User's Manual

EXAxi

Model ZR202G
Integrated type Zirconia High Temperature Humidity Analyzer

IM 11M12A01-05E

vigilantplant.™

YOKOGAWA
Yokogawa Electric Corporation

IM 11M12A01-05E
6th Edition

Introduction

The EXAxt ZR series of Integrated-type Zirconia High-temperature Humidity Analyzers was developed for humidity control in various industrial processes. There are versions for virtually every application.

Optional accessories are also available to improve measurements and automate calibration. An optimal control system can be realized by adding appropriate options.

This instruction manual describes installation, operator, inspection and maintenance for almost all of the equipment related to the EXAxt ZR. You may skip any section(s) on the equipment which is/are not included in your system.

Regarding the HART communication Protocol, refer to IM 11M12A01-51E.

IM11M12A01-51E is titled "Model EXAxt ZR series HART protocol".

The separate version (sensor and converter separated) is described in IM 11M12A01-03E.

<Before using the equipment, please read any related descriptions in this manual for the equipment and the system you have, on appropriate use and operation of the EXAxt ZR.>

Models and descriptions in this manual are listed below.

Model	Product Name	Description in this manual				
		Specification	Installation	Operation	Maintenance	CMPL
ZR202G	Integrated type Oxygen Analyzer	○	○	○	○	○
ZO21R-L	Probe protector	○	○			
ZA8F	Flow setting unit (for manual calibration use)	○	○	○		
ZR20H	Automatic Calibration unit	○	○	○		○
-	Calibration gas unit case (Part No. E7044KF)	○	○			
-	Check valve (Part No. K9292DN, K9292DS)	○	○			
-	Dust filter for the detector (Part No. K9471UA)	○	○		○	
ZO21S	Standard gas unit	○		○	○	○

T.Int.1E

CMPL: Customer Maintenance Parts List

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This manual consists of twelve chapters. Please refer to the reference chapters for installation, operation and maintenance.

Chapter	Outline	References		
		Installation	Operation	Maintenance
1. Overview	Equipment models and system configuration examples	○	△	○
2. Specifications	Standard specification, model code (or part number), dimension drawing for each equipment	◎	○	○
3. Installation	Installation method for each equipment	◎		△
4. Piping	Examples of piping in three standard system configurations	◎		△
5. Wiring	Wiring procedures such as Power supply wiring , output signal wiring or others	◎		△
6. Components	These are described in this manual	△	○	○
7. Startup	Basic procedure to start operation of EXAxt ZR. Chapter 7 enables you to operate the equipment immediately.		◎	△
8. Detailed Data Setting	Details of key operations and displays		○	△
9. Calibration	Describes the calibration procedure required in the course of operation.		○	△
10. Other Functions	Other functions described		○	△
11. Inspection and Maintenance	How to conduct maintenance of EXAxt ZR and procedures for replacement of deteriorated parts		○	◎
12. Troubleshooting	This chapter describes measures to be taken when an abnormal condition occurs.		△	◎
CMPL (parts list)	User replaceable parts list		△	○

T.Int.2E

◎ : Read and completely understand before operating the equipment.

○ : Read before operating the equipment, and refer to whenever necessary.

△ : Recommended to read at least once.

◆ For the safe use of this equipment

CAUTION

The cell (sensor) at the tip of the probe is made of ceramic (zirconia element). Do not drop the equipment or subject it to pressure stress.

- Do NOT allow the sensor (probe tip) to make contact with anything when installing the analyzer.
- Avoid any water dropping directly on the probe (sensor) of the analyzer when installing it.
- Check the calibration gas piping before introducing the calibration gas to ensure that there is no leakage of the gas. If there is any leakage of the gas, the moisture drawn from the measuring gas can condense in the calibration gas pipe and damage the sensor.
- The probe (especially the tip) becomes very hot. Be sure to handle it with gloves.

DANGER

EXAxt ZR is very heavy. Be sure not to accidentally drop it. Handle safely to avoid injury.

Connect the power supply cord only after confirming that the supply voltage matches the rating of this equipment. In addition, confirm that the power is switched off when connecting power supply.

Some process gas is dangerous to people. When removing this equipment from the process line for maintenance or other reasons, protect yourself from potential poisoning by using a protective mask or ventilating the area well.

(1) About This Manual

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

(2) Safety and Modification Precautions

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

(3) The following safety symbols are used in this manual.

 DANGER

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

 WARNING

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

 CAUTION

This symbol draws attention to information essential for understanding the operation and functions.

 **Tip**

This symbol gives information that complements the present topic.

 **SEE ALSO**

This symbol identifies a source to which to refer.

 Protective Ground Terminal

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

 Alternating current

■ Special descriptions in this manual

This manual indicates operation keys, displays and drawings on the product as follows:

- Operation keys, displays on the panel

  Enclosed in [ ]. (Ex. "MODE" key)

  (Ex. message display ⟶ "BASE-L")

  (Ex. data display ⟶ "102" lit, "102" flashing)

- Drawing representing flashing

  Indicated by gray characters. (Flashing) 102 **(lit)** 102

- Displays on the LCD display panel

Alphabetic code	LCD display	Alphabetic code	LCD display	Numeric code	LCD display
A	A	N	n	1	1
B	b	O	o	2	2
C	C	P	P	3	3
D	d	Q	q	4	4
E	E	R	r	5	5
F	F	S	S	6	6
G	G	T	t	7	7
H	H	U	U	8	8
I	I	V	v	9	9
J	J	W	u	0	0
K	K	X			
L	L	Y	y		
M	m	Z	z		

LCD display.EPS

◆ NOTICE

• Specification check

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. In addition, please check that the specification matches the order, and required accessories are not missing. Specifications can be checked by the model codes on the nameplate. Refer to Chapter 2 specifications for the list of model codes.

• Details on operation parameters

When the EXAxt ZR Integrated-type High-temperature Humidity Analyzer arrives at the user site, it will operate based on the operation parameters (initial data) set before shipping from the factory.

Ensure that the initial data is suitable for the operating conditions before starting analysis.

Where necessary, set the instrument parameters appropriately. For details on setting data, refer to Chapters 7 to 10.

When the user changes the operation parameters, it is recommended that original and new setting data be noted down.

◆ After-Sales Warranty

● Do not modify the product.

● During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.

● Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.

● If we replace the product with a new one, we won't provide you with a repair report.

● Yokogawa warrants the product for the period stated in the pre-purchase quotation. Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.

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

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

- Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.
- Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.
- Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.

Contents

1. Overview

The EXAxt ZR Integrated-type Zirconia High-temperature Humidity Analyzer integrates the detector and the converter in one unit. This analyzer can measure humidity of hot air continuously, so can be used to measure humidity of air in driers which are heated by steam or electricity. It can also be used in a variety of manufacturing applications with humidifiers, as well as with driers, for humidity measurement and control. It can help improve productivity in these application fields.

Optional accessories are also available to improve measurement accuracy and provide automate calibration.

The analyzer is equipped with three infrared switches, which enable the user to operate the equipment on site without opening the cabinet.

An optimal control system can be realized by choosing the most suitable of several equipment versions.

Some examples of typical system configurations are illustrated following pages.

1.1 < EXAxt ZR > System Configuration

The system configuration determines whether calibration is initiated automatically or manually.

The three basic system configurations are given below:

1.1.1 System 1

This is the simplest system which consists of an integrated-type (all-in-one) detector and analyzer. This system can be used for monitoring humidity in driers used in food processing, or the like. No piping is required for the reference gas (air) which is fed in at the installation site. The handheld ZO21S standard gas unit is used for calibration. Zero and span gases from the standard gas unit are only fed to the detector through a tube during calibration.

CAUTION

- As this system uses ambient air for the reference gas, measuring accuracy will be affected by the installation location.
- A stop valve should be connected to the calibration gas inlet of the equipment. The valve should be fully closed unless calibration is being performed.

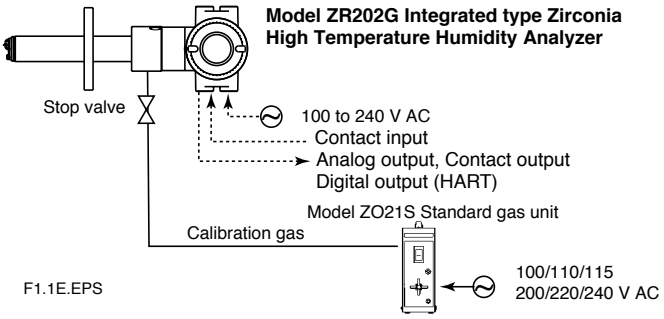


Figure 1.1

1.1.2 System 2

This system is used where the installation atmosphere is polluted by gases other than air, or where accurate monitoring and controlling of the humidity is required. Instrument air (clean and dry air of oxygen concentration 21%) is used as the reference gas and the span gas for calibration. Zero calibration gas is supplied from the cylinder. The gas flow is controlled by the ZA8F flow setting unit (for manual valve operation).

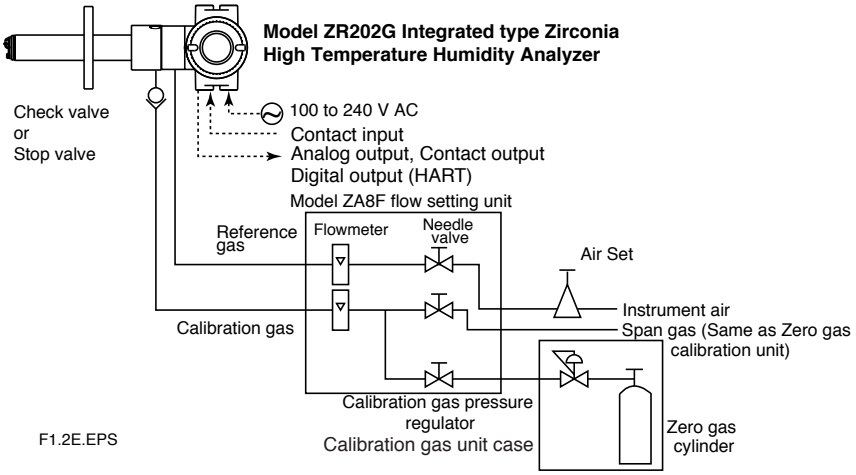
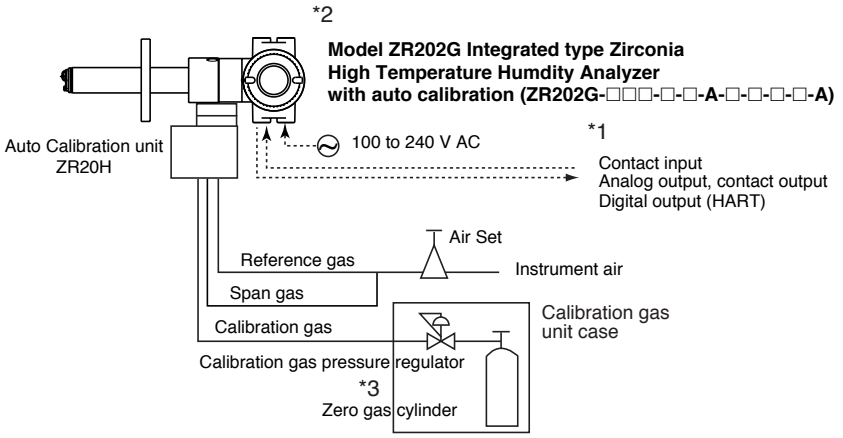


Figure 1.2

1.1.3 System 3

This system is also used where accurate monitoring and controlling of the humidity is required. Instrument air (clean and dry air of oxygen concentration 21%) is used as the reference gas and span gas for calibration. A calibration zero gas is supplied from a cylinder. This system uses an automatic calibration unit to control the calibration gas flow automatically.



Note:
The installation temperature limits for an integrated unit range from -20 to 55 °C.

F1.3E.EPS

*1 Shield cable:
Use shielded signal cables, and connect the shields to the FG terminal of the converter.

*2 Select the desired probe from the Probe Configuration table on page 1-4.

*3 100% N_2 gas cannot be used as the zero gas. Use approx. 1 vol% O_2 gas (N_2-based).

Figure 1.3

1.2 < EXAxtZR > System Components

1.2.1 System Components

System Components	Integrated type System config. Ex.1	Ex.2	Ex.3
Model ZR202G Integrated type Zirconia High Temperature Humidity Analyzers	●	●	●
Model ZH21B Dust Protector	○	○	○
Model ZO21S Standard Gas Unit	●		
Model ZA8F Flow setting unit for manual calibration		●	
Model ZR20H Automatic Calibration Unit for integrated type Analyzer			●
L9852CB, G7016XH Stop Valve for Calibration-gas line	●	(●)	
K9292DN, K9292DS Check Valve for Calibration-gas line		(●)	●
K9473XH/K9473XJ, G7004XF/K9473XG Air Set		●	●
G7001ZC Zero-gas Cylinder		●	●
G7013XF, G7014XF Pressure Regulator for Gas Cylinder		●	●
E7044KF Case Assembly for Calibration-gas Cylinder		●	●

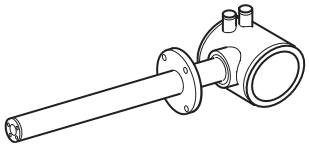
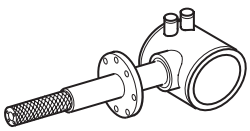
T1.1.EPS

● : Items required for the above system example

○ : To be selected depending on each application.

(●) : Select either

1.2.2 High-temperature Humidity Analyzer and Accessories

● General-use Analyzer (gas temperature 0 to 700°C)	
General-use probe	Components
	ZR202G
	Installation
	Horizontal to Vertical, when insertion length is 0.4 to 2 m. Vertical, when insertion length is 2.5 to 3 m.
Probe with Dust Protector	
	Components
	ZR202G-040 and ZH21B
	Installation
	Horizontal to Vertical, when insertion length is 0.4 m.

F1.2.2.1.EPS

2. Specifications

This chapter focuses on the specifications for the High-temperature Humidity Analyzer (integrated model) and associated equipment, including:

ZR202G	Integrated type Zirconia High-temperature Humidity Analyzer	(See Section 2.1.2)
ZH21B	Dust protector	(See Section 2.1.3)
ZA8F	Flow setting unit	(See Section 2.2.1)
ZR20H	Automatic calibration unit	(See Section 2.2.2)
ZO21S	Standard gas unit	(See Section 2.3)

2.1 General Specifications

2.1.1 Standard Specifications

High-temperature Humidity Analyzer

Oxygen concentration in mixed gas which consists of water vapor and air is proportional to the volumetric ratio of oxygen in the air, so the volumetric ratio of water vapor can be calculated from the oxygen concentration.

Measured Objects : Water vapor (in vol%) in mixed gases (air and water vapor)
Measured System : Zirconia system
Measured Range : 0.01 to 100 vol% O_2, 0 to 100 vol% H_2O or 0 to 1.000 kg/kg
Output Signal : 4 to 20 mA DC (maximum load resistance 550 Ω)
Oxygen concentration; Any setting in the range of 0 to 5 through 0 to 100 vol% O_2 (in 1 vol% O_2), or partial range.
Moisture quantity; 0 to 25 through 0 to 100 vol% H_2O (in 1 vol% H_2O), or partial range.
Mixture ratio 0 to 0.2 through 0 to 1.000 kg/kg (in 0.001 kg/kg), or partial range.
Digital Communication (HART): 250 to 550 Ω, depending on quantity of field devices connected to the loop (multi-drop mode).
Note: HART is a registered trademark of the HART Communication Foundation.

