key 4 times to move the cursor to the 1 from the C.



C 0 CAL GAS CONC(%O<sub>2</sub>)  
SPAN = 02 00



The 1 is changed to 0 to come up with the figure 20.00.

C 0 CAL GAS CONC(%O<sub>2</sub>)  
SPAN = 020.00



The displayed data are registered and the cursor moves to the upper left.

0 CAL GAS CONC(%O<sub>2</sub>)  
SPAN = 020.00

SET RANGE EXCEEDED

If the entered value exceeds the settable range, such a display is presented and then the input state display returns again. Check the setting range in Table 7.1 and enter a correct value again.

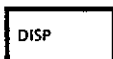
### (8) Changeover from the setting mode to the measurement mode

Use the measurement mode select key.

- When changing over from Function No. D-0

Display of Function No. D-0

D 0 OUTPUT RANGE 1  
000 - 050 %O<sub>2</sub>



0 1 25

The mode is changed over to the measurement mode and the analog bar-graph is displayed.

### (9) Changing displayed data

Use the number increase key to change the function number. Use the cursor key to change to another function group or to move to the next screen.

- When changing from Function No. A-0

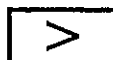
Display of Function No. A-0

0 1 25



The no. changes every time the key is pressed. The number will return to 0 if the key is pressed again after reaching 7 in group A.

A7 EXCESS AIR RATIO  
= 01.40



The display changes from Group A to Group B.

B0 SPAN(0) = 099.7 %  
89/04/26 14:30 H

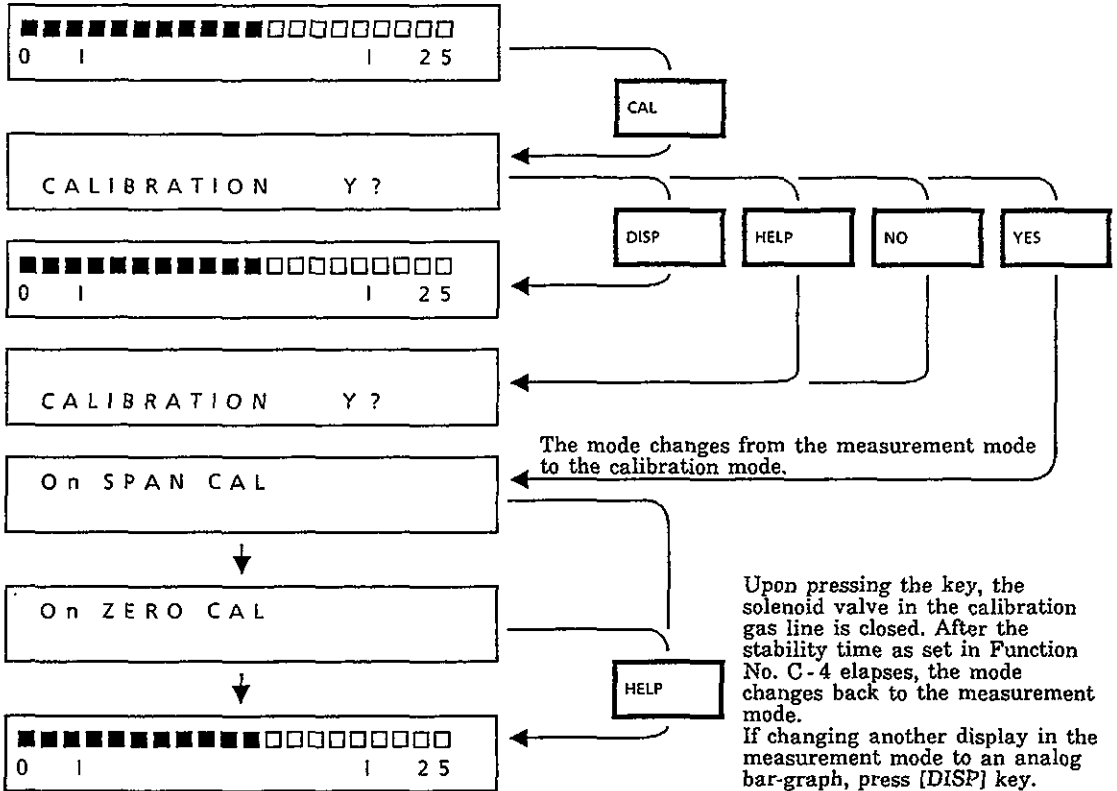
When there are 2 or more component screens, the second (or next) screen can be displayed by pressing the cursor key.

### (10) Calibration start or suspension instructions

Use the calibration start or suspension key. For more details on the calibration keys, see Chapter?

- When a calibration start instruction issued in the semi-automatic calibration mode is suspended during mid-activity.

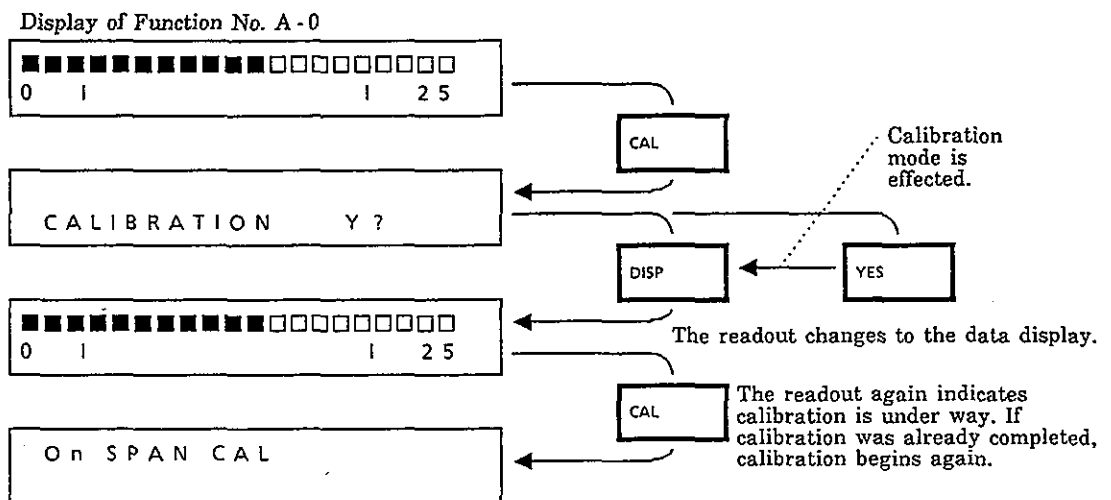
Display of Function No. A-0



### (11) Displaying the data values in the calibration mode

You can display the readout from Function No. A-0. You can also display the set data in Function No. C-0 and subsequent functions. However, no data is settable.

- When calibration commences in the semi-automatic calibration mode and the data is displayed

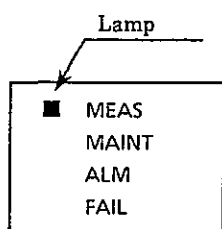


## 8.2 Readout Displays

There are 3 kinds of readouts: a status display, data display, and message display on the operation panel of the converter. In the status readout, the operation mode and the error alarm (if any) are displayed. In the data readout, the measured oxygen concentration and the details of any error which has occurred are displayed. In the message readout, various measured data, set data and messages are displayed.

### 8.2.1 Status Display

The related operation mode and the occurrence of an alarm, etc. are indicated by lit-up lights.



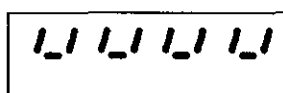
Status display

- MEAS : Lights up in the measurement mode.
- MAINT : Lights up in the calibration mode or setting mode.  
This light also glows when an error occurs with the instrument stopping measurement operations.
- ALM : Lights up when an alarm is issued according to the details set in Function Nos. G-0 to G-2. The operation mode changes from the measurement mode to the maintenance mode depending on the type of alarm.
- FAIL : Lights up when an error occurs while stopping the measurement operations of the instrument.

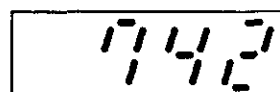
### 8.2.2 Data Display

This display incorporates a large 4-digit LED. Items displayed here are the warm-up state (warm-up symbol ON and the current temperature of the sensor), measured oxygen concentration (vol% O<sub>2</sub>) and the error code. Normally, just the measured oxygen concentration is displayed.

- Example of warm-up state display

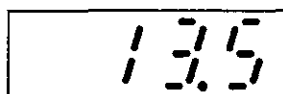


Alternately  
displayed



(Current temperature of sensor in °C)

- Example of measured oxygen concentration display



(Note 1) Measured value is displayed. Thus, even if "1" (oxygen concentration in dry gas) is selected in function No. D-6, indication in the data display is the oxygen concentration in wet gas.

- Example of error occurrence display



(Note 2) An error display, "E-5", "E-6" or "E-7" generated in calibration is indicated alternately with oxygen concentration display.

### 8.2.3 Message Display

The message display incorporates the dot matrix LCD of 40 characters (20 characters  $\times$  2 lines). This readout displays the following messages:

To display the message of a value-setting group, you have to enter the specified password. The password is the 2-digit number "16".

- (1) Measurement value group A (Function Nos. A-0 - A-7)
- (2) Measurement value group B (Function Nos. B-0 - B-8)
- (3) Value-setting group C (Function Nos. C-0 - C-7)
- (4) Value-setting group D (Function Nos. D-0 - D-6)
- (5) Value-setting group E (Function Nos. E-0 - E-2)
- (6) Value-setting group F (Function Nos. F-0 - F-5)
- (7) Value-setting group G (Function Nos. G-0 - G-4)
- (8) Value-setting group H (Function Nos. H-0 - H-1)
- (9) Value-setting group J (Function Nos. J-0 - J-7)
- (10) Status message group
- (11) Interactive message group
- (12) Sub-message group

Among other message groups, the value-setting group has already been described in 7.1.5. For the status, interactive and sub-message groups to be displayed automatically, the relevant descriptions will be given when required (e.g., "Calibration" in Chapter 9). Therefore, the following description describes only the messages in the measurement value groups (1) and (2):

#### <Displaying measurement value group messages>

##### A - 0 Display of an Analog Bar-graph

When you press the measurement mode select key, an analog bar-graph is first displayed. On the top line is displayed the analog bar-graph showing the oxygen concentration of the measurement span. On the bottom line are displayed the minimum and maximum values of the measurement range and arrows indicating the lower limit alarm set value (Lo) and the upper limit alarm set value (Hi).

When an error occurs, a message is also displayed. If there are multiple messages, "H" is displayed at the bottom right part of the display. Thus, in this case, display auxiliary messages using [HELP] key to confirm the contents.

- (1) The minimum unit on the analog bar-graph corresponds to 2.5% created by dividing the 100% of measurement span by 40. There is one displayed value after being smoothed.
- (2) Displayable alarm set values (indexes) are those only for the lower and upper limits. The extreme upper and extreme lower limits, if any, are not displayed. In addition, if the lower or upper alarm set value is set in excess of the measurement range, it is not displayed either.
- (3) If the alarm set value indication (index) overlaps the display unit of the minimum or maximum value in the measurement range, it is not displayed.
- (4) If the analog bar-graph indicates the hold value (preset or preceding value), "HOLD" is displayed in the lower line.

Display of analog bar-graph (Example 1)



(Note 1) The value corresponding to the output current is shown in the analog bar-graph. Therefore, when "1" is selected with function No. D-4, logarithmic indication of the current is displayed. When "1" is selected with function No. D-6, oxygen concentration in dry gas is displayed.

(Note 2) If a HOLD value is displayed, "HOLD" is also displayed.

(Example 2):  
In HOLD state



In addition, if an error occurs during displaying a bargraph, it changes to the following error message display.

• Error Code "E-1"

Display when an error occurs (Example 1)

CELL FAILURE - CAUSE?  
INCOR WRG (CONV → DET) H

When more than one error occurs, "H" is displayed.  
Sequentially transfer the display using the auxiliary message display key.

POOR or NC in OUTLINE  
CELL BRKN or DMGD H

PLS READ INST MANUAL  
"TROUBLESHOOTING"

• Error Code "E-2"

Display when an error occurs (Example 2)

TEMP TOO LO - CAUSE?  
INCOR or BRKN WRG H

CLDJCT CKT, e + c - ABNL  
HTR or TC LINE BRKN H

BLWN FU or POOR CONT  
SHORT in TC H

PLS READ INST MANUAL  
"TROUBLESHOOTING"

• Error Code "E--3"

Display when an error  
occurs (Example 3)

TEMP TOO HI - CAUSE?  
INCOR or BRKN WRG H

CLDJCT CKT, e + c - ABNL  
HTR or TC LNE BRKN H

BLWN FU or POOR CONT  
SHORT in TC H

PLS READ INST MANUAL  
"TROUBLESHOOTING"

• Error Code "E--4"

Display when an error  
occurs (Example 4)

ANALOG CKT FAILURE  
AD CONV DEFECTIVE H

CUST RPR IMPOSSIBLE  
CONT YKGW SVCE DEPT

• Error Code "E--5"

Display when an error  
occurs (Example 5)

CALVAL ABNL (0 PT)  
CAUSE? CELL DMGD H

CAL GAS FLRT < IND' D  
POSSIBLE LEAK H

WRNG GAS - CHNG SPAN → 0  
DIFF CONC & MEM VAL H

PLS READ INST MANUAL  
"TROUBLESHOOTING"

• Error Code "E--6"

Display when an error  
occurs (Example 6)

CALVAL ABNL - SPAN PT  
CAUSE? CELL DMGD H

CAL GAS FLRT < IND' D  
POSSIBLE LEAK H

WRNG GAS - CHNG 0 → SPAN  
DIFF CONC & MEM VAL H

PLS READ INST MANUAL  
"TROUBLESHOOTING"

● Error Code "E-7"

Display when an error  
occurs (Example 7)

STABTFNSHD - CAUSE?
TOVBFR OUTSTBLNH

CALGASFLRT < IND'D
POS LKG/CELL DMGD H

PLS READ INST MANUAL
"TROUBLESHOOTING"

● Error Code "E-8"

Display when an error  
occurs (Example 6)

MEMORY FAILURE in
ROM / RAM H

CUST RPR IMPOSSIBLE
CONT YKGW SVCE DEPT

A-1 Maximum or Minimum O<sub>2</sub> Concentration

The maximum and minimum values of measured oxygen concentrations are stored and updated according to the time intervals set in Function No. F-2. In Function No. A-1, the latest values are displayed. By subsequently pressing "HELP", the auxiliary message display key, generated data and time of those values are displayed.

Display of maximum  
and minimum O<sub>2</sub>  
concentrations  
(example)

A 1	MAX = 19 . 32	% O <sub>2</sub>	
	MIN = 15 . 48	% O <sub>2</sub>	H

A-2 Mean O<sub>2</sub> Concentration

The mean value of the measured oxygen concentration is stored and updated according to the time intervals set in Function No. F-1. In Function No. A-2, the latest value is displayed.

Display of mean O<sub>2</sub>  
concentration  
(example)

A 2	AVERAGE (0 2 4 h o u r)
	0 1 6 . 9 2 % O <sub>2</sub>

## A-3 Cell Voltage

Cell (sensor) voltage is an index for noting the deterioration of the sensor. In Function No. A-3, the cell voltage at the oxygen concentration presently measured is displayed. The sensor is judged to be normal if the measured value agrees with the theoretical value at the same oxygen concentration.

$$E = -50.74 \log (P_x / P_a) \text{ [mV]}$$

Where  $P_x$  : O<sub>2</sub> concentration in the measurement gas

$P_a$  : O<sub>2</sub> concentration in the comparison gas (21 vol% O<sub>2</sub>)

Table 8.2 shows the relationship between the oxygen concentration and cell voltage.

Table 8.2 Oxygen Concentration, vol% O<sub>2</sub> Vs. Cell Voltage mV (Cell Temperature 750 °C)

% O <sub>2</sub>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
mV	117.83	102.56	93.62	87.28	82.36	78.35	74.95	72.01	69.41
% O <sub>2</sub>	1	2	3	4	5	6	7	8	9
mV	67.09	51.82	42.88	36.54	31.62	27.61	24.21	21.27	18.67
% O <sub>2</sub>	10	21.0	30	40	50	60	70	80	90
mV	16.35	0	-7.86	-14.2	-19.2	-23.1	-26.5	-29.5	-32.1
% O <sub>2</sub>	100								
mV	-34.4								

Display of cell  
voltage (example)

A 3	CELL EMF = 0 1 8 . 3 m V
-----	--------------------------

#### A-4 Cell Temperature/Thermocouple Voltage

Cell temperature is measured using a type K (chromel-alumel) thermocouple. The cold junction of this thermocouple is located at the terminal end of the detector. The temperature at this cold junction is measured with a transistor. In Function No. A-4, displayed is a voltage affected by the temperature at the cold junction terminal.

If the cell temperature is higher than 780°C, error "E-3" is effected, while error "E-2" is displayed at 730°C or less.

(Note) When the cell temperature is to be determined based on the displayed voltage, compensate for voltage error due to the temperature at the cold junction.

Display of cell  
temperature/  
thermocouple voltage  
(example)

A 4 CELL TEMP = 0750 °C  
T C (K) EMF = 030.4 mV

#### A-5 Output Current/Output (Measurement) Range

The current output value (mA) of the output signal and the measurement range (vol% O<sub>2</sub>) are displayed.

Display of the output  
current/  
measurement range  
(example)

A 5 OUTPUT = 10.4 mA DC  
RANGE = 000 - 025 % O<sub>2</sub>

(Note) The relationship between the output values of the current (mA DC) and the oxygen concentration (vol% O<sub>2</sub>) is as shown below:

- (1) For a linear output signal of 0 to 20 mA DC:

$$\text{Output current (mA)} = 20 \times (P_x / \text{RangeH})$$

- (2) For a linear output signal of 4 to 20 mA DC:

$$\text{Output current (mA)} = 16 \times (P_x / \text{RangeH}) + 4$$

- (3) For a logarithmic output signal of 0 to 20 mA DC:

$$\text{Output current (mA)} = 20 \times \{(1 / \log(\text{RangeH}/0.1))\} \{\log(P_x/0.1)\}$$

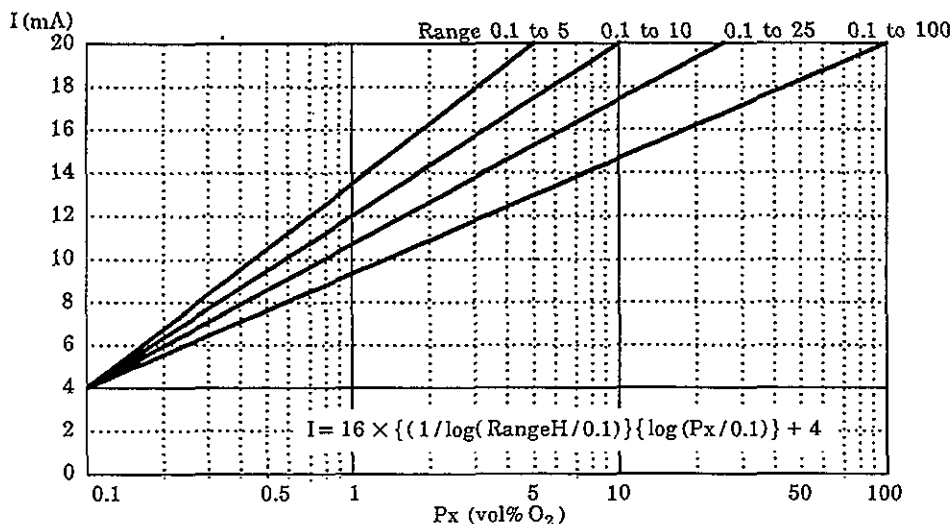
- (4) For a logarithmic output signal of 4 to 20 mA DC:

$$\text{Output current (mA)} = 16 \times \{(1 / \log(\text{RangeH}/0.1))\} \{\log(P_x/0.1)\} + 4$$

where  $P_x$  : Oxygen concentration (vol% O<sub>2</sub>)

RangeH : Maximum value of measurement range (vol% O<sub>2</sub>)

The figure below indicates the relationship between each range and the logarithmic output signal (4 to 20 mA DC).



## A-6 Time

The time is displayed by the clock function of the converter (year, month, day, hour, minute). If correction of this time is required, enter the correct time in Function No. F-0.

Display of time  
(example)

A 6	P R E S E N T	T I M E
9 0	/ 0 5	/ 2 6 1 3 : 0 0

## A-7 Air Ratio

The current air ratio, obtained by calculation, is displayed. If you use this air ratio data for estimating the combustion efficiency, etc., check that there is no air leaking in beforehand and that the measured value has not been affected by any interference gas (CH<sub>4</sub>, CO, H<sub>2</sub>, etc.).

Air ratio  $m$  is calculated by the following formula:

$$m = \{1 / (21 - \text{Oxygen concentration})\} \times 21$$

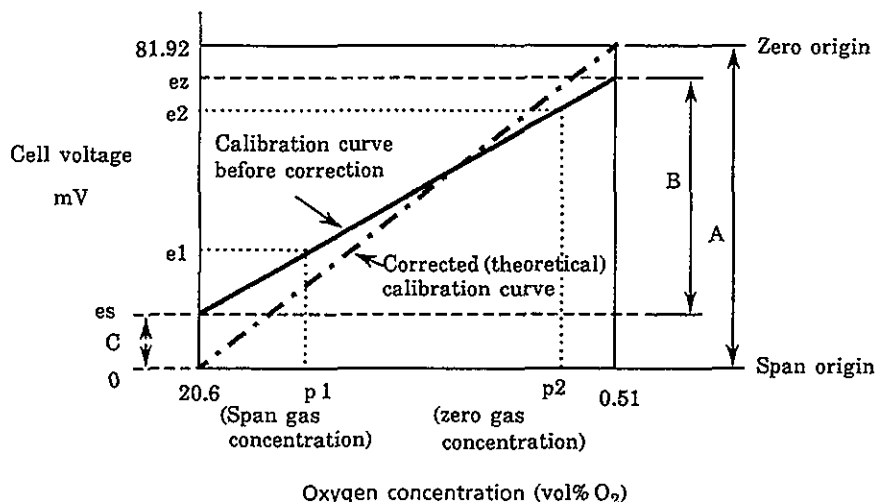
Display of air ratio  
(example)

A 7	E X C E S S	A I R	R A T I O
0 3	.	5 9	

A-7 is the last message in the measured value group A. If you want to display messages in measured value group B, press the cursor key.

### B-0 Span Point Correction Ratio Record

The span point correction ratio, obtained every time the span point is calibrated, is displayed. You can determine the degree of deterioration in the cell (sensor) from this value. You can display the data record for the previous 10 times including the latest data. To display each datum on the screen, call up the next screen by pressing the message "HELP" key. You can have the span point correction ratio as follows. The correctable range of the span point is  $0 \pm 18\%$  (corresponding to a voltage at a span point of about  $\pm 15$  mV).



$$\text{Zero point correction factor} = (B/A) \times 100 (\%) \quad \text{Correctable range: } 100 \pm 30\%$$

$$\text{Span point correction factor} = (C/A) \times 100 (\%) \quad \text{Correctable range: } 0 \pm 18\%$$

Figure 8.1 Calculation of the Zero Point Correction Ratio and the Span Point Correction Ratio

Display of the span  
point correction ratio  
record (1) (example)

```
B 0  SPAN ( 0 ) = 0 0 1 . 5  %
      8 9 / 0 4 / 3 0    0 9 : 3 0  H
```

### B-1 Zero Point Correction Ratio Record

The zero point correction ratio, obtained every time the zero point is calibrated, is displayed. You can determine the degree of cell (sensor) deterioration from this value. You can display the data record for the previous 10 times including the latest data. To display each data display screen, call up the next screen by pressing the message "HELP" key. You can get the zero point correction ratio by the method in Figure 8.1. The correctable range for the zero point is  $100 \pm 30\%$ .