Display Range: Oxygen concentration 0 to 100 vol% O_2 ,
Moisture quantity 0 to 100 vol% H_2O
Mixture ratio 0 to 1 kg/kg

Relative humidity 0 to 100% RH

Dew point -40 to 370° C

Warm-up Time : Approx. 20 min.
These characteristics are calculated by oxygen concentration measured in air which include water vapor.
(Note) Those values are calcurated by temperature and absolute pressure. Then accurate tempera ture and pressure value must be input to the converter.

Repeatability : (See Note 1)
±1 vol% H_2O (sample gas pressure 2 kPa or less)

Linearity : (Excluding standard gas tolerance) (See Note 1)
(Use oxygen of known concentration (in the measuring range) as the zero and span calibration gas.)
±2 vol% H_2O; (Sample gas pressure: within ±0.49 kPa)
±3 vol% H_2O; (Sample gas pressure: 2 kPa or less)
Drift: (Excluding the first two weeks in use) (See Note 1)
Both zero and span ±3 vol% H_2O/month
Response Time : Response of 90% within 5 second. (Measured after gas is introduced from calibration-gas inlet and analog output start changing.)
(Note1) These tolerances do not apply to the pressure compensated version, or where natural convection is used for the reference air.

2.1.2 ZR202G Integrated-type Zirconia High-temperature Humidity Analyzer

Can be operated in the field without opening the cover using optical switches.

Display : 6-digit LCD
Switch : Three optical switches
Output Signal: 4 to 20 mA DC, one point (maximum load resistance 550 Ω)
Digital Communication (HART) : 250 to 550 Ω, depending on quantity of field devices connected to the loop (multi-drop mode).
Note : HART is a registered trademark of the HART Communication Foundation.
Contact Output Signal : Two points (one is fail-safe, normally open)
Contact Input Signal : Two points
Sample Gas Temperature : 0 to 700° C
It is necessary to mount the cell using Inconel cell-bolts when the temperature measures more than 600° C or greater.
Sample Gas Pressure : -5 to +20 kPa
When the pressure in the process exceeds 3kPa, it is recommended that you compensate the pressure. When the pressure in the process exceeds 5kPa, you must perform pressure compensation.)
No pressure fluctuation in the process should be allowed.
Probe Length : 0.4, 0.7, 1.0, 1.5, 2.0, 2.5, 3.0m
Probe Material : SUS 316 (JIS)
Ambient Temperature : -20 to +55° C (- 5 to +70° C on the case surface)
Storage Temperature : -30 to +70° C
Humidity Ambient : 0 to 95%RH (non-condensing)
Installation Altitude : 2000 m or less
Category based on IEC 1010 : II (Note)
Pollution degree based on IEC 1010 : 2 (Note)
Note : Installation category, called over-voltage category, specifies impulse with-stand voltage. Category II is for electrical equipment.
Pollution degree indicates the degree of existence of solid, liquid, gas or other inclusions which may reduce dielectric strength. Degree 2 is the normal indoor environment.
Power Supply Voltage : Ratings; 100 to 240 V AC Acceptable range; 85 to 264 V AC
Power Supply Frequency : Ratings; 50/60 Hz
Acceptable range ; 45 to 66 Hz
Power Consumption : Max. 300 W, approx. 100 W for ordinary use.
Safety and EMC conforming standards
Safety : EN61010-1
CSA C22.2 No.61010-1
UL61010-1

EMC : EN 61326 Class A
EN 55011 Class A Group 1
EN 61000-3-2
AS/NZS CISPR 11
Reference Air System : Natural Convection, Instrument Air
Instrument Air System (excluding Natural Convection): Pressure; 200 kPa + the pressure inside the dryer (It is recommended to use air which is dehumidified to dew point -20° C or less, and with dust or oil mist removed.)
Consumption; Approx. 1 Nl/min
Material in Contact with Gas : SUS 316(JIS), Zirconia, SUS 304(JIS) (flange), Hastelloy B, (Inconel 600, 601)
Construction: Heater and thermocouple replaceable construction. Non explosion-proof JIS C0920 / equivalent to IP44D. Equivalent to NEMA 4X / IP66 (Achieved when the cable entry is completely sealed with a cable gland in the recirculation pressure compensated version.)
Gas Connection : Rc 1/4 or 1/4 NPT (F)
Wiring Connection : G1/2, Pg13.5, M20 by 1.5 mm, 1/2 NPT select one type (4 pieces)
Installation : Flange mounting
Probe Mounting Angle :
Horizontal to vertically downward.
When the probe insertion length is 2 m or less, installing at angles from horizontal to vertically downward is possible.
When the probe insertion length is 2.5 m or more, mount vertically downward (within ±5°), or both mount horizontally (within ±5°) and use a probe protector.
Case : Aluminum alloy
Paint Color: Cover; Mint green (Munsell 5.6BG3.3/2.9)
Case : Mint green (Munsell 5.6BG3.3/2.9)
Finish : Polyurethane corrosion-resistance coating
Weight:
Insertion length of 0.4 m : approx. 8 kg (JIS 5K 65) / approx. 13 kg (ANSI 150 4)
Insertion length of 1.0 m: approx. 10 kg (JIS 5K 65) / approx. 15 kg (ANSI 150 4)
Insertion length of 1.5 m: approx. 12 kg (JIS 5K 65) / approx. 17 kg (ANSI 150 4)
Insertion length of 2.0 m: approx. 14 kg (JIS 5K 65) / approx. 19 kg (ANSI 150 4)
Insertion length of 3.0 m: approx. 17 kg (JIS 5K 65) / approx. 22 kg (ANSI 150 4)

Functions

Display Function : Displays values of the measured oxygen concentration, moisture quantity, mixture ratio etc.
Alarm, Error Display : Displays alarms such as “AL-06” or errors such as “Err-01” when any such status occurs.
Calibration Functions:
Autocalibration ; Requires the Autocalibration Unit. It calibrates automatically at specified intervals.
Semi-auto Calibration ; Requires the Autocalibration Unit. Input calibration started by optical switch or contact, then it calibrates automatically afterwards.
Manual Calibration ; Calibration by interactively opening/closing the valve of calibration gas during operation with optical switch.
Maintenance Functions :
Can set new data settings during daily operation and at inspection/maintenance time. Display data settings, calibration data settings, test settings (current output loop check, input/output contact check).
Setup Functions :

Initial settings should be set to match the plant conditions when installing the converter. Current output data settings, alarm data settings, contact data settings, other settings.

Display and setting content:

Display Related Items : Oxygen concentration (vol% O_2), Moisture quantity (vol% H_2O), mixture ratio (kg/kg), relative humidity (%RH), dew point (° C), cell temperature (° C), thermocouple reference junction temperature (° C), maximum/minimum/average oxygen concentration (vol% O_2), maximum/minimum/average moisture quantity (vol% H_2O), maximum/minimum/average mixture ratio (kg/kg), cell e.m.f. (mV), output 1, 2 current (mA), cell response time (seconds), cell internal resistance (V), cell condition (in four grades), heater on-time rate (%), calibration record (ten times), time (year/month/day/hour/minute)

Calibration Setting Items : Span gas concentration (vol% O_2), zero-gas concentration (vol% O_2), calibration mode (auto, semi-auto, manual), calibration type and method (zero-span calibration, zero calibration only, span calibration only), stabilization time (min.sec), calibration time (min.sec), calibration period (day/hour), starting time (year/month/day/hour/minute)

Output Related Items : Analog output/output mode selection, output conditions when warming-up/maintenance/calibrating/abnormal, oxygen concentration at 4mA/ 20mA (vol% O_2), moisture quantity at 4mA/ 20mA (vol% H_2O), mixture ratio at 4mA/ 20mA (kg/kg), time constant, preset values when warming-up/maintenance/ calibrating/abnormal, output preset values on abnormal

Alarm Related Items : Oxygen concentration high-alarm/high-high alarm limit values (vol% O_2), Oxygen concentration low-alarm/low-low alarm limit values (vol% O_2), Moisture quantity high-alarm/high-high alarm limit values (vol% H_2O), moisture quantity low-alarm/low-low alarm limit values (vol% H_2O), mixture ratio high-alarm/high-high alarm limit values (kg/kg), mixture ratio low-alarm/low-low alarm limit values (kg/kg), oxygen concentration alarm hysteresis (vol% O_2), moisture quantity alarm hysteresis (vol% H_2O), mixture ratio alarm hysteresis (kg/kg), oxygen concentration/moisture quantity/ mixture ratio detection, alarm delay (seconds)

Contact Related Items : Selection of contact input 1 and 2, selection of contact output 1 and 2 (abnormal, high-high alarm, high-alarm, low-alarm, low-low alarm, maintenance, calibrating, range switching, warming-up, calibration-gas pressure decrease, flameout gas detection

Converter Output : One mA analog output point (4 to 20 mA DC (maximum load resistance of 550 Ω)) with mA digital output point (HART) (minimum load resistance of 250 Ω).

Range: any setting between 0 to 25 through 0 to 100 vol% H_2O, and partial range is available (Maximum range value/minimum range value 1.3 or more)

For the log output, the minimum range values are fixed to 0.1 vol% O_2 for the oxygen concentration, 0.1 vol%H_2O for the moisture quantity, and 0.01 kg/kg for the mixture ratio.

4 to 20 mA DC linear or log can be selected.

Input/output isolation

Output damping : 0 to 255 seconds.

Hold/non-hold selection, preset value setting possible with hold.

Contact Output : Two points, contact capacity 30V DC 3A, 250V AC 3A (resistive load)

Normally energized or normally de-energized can be selected.

Delayed functions (0 to 255 seconds) and hysteresis function (0 to 9.9 vol% O_2) can be added to high/low-alarms.

The following functions are programmable for contact outputs.

(1) Abnormal, (2) High-high alarm, (3) High-alarm, (4) Low-low alarm, (5) Low-alarm, (6) Maintenance, (7) Calibration, (8) Range switching answer-back, (9) Warm-up, (10) Calibration-gas pressure decrease (answerback of contact input), (11) Flameout gas detection (answerback of contact input).

Contact Input : Two points, voltage-free contacts

The following functions are programmable for contact inputs:

(1) Calibration-gas pressure decrease alarm, (2) Range switching (switched range is fixed), (3) External calibration start, (4) Process alarm (if this signal is received, the heater power turns off)

Contact capacity : Off-leakage current; 3 mA or less.

Self-diagnosis : Abnormal cell, abnormal cell temperature (low/high), abnormal calibration, A/D converter abnormal, digital circuit abnormal

Calibration : Method; zero/span calibration

Calibration mode ; automatic, semi-automatic and manual (All are operated using optical switches). Either zero or span can be skipped.

Zero calibration-gas concentration setting range : 0.3 to 100 vol% O_2 (0.01 vol% in smallest units).

Span calibration-gas concentration setting range : 4.5 to 100 vol% O_2 (0.01 vol% in smallest units).

Use nitrogen-balanced mixed gas containing 10% scale of oxygen for standard zero-gas, and 80 to 100% scale of oxygen for standard span-gas.

Calibration period ; date/time setting: maximum 255 days

• Model and Codes

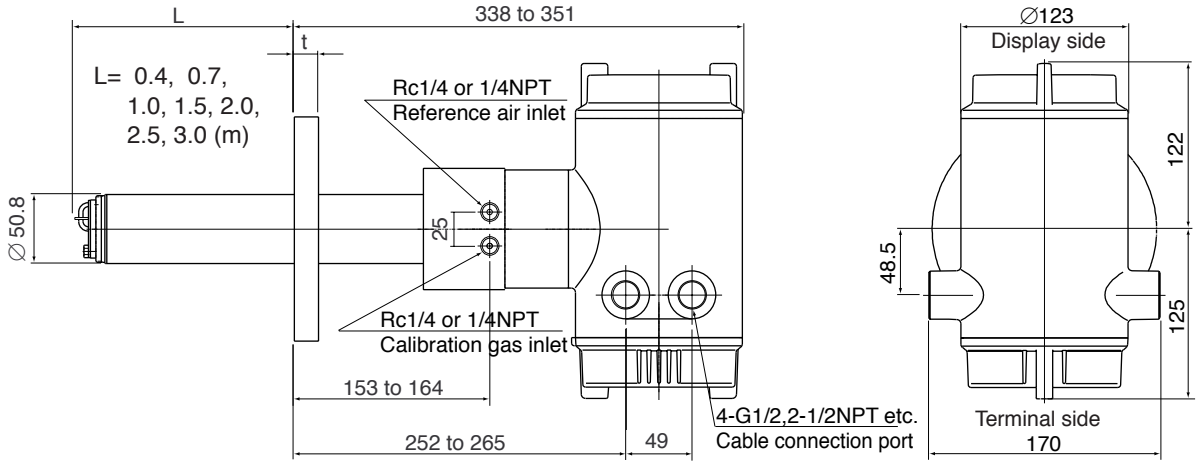
Model	Suffix code	Option code	Description
ZR202G	----------	----------	Integrated type Zirconia High Temperature Homidity Analyzer
Length	-040	----------	0.4 m
	-070	----------	0.7 m
	-100	----------	1.0 m
	-150	----------	1.5 m
	-200	----------	2.0 m
	-250	----------	2.5 m (*1)
	-300	----------	3.0 m (*1)
Wetted material	-S	----------	SUS316
	-C	----------	Stainless steel with Inconel calibration gas tube
Flange (*2)	-A	----------	ANSI Class150 2 RF SUS304
	-B	----------	ANSI Class150 3 RF SUS304
	-C	----------	ANSI Class150 4 RF SUS304
	-E	----------	DIN PN10-DN50 SUS304
	-F	----------	DIN PN10-DN80 SUS304
	-G	----------	DIN PN10-DN100 SUS304
	-K	----------	JIS 5K 65 FF SUS304
	-L	----------	JIS 10K 65 FF SUS304
	-M	----------	JIS 10K 80 FF SUS304
	-P	----------	JIS 10K 100FF SUS304
	-R	----------	JPI Class150 4 RF SUS304
	-S	----------	JPI Class150 3 RF SUS304
	-W	----------	Westinghouse
Auto Calibration	-N	----------	No auto calibration unit mounted
	-A	----------	Horizontal mounting (*7)
	-B	----------	Vertical mounting (*7)
Reference air	-C	----------	Natural convection
	-E	----------	External connection (Instrument air) (*10)
	-P	----------	Pressure compensation (*10)
Gas Thread	-R	----------	Rc 1/4
	-T	----------	1/4 FNPT
Connection box thread	-P	----------	G1/2
	-G	----------	Pg13.5
	-M	----------	M20x1.5 mm
	-T	----------	1/2NPT
Instruction manual	-J	----------	Japanese
	-E	----------	English
—	-A	----------	Always -A
Options		/D	DERAKANE coating (*9)
		/C	Inconel bolt (*3)
		/HS	Set for Humidity Analyzer (*4)
		/CV	Check valve (*5)
		/SV	Stop valve (*5)
		/H	Hood (*8)
		/SCT	Stainless steel tag plate (*6)
		/PT	Printed tag (*6)

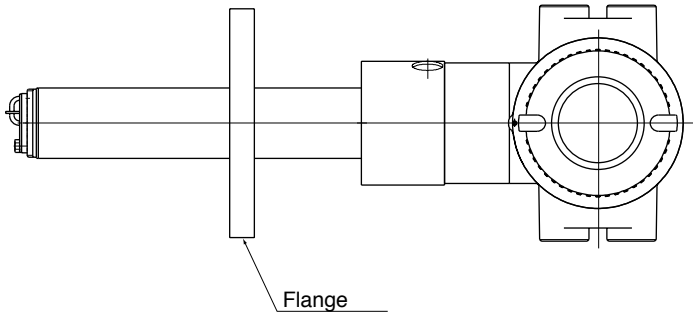
T12.EPS

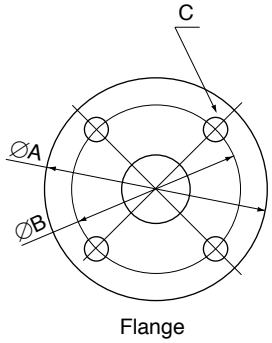
*1 For the horizontal installed probe whose insertion length is 2.5 meters or more, use the Probe Protector. Be sure to specify ZO21R-L-□□□-□. Specify the flange suffix code either -C or -K.
*2 The thickness of the flange depends on its dimensions.
*3 Inconel probe bolts and U shape pipe are used. Use this option for high temperature use (ranging from 600 to 700°C).
*4 For humidity measurements, be sure to specify /HS options.
*5 Specify either /CV or /SV option code.
*6 Specify either /SCT or /PT option code.
*7 No need to specify the option codes, /CV and /SV, since the check valves are provided with the auto-calibration unit. Auto calibration cannot be used when natural convection is selected as reference air.
*8 Sun shield hood is still effective even if scratched. Hood is necessary for outdoor installation out of sun shield roof. Piping for reference air must be installed to supply reference air constantly at a specified flow rate.
*9 Available only in the U.S. DERAKANE is a registered trademark of the Dow Chemical Company.
*10 Piping for reference air must be installed to supply reference air constantly at a specified flow rate.

• External Dimensions

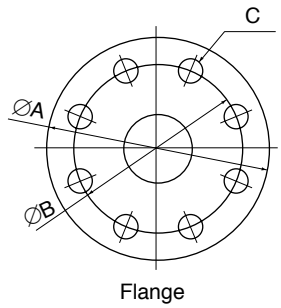
Model ZR202G Integrated type Zirconia High Temperature Humidity Analyzers **Unit: mm**







Flange	A	B	C	t
ANSI Class 150 2 RF SUS304	152.4	120.6	4 - ∅19	19
ANSI Class 150 3 RF SUS304	190.5	152.4	4 - ∅19	24
ANSI Class 150 4 RF SUS304	228.6	190.5	8 - ∅19	24
DIN PN10 DN50 SUS304	165	125	4 - ∅18	18
DIN PN10 DN80 SUS304	200	160	8 - ∅18	20
DIN PN10 DN100 SUS304	220	180	8 - ∅18	20
JIS 5K 65 FF SUS304	155	130	4 - ∅15	14
JIS 10K 65 FF SUS304	175	140	4 - ∅19	18
JIS 10K 80 FF SUS304	185	150	8 - ∅19	18
JIS 10K 100 FF SUS304	210	175	8 - ∅19	18
JPI Class 150 4 RF SUS304	229	190.5	8 - ∅19	24
JPI Class 150 3 RF SUS304	190	152.4	4 - ∅19	24
Westinghouse	155	127	4 - ∅11.5	14



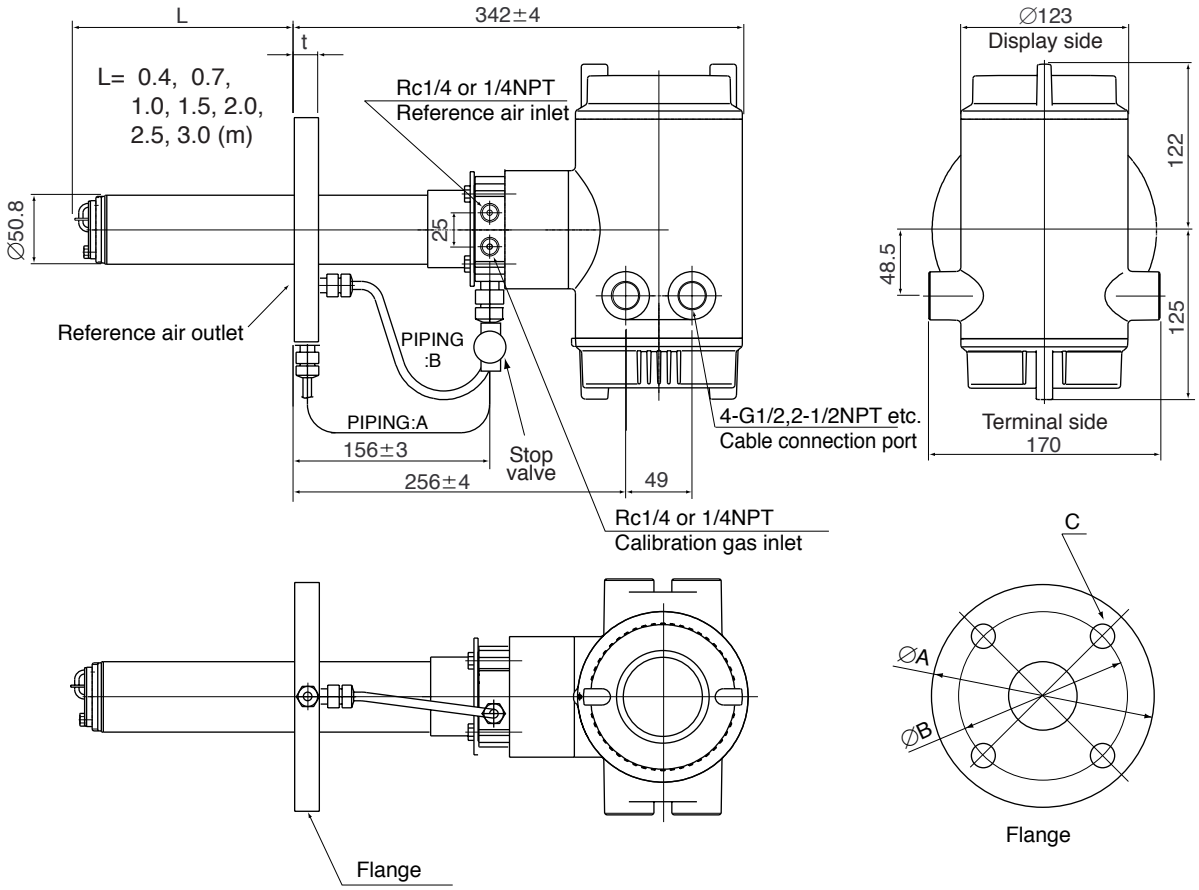
F11_01.EPS

• Standard Accessories

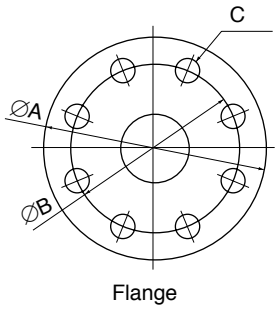
Item	Part. No.	Qty	Description
Fuse	A1113EF	1	3.15A
Allen wrench	L9827AB	1	For lock screw

T02-01.EPS

Model ZR202G...-P(with pressure compensation) Integrated type Zirconia High Temperature Humidity Analyzer **Unit : mm**



Flange	A	B	C	t	PIPING
ANSI Class 150 2 RF SUS304	152.4	120.6	4 - ∅19	19	A
ANSI Class 150 3 RF SUS304	190.5	152.4	4 - ∅19	24	B
ANSI Class 150 4 RF SUS304	228.6	190.5	8 - ∅19	24	B
DIN PN10 DN50 SUS304	165	125	4 - ∅18	18	A
DIN PN10 DN80 SUS304	200	160	8 - ∅18	20	B
DIN PN10 DN100 SUS304	220	180	8 - ∅18	20	B
JIS 5K 65 FF SUS304	155	130	4 - ∅15	14	A
JIS 10K 65 FF SUS304	175	140	4 - ∅19	18	A
JIS 10K 80 FF SUS304	185	150	8 - ∅19	18	B
JIS 10K 100 FF SUS304	210	175	8 - ∅19	18	B
JPI Class 150 4 RF SUS304	229	190.5	8 - ∅19	24	B
JPI Class 150 3 RF SUS304	190	152.4	4 - ∅19	24	B
Westinghouse	155	127	4 - ∅11.5	14	A



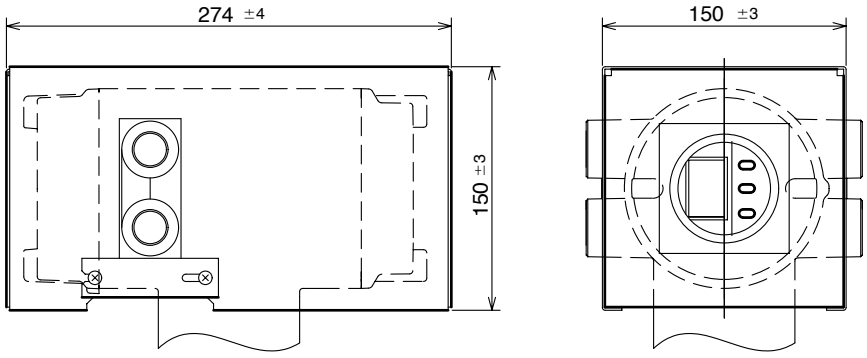
F11_02.EPS

• Standard Accessories

Item	Part. No.	Qty	Description
Fuse	A1113EF	1	3.15A
Allen wrench	L9827AB	1	For lock screw

T02-01.EPS

• Hood (Option code /H)



Hood Material : Aluminum

Hood Weight : Approx. 800g

ZR202G-F.eps

2.1.3 ZH21B Dust Protector

This protector is designed to protect the probe output from dust agitation (i.e., to prevent combustible materials from entering the probe cell where humidity measurements are made) in a dusty environment.

Insertion length : 0.428m
Flange : JIS 5K 80 FF equivalent or ANSI Class 150 4 FF SUS304. (However, flange thickness is different.)
Material : SUS 316 (JIS), SUS 304 (JIS) (flange)
Weight: Approx. 6kg (JIS), approx. 8.5kg (ANSI)
Mounting : Mounted on the probe or process flange with bolts and associated nuts and washers.

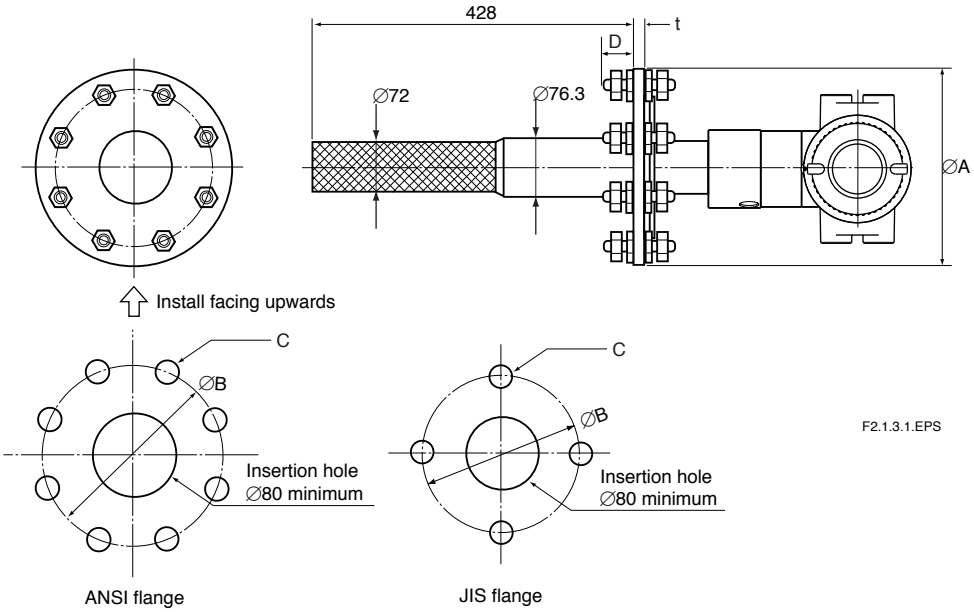
● Model and Codes

Model	Suffix code	Option code	Description
ZH21B			Dust protector (0 to 600°C)
Insertion length	**-040**		0.428 m
Flange	**-J**		JIS 5K 80 FF SUS304 (1)
	-A		ANSI Class 150 4B FF SUS304 * (2)
Style code	***B**		Style B

* The flange thickness varies. T2.1.3.1.EPS
Specify the probe ZR202G-040 -□-K in case of (1).
ZR202G-040 -□-C in case of (2).

● External Dimensions

Unit : mm



F2.1.3.1.EPS

Flange	A	B	C	t	D
JIS 5K 80 FF SUS304	180	145	4-∅19	12	40
ANSI Class 150 4B FFSUS304	228.5	190.5	8-∅19	12	50

2.2 ZA8F Flow Setting Unit and ZR20H Automatic Calibration Unit

2.2.1 ZA8F Flow Setting Unit

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

This unit consists of a flow meter and flow control valves to control the flow of calibration gas and reference air.

Standard Specifications

Flowmeter: Calibration gas; 0.1 to 1.0 l/min. Reference air; 0.1 to 1.0 l/min.

Construction : Dust-proof and rainproof construction

Case Material: SPCC (Cold rolled steel sheet)

Painting : Baked epoxy resin , Dark-green (Munsell 2.0 GY 3.1/0.5 or equivalent)

Pipe Connections : Rc1/4 or 1/4FNPT

Reference Air pressure : Clean air supply of measured gas pressure plus approx. 50 kPa G (or measured gas pressure plus approx. 150 kPa G when a check valve is used, maximum pressure rating is 300 kPa G) (pressure at inlet of the auto-calibretion unit)

Air Consumption: Approx. 1.5 l/min

Weight: Approx. 2.3 kg

Calibration gas (zero gas, span gas) flow: 0.7 l/min (at calibration time only)

Note

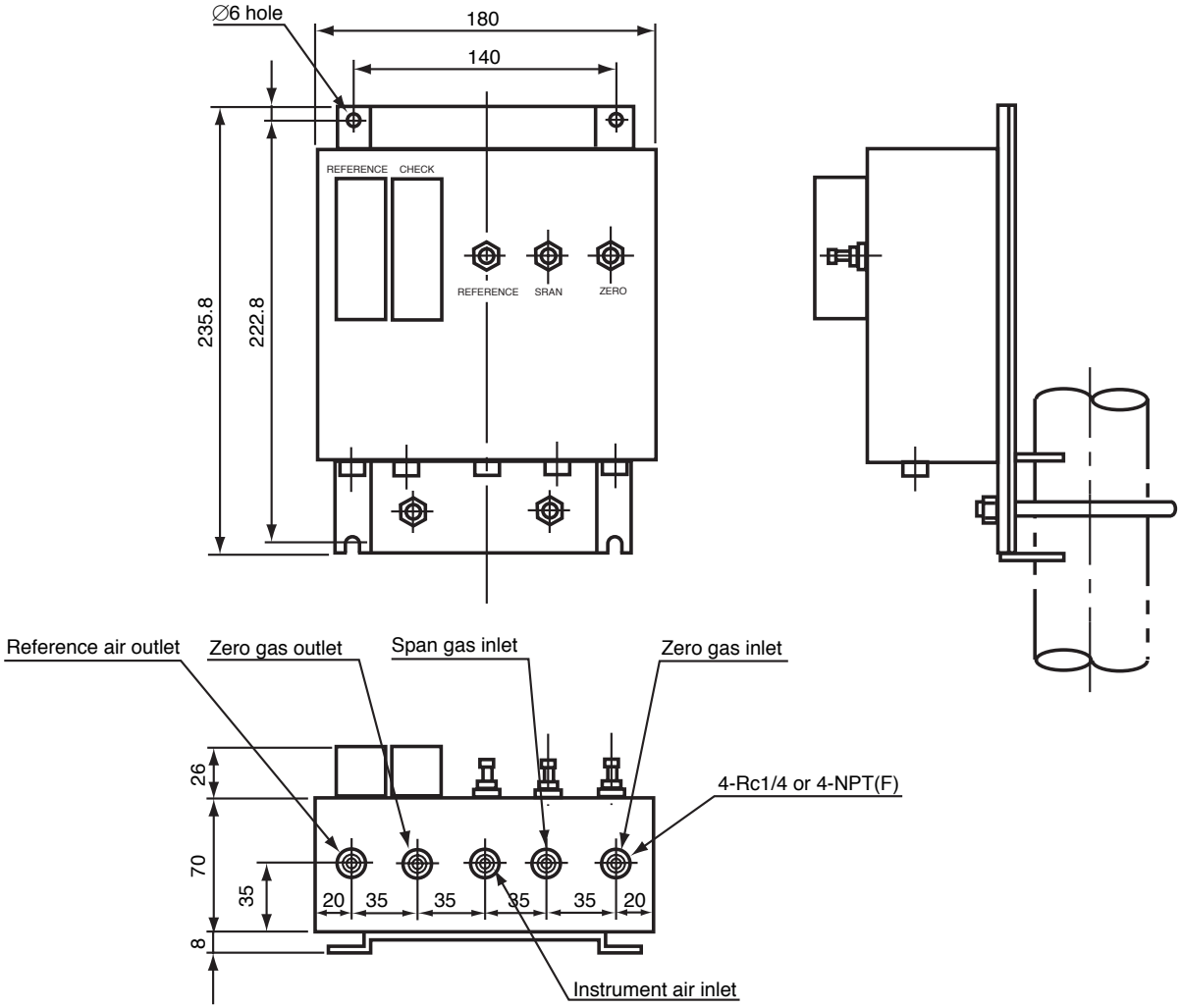
Use instrument air for span calibration gas, if no instrument air is available, contact YOKOGAWA.