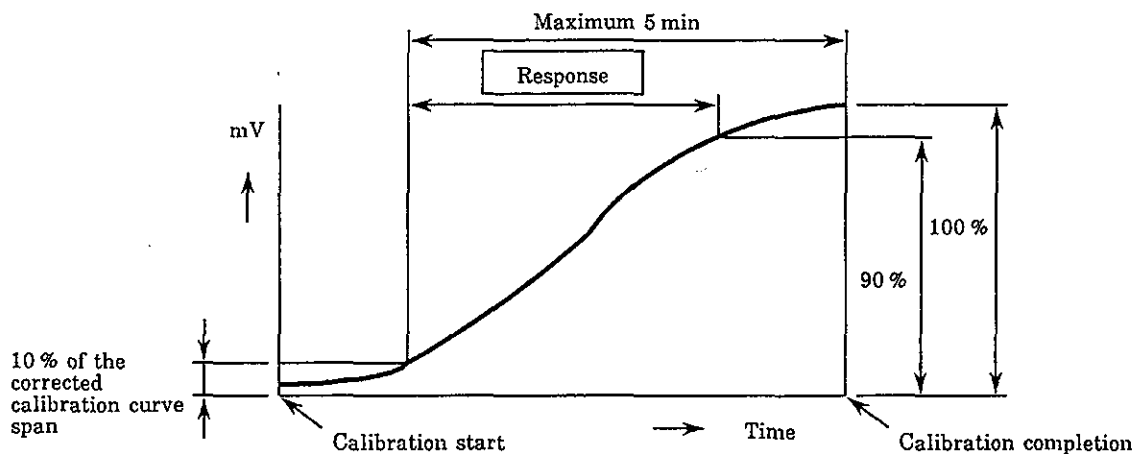
Display of the zero  
point correction ratio  
record (1) (example)

```
B 1  ZERO ( 0 ) = 0 9 8 . 7  %
      8 9 / 0 4 / 3 0    0 9 : 3 0  H
```

### B-2 Response Time

Response time, displayed in Function No. B-2, can be obtained during calibration by the method in Figure 8.2.

(Note) If the zero point or the span point is skipped, it is not executed. In one-touch calibration mode, also not executed.



Response time is calculated after the corrected calibration curve is obtained. With a starting point where a voltage corresponding to 10 % of the corrected calibration curve span is found, the time that it takes for the voltage to reach the 90 % mark of a 100 % voltage corresponding to the oxygen concentration of a calibration gas (zero gas) set in the converter is calculated. In other words, the response time for the above is in the range from 10 to 90 %.

Figure 8.2 Calculation of response time

Display of response  
time (example)

B 2 CELL RESPONSE  
( 10 - 90 % ) = 003 sec

#### B-3 Resistance in the Cell

A new cell (sensor) has an internal resistance of less than 200  $\Omega$ . The resistance increases as the cell deteriorates. Therefore, the internal resistance of a cell is an index for indicating the degree of sensor deterioration. In Function No. B-3, the value obtained at the most recent calibration is displayed.

Display of inner  
resistance of cell  
(example)

B 3 CELL RESISTANCE  
00175  $\Omega$

#### B-4 Robustness of the Cell

The robustness of the cell, an index for estimating the remaining life of the cell (sensor), is classified by a number from 5 (good) to 1 (poor). This robustness is determined after comprehensively evaluating various data monitored during calibration (e.g., the response time, the internal resistance of the cell, and the calibration coefficient). However, when the zero point or span is skipped, no response time is measurable. Thus, cell robustness is obtained from the other evaluation items.

Display of cell  
robustness (example)

B 4 CELL ROBUSTNESS (5)  
LIFE > 12 MONTH

## B-5 Temperature at the Cold Junction on a Thermocouple

The temperature at the cold junction terminal, measured with a transistor, is displayed. The highest permissible temperature of the terminal is 80°C. If this temperature is exceeded, it must be lowered by shielding the detector terminal box from radiation heat, etc.

Display of the  
temperature at the cold  
junction on a  
thermocouple (example)

B 5 C J TEMP = 0 2 6 ° C

## B-6 Heater ON Time Ratio

The sensor in the detector is heated up to and maintained at a temperature of 750°C by the heater. The higher the temperature of the measurement gas is, the less the ON time of the heater becomes. However, if this time becomes too short, the temperature of the measurement gas might exceed the limit temperature of 600°C, which is not good for the detector. The heater ON time ratio is an index for monitoring an abnormal temperature rise in the measurement gas. However, its critical temperature rise varies depending on the conditions in individual processes. Therefore, no definite specifications are given herein. A general guideline, though, is about 20 to 30 %.

Display of the heater  
ON time ratio  
(example)

B 6 CELL HEATER DUTY  
0 3 7 . 5 %

B-7 Dry O<sub>2</sub> Concentration/Moisture Content

When data corresponding to Function Nos. J-0 to J-7 are set, the captioned values are calculated based on the data while displaying the dry O<sub>2</sub> concentration (vol% O<sub>2</sub>) and the moisture content (% H<sub>2</sub>O) in the exhaust gas as follows:

Display of the dry O<sub>2</sub>  
concentration/  
moisture content  
(example)

B 7 DRY O 2 = 0 9 7 . 5 1 % O 2  
SET H 2 O = 0 0 1 0 . 5 % H 2 O

## B-8 Combustion Efficiency

The combustion efficiency is an effective operation control item even with a small boiler as, for example, a package boiler. When the data related to Function Nos. J-0 to J-7 are set, and approximate combustion efficiency is calculated based on the data and is displayed by Function No. B-8.

When 0°C (°F) is assigned in Function F-4, "range of input temperature", the value J6 is displayed directly as the temperature of the exhaust gas.

Display of  
combustion efficiency  
(example)

B 8 GAS TEMP = 0 4 5 0 ° C  
COMB EFF = 0 7 6 . 0 %

The readouts of all the messages in measured value group B have been described on the preceding pages.

## 9. CALIBRATION

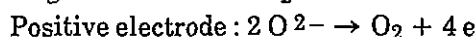
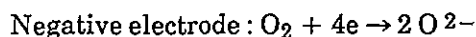
In this Chapter, the method for calibrating a zirconia oxygen analyzer is described.

### 9.1 General

#### 9.1.1 Principles of the Zirconia Oxygen Analyzer

Before detailing calibration, the principles of measuring with a zirconia oxygen analyzer will be described.

A solid electrolyte such as zirconia allows the conductivity of oxygen ions in a high-temperature state. Therefore, when a zirconia-plated element with platinum electrodes on both sides is heated up in contact with gases having different partial-oxygen pressures on each side, the element shows the action of the concentration cell. In other words, the electrode in contact with a gas with a higher partial-oxygen pressure acts as a negative electrode. As the gas comes in contact with the zirconia element in this negative electrode, oxygen molecules in the gas acquire electrons and become ions. Moving in the zirconia element, they eventually arrive at the positive electrode on the opposite side. There, the electrons are released and the ions return to oxygen molecules. This reaction is indicated as follows:



The electromotive force  $E$  (mV) between the 2 electrodes, generated by the reaction, is governed by Nernst's equation as follows:

$$E = - \frac{RT}{nF} \ln \frac{P_X}{P_A} \quad \text{..... (1)}$$

Where,  $R$ : Gas constant

$T$ : Absolute temperature

$n$ : 4

$F$ : the Faraday constant

$P_X$ : Oxygen concentration in the gas in contact with the negative zirconia electrode (%)

$P_A$ : Oxygen concentration in the gas in contact with the positive zirconia electrode (%)

Assuming the zirconia element is heated up to 750°C, then the equation (1) becomes:

$$E = -50.74 \log \frac{P_X}{P_A} \quad \text{..... (2)}$$

With this analyzer, the sensor (zirconia element) is heated up to 750°C, so the relationship of equation (2) remains valid. At that time, a relationship, as in Figure 9.1, is effected between the oxygen concentration of the measurement gas in contact with the positive electrode and the electromotive force of the sensor (= cell), where a comparison gas of air is used on the negative electrode side.

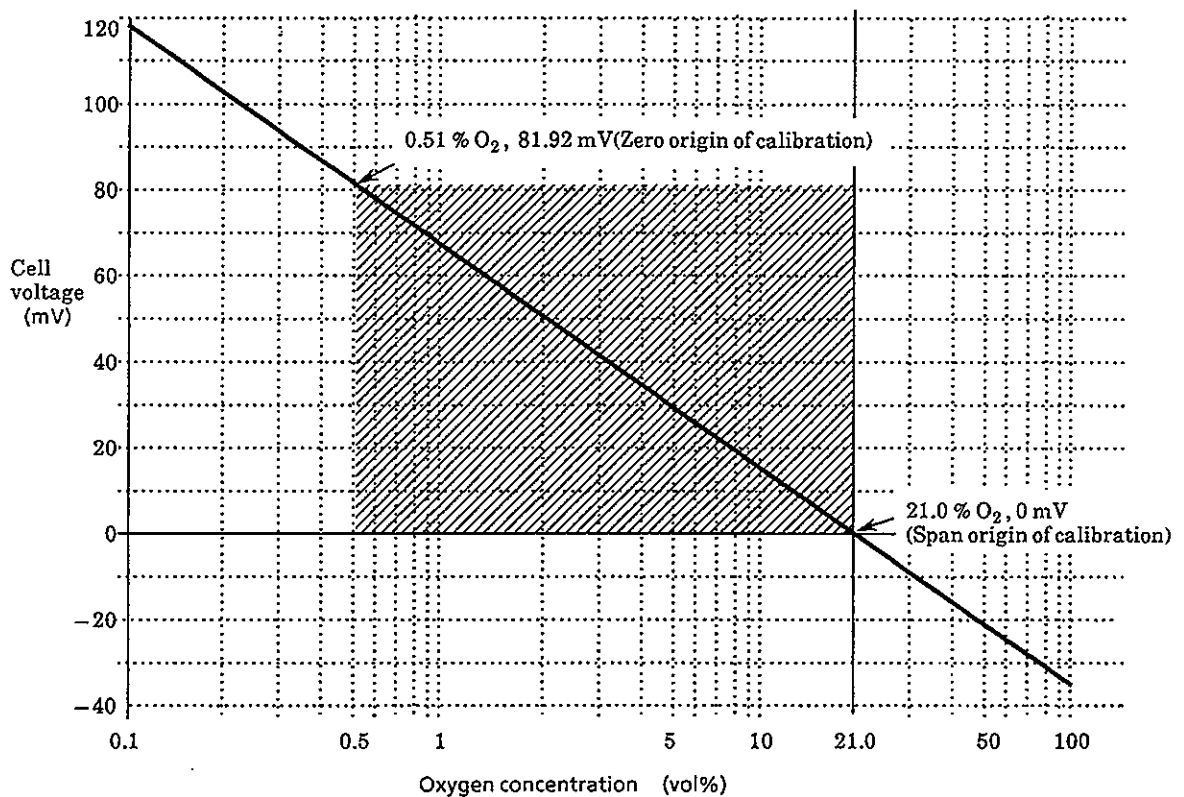


Figure 9.1 Oxygen Concentration in a Measurement Gas vs. Cell Voltage (21.0 % O<sub>2</sub> Equivalent)

Measurement principles of a zirconia oxygen analyzer have been described above. However, the relationship between oxygen concentration and the electromotive force of a cell is only a theoretical one. Usually, a practical sensor shows a slight deviation from the theoretical value. This is the reason why calibration is required. It's performed to obtain a calibration curve for correcting a deviation from a theoretical cell electromotive force.

### 9.1.2 Calibration Gas

A gas with a known oxygen concentration is used for calibration. Normal calibration is performed using 2 different gases: a zero gas of low oxygen concentration and a span gas of high oxygen concentration. In some cases, only one or the other gas may be used for calibration. However, even if only one of the gases is normally used, calibration using both gases should be done at least once.

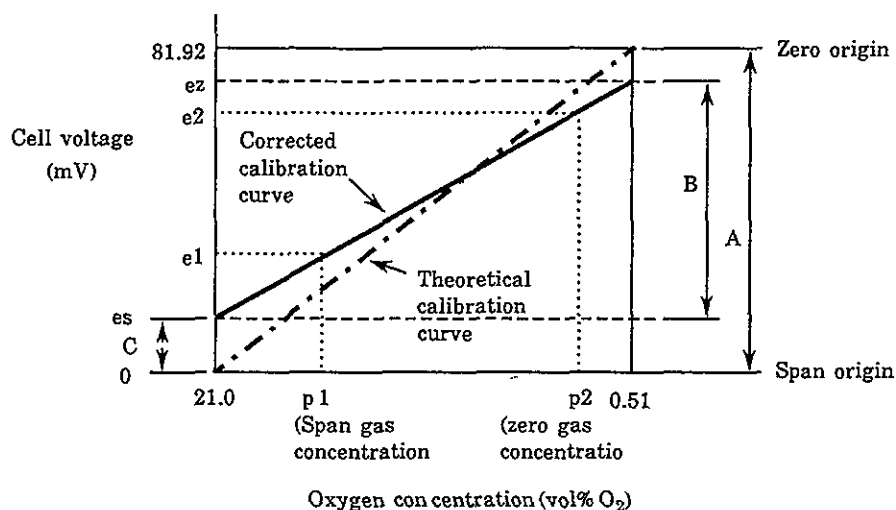
The zero gas normally used has an oxygen concentration of 0.95 to 1.0 vol% O<sub>2</sub> with a balance of nitrogen gas (N<sub>2</sub>). The span gas widely used is clean air (e.g., instrument air).

### 9.1.3 Compensation

The deviation of a measured value from the theoretical cell electromotive force is checked by the method in Figure 9.2 or 9.3.

Figure 9.2 shows a 2-point calibration using 2 gases: zero and span. Cell electromotive forces for a span gas with an oxygen concentration  $p_1$  and a zero gas with an oxygen concentration  $p_2$  are measured while determining a calibration curve passing between these 2 points. The oxygen concentration of the measurement gas is determined from this calibration curve. In addition, the calibration curve corrected by calibration is compared

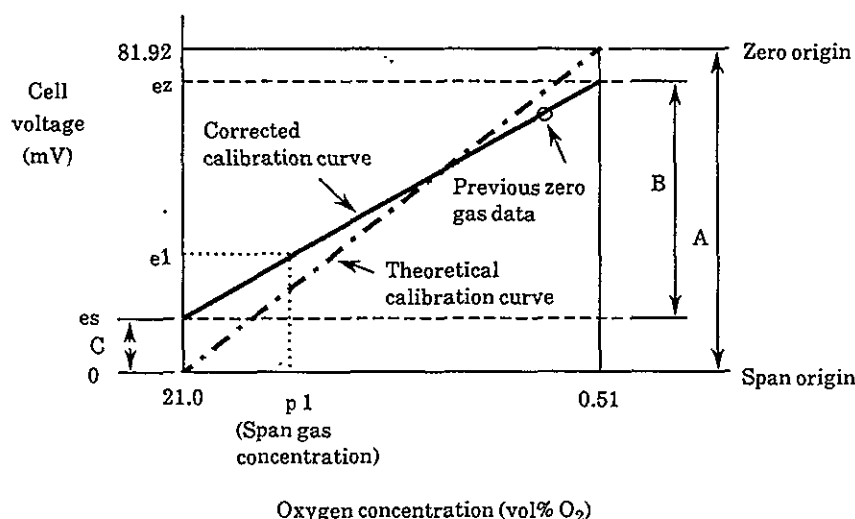
with the theoretical calibration curve for determining the zero point correction ratio represented by  $B/A \times 100(\%)$  on the basis of A, B and C shown in Figure 9.2 and the span point correction ratio of  $C/A \times 100(\%)$ . If the zero point correction ratio exceeds a range of  $100 \pm 30\%$  or the span point correction ratio becomes larger than  $0 \pm 18\%$ , calibration of the sensor becomes impossible.



$$\begin{aligned} \text{Zero point correction factor} &= (B/A) \times 100 (\%) & \text{Correctable range: } 100 \pm 30\% \\ \text{Span point correction factor} &= (C/A) \times 100 (\%) & \text{Correctable range: } 0 \pm 18\% \end{aligned}$$

Figure 9.2 Calculation of a Calibration Curve and Correction Factor in a 2-Point Calibration Using Zero and Span Gases

Figure 9.3 shows a 1-point calibration using only a span gas. In this case, only the cell electromotive force for a span gas with an oxygen concentration  $p_1$  is measured. The cell electromotive force for the zero gas is carried over from a previous measurement to obtain the calibration curve. The principles of calibration using only a span gas also applies to the 1-point calibration method using a zero gas only.



$$\begin{aligned} \text{Zero point correction factor} &= (B/A) \times 100 (\%) & \text{Correctable range: } 100 \pm 30\% \\ \text{Span point correction factor} &= (C/A) \times 100 (\%) & \text{Correctable range: } 0 \pm 18\% \end{aligned}$$

Figure 9.3 Calculation of a Calibration Curve and Correction Factor in a 1-Point Calibration Using a Span Gas

#### 9.1.4 Characteristic Data from a Sensor Measured During Calibration

During calibration, the following data for monitoring the conditions of the sensor are collected, as well as calibration data. However, if calibration is not properly executed (error occurs in automatic or semi-automatic calibration), these data are not collected in the current calibration.

(1) Record of span correction factor

You can monitor values acquired from the past 10 calibrations using Function No. B-0.

(2) Record of zero correction factor

You can monitor values acquired from the past 10 calibrations using Function No. B-1.

(3) Response time

You can monitor the response time provided that a 2-point calibration has been performed. These values can be monitored using Function No. B-2.

(4) Internal resistance of a cell

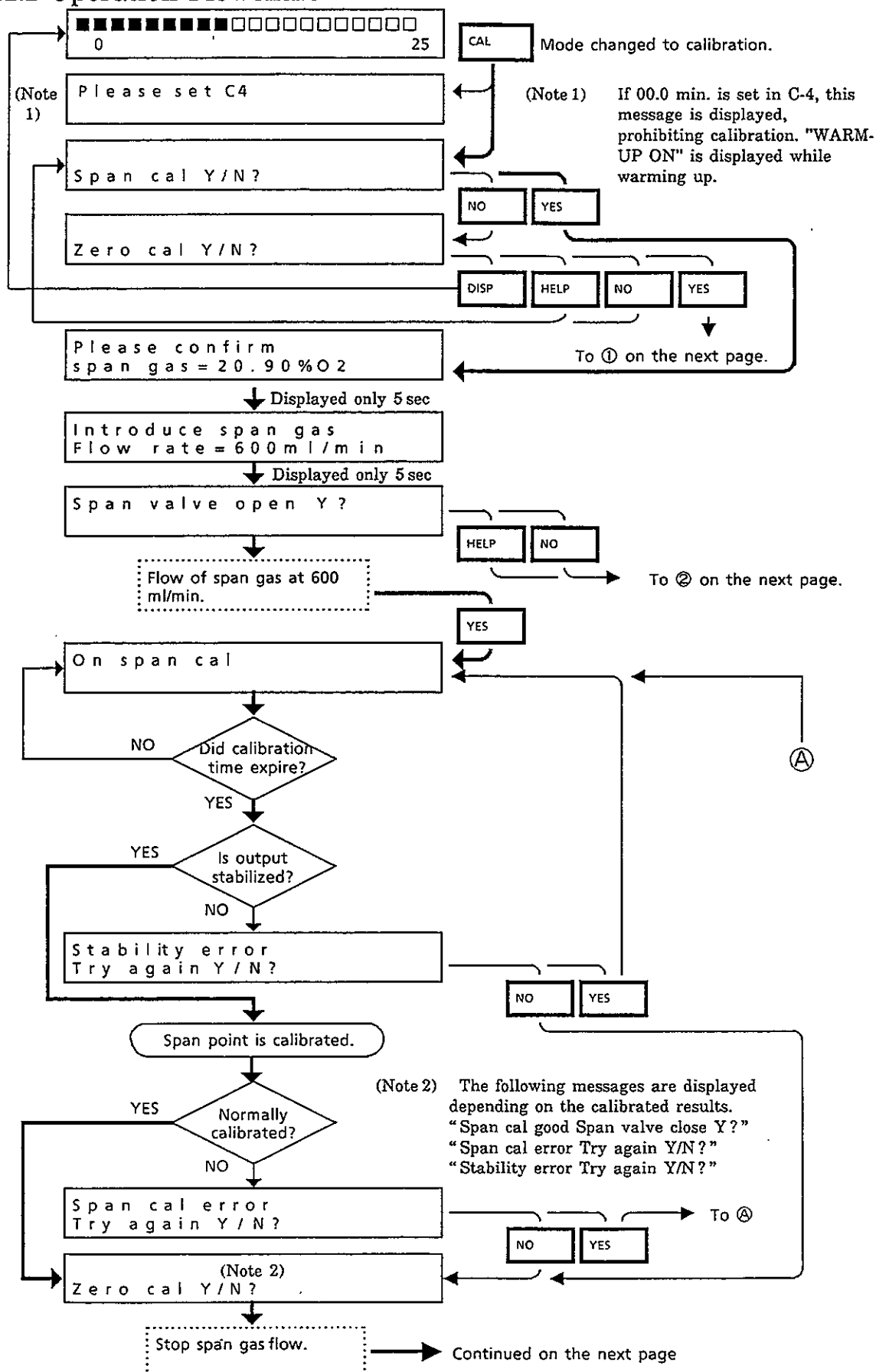
Internal resistance gradually increases as the cell (sensor) deteriorates. You can monitor the value measured during the latest calibration using Function No. B-3.

(5) Robustness of a cell

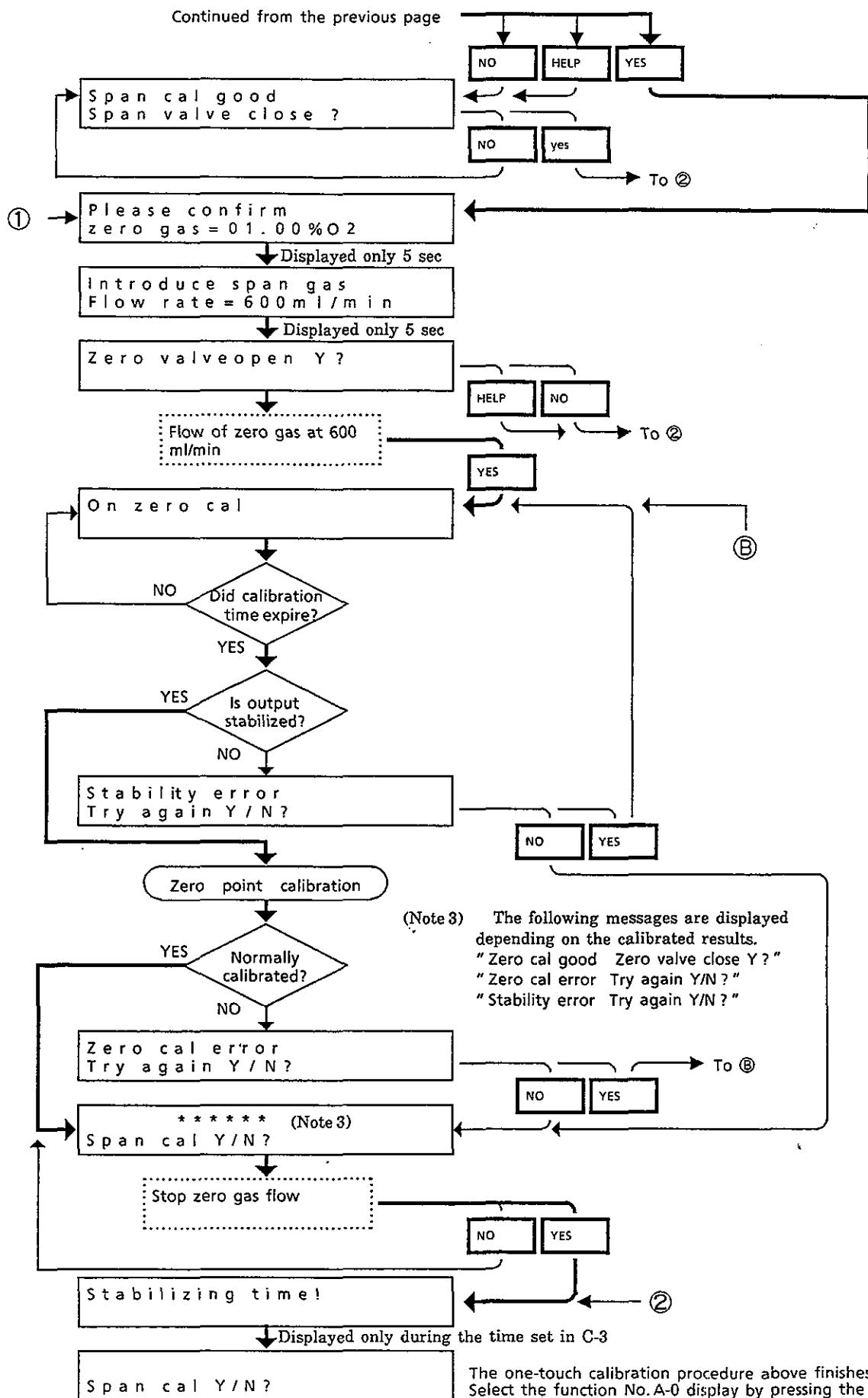
The robustness of a cell is an index for predicting the remaining life of a sensor and is expressed in a number on 5 levels. You can monitor cell robustness using Function No. B-4.