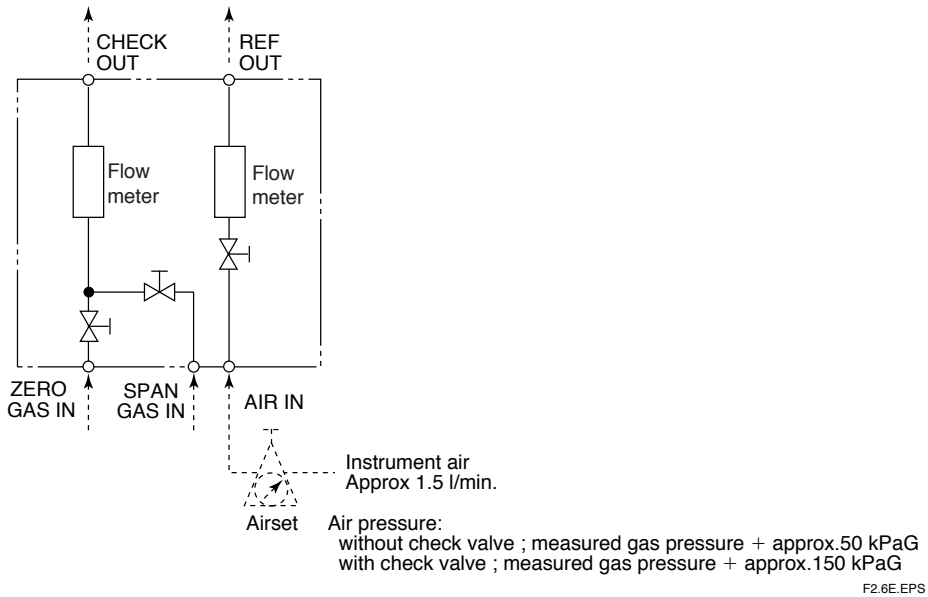
Model and Codes

Model	Suffix code	Option code	Description
ZA8F	.....	.....	Standard gas unit
Joint	-J	.....	Rc 1/4
	-A	.....	With 1/4" NPT adapter
Style code	*B	.....	Style B

T2.5E.EPS

External Dimensions **Unit: mm**





F2.6E.EPS

2.2.2 ZR20H Automatic Calibration Unit

This automatic calibration unit is applied to supply specified flow of reference gas and calibration gas during automatic calibration to the detector in a system configuration (System 3).

• Specifications

Equipped with the analyzer when automatic calibration is specified in the suffix code of the ZR202G Integrated type by selecting either "-A (Horizontal mounting)" or "-B (Vertical mounting)". The ZR20H should be arranged when auto-calibration is to be required after the ZR202H has been installed. Ask Yokogawa service station for its mounting.

Construction: Dust-proof and rainproof construction: NEMA4X/IP67 (excluding flow-meter)

Mounting: Mounted on ZR202G, no vibration

Materials: Body: Aluminum alloy, Piping: SUS316 (JIS), SUS304 (JIS), Flowmeter: MA (Methacrylate resin), Bracket; SUS304 (JIS)

Finish: Polyurethane corrosion-resistance coating, Case: Mint green (Munsell 5.6BG3.3 /2.9), Cover: Mint green (Munsell 5.6BG3.3/2.9)

Piping Connection: Refer to Model and Suffix Codes

Power Supply: 24V DC (from ZR202G), Power consumption: Approx. 1.3 W

Reference Air Pressure: Sample gas pressure plus Approx. 150 kPa (690 kPa max.), (Pressure at inlet of auto-calibration unit)

Air Consumption: Approx. 1.5 l/min

Weight: Approx. 2 kg

Ambient Temperature: -20 to +55° C, no condensing or freezing

Ambient Humidity: 0 to 95% RH

Storage Temperature: -30 to +65° C

• Model and Codes

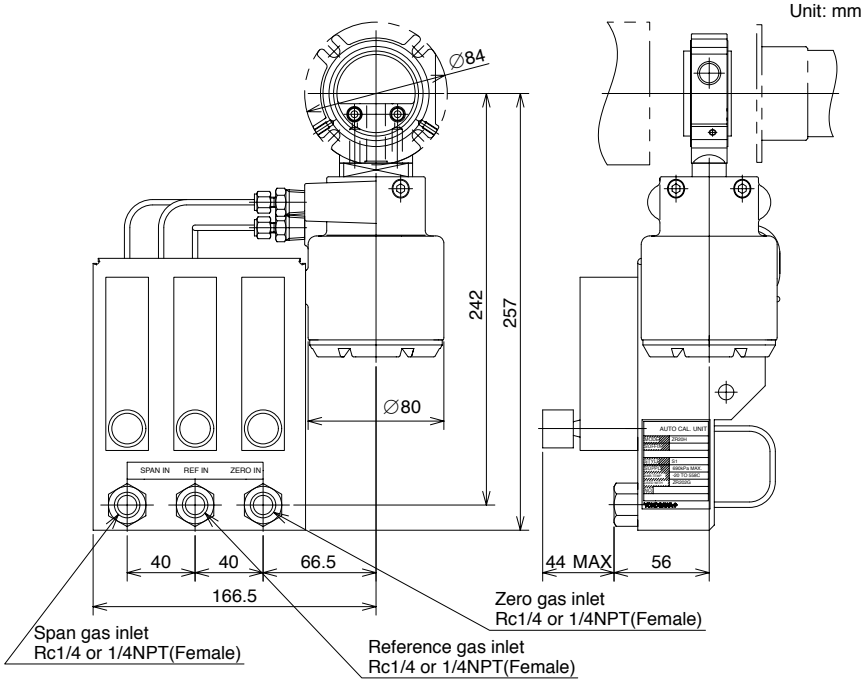
Model	Suffix code	Option code	Description
ZR20H	·····	·····	Automatic calibration unit for ZR202G *1
Gas piping connection	-R	·····	Rc 1/4
	-T	·····	1/4" NPT
Reference air *2	-E	·····	Instrument air
	-P	·····	Pressure compensated
Mounting	-A	·····	Horizontal mounting
	-B	·····	Vertical mounting
-	-A	·····	Always -A

*1 Ask Yokogawa service station for additional mounting of ZR20H to the preinstalled ZR202G.
*2 Select the appropriate reference air of ZR20H according to the one of ZR202G. T22E.EPS

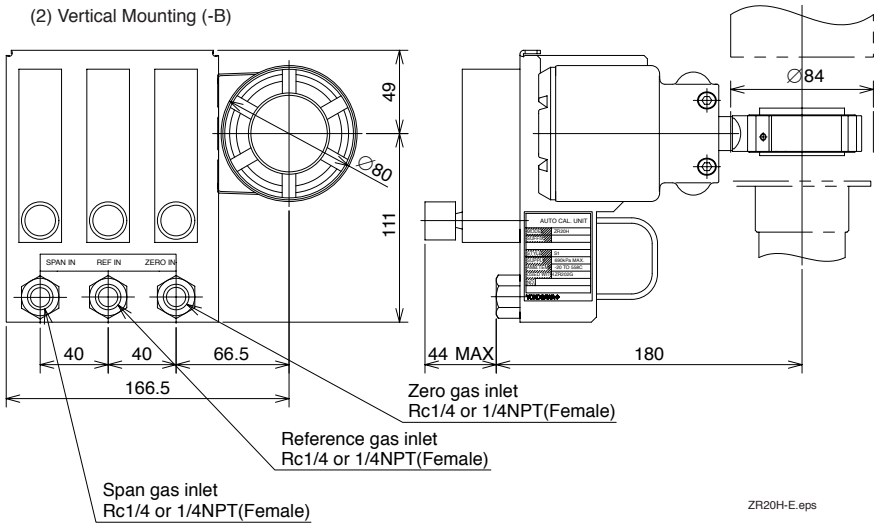
• **External Dimensions**

(1) For Horizontal Mounting (-A)

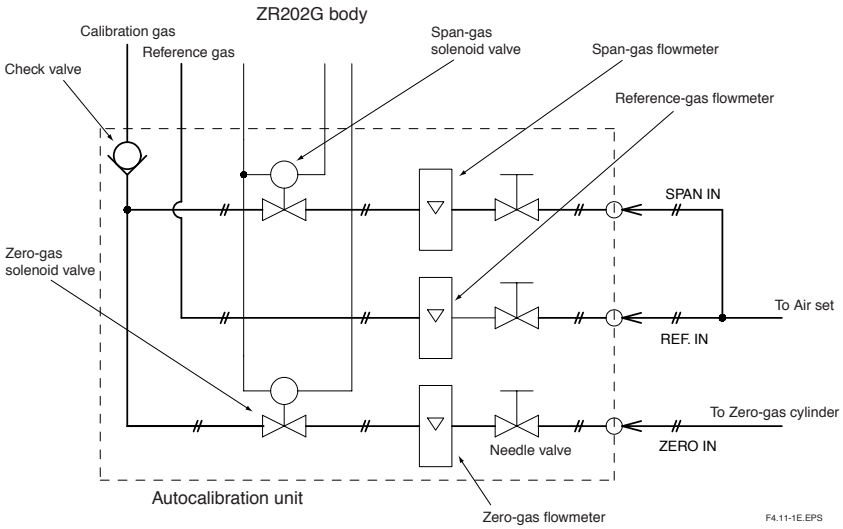
Unit: mm



(2) Vertical Mounting (-B)



ZR20H-E.eps



F4.11-1E.EPS

2.3 ZO21S Standard Gas Unit

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

Standard Specifications

Function : Portable unit for calibration gas supply consisting of span gas (air) pump, zero gas cylinder with sealed inlet, flow rate checker and flow rate needle valve.

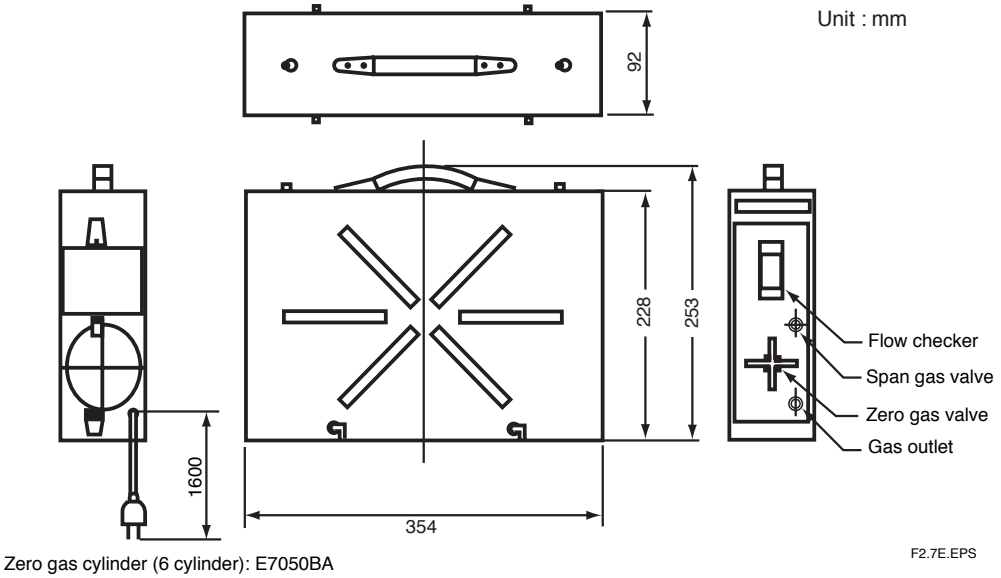
Sealed Zero Gas Cylinders (6 provide): E7050BA

Capacity : 1 l
Filled pressure : Approx. 686 kPa G (at 35 ° C)
Composition : 0.95 to 1.0 vo1% 0_2+N_2 balance
Power Supply : l00, 110, 115, 200, 220, 240 V AC± 10%, 50/60 Hz
Power Consumption : Max. 5 VA
Case Material : SPCC (Cold rolled steel sheet)
Paint : Epoxy resin, baked
Paint Color :
Mainframe ; Munsell 2.0 GY3.1/0.5 equivalent
Cover; Munsell 2.8 GY6.4/0.9 equivalent
Piping :Φ6 ×Φ4 mm flexible tube connection
Span Gas : Internal pump drains in air from atmosphere, and feeds to detector.
Weight: Approx. 3 kg
* Non CE Mark.

Model and Codes

Model	Suffix code	Option code	Description
ZO21S	·····	·····	Standard gas unit
Power supply	-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
Panel	-J ·····	·····	Japanese version
	-E ·····	·····	English version
Style code	*A ·····	·····	Style A

T2.6E.EPS



F2.7E.EPS

Zero gas cylinder (6 cylinder): E7050BA

2.4 Other Equipment

2.4.1 Stop Valve (part number: L9852CB or G7016XH)

This valve is mounted on the calibration gas line in the system to allow for one-touch calibration. This applies to the system configuration shown for System 1 in section1.

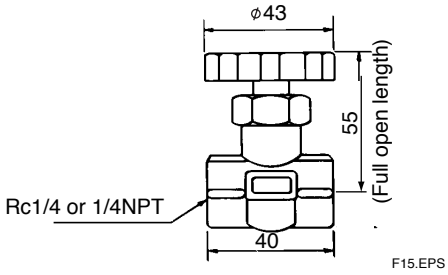
Standard Specifications
Connection : Rc 1/4 or 1/4 FNPT

Material : SUS 316 (JIS)

Weight : Approx. 80 g

Part No.	Description
L9852CB	Joint: RC 1/4, Material: SUS 316 (JIS)
G7016XH	Joint: 1/4 NPT, Material: SUS 316 (JIS)

T2.9E.EPS



F15.EPS

2.4.2 Check Valve (part number: K9292DN or K9292DS)

This valve is mounted on the calibration gas line (directly connected to the detector). This is applied to a system based on the system configuration (System 2 and 3).

This valve prevents the process gas from entering the calibration gas line. Although it functions as the stop valve, operation is easier as it does not require opening/closing at each calibration.

Screw the check valve into the calibration gas inlet of the detector instead of the stop valve.

Standard Specification
Connection : Rc1/4 or 1/4FNPT

Material : SUS304 (JIS)

Pressure : 70 kPa G or more and 350 kPa G or less

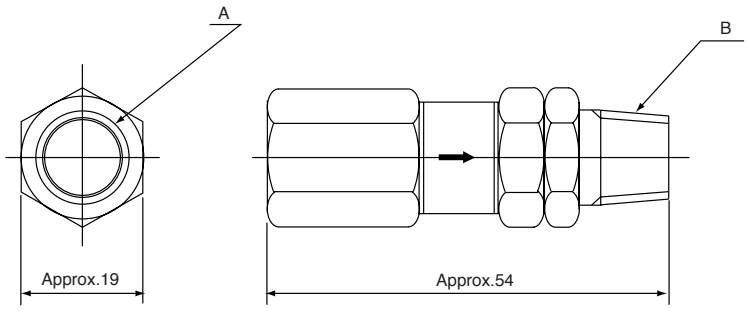
Weight: Approx. 40 g

Part No.	Description
K9292DN	Joint: RC 1/4, Material: SUS304 (JIS)
K9292DS	Joint: 1/4 NPT, Material: SUS304 (JIS)

T2.10E.EPS

K9292DN : Rc 1/4(A part),R 1/4(B)
K9292DS : 1/4FNPT(A part),1/4NPT(Male)(B part)

unit : mm



F2.11E.EPS

2.4.3 Air Set

This set is used to lower the pressure when instrument air is used as the reference and span gases.

• Part number: K9473XH or K9473XJ Standard Specifications
Primary Pressure : Max. 2 MPa G

Secondary Pressure : 0 to 0.25 MPa G

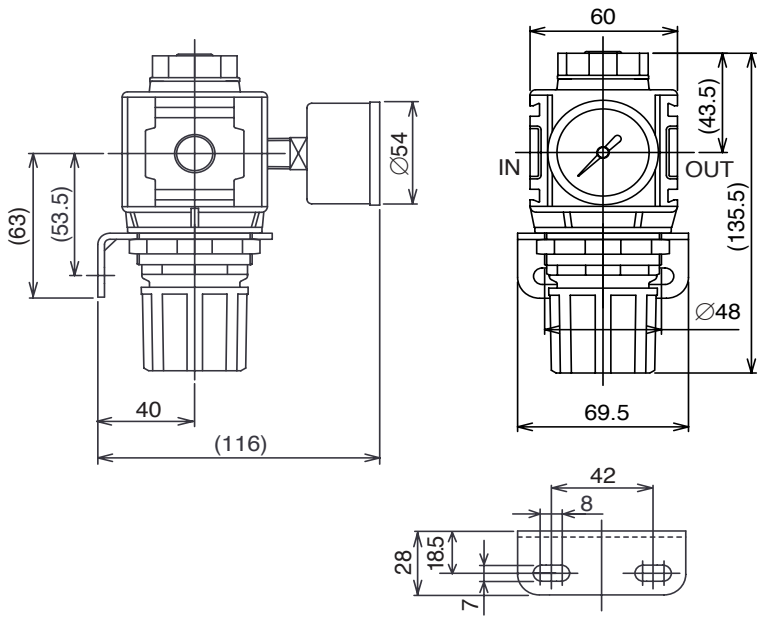
Connection : Rc1/4 or 1/4FNPT (included joint adapter)

Weight: Approx.1 kg

Part No.	Description
K9473XH	Joint: Rc 1/4, Material: Aluminum
K9473XJ	Joint: 1/4 NPT (F) , Material: Body; Aluminum, Adapter; Zinc alloy

T2.11E.EPS

Unit: mm
Dimensions in parentheses are approximate.



Bracket Mounting Dimensions

K9473XH: Piping connection (IN: Primary side, OUT: Secondary side), Rc1/4
K9473XJ: Piping connection (IN: Primary side, OUT: Secondary side), 1/4NPT

• Part. no. G7004XF or K9473XG Standard Specification

Primary Pressure: Max. 1 MPa G

Secondary Pressure: 0.02 to 0.5 MPa G

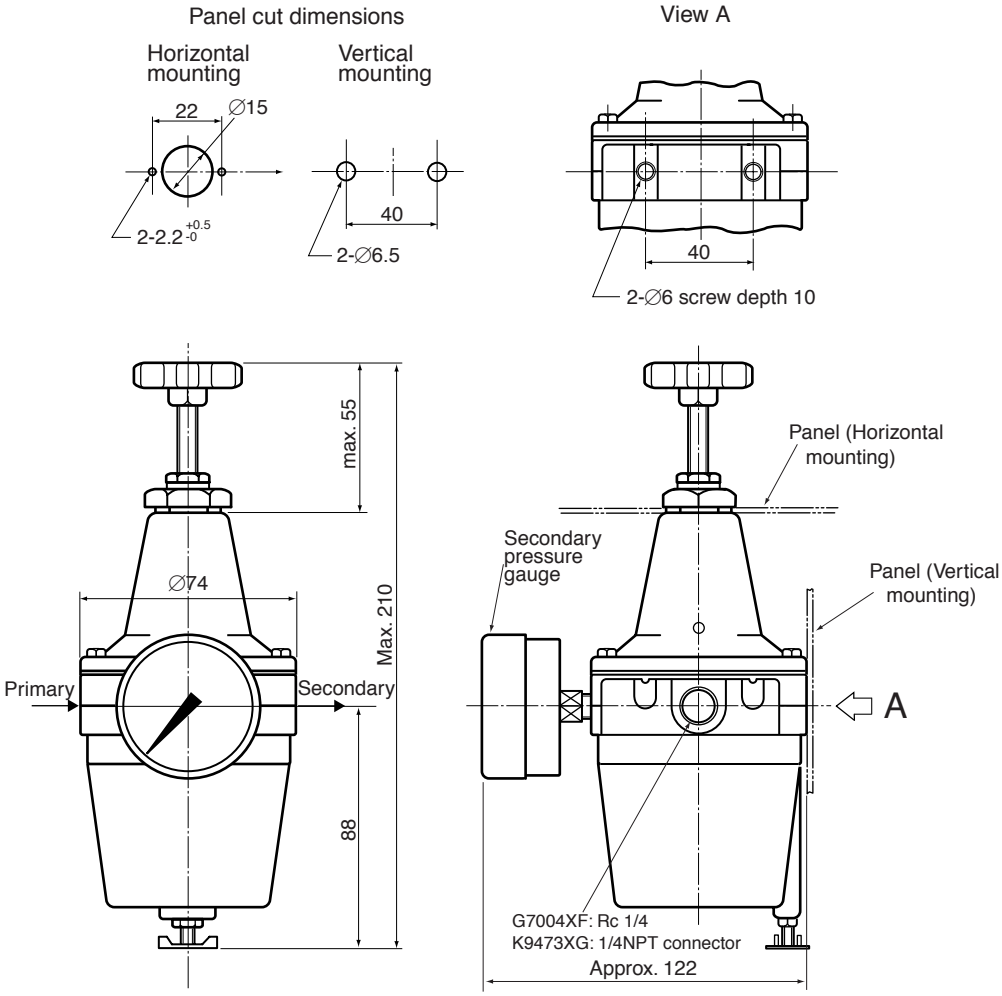
Connection: Rc1/4 or 1/4 FNPT with joint adapter

Weight : Approx. 1 kg

Part No.	Description
G7004XF	Joint: Rc 1/4, Material: Zinc Alloy
K9473XG	Joint: 1/4 NPT (F) , Material: Body; Zinc Alloy, Adapter; SUS316

T2.13E.EPS

Unit :mm



2.4.4 Zero-gas Cylinder (part number: G7001ZC)

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

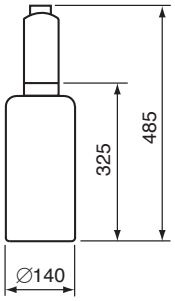
Standard Specifications

Capacity : 3.4 l

Filled pressure : 9.8 to 12 MPa G

Composition : 0.95 to 1.0 vol% O_2 in N_2

(Note) Export of such high pressure filled gas cylinders to most countries is prohibited or restricted.



Unit : mm

Weight : Approx. 6 kg

F2213.EPS

2.4.5 Pressure Regulator for Gas Cylinder (part number: G7013XF or G7014XF)

This regulator valve is used with the zero gas cylinders.

Standard Specifications

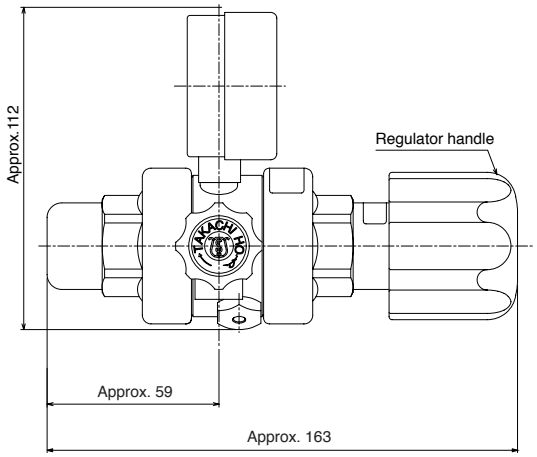
Primary Pressure: Max. 14.8 MPa G

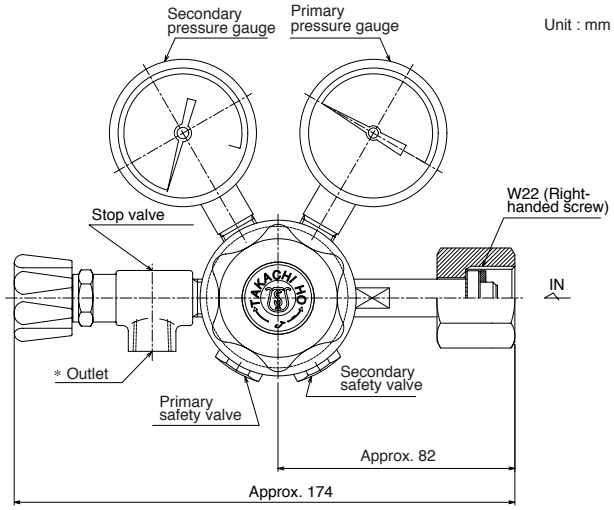
Secondary Pressure: 0 to 0.4 MPa G

Connection : Inlet W22 14 threads, right hand screw

Outlet Rc1/4 or 1/4FNPT

Material: Brass body





Part No.	* Outlet
G7013XF	Rc1/4
G7014XF	1/4 NPT female screw

2.4.6 Case Assembly for Calibration-gas Cylinder (part number: E7044KF)

This case is used to store the zero gas cylinders.

Standard Specifications

Case Paint : Baked epoxy resin, Jade green (Munsell 7.5 BG 4/1.5)

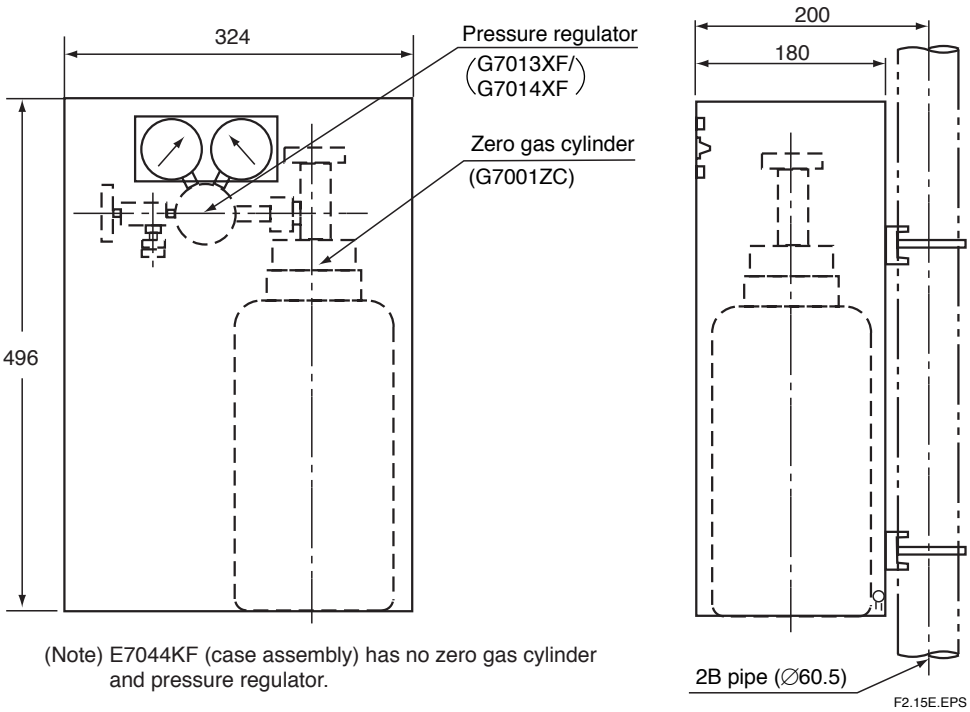
Installation : 2B pipe mounting

Material : SPCC (Cold rolled steel sheet)

Weight : Approx. 3.3 kg,10 kg with gas cylinder

(Note) Export of such high pressure filled gas cylinders to most countries is prohibited or restricted.

unit : mm



(Note) E7044KF (case assembly) has no zero gas cylinder and pressure regulator.

2.4.7 Model ZR202A Heater Assembly

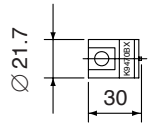
Model	Suffix code	Option code	Description
ZR202A	·····	·····	Heater Assembly for ZR202G
Length (∗1)	-040	·····	0.4 m
	-070	·····	0.7 m
	-100	·····	1 m
	-150	·····	1.5 m
	-200	·····	2 m
	-250	·····	2.5 m
	-300	·····	3 m
Jig for change	-A	·····	with Jig
	-N	·····	None
	-A		Always -A

T2.2E.EPS

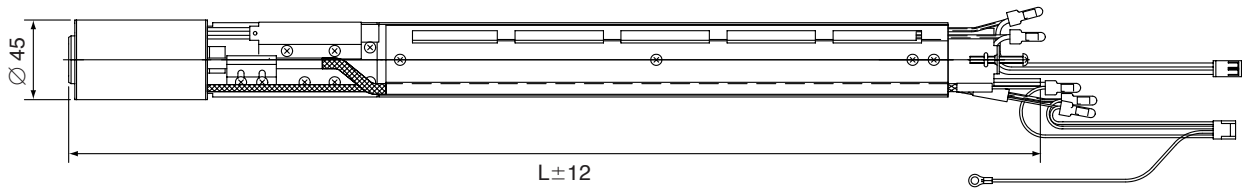
(∗1) Suffix code of length should be selected as same as ZR202G installed.
* The heater is made of ceramic, do not drop or subject it to pressure stress.

● External Dimensions

Jig for change
(K9470BX)



Unit : mm



F2.16.EPS

L length

Model & Code	L	Weight (kg)
ZR202A-040	552	Approx. 0.8
ZR202A-070	852	Approx. 1.2
ZR202A-100	1152	Approx. 1.6
ZR202A-150	1652	Approx. 2.2
ZR202A-200	2152	Approx. 2.8
ZR202A-250	2652	Approx. 3.4
ZR202A-300	3152	Approx. 4.0

3. Installation

This chapter describes how to install the following equipment and how to test the insulation resistance.