## 9.2.2 Operation Flowchart



Continued from the previous page



The one-touch calibration procedure above finishes. Select the function No. A-0 display by pressing the measurement mode select key.

## 9.3 Operation of the ZO21S Standard Gas Unit

This Chapter describes the methods of operating the ZO21S standard gas unit using zero gas and span gas.

Operate the ZO21S standard gas unit, for calibrating a system classified as a System 1, according to the procedures that follow.

### 9.3.1 Name and Function of Each Part in the Standard Gas Unit

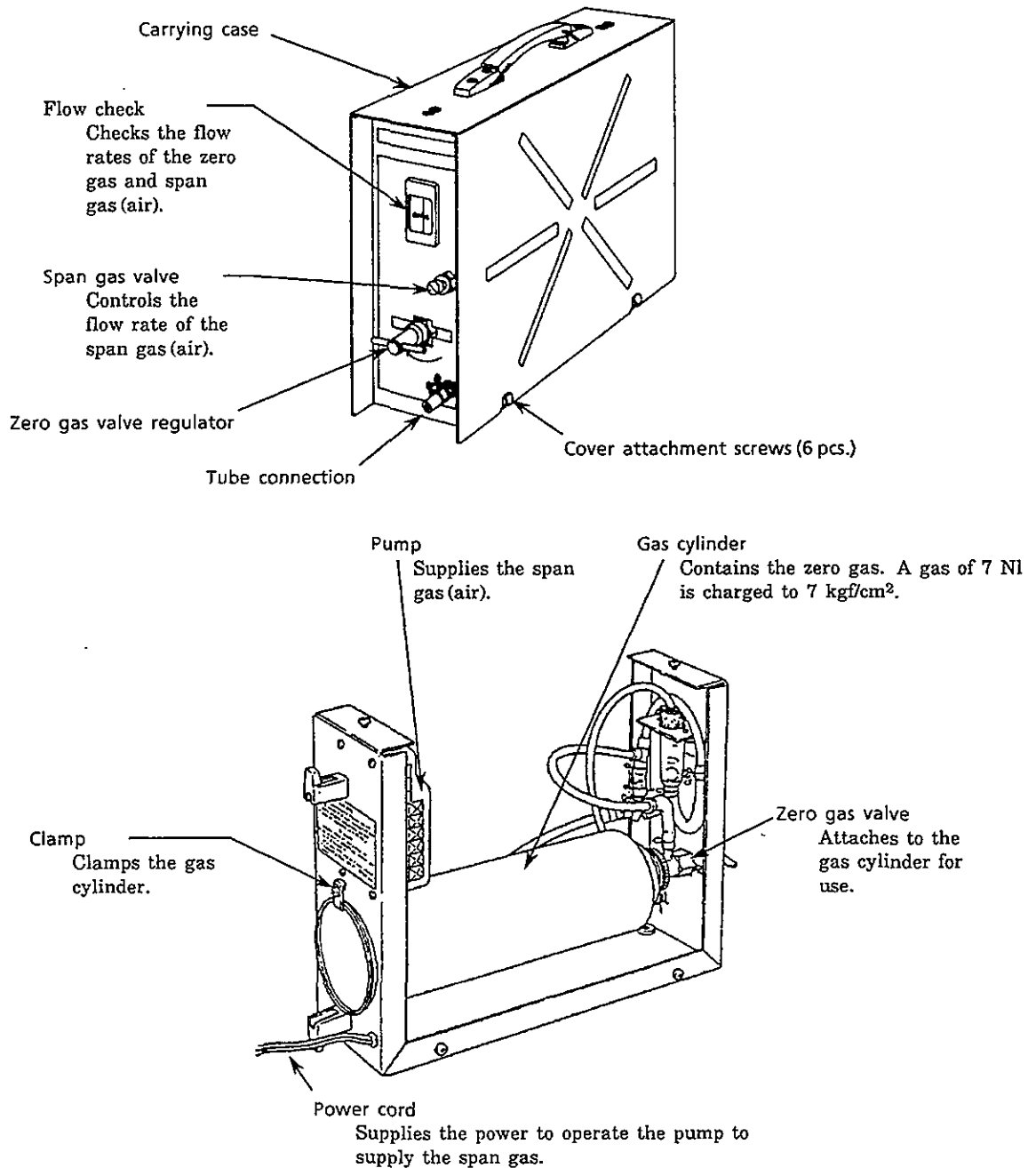


Figure 9.4 Name and Function of Each Part in a Standard Gas Unit

### 9.3.2 Installing Gas Cylinders

Each ZO21S standard gas unit comes with 6 zero gas cylinders including a spare. Each gas cylinder contains 7-liters of gas with a 0.95 to 1.0 vol% O<sub>2</sub> (the concentrations vary for each cylinder) and nitrogen, at a pressure of 7 kgf/cm<sup>2</sup> G (at 35°C).

Install the gas cylinder in the following manner:

The operating details and handling precautions are also printed on the product. Please read them beforehand.

- (1) Attach the zero gas valve onto the gas cylinder. First, turn the valve regulator of the zero gas valve counterclockwise to completely retract the needle at the top from the gasket surface. Maintaining the valve in this position, screw the valve mounting into the mouth piece of the gas cylinder. (Screw the mounting only as far as it will go manually. Do not use any tool). When the gasket comes in contact with the mouth piece of the gas cylinder and you can no longer turn it manually, tighten the lock nut with a wrench.
- (2) Remove the carrying case from the standard gas unit. The case is affixed to the unit with 6 screws. So, remove the screws and lift it off.
- (3) Slide the gas cylinder through the hole in the back of the unit and connect the tube (the piping in the unit) to the valve connections. Insert each tube at least 10 mm to prevent leakage, and secure it using a tube clamp.
- (4) Attach the gas cylinder to the case. Extend the valve regulator of the zero gas valve through the hole in the front panel of the unit and secure the bottom of the cylinder with the clamp.
- (5) Take note of the oxygen concentration of the sealed gas indicated on the gas cylinder and replace the carrying case. Enter the oxygen concentration of the sealed gas (noted from the cylinder) into the converter (Function No. C-1). Also check that no piping is disconnected.

Thus, the work of installing a gas cylinder is completed. However, gases in the cylinders can not immediately flow out after these procedures. To discharge the gases, it is necessary for the needle in the zero gas valve to puncture a hole in the gas cylinder. This operation will be described in 9.3.3.

### 9.3.3 Calibration Gas Flow

#### <Preparation before calibration>

- (1) To operate the standard gas unit, place it on a nearly horizontal surface in order to allow the flow check to indicate the precise flow rate. In addition, a power supply for driving the span gas (air) supply pump is required near the unit (the length of the power cord attached to the unit is 2 m). Select a suitable location for the unit near the installation site of the converter.
- (2) Connect the tube connector port of the standard gas unit to the calibration gas inlet of the detector, using a piping material such as a polyethylene resin tube with an outside diameter of 6 mm. Be careful to prevent gas leakage.
- (3) Fully open the needle valve mounted on the calibration gas inlet of the detector.
- (4) Enter the oxygen concentration of the sealed gas (noted from the cylinder) into the converter. Also check that the oxygen concentration of the span gas is correctly set (20.9 vol% O<sub>2</sub> for clean air).

## &lt;Flow of span gas (air)&gt;

The standard gas unit is used only when one-touch calibration is employed. Therefore, the timing for flowing span gas (air) is included in the one-touch calibration flowchart described in 9.2.2.

- (1) When the message "DID YOU OPEN SPAN VALVE Y?" is displayed in the readout of the converter during calibration, plug the power cord into the power supply socket to start the pump of the standard gas unit.
- (2) Next, adjust the flow rate to 600 ml/min. using the span gas valve "AIR" (the flow check ball stops floating at the green line when the valve is slowly opened). To rotate the valve shaft, loosen the lock nut and turn it using a regular (flat-blade) screwdriver. The flow rate increases with a counterclockwise rotation.
- (3) After adjusting the flow rate, tighten the lock nut on the valve.
- (4) Press the interactive key "YES" of the converter. Because of the time set in Function No. C-4, when this key is pressed, span point calibration is executed. When the message "SPAN CALIBRATION FINISHED" is displayed, unplug the power cord to stop the pump.

## &lt;Flow of zero gas&gt;

When the message "DID YOU OPEN ZERO VALVE Y?" is displayed in the readout of the converter, start the zero gas flow.

- (1) Use the needle of the zero gas valve "CHECK GAS" to puncture a hole in the gas cylinder installed as described in 9.3.2. Turn the valve regulator by hand clockwise all the way around.
- (2) Next, adjust the flow rate to 600 ml/min (the flow check ball stops floating at the green line when the valve is slowly opened). Turn the regulator of the zero gas valve back slowly counterclockwise. At that time, the flow rate also decreases as the inner pressure of the gas cylinder decreases. Therefore, monitor the flow check and, when the ball's position changes greatly, readjust the valve.
- (3) Press the interactive key "YES" of the converter. Because of the time set in Function No. C-4, when this key is pressed, zero point calibration is executed.

(Note) Be sure not to terminate a calibration in progress because of a shortage of gas in the cylinder. Each gas cylinder is operable for 9 minutes or more provided the gas is discharged at the specified rate. Therefore, if your calibration time is estimated at 4 minutes, you can operate 2 zero point calibrations.

- (4) When the message "ZERO CALIBRATION FINISHED" is displayed, immediately stop the zero gas flow. Completely turn the regulator of the zero gas valve clockwise. If the regulator is not turned completely all the way, the hole is not hermetically sealed by the needle, and the gas in the cylinder can leak out. So, make sure it is turned completely.

## &lt;Treatment after completion of calibration&gt;

- (1) Fully close the needle valve mounted on the calibration gas inlet of the detector.
- (2) Remove the tube connecting the detector to the standard gas unit.
- (3) Store the standard gas unit with the gas cylinder mounted, where the ambient temperature does not exceed 40°C. Store the spare gas cylinders under the same condition also.

## 9.4 Methods of Operating Valves in the ZA8F Flow Setting Unit

The ZA8F flow setting unit is used as a calibration device for a system conforming to System 2. Calibration in such a system is to be operated as in a one-touch system. So, you have to operate the valve of the flow setting unit upon each calibration (starting and stopping the calibration gas flow and adjusting the flow rate).

### 9.4.1 Preparation Before Calibration

To operate the ZA8F flow setting unit, prepare for calibration as follows:

- (1) Check for a complete closing of the zero gas flow setting valve in the unit and open the regulator valve for the zero gas cylinder until the secondary pressure is 0.5 to 1 kgf/cm<sup>2</sup>.
- (2) Check that the oxygen concentration of the zero gas in the cylinder is set in the converter.

### 9.4.2 Operating the Span Gas Flow Setting Valve

The following description is given assuming that instrument air, the same as the comparison gas, is used as the span gas.

- (1) When the message "DID YOU OPEN SPAN VALVE Y?" is displayed in the readout of the converter during calibration, open the span gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ml/min. Turn the valve regulator slowly counterclockwise after loosening the lock nut. To check the flow rate, monitor the calibration as with a flow meter.
- (2) After adjusting the flow rate, press the interactive key "YES" of the converter. Because of the time set in Function No. C-4, when this key is pressed, span point calibration is executed. When the message "SPAN CALIBRATION FINISHED" is displayed, close the span gas flow setting valve to stop the span gas (air) flow. Be sure to tighten the lock nut to prevent any leakage of span gas into the sensor during measurement because the valve may become loose during measurement.

### 9.4.3 Operating the Zero Gas Flow Setting Valve

Operation of the zero gas flow setting valve during zero point calibration is as follows:

- (1) When the message "DID YOU OPEN ZERO VALVE Y?" is displayed in the readout of the converter during calibration, open the zero gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ml/min. To rotate the valve shaft, loosen the lock nut and slowly turn it counterclockwise. To check the flow rate, monitor the calibration gas flow meter.
- (2) After adjusting the flow rate, press the interactive key "YES" of the converter. Because of the time set in Function No. C-4, when this key is pressed, zero point calibration is executed. When the message "ZERO CALIBRATION FINISHED" is displayed, close the zero gas flow setting valve to stop the zero gas flow. Be sure to tighten the lock nut to prevent the any leakage of the zero gas into the sensor because the valve may become loose during measurement.

#### **9.4.4 Treatment After Calibration**

No special treatment of the instrument is needed after the completing the calibration. However, it is recommended that the regulator valve for the zero gas cylinder be closed if calibration will not be necessary so frequently in the future.

# 10. INSPECTION AND MAINTENANCE

In this Chapter, inspection and maintenance for keeping or recovering the measuring performances of the EXAOXY In-Situ Type Zirconia Oxygen Analyzer is described:

## 10.1 Inspection and Maintenance of the Detector

### 10.1.1 Precautions for Inspecting the Detector

- (1) Be careful not to touch any hot parts.

The sensor at the tip of the detector probe is heated up to 750°C during operation. If an operation is carried out immediately before inspection, be careful not to touch the probe with your finger tips.

- (2) Do not drop or bump or cause any great impact on the sensor assembly.

The sensor is made of ceramic (zirconia). If the detector is dropped or hit with something, the sensor might be damaged and no longer work.

### 10.1.2 Cleaning the Filter in the Sensor Assembly

If the filter at the back of the detector probe becomes clogged with dust, measurement problems occur. If dust blocks the flow of gas, wipe off the dust with a brush, etc.

### 10.1.3 Cleaning the Calibration Gas Tube

Calibration gas, supplied from the calibration gas inlet of the terminal box into the detector, flows through the tube and comes out at the tip of the probe. The tube might become clogged with dust from the measurement gas. If you become aware of clogging, such as when a higher pressure is required to achieve a specified flow rate, clean the calibration gas tube.

Clean the calibration gas tube in the following manner:

- (1) Remove the detector.
- (2) Remove the 4 bolts (and the spring washers) attaching the sensor assembly from the top of the detector probe.
- (3) Remove the filter. Remove the filter hold plate assembly together with the U-shaped pipe.
- (4) Clean the calibration gas tube equipped in the probe, using a rod of 2 to 2.5 mm in diameter (see Figure 10.1). Keep air flowing from the calibration gas inlet at about 600 ml/min and insert the rod into the tube (3 mm in inside diameter). However, be careful not to insert the rod deeper than 40 cm for the general-purpose detector, or 15 cm for the high-temperature detector.
- (5) Clean the filter and the U-shaped pipe, as removed in (3). The U-shaped pipe can be rinsed with water. However, it should be dried out before reassembly.
- (6) Reassemble the parts removed for cleaning. Replace the filter with the fine-meshed ring element side facing the sensor. Coat the screw threads of the bolts with a heat-resistant agent and then screw them in.

Tighten each bolt with a torque of about 60 kgf·cm, uniformly.

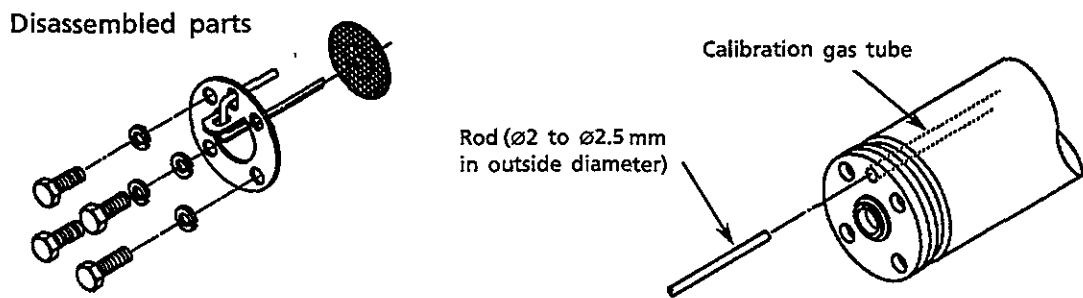


Figure 10.1 Cleaning of Calibration Gas Tube

#### 10.1.4 Replacing the Sensor Assembly

The performance of the sensor (cell) deteriorates as the surface becomes soiled during operation. Therefore, you have to replace the sensor when its life expectancy expires, namely when it can no longer satisfy the range of the zero point correction factor of  $100 \pm 30\%$  or the range of the span point correction factor of  $0 \pm 15\%$ , and so on. In addition, the sensor assembly is to be replaced also when it is damaged and can no longer work normally in measuring.

When the sensor is no longer operable (for example, due to breakage), investigate the cause and remedy the problem as far as possible to prevent its recurrence.

Replace the sensor assembly as follows:

- (1) In order not to lose or damage disassembled parts, identify the parts to be replaced from among all the parts in the sensor assembly. Normally, replace the sensor, filter, metal O-ring and the contact together at the same time. If required, also replace the U-shaped filter hold plate, bolts and the spring washers.

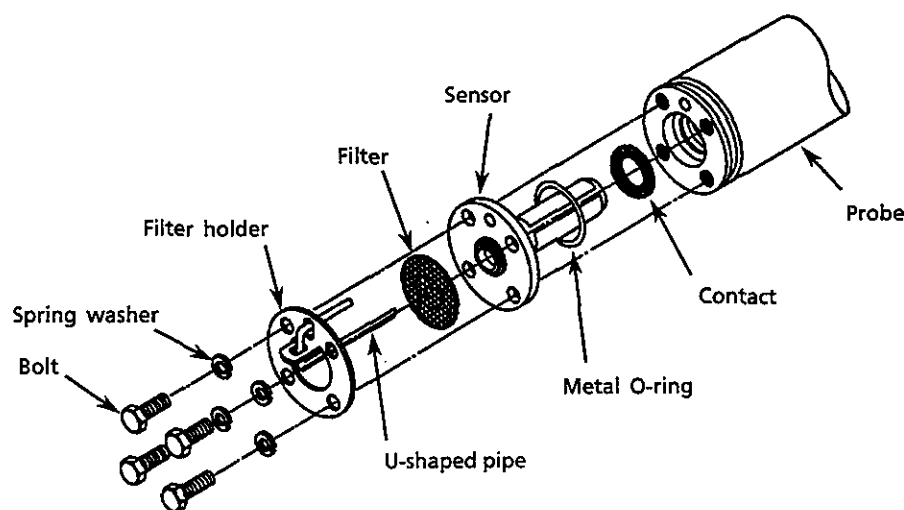


Figure 10.2 Parts in a Sensor Assembly

- (2) Remove the bolts from the back of the detector probe, together with the washers.
- (3) Remove the filter hold plate with the U-shaped pipe. At this point, the filter can also be separated from the detector probe.
- (4) Remove the sensor and the metal O-ring (embedded in a groove on the flange surface of the sensor). Pull the sensor out by twisting it slightly.
- (5) Remove the contact using tweezers to pull it out of the groove.

- (6) If you can use any of the parts from among those removed, clean them up to remove any contaminants adhering to them. Also, clean the parts used for mounting the detector probe, as they may also be soiled with the measurement gas.
- (7) The parts are to be assembled sequentially. First, replace the contact. Being careful not to cause irregularities in the pitch of the coil spirals (i.e., not to bend the coil out of shape), place it in the ringed groove so that it forms a solid contact.
- (8) Next, set the metal O-ring in the O-ring groove on the flange surface of the sensor and then mount the sensor. To insert the sensor, turn it clockwise. After inserting it all the way to its base, adjust its position so that the U-shaped-pipe insertion holes of the sensor and of the probe are properly aligned.
- (9) Replace the filter, the filter hold plate and the U-shaped pipe. To mount the U-shaped pipe, attach the pipe to the filter hold plate and then insert the assembly into the U-shaped-pipe insertion hole. In addition, mount the filter with the fine-meshed ring-shaped element side facing and forming a contact with the sensor.
- (10) Attach the reassembled parts with the 4 bolts. Coat the threads of the bolts with a heat-resistant agent and then screw them in along with the washers. Tighten all 4 bolts with a torque of about 60 kgf-cm.

The work of replacing the sensor assembly is now complete. Mount the detector and restart the operation. However, be sure to calibrate the instrument before beginning a measurement.

### 10.1.5 Cleaning the High-Temperature Probe Adapter

The high-temperature detector is structured so that the gas to be measured is directed toward the detector with a high-temperature probe adapter. Therefore, if the probe or the sample gas outlet clogs, a precise measurement is no longer possible because of no gas flow. Therefore, if you use a high-temperature detector, you have to inspect it periodically and, if any part of it is significantly clogged with dust, clean it.

Dust, sticking to the probe, should be blown off. If any dust still remains after blowing, clean it with a metal rod, etc., inserted. In addition, if dust is found on the auxiliary ejector or needle valve (choke) at the sample gas outlet, remove these parts from the high-temperature probe adapter and then clean them. To remove dust, blow them with air or rinse them with water.

## 10.2 Inspection and Maintenance of the Converter

You need not inspect or perform maintenance work on the converter daily or periodically. If the converter fails to work properly, it might come from power failure or other causes in most cases. However, burned out fuses or ambiguous readouts on the message display after long-time use are sometimes caused by deterioration of the related parts.

### 10.2.1 Replacing Fuses

The converter incorporates a total of 4 fuses: 2 for the detector heater and 2 for the electric circuit in the converter. If any fuse burns out, replace it in the following manner. However, it is recommended that the fuses for the detector heater (F1, F2) be replaced every 2 years even if they are not burned out.

(Note) If a replaced fuse blows out immediately, a problem may exist in the circuit. Completely go over the circuit to find out why the fuse blew.

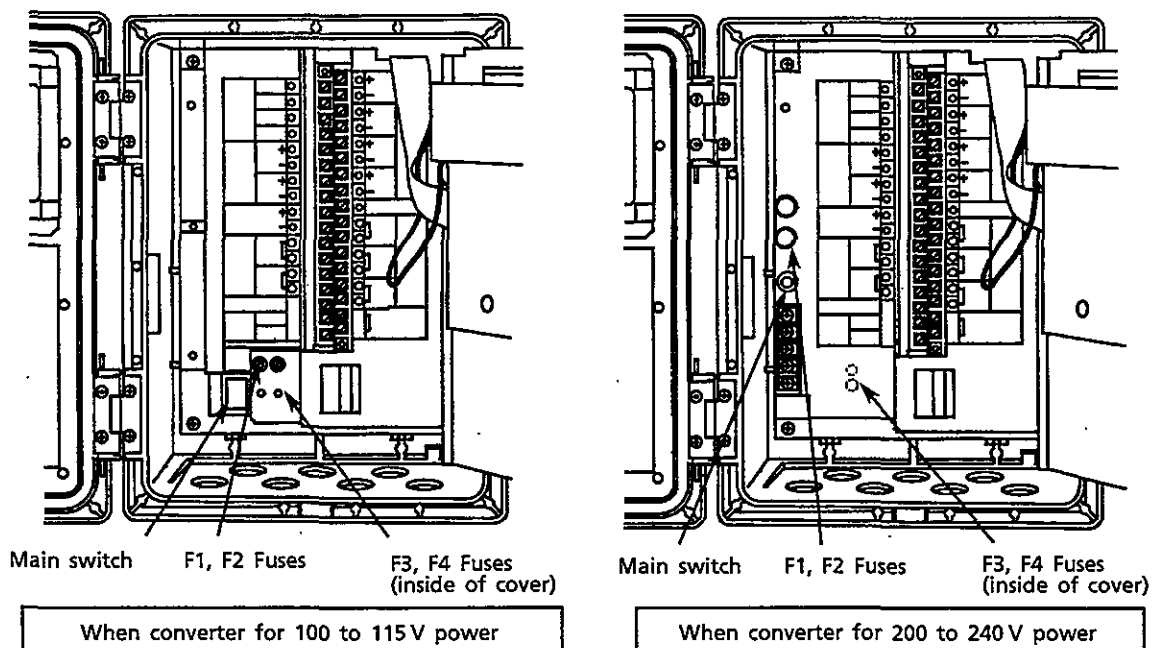


Figure 10.3 Positions for Installing Fuses in a Converter

#### <Replacement of Detector Heater Fuses (F1, F2)>

The location of the fuse and power switch is different in converters for a 100 V series power supply than for a 200 V series power supply. Replace the fuses for the detector heater in the following manner:

- (1) Turn OFF the power to the converter for safe replacement work.
- (2) Remove the fuses from the fuse holders. For 100 V series power converters, turn the fuse holder cap 90° counterclockwise using a flat blade screwdriver that just fits the holder cap slot. In this state, the fuse can be pulled out together with the cap. For 200 V series power converters, the use of a tool is not necessary.