3.1 High-temperature Humidity Analyzer

3.2 ZA8F Flow Setting Unit

3.3 ZR20H Automatic Calibration Unit

3.4 Case Assembly for Calibration-gas Cylinder (E7044KF)

3.5 Insulation Resistance Test

3.1 Installation of High-temperature Humidity Analyzer

3.1.1 Location

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

(1) Easy and safe access to the analyzer for checking and maintenance work.
(2) Ambient temperature of no more than 55° C, and the terminal box should not be affected by radiant heat.
(3) No corrosive gases.

CAUTION

A natural convection type analyzer (model ZR202G-□-□-□-C), which uses ambient air as reference gas, requires that the ambient oxygen concentration be constant.

(4) No vibration.
(5) The measured gas satisfies the specifications described in Chapter 2.
(6) No measured gas-pressure fluctuations.

CAUTION

- Be sure to select the installation location where the ambient temperature is between -20° C and 55° C for the ZR202G Integrated-type High-temperature Humidity Analyzer.

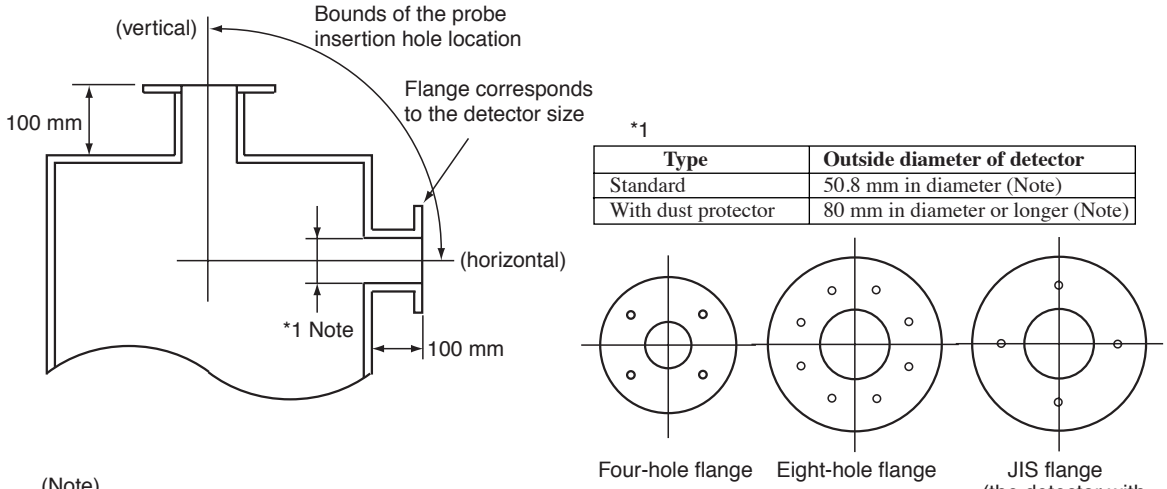
3.1.2 Probe Insertion

CAUTION

- The outside dimension of detector may vary depending on its options. Use a pipe that is large enough for the detector. Refer to Figure 3.1 for the dimensions.
- If the detector is mounted horizontally, the calibration gas inlet and reference gas inlet should face downwards.
- When using the detector with pressure compensation, ensure that the flange gasket does not block the reference air outlet on the detector flange. If the flange gasket blocks the outlet, the detector cannot conduct pressure compensation. Where necessary, make a notch on the flange gasket. Confirm the outside dimensions of the detector in Chapter 3.6 before installation.
- The sensor (zirconia cell) at the probe tip may deteriorate due to thermal shock if water drops are allowed to fall on it, as it is always at high temperature.

(1) Do not orient the end of the detector probe upwards.
(2) If the probe length is 2.5 meters or longer, mount the detector vertically (no more than a 5° tilt).
(3) Position the detector probe perpendicular to the measurement gas flow, or point the tip downstream.

Figure 3.1 illustrates an example of the probe insertion.



Type	Outside diameter of detector
Standard	50.8 mm in diameter (Note)
With dust protector	80 mm in diameter or longer (Note)

(Note)
When the detector with the ZH21B dust protector is used, provide a 80-mm dia. or more flange, as shown in the above figure.
When using the detector with pressure compensation, ensure that the flange gasket does not block the reference air outlet on the detector flange. If the flange gasket blocks the outlet, the detector cannot perform pressure compensation. Where necessary, make a notch in the flange gasket. Confirm the outside dimensions of the detector in Chapter 3.6 before installation.

Figure 3.1 Example of Probe Insertion

3.1.3 Installation of the Detector

CAUTION

- The cell (sensor) at the tip of the detector is made of ceramic (zirconia). Do not drop the detector, as impact will damage it.
- If the detector is mounted horizontally, the calibration gas inlet and reference gas inlet should face downwards.
- A gasket should be used between the flanges to prevent gas leakage. The gasket material should be heatproof and corrosion-proof, suited to the characteristics of the measured gas.

The following should be taken into consideration when mounting the general-use detector:

<General-use detector>

(1) Make sure that the cell mounting screws (four) at the probe tip are not loose.
(2) Where the detector is mounted horizontally, the calibration gas inlet and the reference gas inlet should face downward.

3.1.4 Installation of ZH21B Dust Protector

(1) Place the gasket between the flanges and mount the dust protector in the probe insertion hole.
(2) Make sure that the cell assembly mounting screws (four) at the probe tip are not loose.
(3) Mount the detector so that the calibration gas inlet and the reference gas inlet face downward.

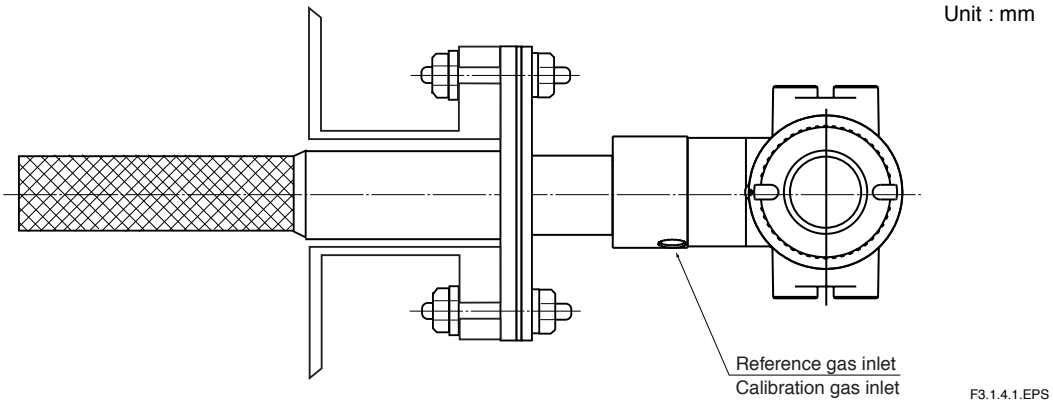


Figure 3.2 Detector with Dust Protector

3.2 Installation of ZA8F Flow Setting Unit

3.2.1 Location

The following should be taken into consideration:

(1) Easy access to the unit for checking and maintenance work.
(2) Near to the analyzer for operating keys on the panel.
(3) No corrosive gas.
(4) An ambient temperature of not more than 55° C and little changes of temperature.
(5) No vibration.
(6) Little exposure to rays of the sun or rain.

3.2.2 Mounting of ZA8F Flow Setting Unit

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

<Pipe Mounting>

(1) Prepare a vertical pipe of sufficient strength (nominal JIS 50A : O.D. 60.5 mm) for mounting the flow setting unit. (The unit weighs approximately 2 to 3.5 kg.)
(2) Mount the flow setting unit on the pipe by tightening the nuts with the U-bolt so that the metal fitting is firmly attached to the pipe.

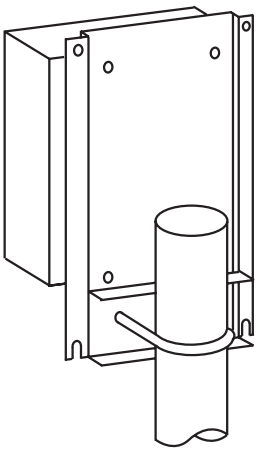


Figure 3.3 Pipe Mounting

<Wall Mounting>

(1) Make a hole in the wall as illustrated in Figure 3.4.

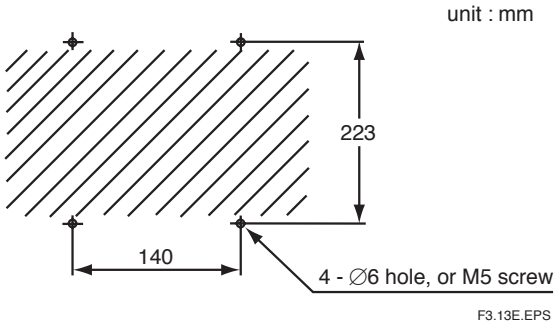


Figure 3.4 Mounting holes

(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.

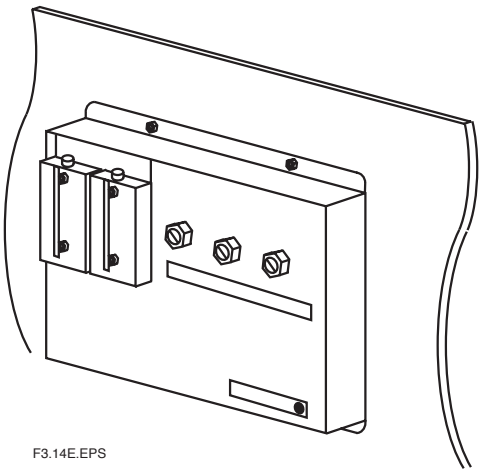


Figure 3.5 Wall mounting

3.3 Installation of ZR20H Automatic Calibration Unit

3.3.1 Location

The following should be taken into consideration:

(1) Easy access to the unit for checking and maintenance work.
(2) Near to the detector and the converter
(3) No corrosive gas.
(4) An ambient temperature of not more than 55° C and little change of temperature.
(5) No vibration.
(6) Little exposure to rays of the sun or rain.

3.3.2 Mounting of ZR20H Automatic Calibration Unit

ZR202G - □ - □ - □ - □ - A or –B is shipped with autocalibration unit attached.
The autocalibration unit includes flowmeters and solenoid valves, so – to ensure reliable and accurate operation — Flowmeter should be mounted vertically. The associated probe is designed for horizontal or vertical mounting.
If you buy the autocalibration unit afterward, and need to install it or replace it, contact our service representative.

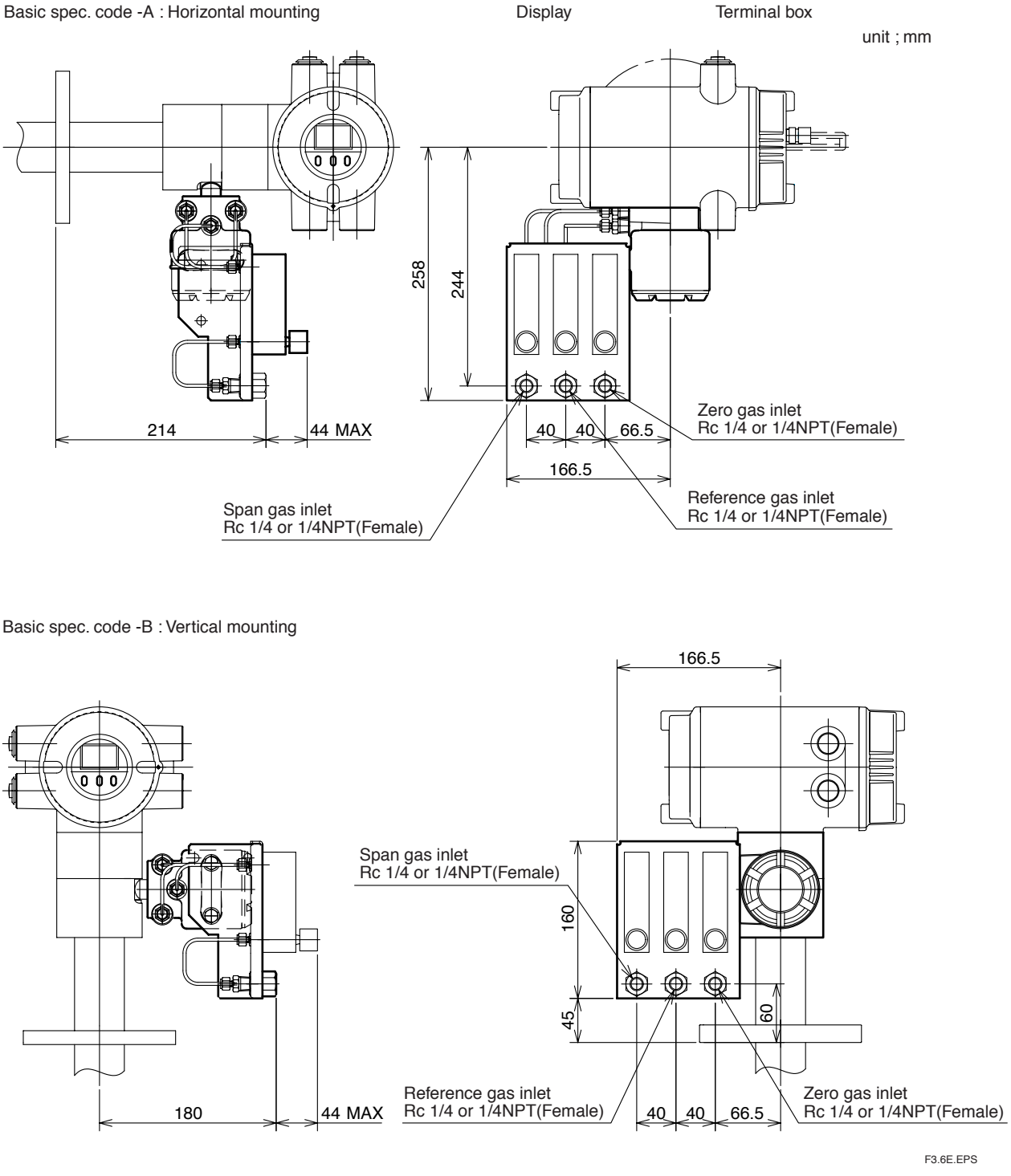


Figure 3.6 Automatic Calibration Unit Mounting

3.4 Installation of the Calibration-gas Unit Case (E7044KF)

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

3.4.1 Location

The following should be taken into consideration:

(1) Easy access for cylinder replacement
(2) Easy access for checking
(3) Near to the detector and converter as well as the flow setting unit.
(4) The temperature of the case does not exceed 40° C due to rays of the sun or radiated heat.
(5) No vibration

3.4.2 Mounting

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

(1) Prepare a vertical pipe of sufficient strength (nominal JIS 50A : O.D. 60.5 mm) for mounting the flow setting unit. (The combination of the calibration gas unit case and the calibration gas cylinder weighs approximately 4.2 kg.)
(2) Mount the unit case on the pipe by tightening the nuts with the U-bolt so that the metal fitting is firmly attached to the pipe.