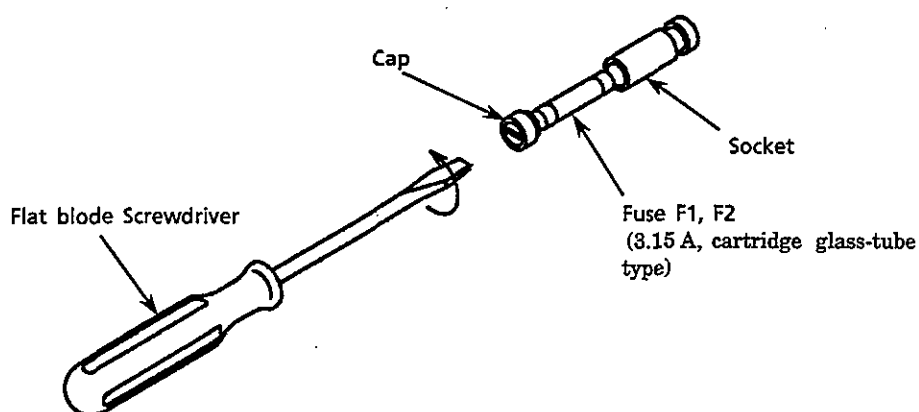


Figure 10.4 Removal of Fuse F1 and F2 (When converter for 100 V series power).

- (3) After checking that the new fuse has the specified rating (3.15 A), place this new fuse (cartridge glass-tube fuse) in the holder. In 100 V series power converters, insert the fuse into the cap and then both into the holder. Turn the cap 90° clockwise while pushing it at the same time with a flat blade screwdriver. In 200 V series power converters, turn the cap clockwise as far as it will go while pushing it at the same time with your fingers.

<Replacing the fuses (F3, F4) to protect the electric circuit in a converter>

- (1) Turn OFF the main switch of the converter to maintain safety while replacing the fuse.
- (2) Remove the fuse. Fuses F3, F4 are cartridge socket types in which 2 prongs of the fuse are inserted into the socket on the printed circuit board. If you cannot remove fuses F3, F4 easily with your hand, use a tool such as long nose or needle nose pliers.
- (3) Check the new fuse for the specified rating (0.5 A) before installing it. Hold the body of the fuse gently with a pair of pliers and fully insert the 2 prongs into the socket on the printed circuit board. Be careful not to bend the prongs during installation (otherwise, the fuse may be damaged).

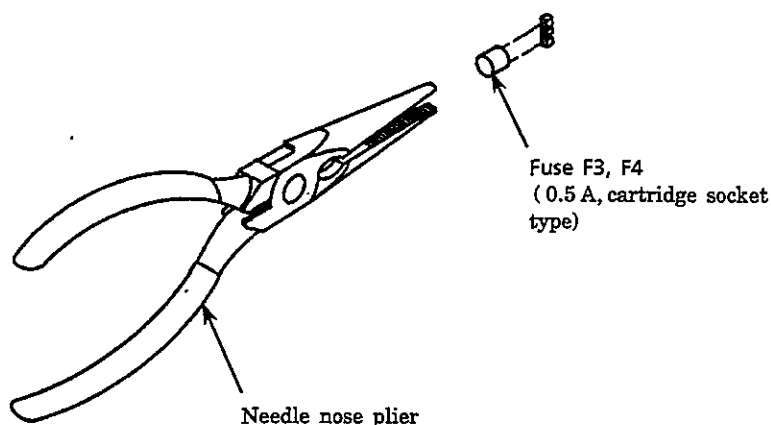


Figure 10.5 Removal of Fuse F3 and F4.

### **10.2.2 Replacing the Message Display Unit**

The dot matrix LCD, incorporated in the message display unit, has a high performance and durability for long-time operation. However, after long-time use, the performance deteriorates gradually and unavoidably (i.e., giving ambiguous readouts, etc. If the readout on the display becomes indistinct, replace the matrix LCD. To replace the LCD, remove it together with the entire unit.

If an error in your message display unit cannot be adjudged as to whether it is due to failure in the dot matrix LCD or a different cause, contact YOKOGAWA.

# 11. TROUBLESHOOTING

This chapter describes the checking and restoring methods when the ZA8C converter self-diagnosis function detected errors or other troubles occur.

## 11.1 Disposal When an Error Code is Displayed

### 11.1.1 Types of Error Codes

There are nine types of error that can be detected with the self-diagnosis function of ZA8C converter. When these errors occur (except for digital circuit failures), the corresponding error codes are displayed in the data display. In the message display, error messages are also displayed. In addition, if more than one error occurs simultaneously, the letter "H" is also displayed in the message display. In this case, by selecting the displayed message using the auxiliary message display key "HELP", individual error that occurred can be confirmed.

Error codes and their contents are shown in Table 11.1.

Table 11.1 Error Codes, Their Contents and States When Each Error Occurs

Error code	Error contents	State when the error occur
E - - 1	Sensor failure (cell)	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E - - 2	Sensor temperature error "Low"	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E - - 3	Sensor temperature error "High"	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E - - 4	A/D (analog circuit) failure	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E - - 5	Calibration value error "Zero"	(Displayed in calibration) The current zero point calibrated value is not employed.
E - - 6	Calibration value error "Span"	(Displayed in calibration) The current span calibrated value is not employed.
E - - 7	EMF stabilization time-over	(Displayed in calibration) The current calibrated value is not employed.
E - - 8	ROM or RAM failure	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
□□□□ (Display disappears)	Digital circuit failure Power interruption occurs	The analyzer goes to the fail mode and power to the detector heater is automatically turned off. (Displayed in turning power on again after power off) Data value default.

Errors displayed with error code "E--5", "E--6", or "E--7" are those generated in carrying out automatic or semi-automatic calibration. If these errors occur, that error code and oxygen concentration value are alternately displayed in the data display. The error is released when the analyzer returns to the measurement mode and, at the same time, the error code display disappears. The error message display is cleared by pressing the measurement mode select key "DISP"

(Note) Re-calibration after an error occurred should be performed after examining that setpoints and piping conditions are not improper.

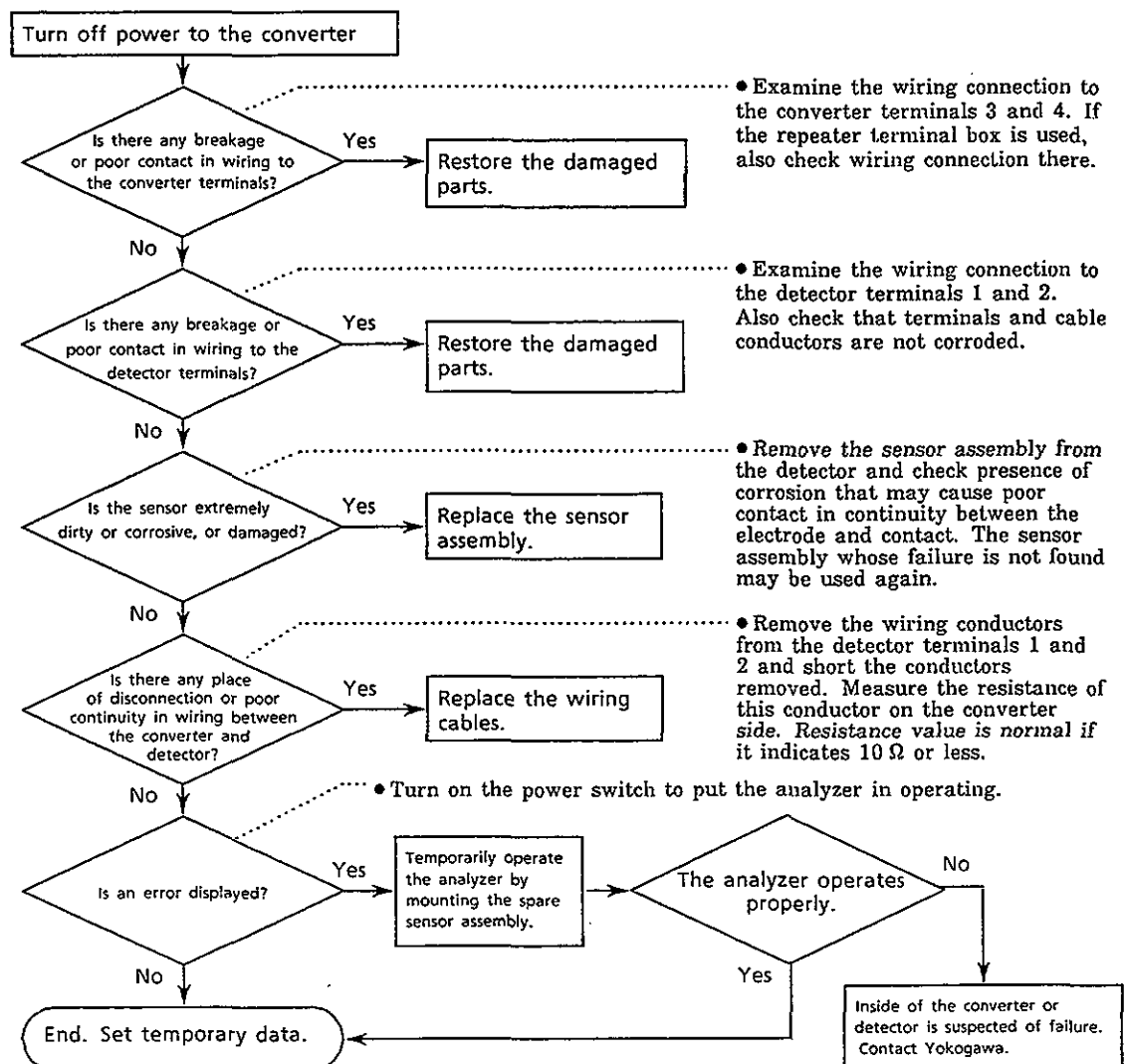
Errors displayed with error code "E-1", "E-2", "E-3", "E-4" or "E-8" including digital circuit failure occur generally caused by equipment failures. If these errors occur, the converter stops the supply of power to the detector heater and holds the output signal at the value immediately before the error occurrence (preset value if "2" is set with function No. D-2). When these errors occur, turn off the converter power and practice restoration. The error code display is released after the equipment is restored and operates normally.

### 11.1.2 Causes of "E-1 Sensor (Cell) Failure" and Procedure for Restoration

#### <Causes>

- (1) Failure in wiring between the converter and the detector (poor contact of terminal connections, disconnection, etc.)
- (2) Sensor (cell) assembly failure (damage, deterioration)
- (3) Failure in the sensor (cell) assembly mounting part (poor continuity between the sensor electrode and the contact, etc.)
- (4) Wiring system failure inside the detector (disconnection, etc.)

#### <Locating the Failure and Taking Measures>



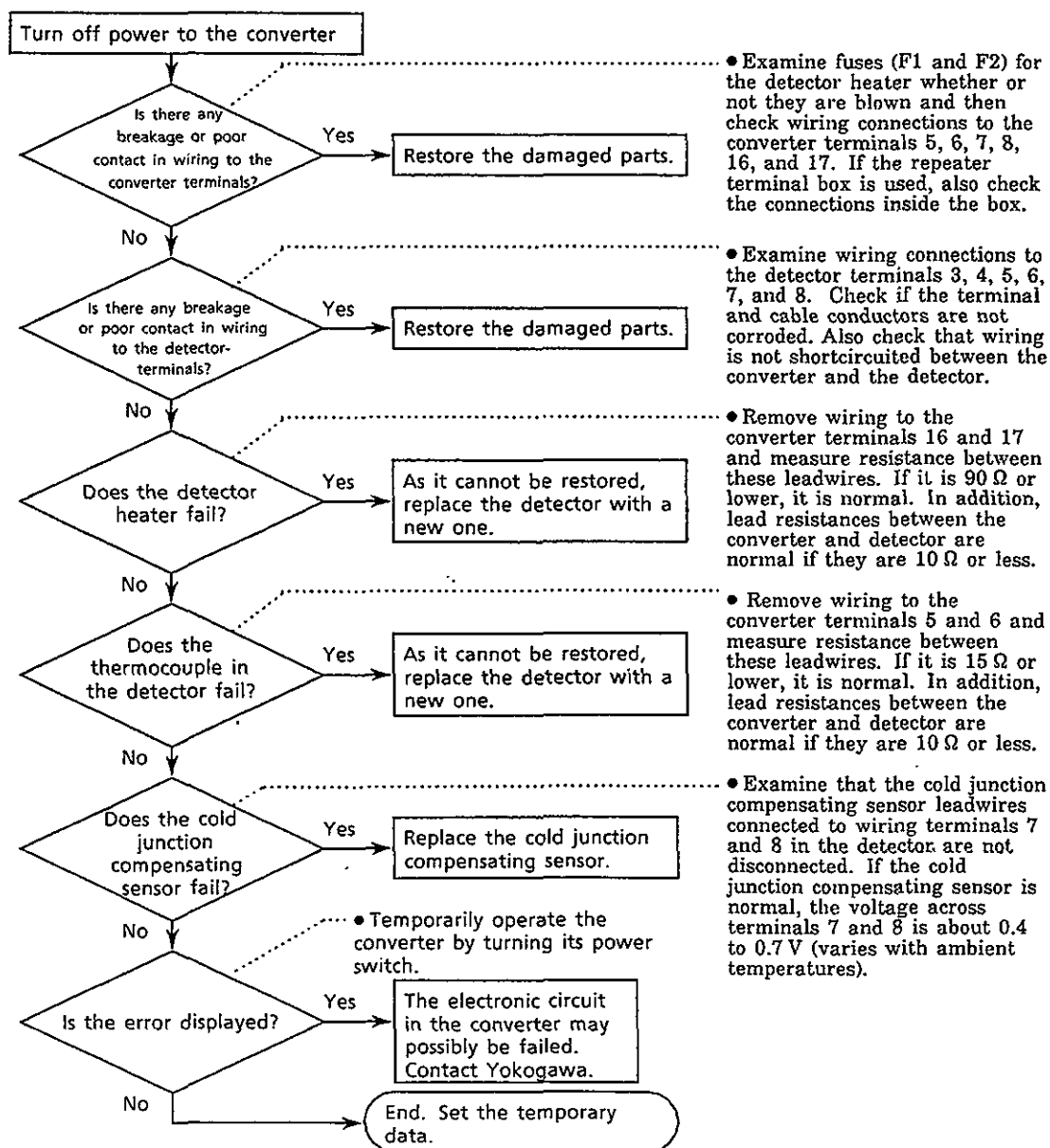
### 11.1.3 Causes of "E--2 Sensor Temperature Error (Low)" and Procedure for Restoration

This error occurs when the sensor temperature after warm-up (in steady state operation) is lower than 730°C (1346°F).

#### <Causes>

- (1) Fuse (F1 and/or F2) for the detector heater in the converter is blown.
- (2) Failure in wiring between the converter and the detector (poor contact of terminal connections, disconnection, shortcircuiting, etc.)
- (3) Failure of Sensor for cold junction compensation at the detector terminal board (poor contact in terminal connections, or failure)
- (4) Failure of thermocouple in the detector (disconnection, shortcircuiting in wiring inside the detector)
- (5) Failure of the heater inside the detector (disconnection, etc.)
- (6) Electronic circuit failure inside the converter

#### <Locating the Failure and Taking Measures>



#### 11.1.4 Causes of "E - -3 Sensor Temperature Error (High)" and Procedure for Restoration

This error occurs when the converter detects that the sensor temperature is higher than 780°C (1436°F). It also occurs if the converter detects failure of the heater circuit and temperature measuring and controlling circuit during warm-up.

##### <Causes>

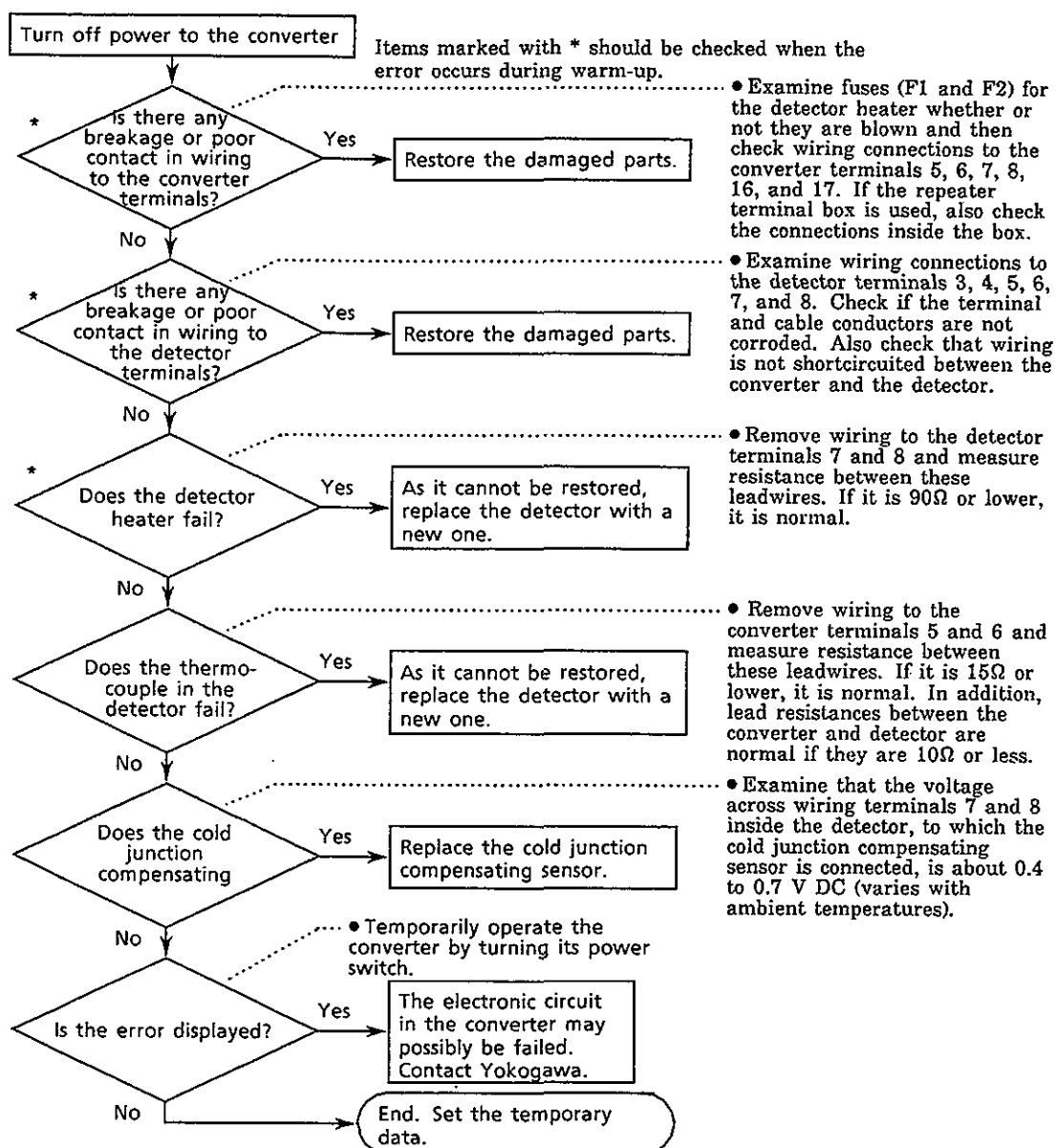
If the error code is displayed in steady state operation, the following is considered as the causes.

- (1) Cold junction compensating sensor failure at the detector terminal board.
- (2) Failure of thermocouple in the detector
- (3) Failure of electronic circuits in the converter.

Next, if the error code is displayed during warm-up, the following is considered as the causes.

- (1) Fuses (F1 and/or F2) in the converter for the detector heater are blown.
- (2) Wiring failure between the converter and the detector (poor contact at the terminal connections, disconnection, shortcircuiting, etc.)
- (3) Failure of the heater in the detector (disconnection, etc.)

## &lt;Locating the Failure and Taking Measures&gt;



### 11.1.5 Causes of "E--4 A/D (Analog Circuit) Failure" and Procedure for Restoration

This error occurs when the electric circuit of the converter does not operate normally.

#### <Causes>

- (1) The analog circuits of the converter contains a failure.
- (2) The supply voltage significantly drops (15% or more of the rating).

#### <Locating the Failures and Measures>

Once turn off the converter power switch and turn on the power switch again, then check whether or not the operation is normal.

If the operation is normal, it is considered that the error may be caused by temporary failure of power system, such as voltage drop or influence of noise. If the cause is clear and the error may possibly occur with the same cause, take suitable measures to prevent re-occurrence.

If the error occurs again, it may be caused with the converter electric circuits, such as CPU card. In this case, it is not so easy to find the failed part and to restore. If the error occurs again, contact Yokogawa. Confirm that power system is not in failure by checking the supply voltage and others to make sure of it.

### 11.1.6 Causes of "E--5 Calibration Value Error (Zero)" and Procedure for Restoration

This error occurs when the zero point correction factor (see subsection 9.1.3) exceeds the range  $100 \pm 30\%$  in the automatic and semi-automatic calibrations.

#### <Causes>

- (1) The oxygen concentration of zero gas and the value set with function No. C-1 do not agree or the span gas is accidentally used as the zero gas.
- (2) The zero gas does not flow by the specified quantity (about 600 ml/min).
- (3) The sensor (cell) is damaged and the cell emf contains an error.

#### <Locating the Cause of Failure and Taking Measures>

- (1) To make sure, carry out the calibration once more. Before calibration, examine the following. If they are not in normal state, correct them.
  - Does the value set in the function No. C-1 agree with the zero gas oxygen concentration?
  - Does the calibration gas tubing have measures to no zero gas leakage?
- (2) If the error does not occur in re-calibration, it is considered as the cause of the error in the first calibration that the calibrating conditions were not proper. In this case, no particular restoration is necessary. Restart the steady state operation.  
 If the error also occur in re-calibration, it is considered as the cause of error occurrence that the sensor deteriorates or is damaged. Confirm that the error corresponds to one or more of the following phenomena and replace it with a new sensor (see 10.1.4).
  - When zero gas is passed, the sensor (cell) emf indicated with function No. A-3 greatly differs from the theoretical value in that oxygen concentration.
  - When three kinds of gas (zero gas, span gas, and the gas having approximately middle oxygen concentration between the above two) are measured, correlation cannot be found in these measured data for oxygen concentration.

In addition, check the sensor deterioration or damage which caused the error occurrence whether or not it abruptly occurs by the following phenomena. If abrupt occurrence may be suspected, check the check valve located at the inlet of detector

calibration gases whether or not the valve has failed. Check valve failure causes condensed water in the calibration gas tubing, which is the cause of sensor breakage.

- Examine historical data of the zero point correction factor displayed with function No. B-1. Permissible range of the zero point correction factor is  $100 \pm 30\%$ .
- Examine the sensor (cell) internal resistance displayed with function No. B-3. A new sensor shows the value of  $200 \Omega$  or less. While the dissipated sensor approaching to the end of the life indicates the value of 3 to  $10 \text{ k}\Omega$ .
- Examine the sensor integrity data (five grade evaluation of 5 to 1) displayed with function No. B-4. A sensor in good state shows "5".

### 11.1.7 Causes of "E -- 6 Calibration Value Error (Span)" and Procedure for Restoration

This error occurs when the span point correction factor (see subsection 9.1.3) exceeds the range  $0 \pm 18\%$  in the automatic and semi-automatic calibrations.

#### <Causes>

- (1) The oxygen concentration of span gas and the value set with function No. C-0 do not agree or the zero gas is accidentally used as the span gas.
- (2) The span gas does not flow by the specified quantity (about 600 ml/min).
- (3) The sensor (cell) is damaged and the cell emf contains an error.

#### <Locating the Cause of Failure and Taking Measures>

- (1) To make sure, carry out the calibration once more. Before calibration, examine the following. If they are not in normal state, correct them.
  - Does the value set in the function No. C-0 agree with the span gas oxygen concentration?
  - Does the calibration gas tubing have measures to no span gas leakage?
- (2) If the error does not occur in re-calibration, it is considered as the cause of the error in the first calibration that the calibrating conditions were not proper. In this case, no particular restoration is necessary. Restart the steady state operation.  
 If the error also occur in re-calibration, it is considered as the cause of error occurrence that the sensor deteriorates or is damaged. Confirm that the error corresponds to one or more of the following phenomena and replace it with a new sensor (see Section 10.1.4).
  - When span gas is passed, the sensor (cell) emf indicated with function No. A-3 greatly differs from the theoretical value in that oxygen concentration.
  - When three kinds of gas (zero gas, span gas, and the gas having approximately middle oxygen concentration between the above two) are measured, correlation cannot be found in these measured data for oxygen concentration.

In addition, check the sensor deterioration or damage which caused the error occurrence whether or not it abruptly occurs by the following phenomena. If abrupt occurrence may be suspected, check the check valve located at the inlet of detector calibration gases whether or not the valve has failed. Check valve failure causes condensed water in the calibration gas tubing, which is the cause of sensor breakage.

- Examine historical data of the span point correction factor displayed with function No. B-0. Permissible range of the span point correction factor is  $0 \pm 18\%$ .
- Examine the sensor (cell) internal resistance displayed with function No. B-3. A new sensor shows the value of  $200 \Omega$  or less.  
 While the dissipated sensor approaching to the end of the life indicates the value of 3 to  $10 \text{ k}\Omega$ .

- Examine the sensor integrity data (five grade evaluation of 5 to 1) displayed with function No. B-4. A sensor in good state shows "5".

### 11.1.8 Causes of "E -- 7 EMF Stabilization Time Over" and Procedure for Restoration

This error occurs when the sensor (cell) emf is not stabilized even if the calibration time is over because the sensor part of the detector is not filled with calibration gas (zero and span gases) at the one-touch calibration.

#### <Causes>

- (1) Flow of the calibration gas is small (specified flow: about 600 ml/min).
- (2) Measuring gas flows toward the tip of the detector probe.
- (3) Sensor (cell) response is deteriorated.

#### <Locating the Cause of Failure and Taking Measures>

- (1) Examine the setting time with function No. C-4 whether or not it is suitable. If not suitable, modify the setpoint and perform recalibration again. Carry out recalibration after confirming that the tubings does not leak and flowing calibration gas by the specified rate (about 600 ml/min).
- (2) When calibration is normally carried out, continue the steady state operation.  
If the error occurs again, replace the sensor assembly after checking that whether or not the error corresponds to the following.
  - Dust significantly sticks to the detector probe tip. — If dust sticks, clean it (see 10.1.2).
 If the error occurs in calibration even after the sensor assembly is replaced, influence of measuring gas flow is considered as the cause. Make the measuring gas not flow toward the detector probe tip by changing the mounting position of the detector or in other means.

### 11.1.9 Causes of "E -- 8 ROM and RAM Failure" and Procedure for Restoration

This error occurs when ROM contents reading and/or writing memory to RAM are not possible.

#### <Causes>

- (1) ROM and RAM pins are not fully inserted into the socket.
- (2) High supply voltages exceeding the specifications are applied or the effect of noise is given to ROM and RAM.
- (3) ROM and/or RAM failed.
- (4) Failure occurred in digital circuits on the CPU board and others.

#### <Locating the Cause of Failure and Taking Measures>

Once turn off the converter power switch. After confirming that the supply voltage satisfies the specification, turn on the power switch again to operate the converter.

If the error also occurs, repair is necessary. Contact Yokogawa.

### 11.1.10 Causes of Display Disappearance (Data Display) and Procedure for Restoration

Operation of the converter digital circuits is being self-checked with the watchdog timer (WDT) or clock monitor.

This error occurs when power is turned on again after power supply to the converter electrical circuit is interrupted due to power failure. This error also occurs when the converter digital circuits fail, such as time-up of the watchdog timer normally reset in a fixed period. In either case, if the error occurs, display in the data display disappears.

Next, measures when the error occurs due to the digital circuit operation failure will be described.

<Causes>

- (1) Low supply voltages exceeding the specifications are applied or the effect of noise is given to digital circuits.
- (2) Digital circuit failure.

<Locating the Cause of Failure and Taking Measures>

Once turn off the converter power switch. After confirming that the fuse for protecting electrical circuits in the converter is not likely to blow and the supply voltage satisfies the specification, turn on the power switch again to operate the converter.

If the error occurs again, repair is necessary. Contact Yokogawa.

## 11.2 Measures When Measured Value Shows an Error

The causes that the measured value shows an abnormal value is not always due to instrument failures. There are rather many cases where the causes are those that measuring gas itself is in abnormal state or external causes exist, which disturb the instrument operation. In this section, causes of and measures against the cases where measured values show the following phenomena.

- (1) The measured value is higher than the true value.
- (2) The measured value is lower than the true value.
- (3) The measured value sometimes show abnormal values.

### 11.2.1 Measured Value Higher Than True Value

#### <Causes and Measures>

- (1) The measuring gas pressure becomes higher.

The measured oxygen concentration value  $X$  (vol%  $O_2$ ) is expressed as shown below, when the measuring gas pressure is higher than that in calibration by  $\Delta p$  (mm  $H_2O$ ).

$$X = Y[1 + (\Delta p/10336)]$$

where  $Y$ : Measured oxygen concentration value at the same pressure as in calibration (vol%  $O_2$ ).

Where an increment of the measured value by pressure change cannot be neglected, measures must be taken.

Investigate the following points to perform improvement available in each process.

- Is improvement in facility's aspect available so that pressure change does not occur?
  - Is performing calibration available under the averaging measuring gas pressure (internal pressure of a furnace)?
- (2) Moisture content in a reference gas changes (increase) greatly.

If air at the detector installation site is used for the reference gas, large change of moisture in the air may cause an error in measured oxygen concentration value (vol%  $O_2$ ).

When this error is not ignored, use a gas in which moisture content is constant such as instrument air in almost dry condition as a reference gas.

In addition, change of moisture content in exhaust gas after combustion is also considered as a cause of error. However, normally this error is negligible.

- (3) Calibration gas (span gas) is mixing into the detector due to leakage.

If the span gas is mixing into the detector due to leakage for the reason of failure of the valve provided in the calibration gas tubing system, the measured value shows a value a little higher than normal.

Check valves in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in fully closed state.

- (4) The reference gas is mixing into the measuring gas and vice versa.

Since the difference between oxygen partial pressures on the sensor anode and cathode sides becomes smaller, the measured value shows a higher value.

An error which does not appear as the error "E-1" may occur in the sensor. Visually inspect the sensor. If any crack is recognized, replace it with a new sensor assembly.

(Note) Data such as cell integrity displayed with function No. B-4 should also be used for deciding sensor quality.

### 11.2.2 Measured Value Lower Than True Value

#### <Causes and Measures>

- (1) The measuring gas pressure becomes lower.

Where an increment of the measured value by pressure change cannot be neglected, take measures referring to subsection 11.1.1 (1).

- (2) Moisture content in a reference gas changes (decrease) greatly.

If air at the detector installation site is used for the reference gas, large change of moisture in the air may cause an error in measured oxygen concentration value (vol% O<sub>2</sub>).

When this error is not ignored, use a gas in which moisture content is constant such as instrument air in almost dry condition as a reference gas.

In addition, change of moisture content in exhaust gas after combustion is also considered as a cause of error. However, normally this error is negligible.

- (3) Calibration gas (zero gas) is mixed into the detector due to leakage.

If the zero gas is mixed into the detector due to leakage for the reason of failure of the valve provided in the calibration gas tubing system, the measured value shows a value a little lower than normal.

Check valves in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in fully closed state.

### 11.2.3 Measured Value Sometimes Show Abnormal Values

#### <Causes and Measures>

- (1) Noise is mixed into the converter from the detector output wiring.

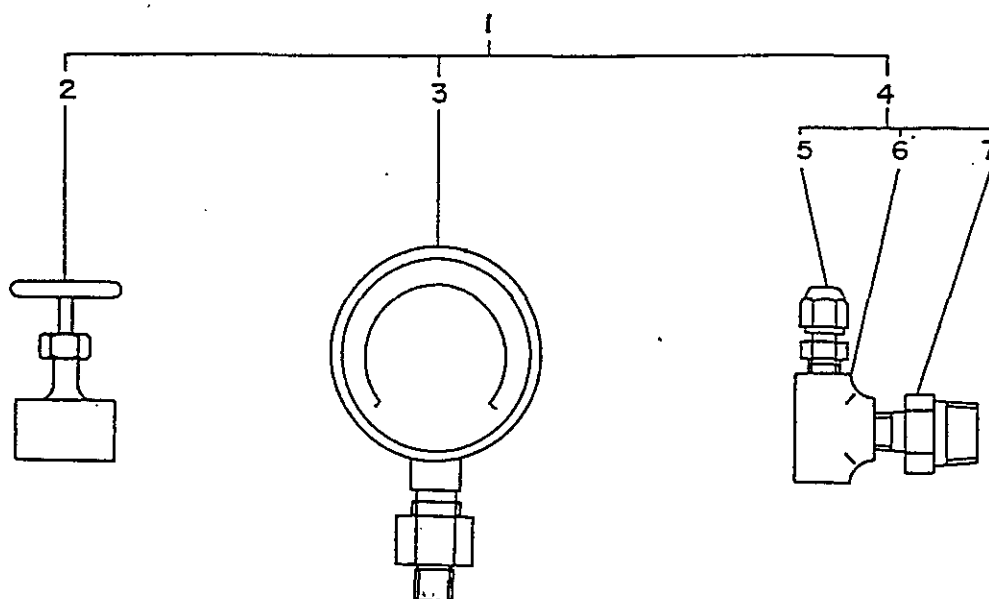
Take measures so that noise is not mixed into the converter, e.g., by shielding the wiring.

- (2) The converter is affected with noises from the power supply.

Insert the line filter in the power line.

# Customer Maintenance Parts List

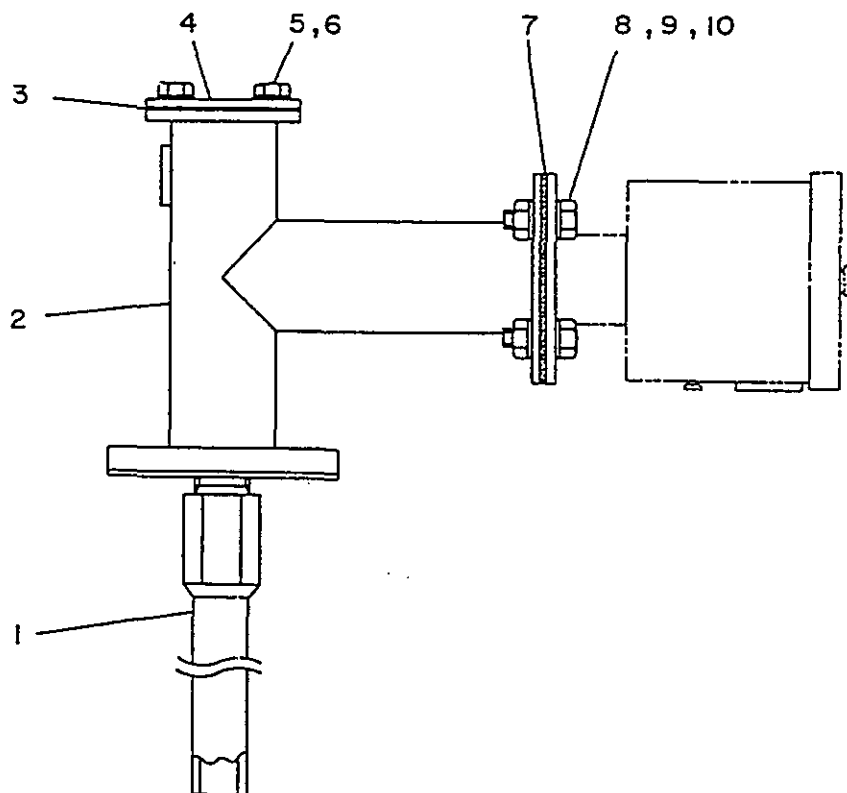
E7046EC / E7046EN  
Zirconia Oxygen Analyzer  
Auxiliary Ejector (for model ZO21P-H)



Item	Part No.	Qty	Description
1	E7046EC	1	Auxiliary Ejector, Connection PT 1/4
	E7046EN	1	Auxiliary Ejector, Connection 1/4 NPT
2	G7008XH	1	Needle Valve, Connection PT 1/4
	G7016XH	1	Needle Valve, Connection 1/4 NPT
3	E7046EK	1	Pressure Gauge, Connection PT 1/4
	E7046EV	1	Pressure Gauge, Connection 1/4 NPT
4	E7046ED	1	Ejector Assembly, Connection PT 1/4
	E7046EP	1	Ejector Assembly, Connection 1/4 NPT
5	E7046EF	1	Connector, Connection PT 1/4
	E7046ER	1	Connector, Connection 1/4 NPT
6	G7031XA	1	Ejector, Connection PT 1/4
	G7080XA	1	Ejector, Connection 1/4 NPT
7	E7046EJ	1	Connector, Connection PT 1/4

# Customer Maintenance Parts List

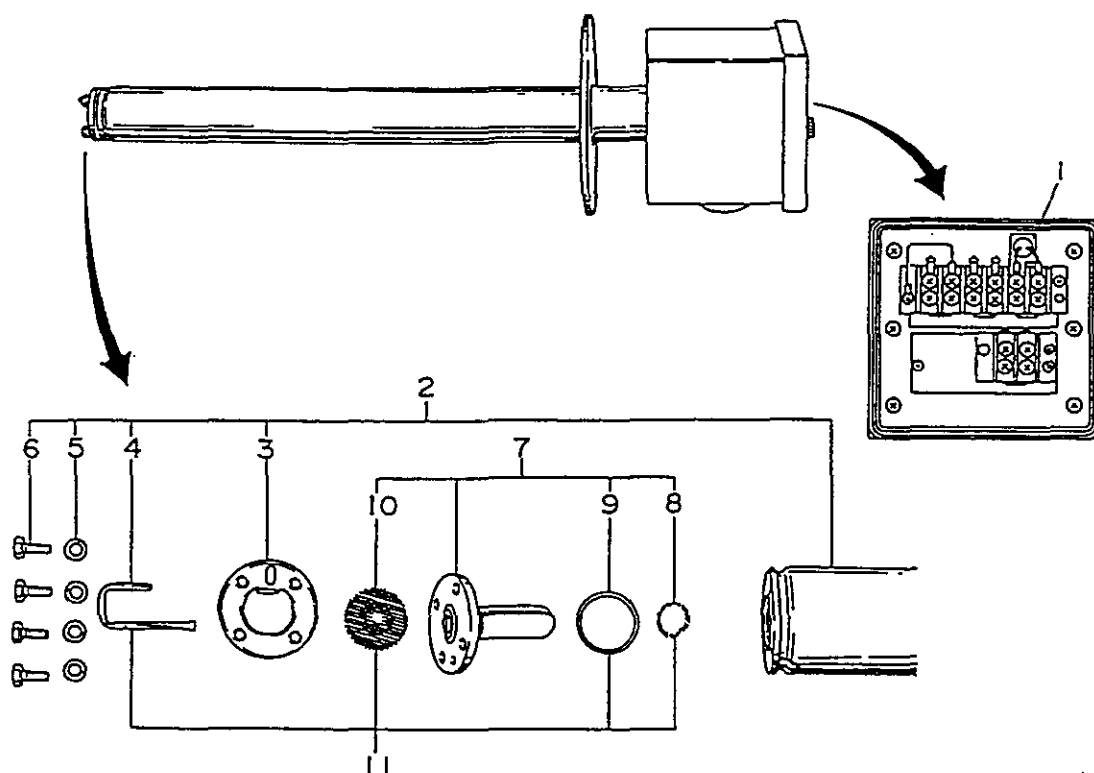
Model ZO21P—H  
Zirconia Oxygen Analyzer  
High Temperature Probe Adaptor



Item	Part No.	Qty	Description
1	E7046AL	1	Probe (sic, L=1.0 m)
	E7046BB	1	Probe (sic, L=1.5 m)
	E7046AP	1	Probe (SUS 310S, L=1.0 m)
	E7046AQ	1	Probe (SUS 310S, L=1.5 m)
2	E7046AD	1	Probe Adaptor (for JIS 5K 50A)
	E7046CB	1	Probe Adaptor (for ANSI 150LB 4B RF)
3	E7046AC	1	Gasket
4	E7046AB	1	Plate
5	G7030YC	4	Bolt
6	Y9800WU	8	Washer
7	G7073XL	1	Gasket
8	Y9630RU	4	Bolt
9	Y9121BU	4	Nut
10	Y9120WU	4	Washer

# Customer Maintenance Parts List

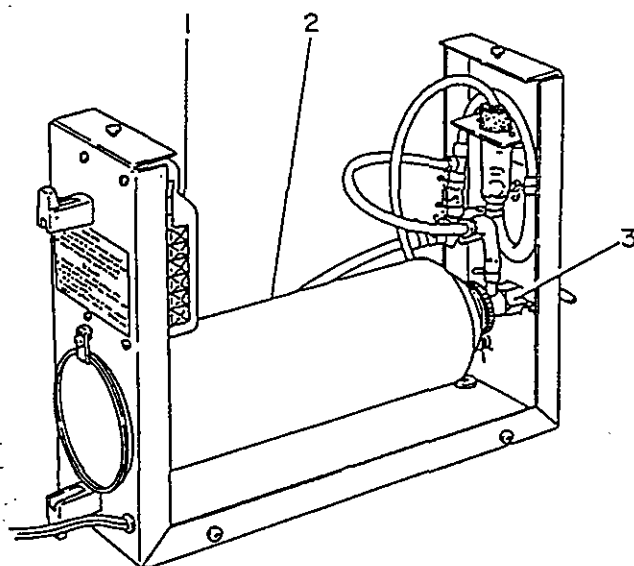
Model ZO21D  
Zirconia Oxygen Analyzer  
Detector



Item	Part No.	Qty	Description
1	E7042AU	1	Cold Junction Assembly
2	—	1	Detector Assembly
3	E7042BR	1	Plate
4	E7042BQ	1	Pipe
5	Y9500SU	4	Spring Washer (M5, SUS304 stainless steel)
6	G7109YC	4	Bolt (M5 × 12, SUS316 stainless steel)
7	E7042UD	1	Cell Assembly
8	E7042BS	1	Contact
9	G7048XL	1	Metal O-Ring
10	E7042AY	1	Filter Assembly
11	K9119EN	1	Cell Part

# Customer Maintenance Parts List

Model ZO21S  
Zirconia Oxygen Analyzer  
Standard Gas Unit



Item	Part No.	Qty	Description
1	—	1	Pump (see Table 1)
2	E70508A	1	Zero Gas Cylinder (×6 pcs)
3	E70508J	1	Needle Valve

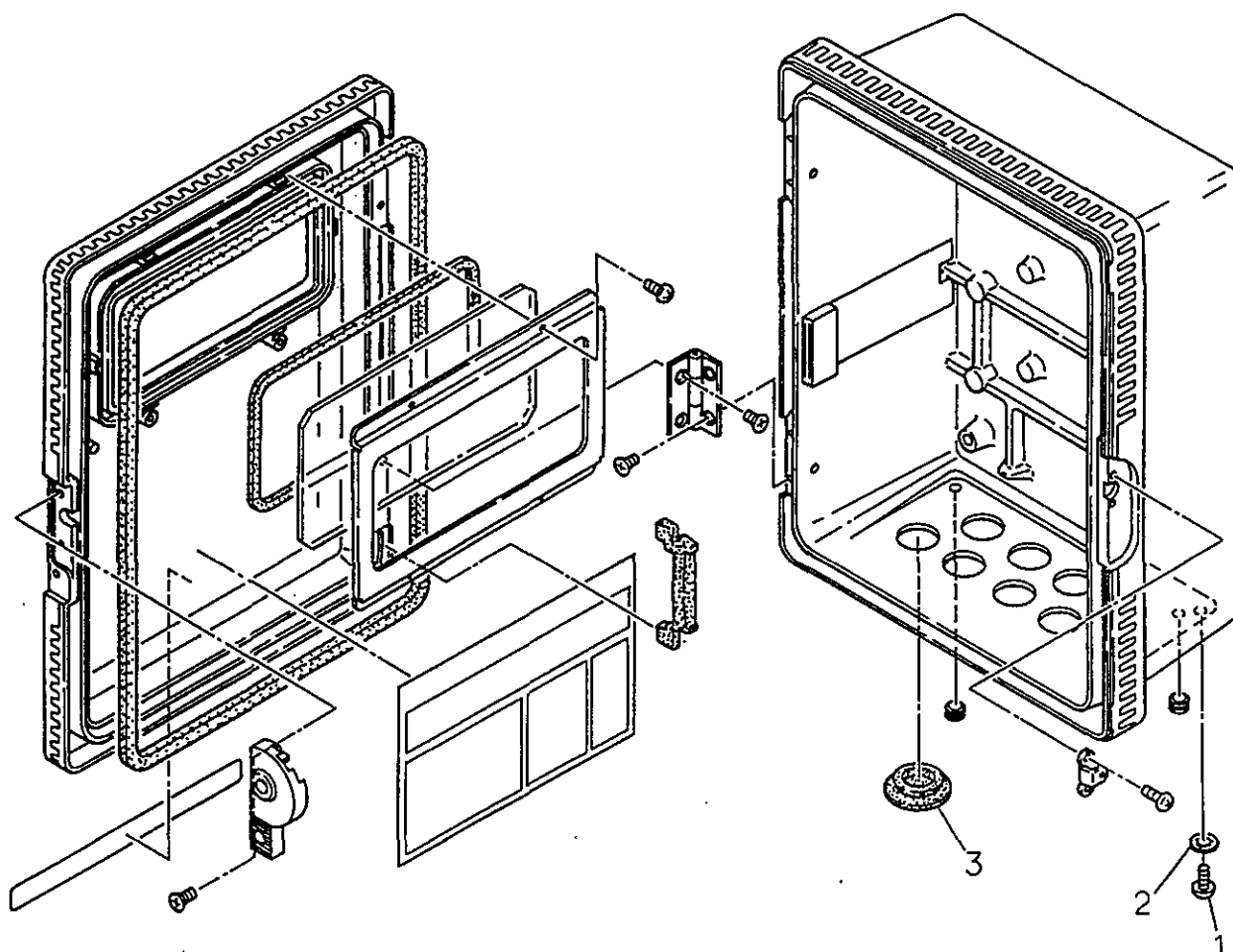
Table 1

Power	Pump
AC 100 V 110 115	E7050AU
AC 200 V 220 240	E7050AV

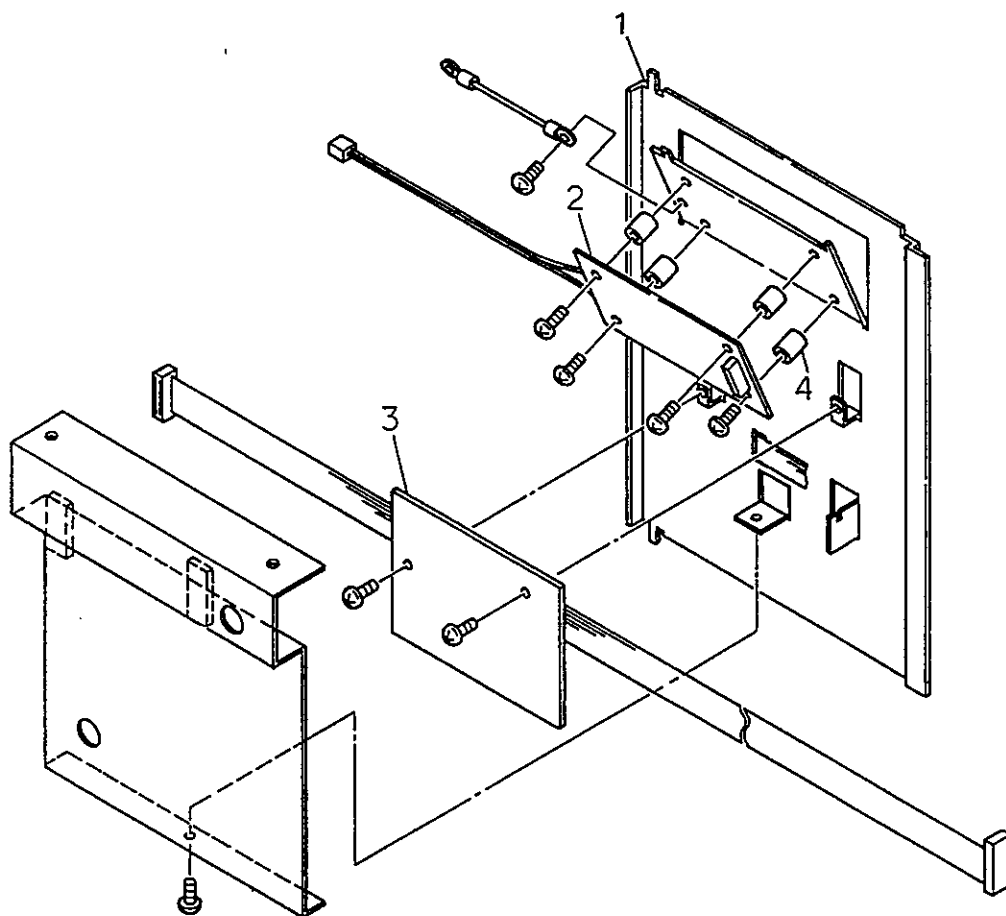
# Customer Maintenance Parts List

EXA OXY

In-Situ Type Zirconia Oxygen Analyzer  
Model ZA8C (Style B)  
Converter



Item	Part No.	Qty	Description
1	Y9508JU	1	Pan H. Screw, M5×8
2	Y9501WL	1	Toothed Lock Washer
3	K9290PZ	7	Bushing