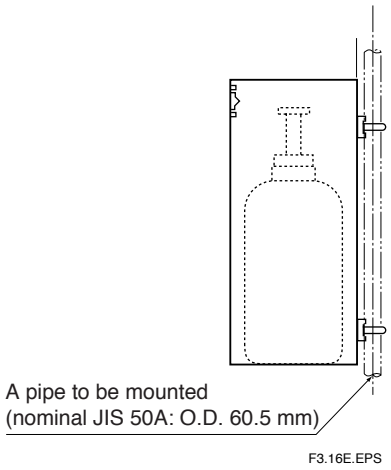


Figure 3.7 Pipe Mounting

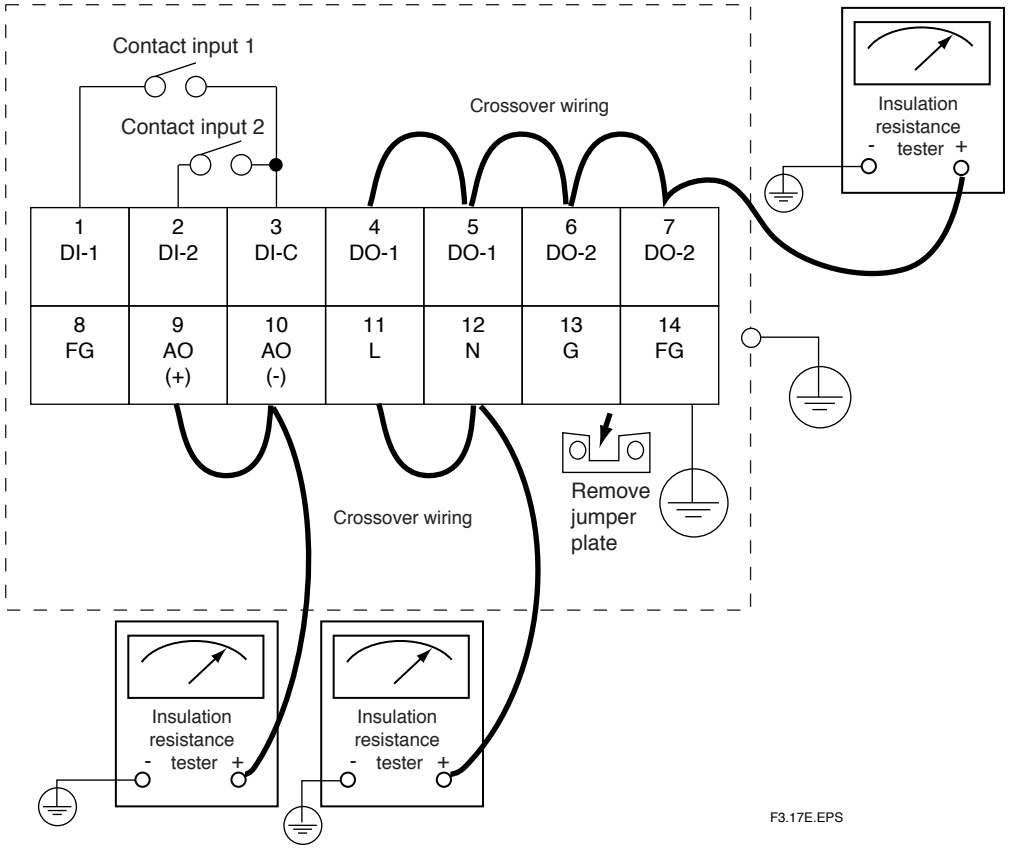
3.5 Insulation Resistance Test

Even if the testing voltage is not so great it causes dielectric breakdown, testing may cause deterioration in insulation and a possible safety hazard. Therefore, conduct this test only when it is necessary.

The applied voltage for this test shall be 500 V DC or less. The voltage shall be applied for as short a time as practicable to conform that insulation resistance is 20 MΩ or more.

Remove wiring from the converter and the detector.

1. Remove the jumper plate located between terminal G and the protective grounding terminal.
2. Connect crossover wiring between L and N.
3. Connect an insulation resistance tester (with its power OFF). Connect (+) terminal to the crossover wiring, and (-) terminal to ground.
4. Turn the insulation resistance tester ON and measure the insulation resistance.
5. After testing, remove the tester and connect a 100 kΩ resistance between the cross-over wiring and ground to discharge.
6. Testing between the heater terminal and ground, contact output terminal and ground, analog output/input terminal and ground can be conducted in the same manner.
7. Although contact input terminals are isolated, insulation resistance test cannot be conducted because the breakdown voltage of the surge-preventing arrester between the terminal and ground is low.
8. After conducting all the tests, replace the jumper plate as it was.



3.6 Installation of the High Temperature Humidity Analyzer (with pressure compensation)

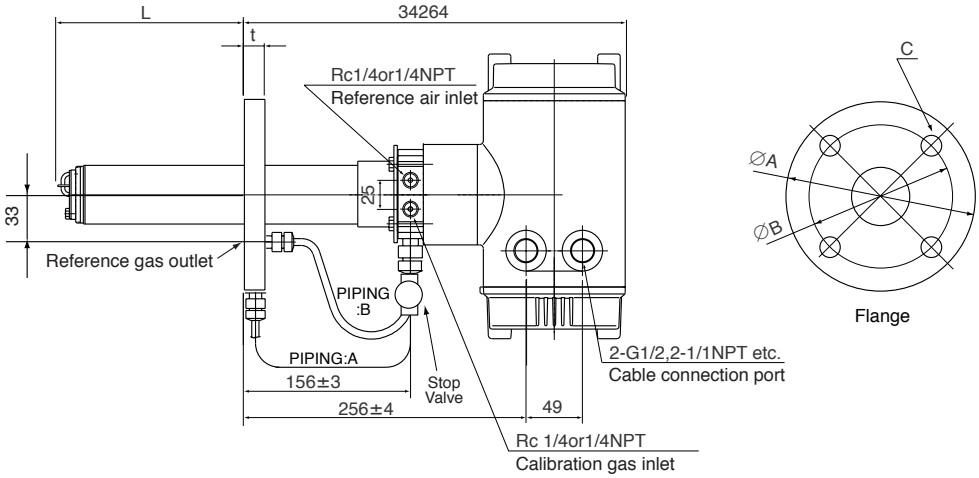
Installation for each flange type

Unit: mm

1. ANSI Class 150 2 RF

● **ZR202G-□□□-□-A-P**

Flange : ANSI Class 150 2 RF SUS304



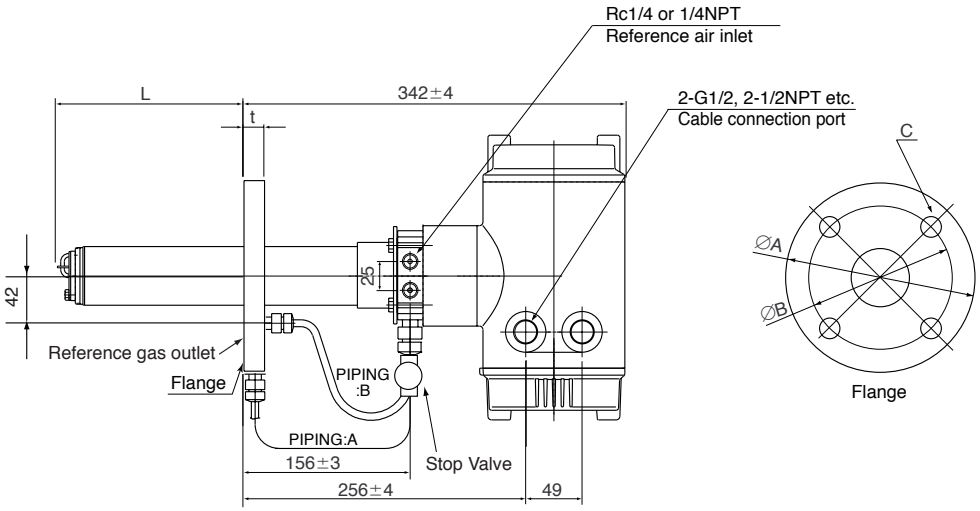
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-A	400	ANSI Class 150 2 RF SUS304	152.4	120.6	4-∅19	19	A	Approx. 8
	ZR202G-070-□-A	700							Approx. 9
	ZR202G-100-□-A	1000							Approx. 10
	ZR202G-150-□-A	1500							Approx. 12
	ZR202G-200-□-A	2000							Approx. 14
	ZR202G-250-□-A	2500							Approx. 16
	ZR202G-300-□-A	3000							Approx. 17

F3.18E.EPS

2. ANSI Class 150 3 RF

● ZR202G-□□□-□-B-P

Flange : Equivalent to ANSI Class 150 3 RF SUS304



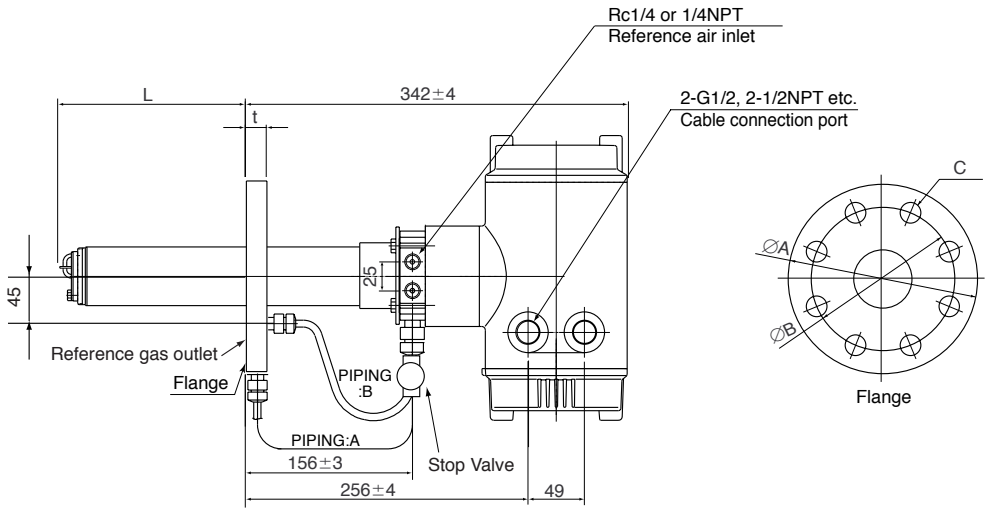
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-B	400	ANSI Class 150 3 RF SUS304	190.5	152.4	4-∅19	24	B	Approx. 11
	ZR202G-070-□-B	700							Approx. 12
	ZR202G-100-□-B	1000							Approx. 13
	ZR202G-150-□-B	1500							Approx. 15
	ZR202G-200-□-B	2000							Approx. 16
	ZR202G-250-□-B	2500							Approx. 18
	ZR202G-300-□-B	3000							Approx. 20

F3.19E.EPS

3. ANSI Class 150 4 RF

● ZR202G-□□□-□-C-P

Flange : ANSI Class 150 4 RF SUS304



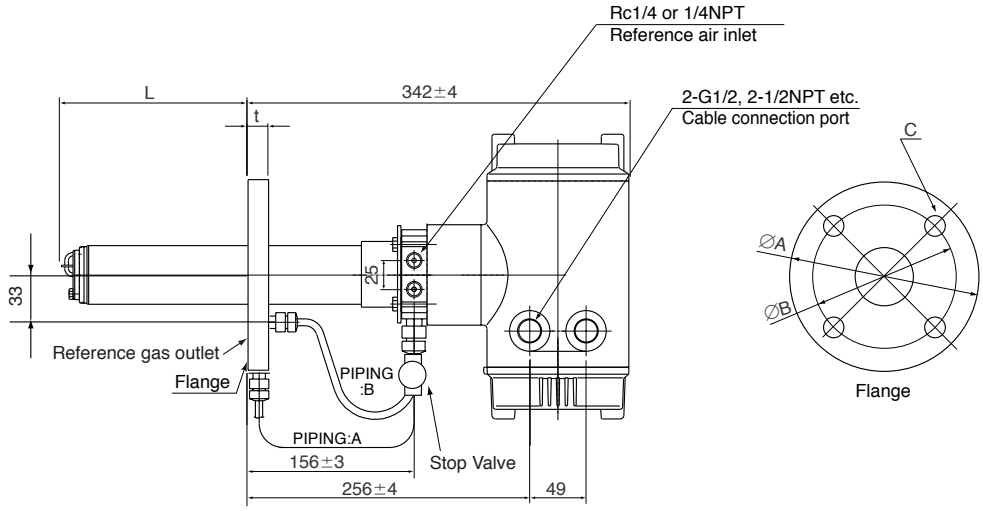
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-C	400	ANSI Class 150 4 RF SUS304	228.6	190.5	8-∅19	24	B	Approx. 13
	ZR202G-070-□-C	700							Approx. 14
	ZR202G-100-□-C	1000							Approx. 15
	ZR202G-150-□-C	1500							Approx. 17
	ZR202G-200-□-C	2000							Approx. 19
	ZR202G-250-□-C	2500							Approx. 21
	ZR202G-300-□-C	3000							Approx. 22

F3.20E.EPS

4. DIN PN10 DN50

● ZR202G-□□□-□-E-P

Flange : DIN PN10 DN50 SUS304



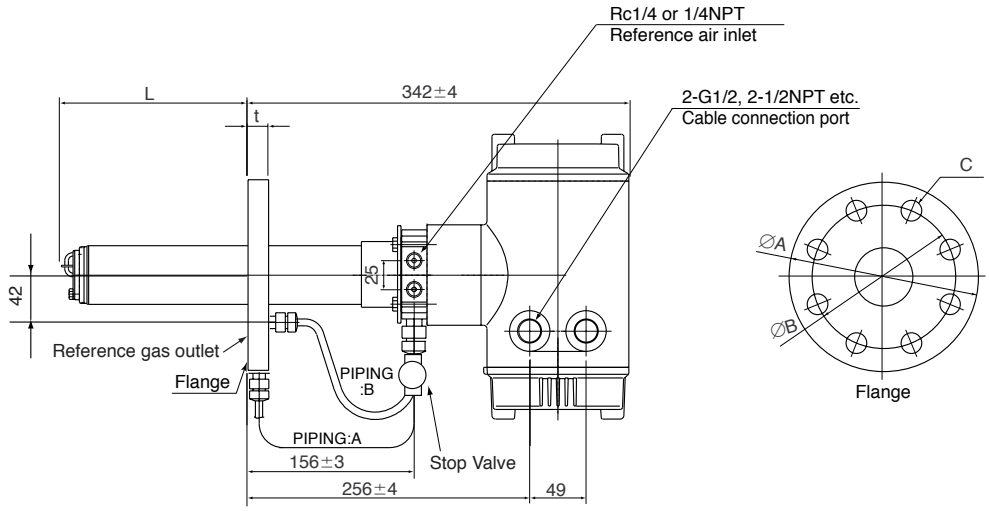
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-E	400	DIN PN10 DN50 SUS304	165	125	4-Ø18	18	A	Approx. 9
	ZR202G-070-□-E	700							Approx. 10
	ZR202G-100-□-E	1000							Approx. 11
	ZR202G-150-□-E	1500							Approx. 12
	ZR202G-200-□-E	2000							Approx. 14
	ZR202G-250-□-E	2500							Approx. 16
	ZR202G-300-□-E	3000							Approx. 18