Item	Part No.	Qty	Description
1	K9290XB	1	Panel (In Japanese)
	K9290XC	1	Panel (In English)
2	K9290UH	1	LCD Assy
3	K9290UA	1	PCB 2
4	Y9906YA	4	Spacer

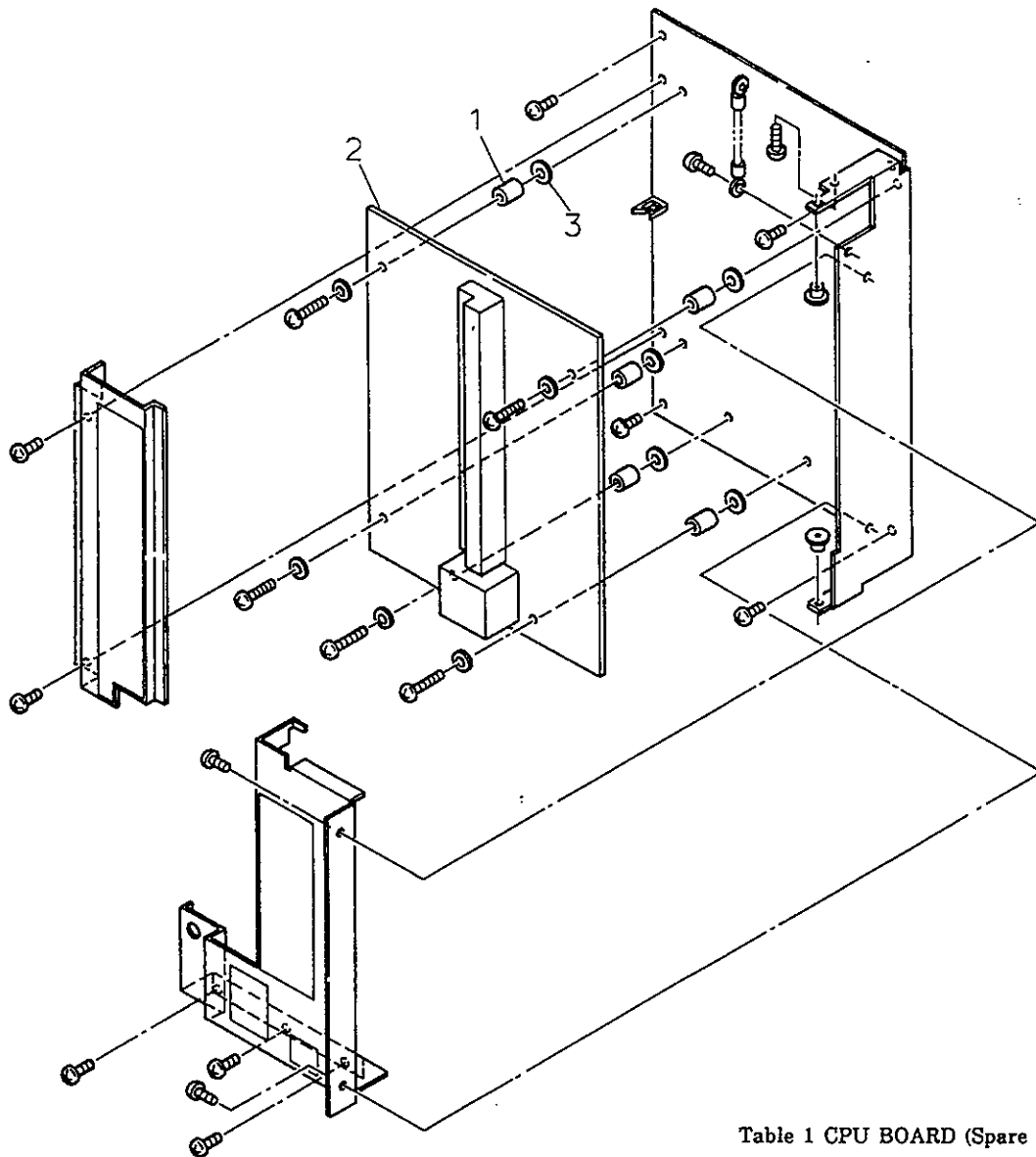
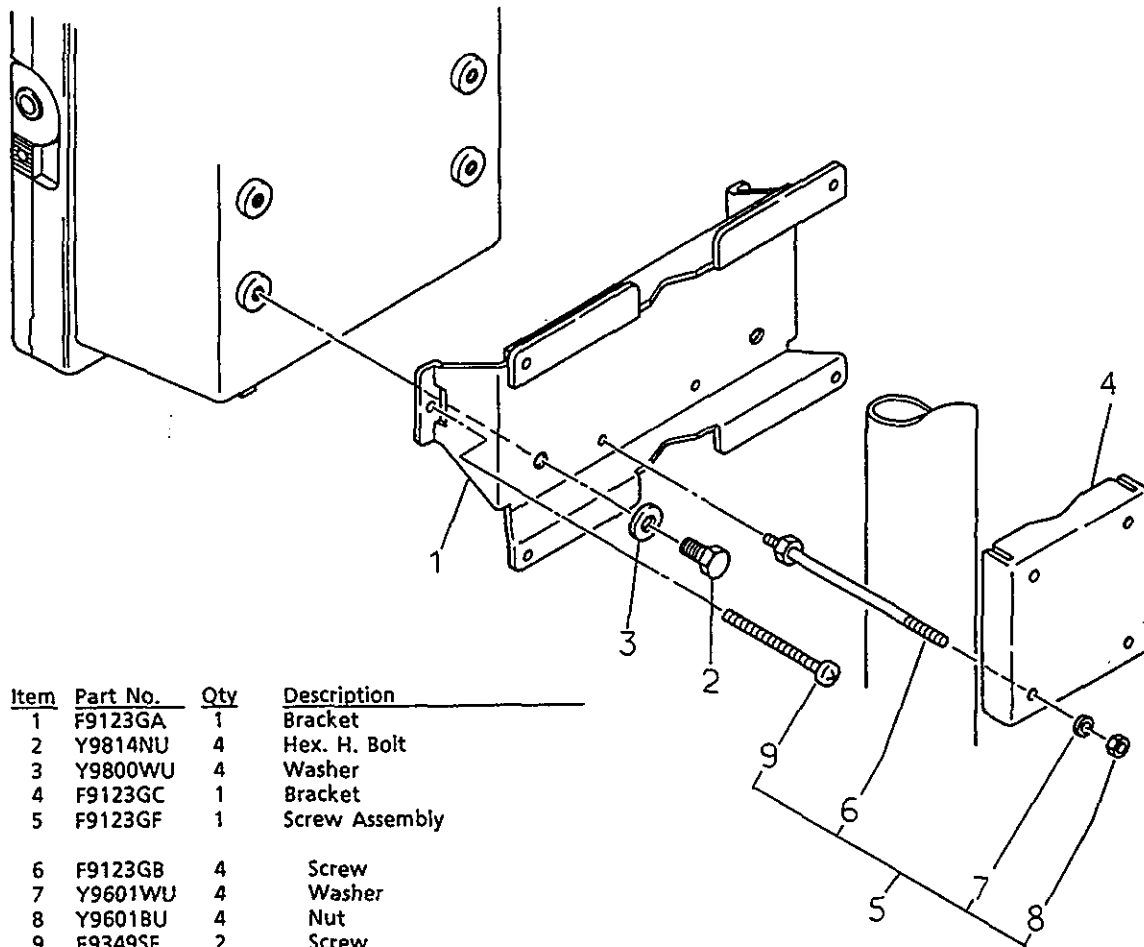


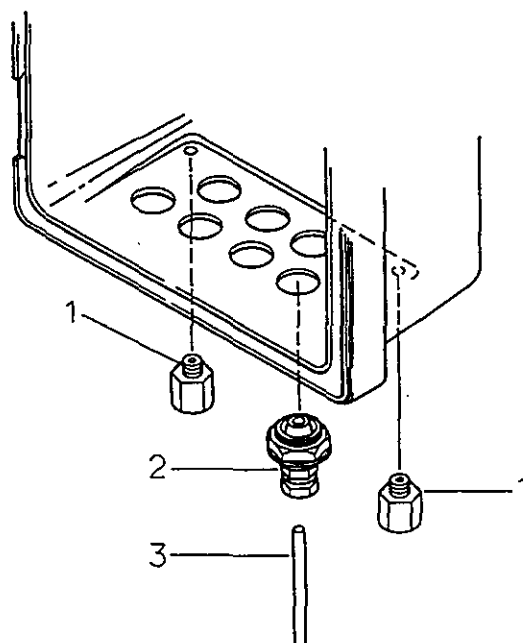
Table 1 CPU BOARD (Spare Part)

Item	Part No.	Qty	Description
1	K9290PK	5	Spacer
2	—	1	CPU Assy (see Table 1)
3	L9801BF	5	Washer

Part No.	Description
K9290XN	For ZA8C-S-5(or -7) -N -0-N-0-J*B
K9290XP	For ZA8C-S-3(or -4) -N -0-N-0-J*B
K9290XQ	For ZA8C-S-5(or -7) -N -0-N-0-E*B
K9290XR	For ZA8C-S-3(or -4) -N -0-N-0-E*B
K9290XJ	For ZA8C-S-5(or -7) -A(or -B) -1-A-1-J*B
K9290XK	For ZA8C-S-3(or -4) -A(or -B) -1-A-1-J*B
K9290XL	For ZA8C-S-5(or -7) -A(or -B) -1-A-1-E*B
K9290XM	For ZA8C-S-3(or -4) -A(or -B) -1-A-1-E*B



Item	Part No.	Qty	Description
1	K9290PS	1	Air purge Assembly (for PT 1/4 Female)
	K9290PT	1	Air purge Assembly (for 1/4 NPT Female)
2	L9811FP	7	Cable Grand
3	K9290PQ	7	Insert











In-Situ Type  
Zirconia Oxygen Analyzer Model ZA8  
(Version 2.00)

Please note the following alterations to the IM 11M6A2-01E.

• Page 2 ~ Safety Precautions2

This instrument is an IEC safety class 1 instrument ( provided with terminal for protective grounding). The following general safety precautions must be observed during all phases of operation, service and repair of this instrument. If this instrument is used in a manner not specified in this manual, the protection provided by this instrument may be impaired. Also, YOKOGAWA Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.

-  To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service Manual.
-  Danger, risk of electric shock.
-  Alternating current.
-  ON (power)
-  OFF (power)
-  Caution, hot surface.
-  Protective grounding terminal.
-  Function grounding terminal. This terminal should not be used as a "Protective grounding terminals".

Make sure to comply with the following safety precautions. Not complying might result in injury, death of personnel or damage to the instrument.

## WARNING

- Power Supply  
Ensure the source voltage matches the voltage of the power supply before turning ON the power.
- Protective grounding  
Make sure to connect the protective grounding to prevent an electric shock before turning ON the power.
- Necessity of protective grounding  
Never cut off the internal or external protective grounding wire or disconnect the wiring of protective grounding terminal. Doing so poses a potential shock hazard.
- Defect of Protective Grounding and Fuse  
Do not operate the instrument when protective grounding or fuse might be defective.

---

## ● Fuse

To prevent a fire, make sure to use fuses with specified standard (voltage, current, type).

Before replacing the fuses, turn off the power and disconnect the power source.

Do not use a different fuse or short-circuit the fuse holder.

## ● Do not Remove any Covers

There are some areas with high voltages. Do not remove any cover if the power supply is connected. The cover should be removed by qualified personnel only.

### •Page 2.1 General Specifications

Power source: 220, 240 VAC(-10%, +10%), 50/60Hz

Power consumption: Maximum 270VA, Ordinary Approx.80VA

Safety standard      Complying Standard: EN61010-1

Overvoltage Category II

Pollution degree 2

EMC compliance standards: compliant with the following EMC standards

Group 1, Class A, EN55011, 1991 for EMI (Emission)

EN50082-2, 1995 for EMS(Immunity)

### Note:

•The "Installation category" implies the regulation for impulse withstanding voltage, which is also called the "Over Voltage Category". It deals with electrical equipment.

•The "Pollution level" describes to which degree a particular solid, liquid, or gas that degrades the dielectric strength is adhering. Two implies a normal outdoor atmosphere.

### •Page 2-2 2.2.1 ZO21D-E Standard Detector

Ambient humidity: 20 to 90%RH (noncondensing)

Altitude of installation site: 2,000 m or lower

### •Page 2-8 2.3.1 ZO21D-F High-temperature Detector

Ambient humidity: 20 to 90%RH (noncondensing)

Altitude of installation site: 2,000 m or lower

### •Page 2-12 2.4 ZA8C-E Converter

Ambient humidity: 20 to 90%RH (noncondensing)

Altitude of installation site: 2,000 m or lower

Power source: 220 or 240 VAC~(-10%, +10%), 50/60Hz

Weight: Approx. 11 kg (220 or 240VAC~)

### •Page 2-20 2.5.2 ZA8H Flow setting Unit

This unit is not complied with CE Conformity standard.

### •Page 3-1 3.1 Installation of the Standard Detector

#### 3.1.1 Installation Site

(2) A location in which the ambient temperature is -10 to 80 °C and the terminal box is not subject to radiant heat.

(6) Ambient humidity is 20 to 90%RH (noncondensing) and Altitude of installation site is 2,000 m or lower.

## 2.9 EMC Conformity Standard

### 2.9.1 Emission

Applicable standards of emission are based on EN5501:1991.

Table 2.1 Emission-Enclosure Port

No.	Test item	Frequency Range	Limits	Basic Standard
1.	Electromagnetic Radiation Disturbance	30MHz-230MHz	30dB( $\mu$ V/m)quasi peak measured at 30m distance.	B
		230MHz-1000MHz	30dB( $\mu$ V/m)quasi peak measured at 30m distance.	
		1GHz-18GHz except 11.7GHz-12.7GHz	Under consideration See Note 1	
		11.7GHz-12.7GHz	57dB(PW) erp See Note 1	

Note 1: This test was not performed.  
The equipment does not work in this high frequency range.

Table 2.2 Emission-AC Mains Port

No.	Test item	Frequency range	Limits	Basic Standard
1.	Mains terminal disturbance voltage	0.15MHz-0.5MHz	79dB( $\mu$ V/m) quasi peak 66dB( $\mu$ V/m) average	EN55011 Class A Group 1
		0.5MHz-5MHz	73dB( $\mu$ V/m) quasi peak 60dB( $\mu$ V/m) average	
		5MHz-30MHz	73dB( $\mu$ V/m) quasi peak 60dB( $\mu$ V/m) average	

### 2.9.2 Immunity

Applicable standards of immunity are based on EN50082-2:1995.

Table 2.3 Immunity-Enclosure Port

No.	Test item	Test specification	Basic Standard	Performance Criteria
1.	Electrostatic discharge	4kV (contact) 8kV (air)	IEC1000-4-2	B
2.	Radio-frequency electromagnetic field	80-1000MHz 10V/m	prIEC1000-4-3	B

Table 2.4 Immunity-Ports for Signal lines

No.	Test item	Test specification	Basic Standard	Performance Criteria
1.	Fast transients common mode	1kV 5/50 Tr/Th ns 5kHz REP.	IEC1000-4-4	B

Table 2.5 Immunity-Ports for AC Input Power Lines

No.	Test item	Test specification	Basic Standard	Performance Criteria
1.	Fast transients common mode	2kV 5/50 Tr/Th ns 5kHz REP.	IEC1000-4-4 See Note 1	B
2.	Electrical conducted disturbance	0.15~80MHz 10V/m	prIEC1000-4-6 See Note 2	B

Note1: Definition of performance criterion B

When the noise is applied, some apparatus will go to be in warming up condition.

However, if the noise is removed, they will return into normal condition.

Note2: Definition of performance criterion B

When the noise is applied, the output of some apparatus will go to be fluctuated within 20%F.S. max. However, if the noise is removed, they will return into normal condition.

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•Page 3-5 3.2 Installation of the High-temperature Detector

3.2.1 Installation Site

- (2) A location in which the ambient temperature is -10 to 150 °C and the terminal box is not subject to radiant heat.
- (6) Ambient humidity is 20 to 90%RH (noncondensing) and Altitude of installation site is 2,000 m or lower.

•Page 3-7 3.3 Installation of the Converter

3.3.1 Installation Site

- (3) location in which the ambient temperature is -20 to 55 °C and temperature varies little (recommended to be within 15°C of difference between days).
- (4) Ambient humidity is 20 to 90%RH (noncondensing) and non corrosive gases is present.  
Note: If the ambient atmosphere contains corrosive gases, carry out air purging. The air-purge tube fittings are attached only when required.

•Page 3-10 3.4 Installation of the Flow Setting Unit

This unit is not complied with CE Conformity standard.

•Page 3-13 3.6 Installation of the Magnetic Valve Unit

This unit is not complied with CE Conformity standard.

•Page 5-1 5.Wiring 5.1 General

5.1 Wiring for a Product with the CE Certification Mark

This instrument is approved to have the CE certification mark on condition that the instrument be installed according to the following wiring procedure. Note that if the instrument's installation does not comply with this procedure, the performance of the electromagnetic compatibility and noise immunity may be degraded and a malfunction may thus result.

Wiring Procedure

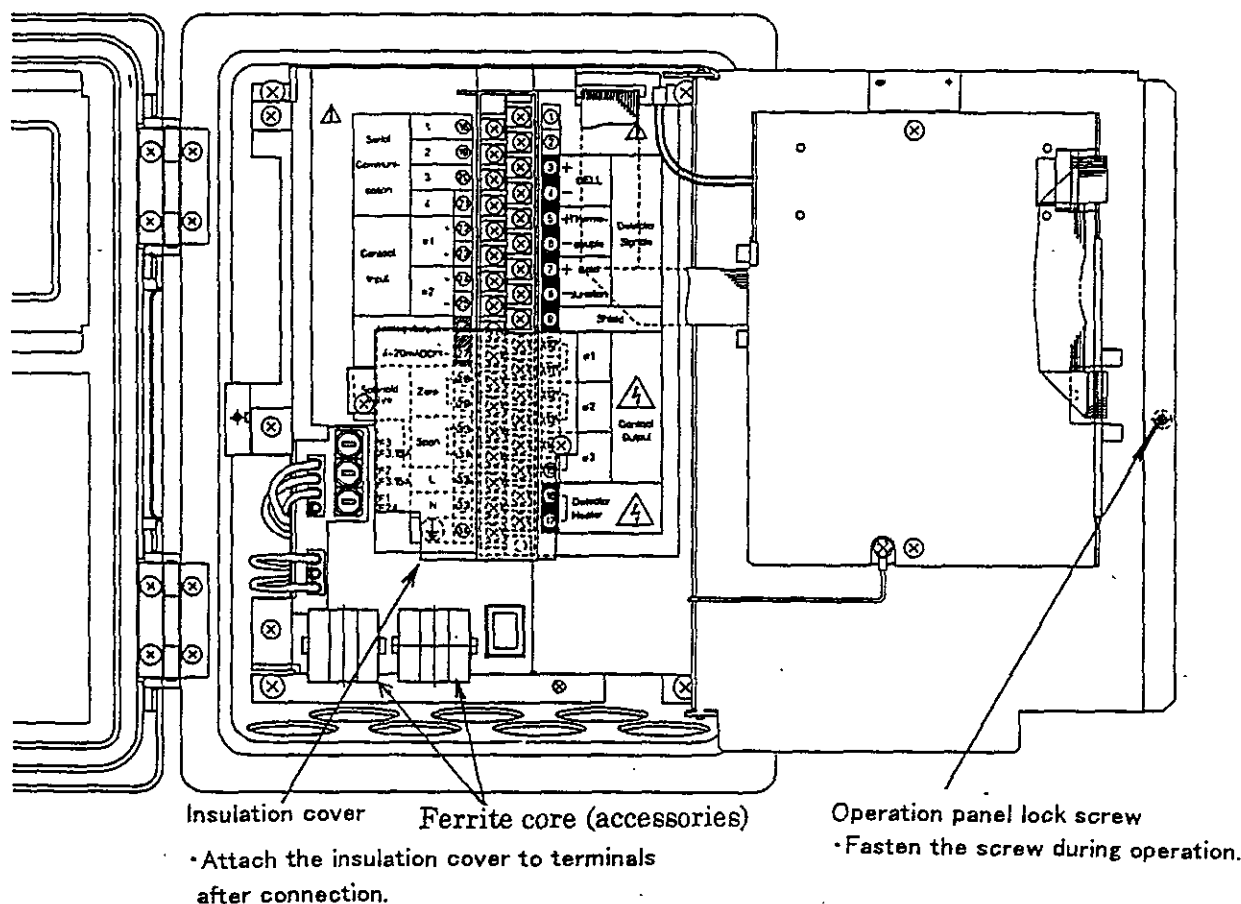
Be sure the signal cables and power cord are wired in compliance with the following conditions.

- 1. The signal cables and power supply cables must be shielded cables. The shielded cables must be wired to the ground terminal of the converter. (See Figure a.)
- 2. Keep coated length of signal cables are to be 50 mm or less.  
Keep coated length of power supply cables are to be 20 mm or less.
- 3. All cables must be metal conduits. For bent sections, use flexible metal conduit cables.  
Be sure to wire all conduits so that electrical continuity in the cables is sufficiently maintained. (See Figure b.)
- 4. Use lock nuts to firmly fasten the conduits to the converter as well as to the detector. (See Figure c.)
- 5. To prevent any malfunctioning caused by noise, use signal cables that are different from the power cables and heater cables so that they are isolated from the power cord and heater cable with certainty.
- 5. Plug metal blind-plugs into openings which have no cables wired to the converter and use nuts to fasten the plugs on the inside of the converter.
- 6. Ensure that the metal conduits have stable grounding. Also, in addition to this grounding, there must be separated safety grounding.
- 7. Use the cables listed below for the wiring. (See list a.)

Terminal		Cable			
Number	Name	Type	Material	Max. dia.	Rating
3 to 8	Detector output	6-wire, shielded	CVVS (KGB for 80°C or more)	14 mm	AWG 26 or higher
16 and 17	Power cord for heater of the detector	2-wire, shielded	CVVS (KGB for 80°C or more)	11 mm	AWG 16 or higher
	Power cord	3-wire (one wire for grounding)	CVV	11 mm	AWG 16 or higher
26 and 27	Analog output signal	2-wire, shielded	CVVS	11 mm	AWG 22 or higher
18 to 21	Digital communication	3-wire, twisted pair, shielded or 6-wire, shielded	CVVS	11 mm	AWG 24 or higher
10 to 15	Contact output	2- or 4-wire, shielded	CVV	11 mm	AWG 22 or higher
28 to 31	Solenoid valve driving contact	4-wire, shielded	CVV	11 mm	AWG 22 or higher
22 to 25	Contact input	2- or 4-wire, shielded	CVV	11 mm	AWG 22 or higher
1 and 2	Temperature input signal	2-wire, shielded	CVV	11 mm	AWG 22 or higher
	Protective grounding		CVV	1.6 mm <sup>2</sup> or more *	100Ω or less

\* For the grounding terminal, the minimum cross-section area of the cable is described in place of the maximum diameter.

Figure a



YOKOGAWA

IM 11M6A2-01E

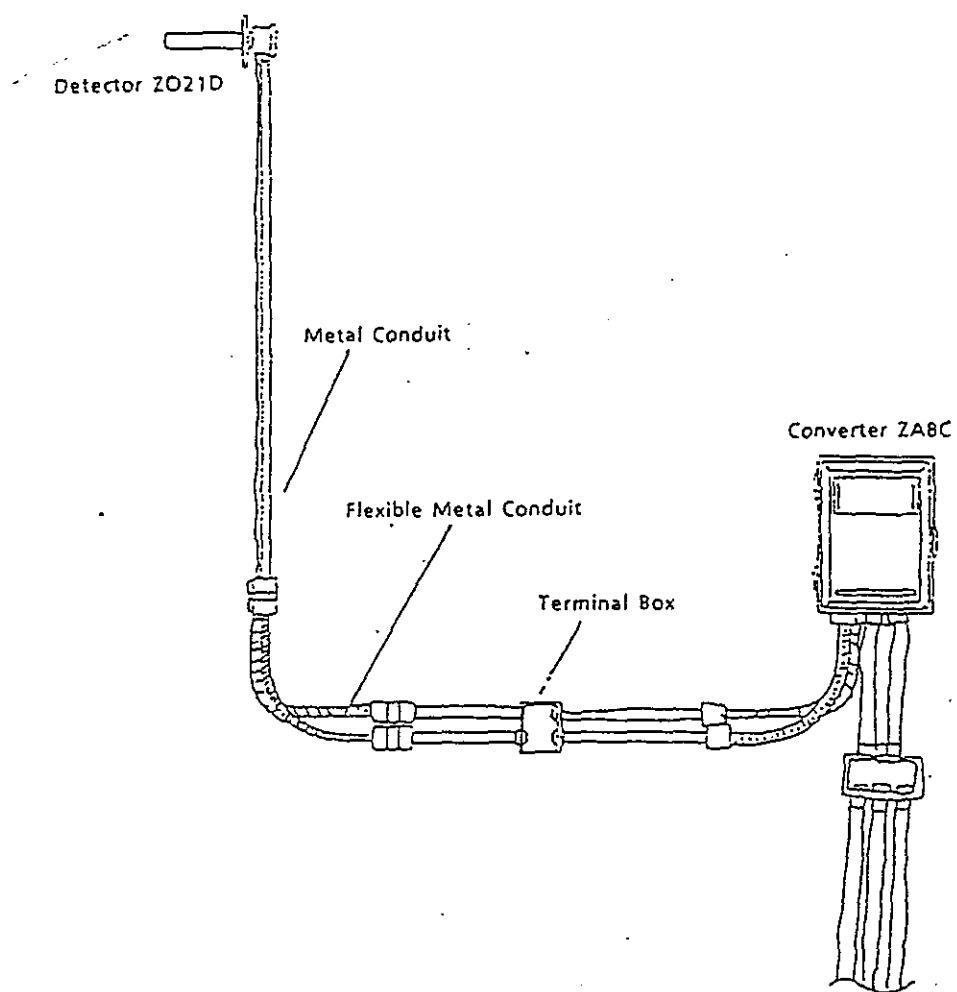
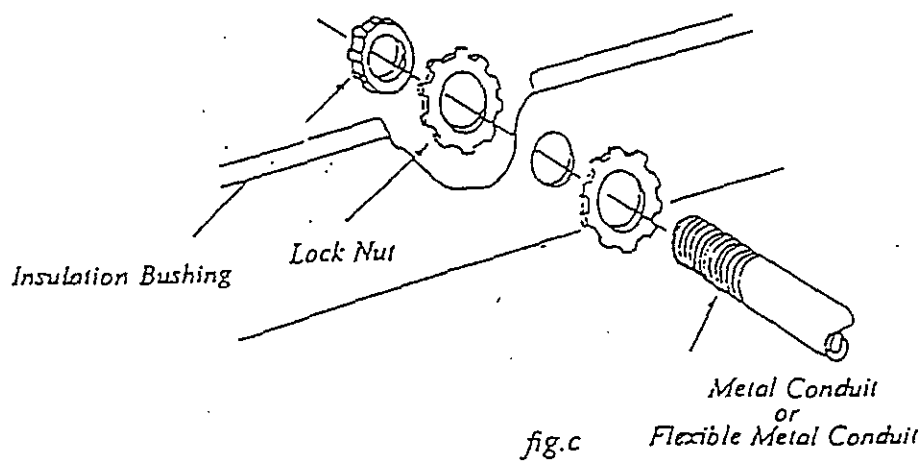


Figure b.



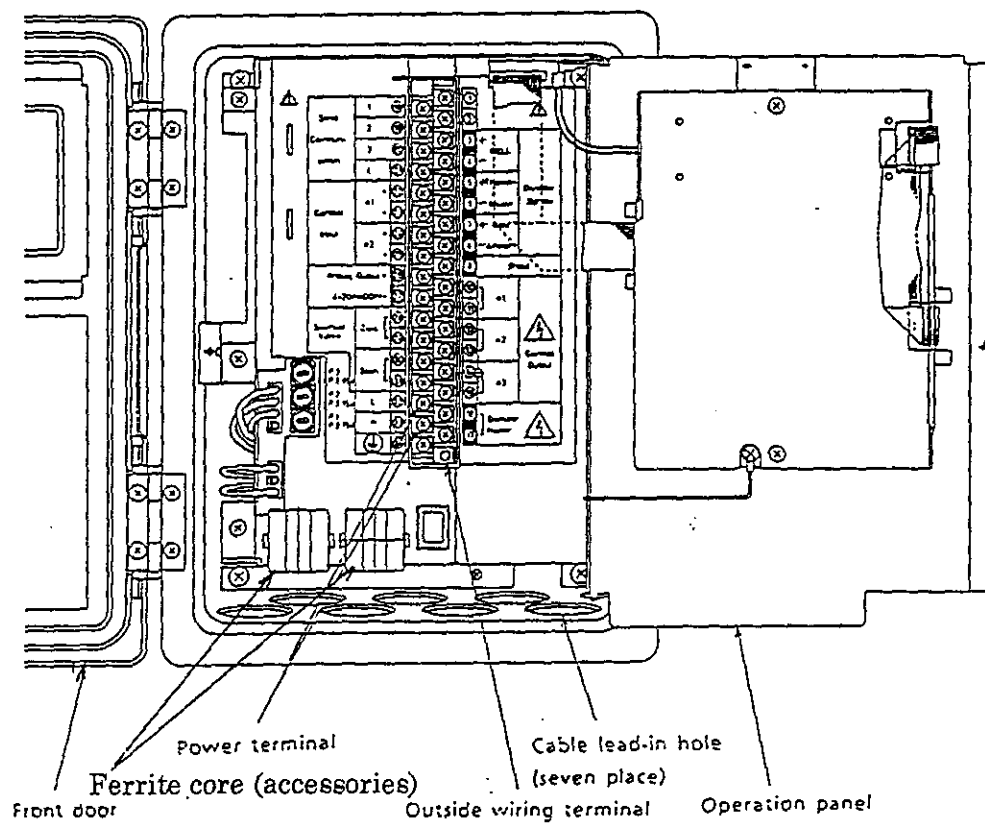


Fig 5.1 Outer wiring terminals of the Converter

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•Page 5-1 5.Wiring 5.1.2 Outer wiring terminals of the Converter

Figure 5.1.1 Outer wiring terminals of the converter ( Model code ZA8C-E with CE marking)

•Page 5-1 5.Wiring 5.1.3 Types of Wiring

Figure 5.2.1 Output Wiring for Converter ( Model code ZA8C-E with CE marking)

•Page 5-3 5.2 Wiring for Detector Output

Figure 5.3 Output Wiring for Detector

•Page 5-4 5.2.2 Connection to detector

Figure 5.4 Layout of detector terminals.

The size of the terminal screw threads are M4 and M3 for general and high-temperature detectors, respectively. So, use a crimp-style terminals with insulating sleeve conforming to your cable terminals.

•Attach the insulation cover to terminals after connection.

•Keep coated length of signal cables are to be 50 mm or less.

•Keep coated length of power supply cables are to be 20 mm or less.

•Keep distance between cables.

•If ambient temperature at the insulation site exceeds 60 °C, use a "bare crimp terminal".

•Page 5-5 5.3 Wiring for Power to the Detector Heater

Figure 5.5 Wiring for Detector Heater Power

•Page 5-7 5.5 Power and Ground Wiring

Figure 5.7 Power and Ground Wiring

Power Supply: rated voltage 220 or 240 VAC ( $\pm 10\%$ ), 50/60Hz

Demand: approximately 80VAC( for ordinary use)

Grounding: JIS Grade 3 grounding (100  $\Omega$  or less).

External circuit breaker rating: 5A ( common to 220 V and 240 V systems)

Use IEC947-1 or IEC947-3 compliant products.

5.5.1 Power Wiring

Connect the power wiring to the terminals of the converter. Be careful of the following when installing the wiring:

- (1) Use a 2-core shielded cable with an outside diameter
- (2) The size of converter terminal screw threads is M4. Use a crimp terminal conforming to the size for connecting your cable by exclusive crimp tool.
- (3) Use equal grade or higher cable when connecting power wiring.

•Page 5-8 5.6.1 Wiring with RS-232-C Communication Cable

It is not available for this instrument to use RS-232-C communication cable.

•Page 5-9 5.6.2 Wiring with RS-422-A Communication Cable

Figure 5.9 Connecting for RS-422-A Communications

Figure 5.10 Connecting for RS-422-A Communications (when using an I/O isolating computer)

•Page 5-21 5.10 Measurement Gas Temperature Input Signal Wiring ( Optional )

This input is not available in this ZA8C-E converter.

### 5.3 Wiring for Power to the Detector heater

This wiring provides electric power from the converter to the heater for heating the sensor in the detector.

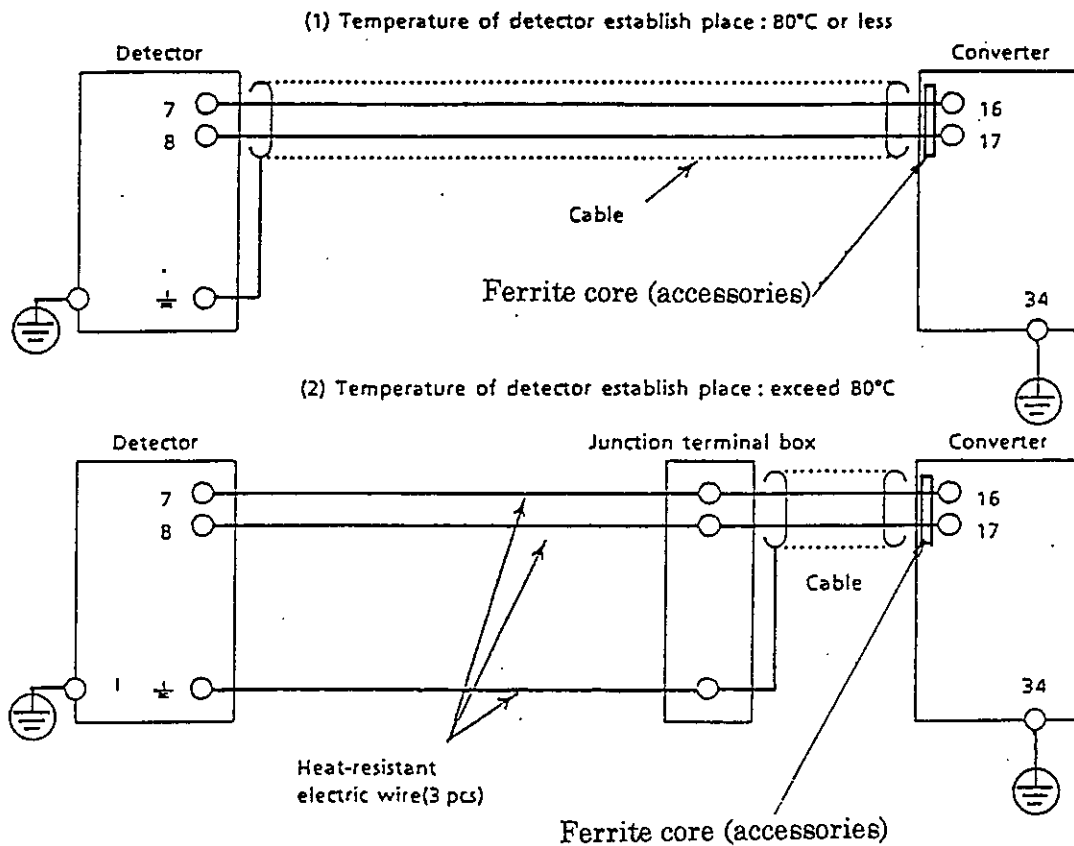


Figure 5.5 Wiring for Detector Heater Power

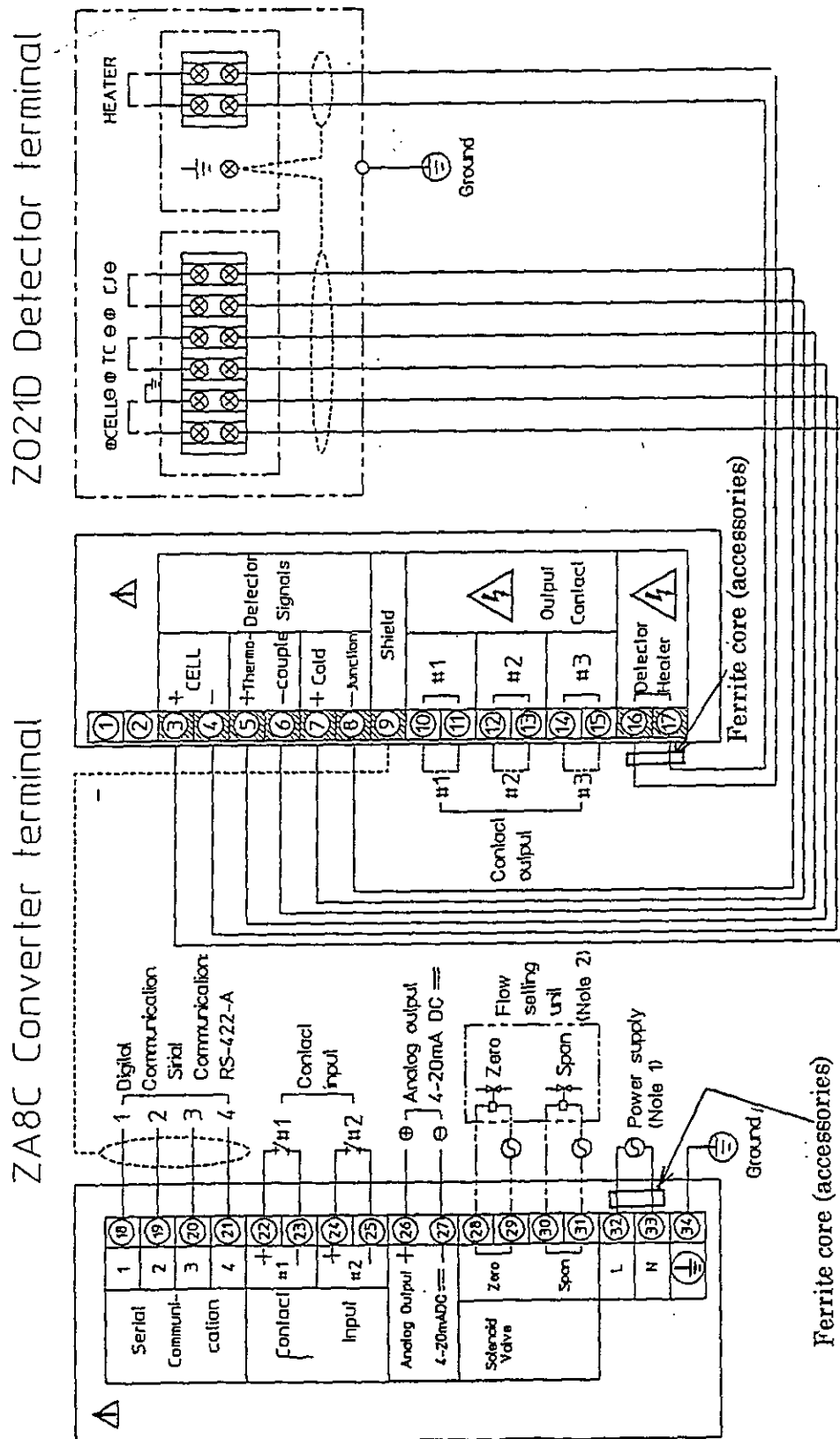


Figure 5.2 Output Wiring for Converter

## 5.2 Wiring for Detector Output

This wiring enables the converter to receive cell output from the detector, output from a thermocouple and a signal for compensating the cold contact. Install wires that allow for  $10\Omega$  of loop resistance or less. Install these wires apart from the power wiring.

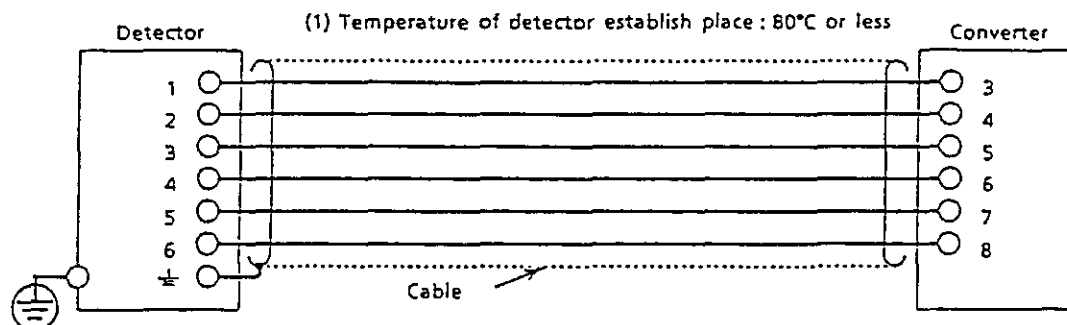


Figure 5.3 Output Wiring for Detector

### 5.2.2 Connection to Detector

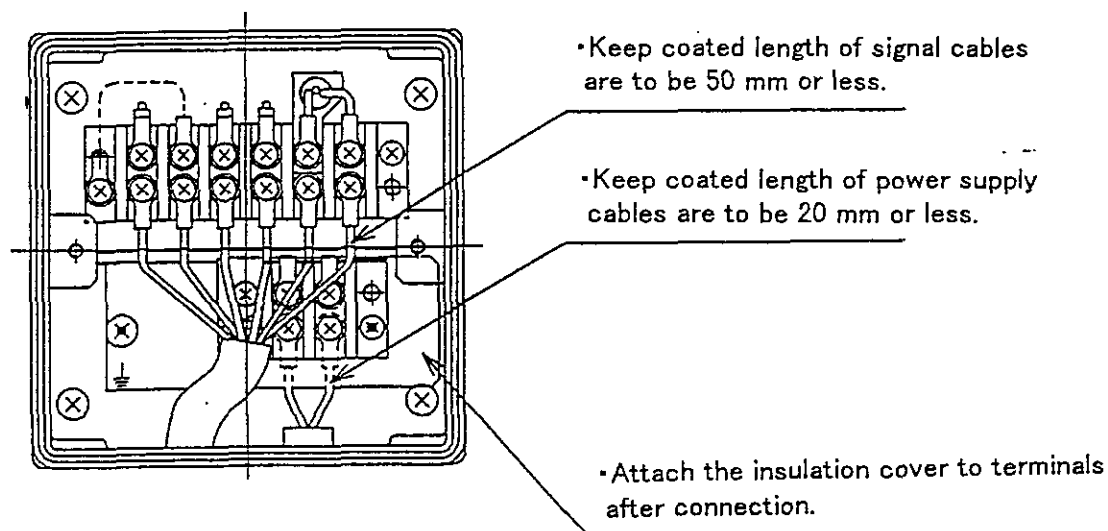


Figure 5.4 Layout of Detector Terminals

## 5.5 Power and Ground Wiring

These wirings provide the converter with driving power and ground the converter.

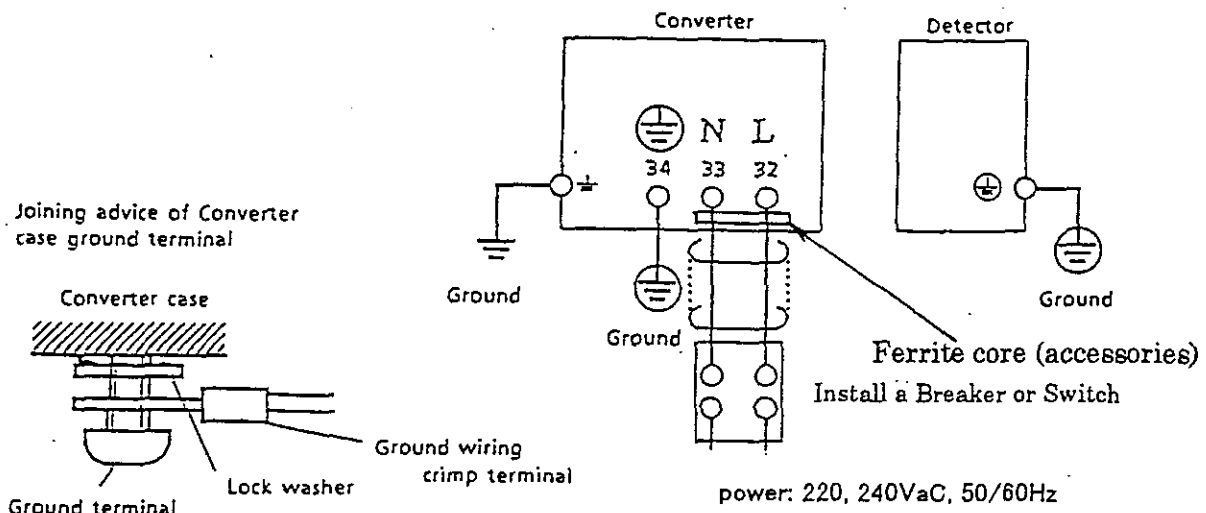


Figure 5.7 Power and Ground Wiring

## 5.6 Digital Communication Wiring ( Optional )

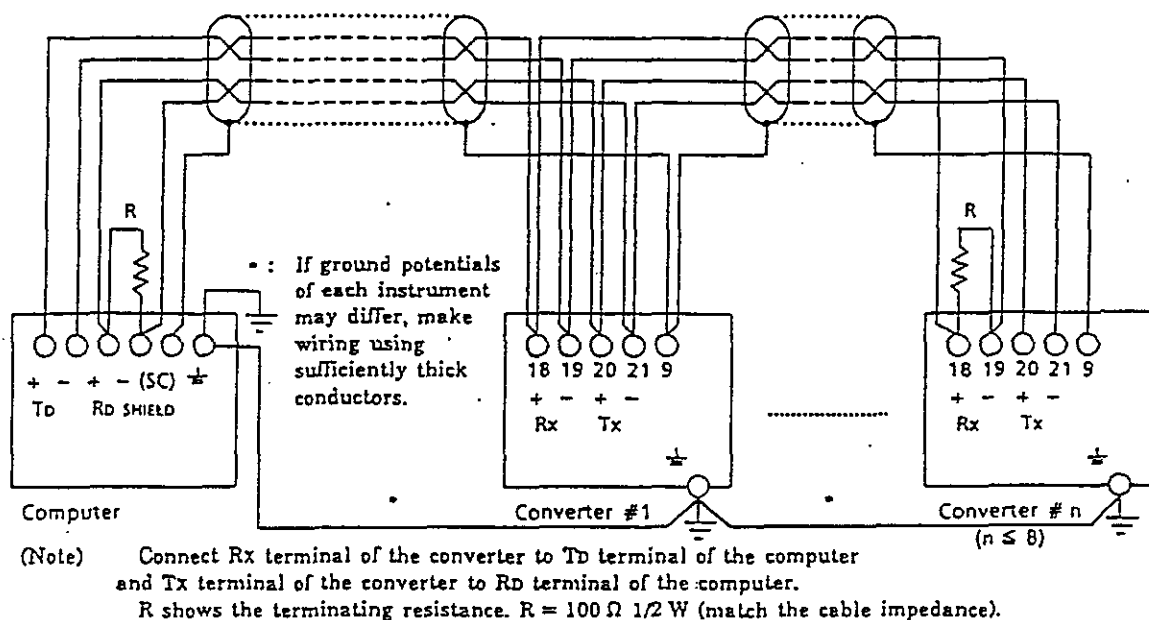


Figure 5.9 Connections for RS-422-A Communications

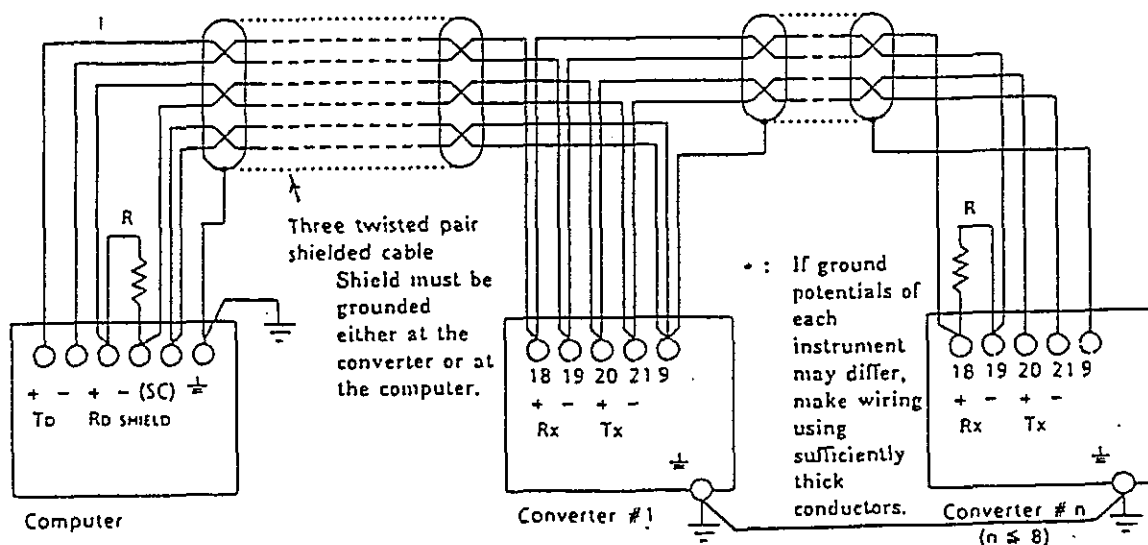


Figure 5.10 Connections for RS-422-A Communications  
(when using an I/O isolating computer)

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•Page 6-3 6.2 Converter

Figure 6.3 Name and Function of Converter Components

(See next page.)

•Page 7-19 7.1.6 Changing Relay Contacts for Contact Output

- 
- (2) Open the operating panel and remove the PCB cover. Remove screws ①, ② and connectors ①, ② in Figure 7.3 .

(3) \_\_\_\_\_

Figure 7.3 Setting Position of Jumper Connector and Setting Method

•Page 9-13 10. INSPECTION AND MAINTENANCE

10.1 Inspection and Maintenance of the Detector

10.1.1 Precautions for Inspecting the Detector

- (1) Be careful not to touch any hot parts.

The sensor at the tip of the detector is heated up to 750°C during operation. And terminal box of the detector is also heated. If an operation is carried out immediately before inspection, be careful not to touch the probe with your finger tips and not to burn your finger on the terminal box.

- (2) Do not drop or bump or cause any great impact on the sensor assembly.

The sensor is made of ceramics (Zirconia). If the detector is dropped or hit with something, the sensor might be damaged and no longer work.

- (3) Dry, soft, clean cloth is used for cleaning in inspection or maintenance.

•Page 10-1 10. INSPECTION AND MAINTENANCE

10.1 Inspection and Maintenance of the Detector

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- (3) Dry, soft, clean cloth is used for cleaning in inspection or maintenance.

•Page 10-4 10. INSPECTION AND MAINTENANCE

10.2 Inspection and Maintenance of the Converter

\_\_\_\_\_ of the related parts.

Dry, soft, clean cloth is used for cleaning in inspection or maintenance.

•Page 10-4 10. INSPECTION AND MAINTENANCE

10.2.1 Replacing Fuses

Figure 10.3.b Positions for Installing Fuses in a Converter

## 6.2 Converter

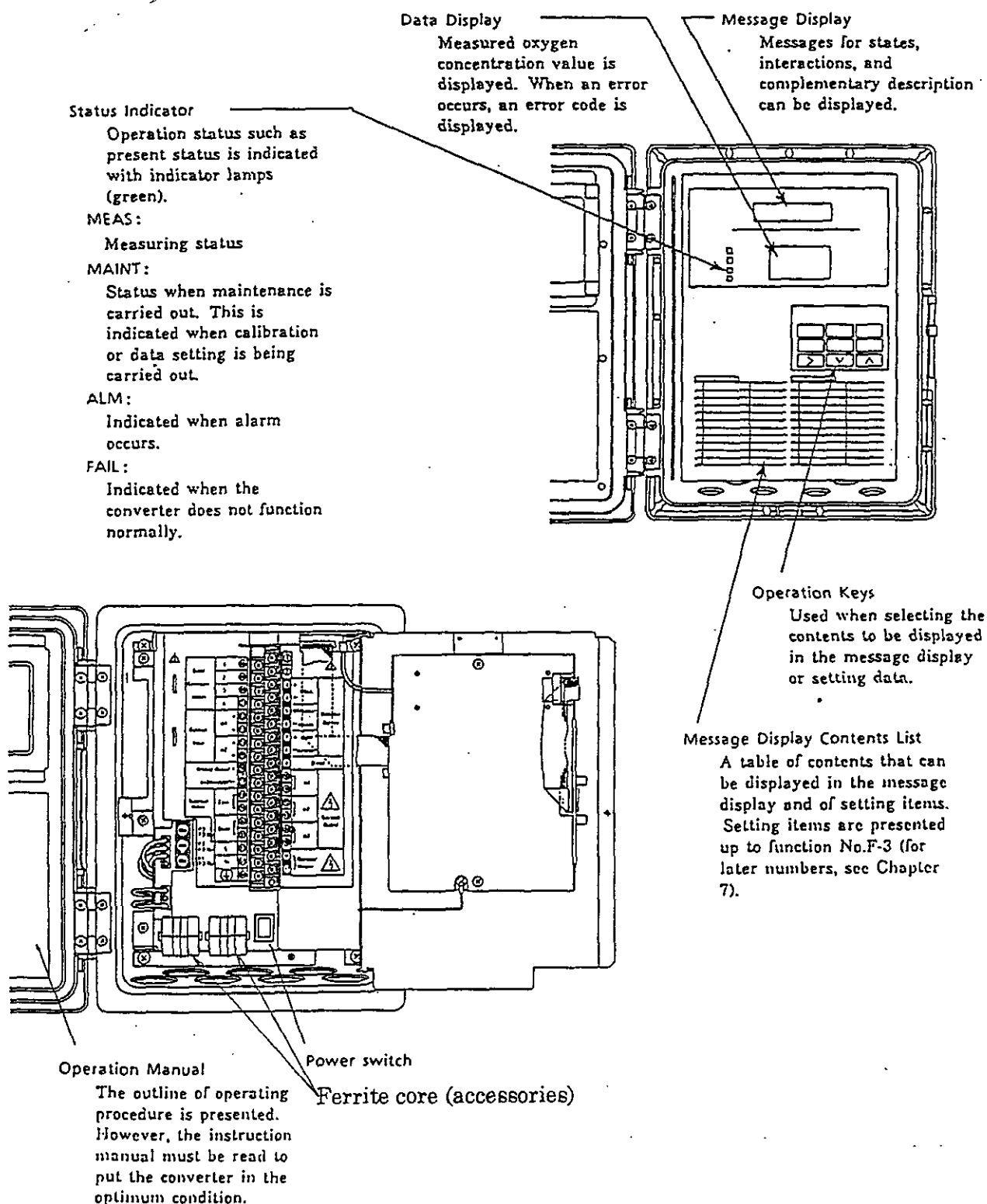


Figure 6.3 Name and Function of Converter Component

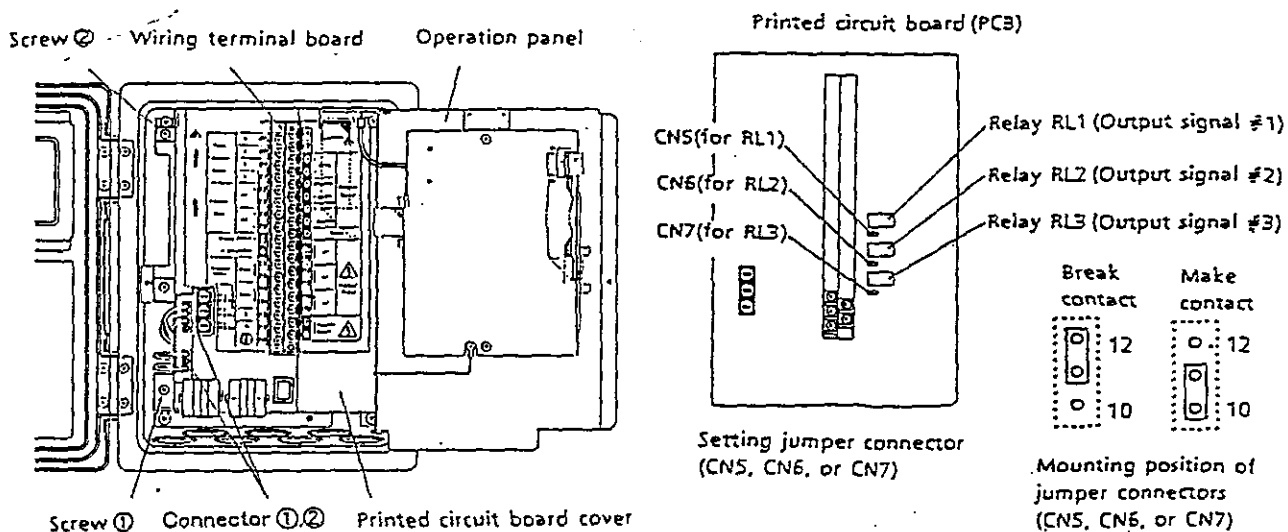


Figure 7.3 Setting Position of Jumper Connector and Setting Method

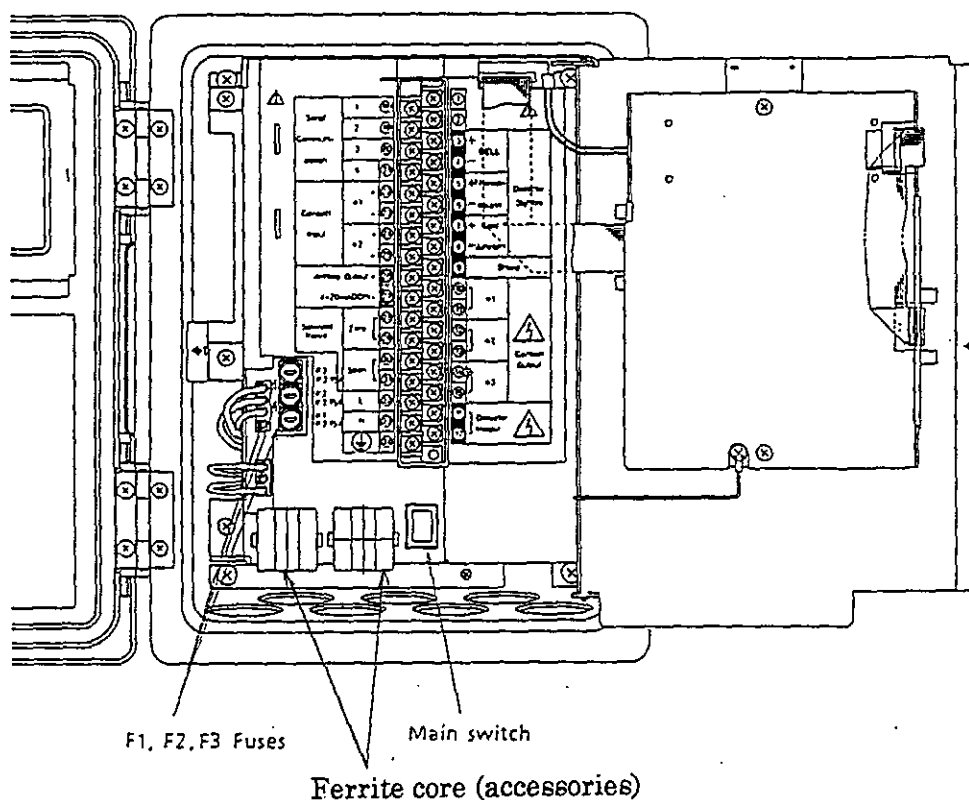


Figure 10.3 Positions for installing Fuses in a Converter

Customer

Notice of Alterations

Maintenance In-Situ Type

Parts List Zirconia Oxygen Analyzer Model ZA8C-E

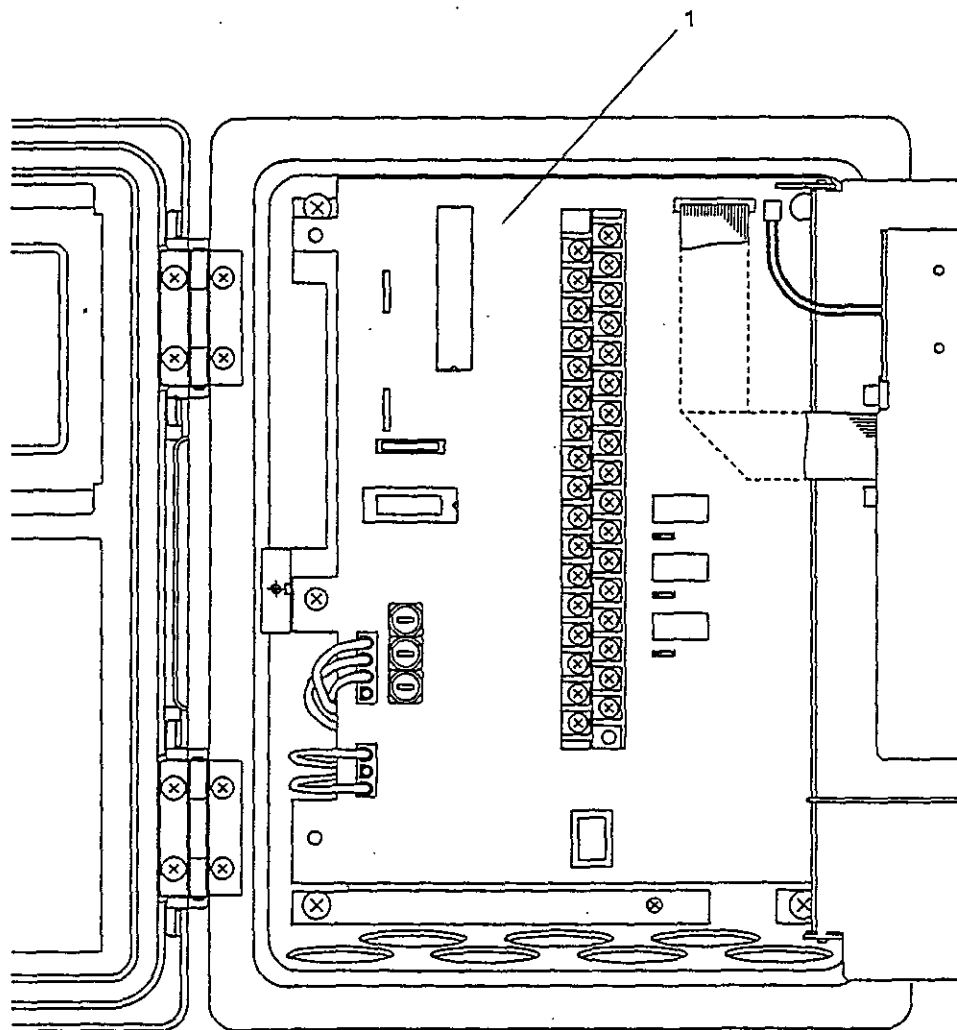


Table2 ZA8C-E CPU BOARD (Spare Parts)

Parts No.	Description
K9290JW	ZA8C-E-3(or4)-N-0-N-0-J*B
K9290JX	ZA8C-E-3(or4)-N-0-N-0-E*B
K9290JY	ZA8C-E-3(or4)-A(orB)-1-A-1-J*B
K9290JZ	ZA8C-E-3(or4)-A(orB)-1-A-1-E*B

**Instruction  
Manual**

Notice of Alterations

**In-Situ Type  
Zirconia Oxygen Analyzer Model ZA8**

(Version 2.00)

Please note the following alterations to the IM 11M6A2-01E.

• Page 1. Product line included in this manual and described content for each.

Model	Name	Description in the manual				
		Specifi- cations	Install- ation	Opera- tion	Mainte- nance	CMPL
ZO21D-L	Standard detector	○	○	○	○	○
ZO21D-E	CE conformity standard <sup>Note1</sup>	○	○	○	○	○
ZO21D-H	High-temperature detector	○	○	○	○	○
ZO21D-F	CE conformity standard <sup>Note1</sup>	○	○	○	○	○
ZA8C-S	Standard converter(Style B)	○	○	○	○	○
ZA8C-E	CE conformity standard <sup>Note1</sup>	○	○	○	○	○
ZO21R-L	Probe protector	○	○			
ZO21P-H	High-temperature probe adapter	○	○			○
ZA8F	Flow setting unit	○	○	○		
ZA8H	Flow setting unit	○	○	○	○	
ZA8T	Solenoid valve unit	○	○			
—	High-temperature auxiliary Ejector (Part No.E7046EC、EN)	○	○			
—	Calibration gas unit case (Part No.E7044KF)	○	○			
—	Check valve (Part No.e7042VR、VV)	○	○			
—	Dust elimination filter for detector (Part No. E7042UQ)	○	○		○	
ZO21S	Standard gas unit	○		○	○	○

Note 1: Select E if CE conformity standard is necessary.

• Page 2-2. ● Standard Specifications

Ambient humidity : 20 to 90%RH (non condensing).

Altitude of installation site : 2000m or lower

**YOKOGAWA**

IM 11M6A2-01E

• Page 2-3. ● Model and Code

Model	Basic specification code	Option Code	Specification
ZO21D	-L . . . . . -E . . . . .	. . . . . . . . . .	Standard detector(for gas temp. From 0 to 600°C) CE conformity standard. Note 1
Insertion length	-040 . . . . . -100 . . . . . -150 . . . . . -300 . . . . .	. . . . . . . . . . . . . . . . . . . .	0.4m 1.0m 1.5m 3.0m
Flange connection	-J . . . . . -A . . . . . -E . . . . .	. . . . . . . . . . . . . . .	JIS 5 k 65 FF equivalent, Rc1/8(F) ANSI CLASS 150 4B FF equivalent ,1/8NTP (F) DIN PN10-DN50-A equivalent , 1/8NTP(F)
Style code	* B . . . . .	. . . . .	Style B
Check valve		/CV	With check valve
Needle valve		/SV	With stop valve

Note 1 : Select E if CE conformity standard is necessary.

• Page 2-4. 2.2.2 ZO21R-L-150-□-R Probe Protector

A probe protector is required when a standard detector with a 3-meter  
Insertion length is used at an inclination other than vertical.

• Page2-4 ● Standard Specifications

Material : SUS316(Protector)

• Page2-4 ● Model and Code

Model	Basic specification code	Option code	Specifications
ZO21R	. . . . .	. . . . .	Probe protector
Insertion Length	-150 . . . . .	. . . . .	1.55m (Protector length) for detector with 3-meter insertion length.
Flange	-J . . . . . -A . . . . .	. . . . . . . . . .	JIS 5 K 65 FF equivalent ANSI CLASS 150 4B FF equivalent
Style code	*B . . . . .	. . . . .	Style B
Ring		/R	3-meter insertion length is used at on inclination other than vertical

• Page 2-5. External Dimensions

Model	①Flange					Weight
	Standard	A	B	D	E	
ZO21R-L-150-J*B/R	JIS 5 K 65 FF equivalent	155	130	40	40	Approx. 10kg
ZO21R-L-150-A*B/R	ANSI CLASS 150 4B FF equivalent	228.6	190.5	50	50	Approx. 13kg

• Page 2-6, ● Model and Code

Model	Basic specification code	Options code	Specifications
ZO21R	-L . . . . .	. . . . .	Probe protector
Insertion length	-100 . . . . . -150 . . . . . -200 . . . . .	. . . . . . . . . . . . . . .	1.05m for a detector of 1m insertion length 1.05m for a detector of 1m insertion length 1.05m for a detector of 1m insertion length
Flange	-J . . . . . -A . . . . .	. . . . . . . . . .	JIS 5 k 65 FF equivalent ANSI CLASS 150 4B FF equivalent
Style code	*B . . . . .	. . . . .	Style B
Ring		/ R	3-meter insertion length is used at an inclination other than vertical

• Page 2-8, 2.3.1 ZO21D-H(-F) High-Temperature Detector

• Page 2-8, ● Standard Specifications

Ambient humidity : 20 to 90%RH (non-condensing)

Altitude of installation site : 2000m or lower

• Page 2-8, ● Model and code

Model	Basic specifications code	Option code	Specifications
ZO21D	-H . . . . . -F . . . . .	. . . . . . . . . .	High temperature probe CE conformity standard Note 1
Insertion length	-015 . . . . .	. . . . .	0.15m
Flange piping	-F . . . . . -K . . . . .	. . . . . . . . . .	JIS 5 K 32 FF equivalent, Rc1/8 (F) JIS 5 K 32 FF equivalent, NPT1/8 (F)
Style code	*A . . . . .	. . . . .	Style B
Check valve		/ CV	With a check valve
Needle valve		/ SV	With a needle (stop) valve

Note 1 : Select F if CE conformity standard is necessary.

• Page 2-10, ● Model and code

Model	Basic specifications code	Option code	Specifications
ZO21P	-H . . . . .	. . . . .	High temperature probe adapter
Probe material	-A . . . . . -B . . . . .	. . . . . . . . . .	Silicon carbide (SiC) SUS310S
Insertion length	-100 . . . . . -150 . . . . .	. . . . . . . . . .	1.0m 1.5m
Flange piping	-J . . . . . -A . . . . . -E . . . . .	. . . . . . . . . . . . . . .	JIS 5 K 50 FF equivalent ANSI CLASS 150 4B RF, equivalent DIN PN10-DN50-A equivalent
Style code	*A . . . . .	. . . . .	Style A

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• Page 2-12, ● Standard Specifications

Ambient humidity : 20 to 90%RH (non-condensing)

Altitude of installation site : 2000m or lower

• Page 2-16, ● Model and code

Model	Basic specifications code	Option code	Specifications
ZA8C	.....	.....	Converter
Display	-E..... -S.....	.....	CE conformity standard    Note 1 Standard
Power supply	-3..... -4..... -5..... -8.....	.....	220V AC, 50/60Hz 240V AC, 50/60Hz 100V AC, 50/60Hz 115V AC, 50/60Hz
Digital Communication	-N..... -A..... -B.....	.....	Not required RS232C(Available in only ZA8C-S: Non CE marking Rs422A
Contact input	-0..... -1.....	.....	Not required 2 point
Process Temp. Input	-N..... -A.....	.....	Not required 4-20mA(Available in only ZA8C-S: Non CE marking)
Auto calibration	-0..... -1.....	.....	Not required required
Panel letter	-E..... -G..... -F..... -J.....	.....	English German French Japanese
Style code	*B..	.....	Style B
Air purge hole		/AP1 /AP2	Rc1/4 1/4NPT(F)
Water tight cable grand		/ECG	JIS A20 equivalent water tight plastic cable grand

Note 1: Select E of CE conformity standard is necessary.

• Page 2-10, 2.5.2 ZA8H Flow Setting Unit

<p style="text-align: center;"><b>CAUTION</b></p> <p style="text-align: center;">This unit is not complied with CE conformity standard.</p>
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• Page 3-3, <Detector with a probe protector>

- (1) Attach the guide ring of the probe protector to the detector 1.5m from the probe base, and affix it with two screws. Tighten the screws firmly.
- (2) Insert the gasket supplied by the user between the flange surfaces and mount the probe protector (in any direction)

Figure 3.3 Mounting the detector with a probe protector.

• Page 3-10, 3.4 Installation of the Flow Setting Unit

This unit is not complied with CE conformity standard.

• Page 10-5. The fuse (F1,F2) in figure 10.4

Fuse F1, F2 (3.15 A cartridge glass-tube type)

- Page 10-5. (3) After checking that the new fuse has the specified rating(3.15 A), place this new fuse(cartridge glass-tube fuse) in the holder.

- Page 10-5 (3) Check the new fuse for the specified rating (0.5 A) before installing it.

• Page10-5 The fuse (F3,F4) in figure 10.5

Fuse F3, F4 (0.5A cartridge glass-tube type)