F3.21E.EPS

5. DIN PN10 DN80

● ZR202G-□□□-□-F-P

Flange : DIN PN10 DN80 SUS304



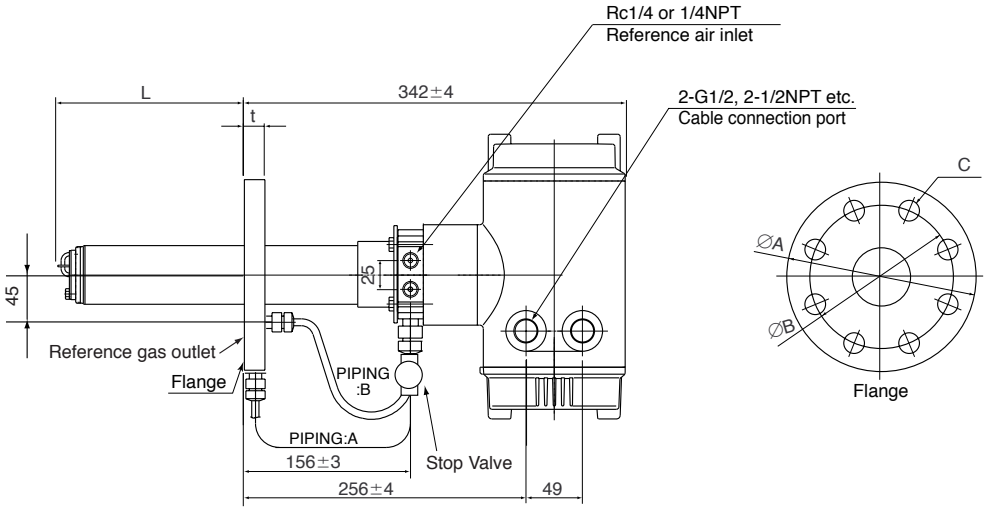
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-F	400	DIN PN10 DN80 SUS304	200	160	8-Ø18	20	B	Approx. 10
	ZR202G-070-□-F	700							Approx. 12
	ZR202G-100-□-F	1000							Approx. 13
	ZR202G-150-□-F	1500							Approx. 14
	ZR202G-200-□-F	2000							Approx. 16
	ZR202G-250-□-F	2500							Approx. 18
	ZR202G-300-□-F	3000							Approx. 20

F3.22E.EPS

6. DIN PN10 DN100

● **ZR202G-□□□-□-G-P**

Flange : DIN PN10 DN100 SUS304



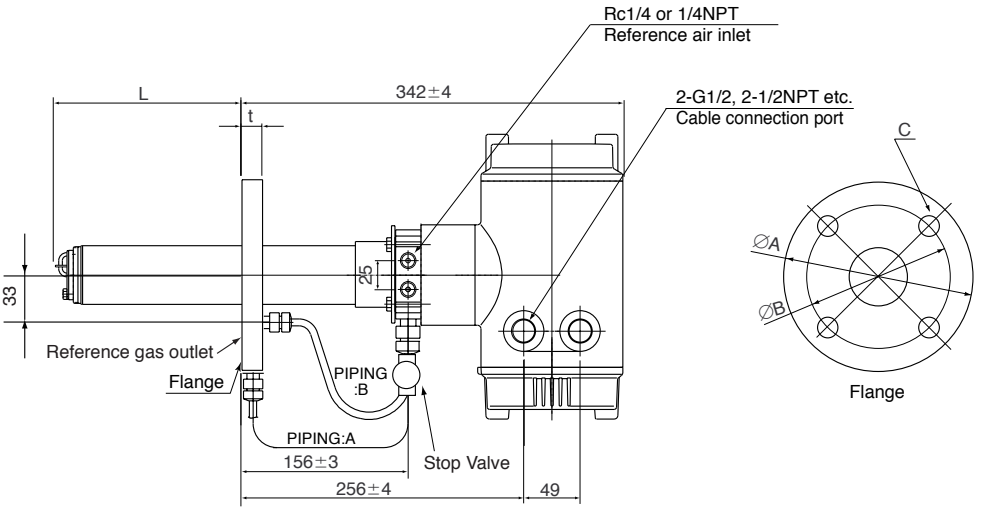
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-G	400	DIN PN10 DN100 SUS304	220	180	8-∅18	20	B	Approx. 11
	ZR202G-070-□-G	700							Approx. 13
	ZR202G-100-□-G	1000							Approx. 14
	ZR202G-150-□-G	1500							Approx. 15
	ZR202G-200-□-G	2000							Approx. 17
	ZR202G-250-□-G	2500							Approx. 19
	ZR202G-300-□-G	3000							Approx. 21

F3.23E.EPS

7. JIS 5K 65 FF

● **ZR202G-□□□-□-K-P**

Flange : JIS 5K 65 FF SUS304



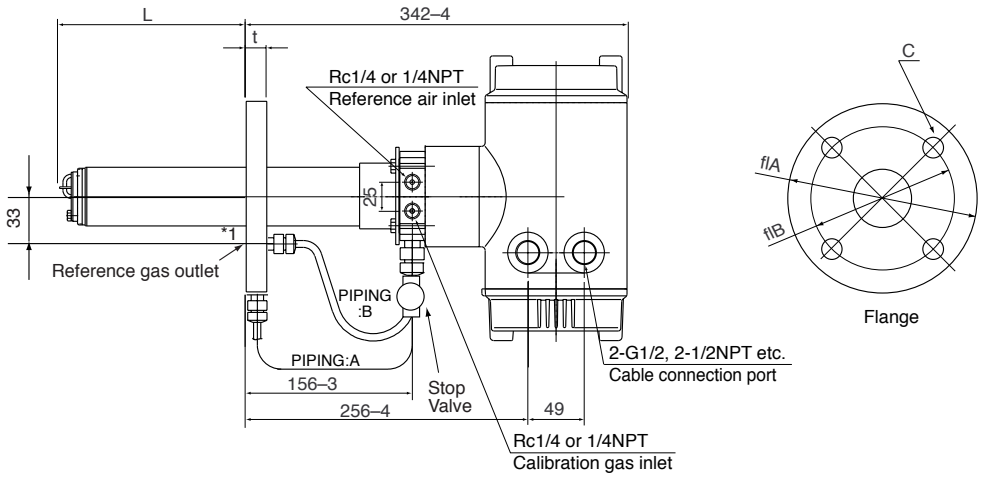
	Model,Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-K	400	JIS 5K 65 FF SUS304	155	130	4-∅15	14	A	Approx, 8
	ZR202G-070-□-K	700							Approx. 9
	ZR202G-100-□-K	1000							Approx. 10
	ZR202G-150-□-K	1500							Approx. 12
	ZR202G-200-□-K	2000							Approx. 14
	ZR202G-250-□-K	2500							Approx. 15
	ZR202G-300-□-K	3000							Approx. 17

F3.24E.EPS

8. JIS 10K 65 FF

● ZR202G-□□□-□-L-P

Flange : JIS 10K 65 FF SUS304



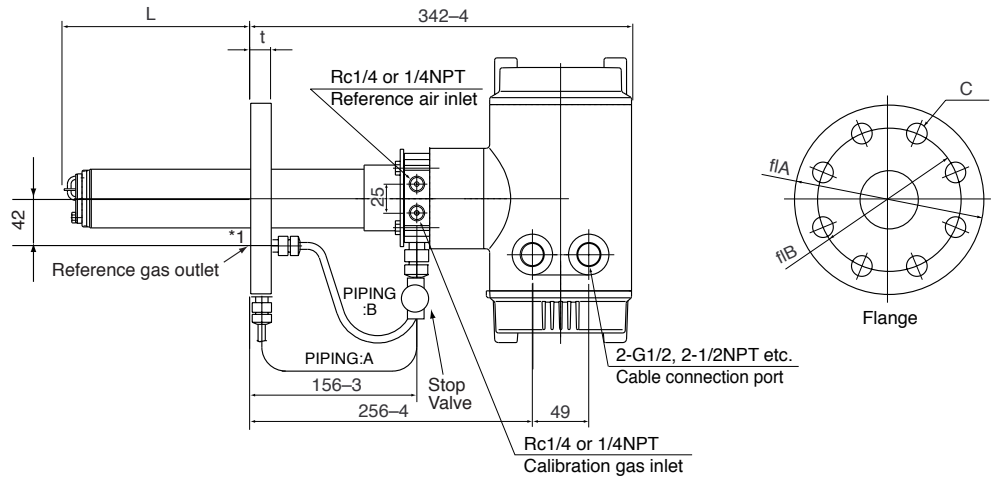
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-L	400	JIS 10K 65 FF SUS304	175	140	4-∅19	18	A	Approx. 9
	ZR202G-070-□-L	700							Approx. 10
	ZR202G-100-□-L	1000							Approx. 11
	ZR202G-150-□-L	1500							Approx. 13
	ZR202G-200-□-L	2000							Approx. 15
	ZR202G-250-□-L	2500							Approx. 16
	ZR202G-300-□-L	3000							Approx. 18

F3.25E.EPS

9. JIS 10K 80 FF

● ZR202G-□□□-□-M-P

Flange : JIS 10K 80 FF SUS304



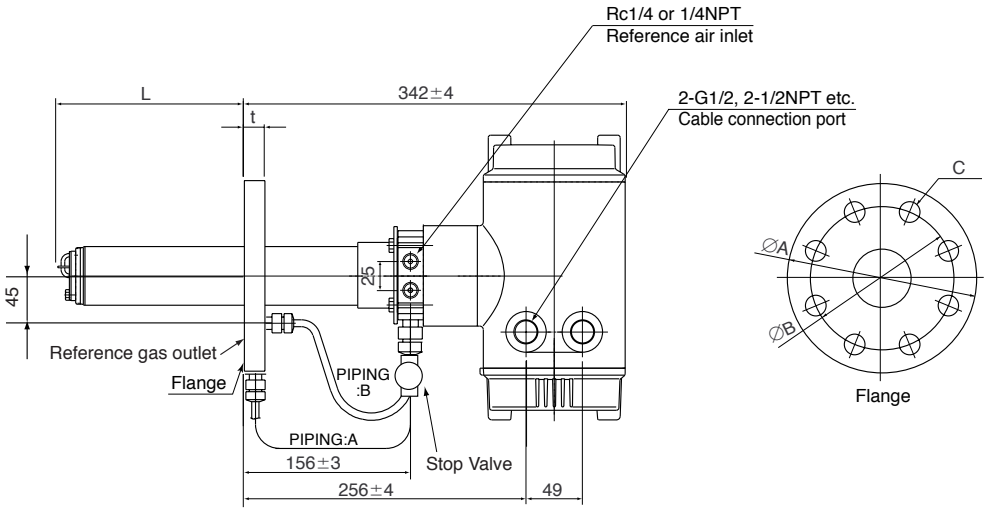
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-M	400	JIS 10K 80 FF SUS304	185	150	8-fl19	18	B	Approx. 9
	ZR202G-070-□-M	700							Approx. 10
	ZR202G-100-□-M	1000							Approx. 11
	ZR202G-150-□-M	1500							Approx. 13
	ZR202G-200-□-M	2000							Approx. 15
	ZR202G-250-□-M	2500							Approx. 16
	ZR202G-300-□-M	3000							Approx. 18

F3.26E.EPS

10. JIS 10K 100 FF

● **ZR202G-□□□-□-P-P**

Flange : JIS 10K 100 FF SUS304



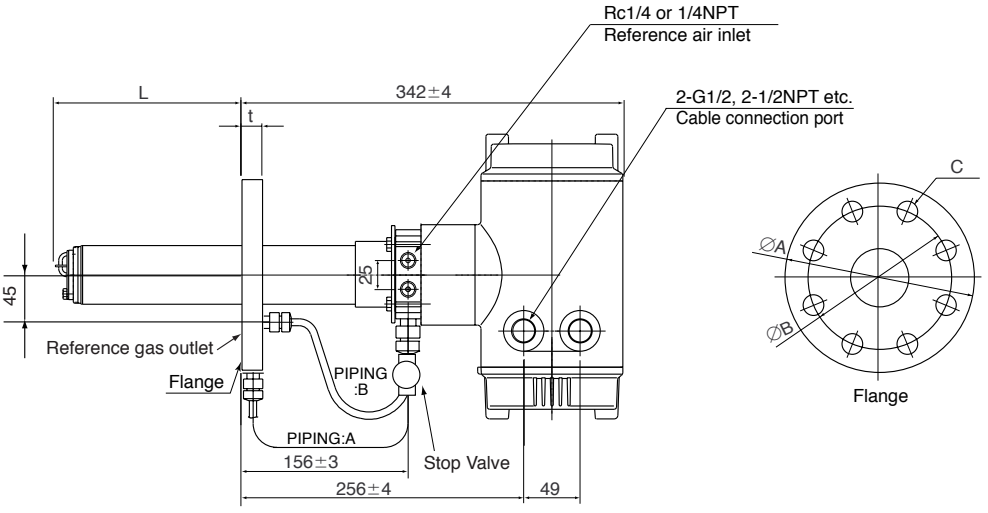
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-P	400	JIS 10K 100 FF SUS304	210	175	8-∅19	18	B	Approx. 10
	ZR202G-070-□-P	700							Approx. 12
	ZR202G-100-□-P	1000							Approx. 13
	ZR202G-150-□-P	1500							Approx. 14
	ZR202G-200-□-P	2000							Approx. 16
	ZR202G-250-□-P	2500							Approx. 18
	ZR202G-300-□-P	3000							Approx. 20

F3.27E.EPS

11. JPI Class 150 4 RF

● **ZR202G-□□□-□-R-P**

Flange : JPI Class 150 4 RF SUS304



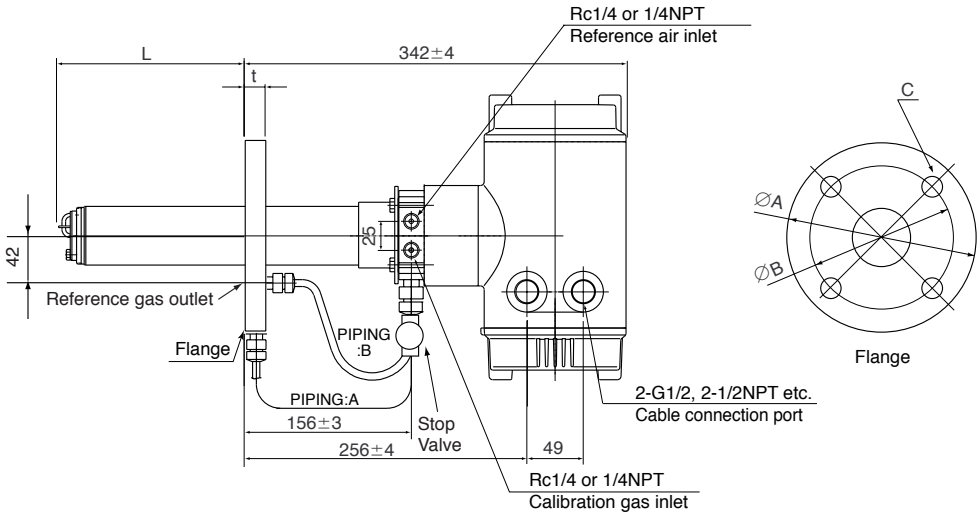
	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-R	400	JPI Class 150 4 RF SUS304	229	190.5	8-∅19	24	B	Approx. 13
	ZR202G-070-□-R	700							Approx. 14
	ZR202G-100-□-R	1000							Approx. 15
	ZR202G-150-□-R	1500							Approx. 17
	ZR202G-200-□-R	2000							Approx. 19
	ZR202G-250-□-R	2500							Approx. 21
	ZR202G-300-□-R	3000							Approx. 22

F3.28E.EPS

12. JPI Class 150 3 RF

● **ZR202G-□□□-□-S-P**

Flange : JPI Class 150 3 RF



	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-S	400	JPI Class 150 3 RF SUS304	190	152.4	4-∅19	24	B	Approx. 11
	ZR202G-070-□-S	700							Approx. 12
	ZR202G-100-□-S	1000							Approx. 13
	ZR202G-150-□-S	1500							Approx. 14
	ZR202G-200-□-S	2000							Approx. 16
	ZR202G-250-□-S	2500							Approx. 18
	ZR202G-300-□-S	3000							Approx. 20

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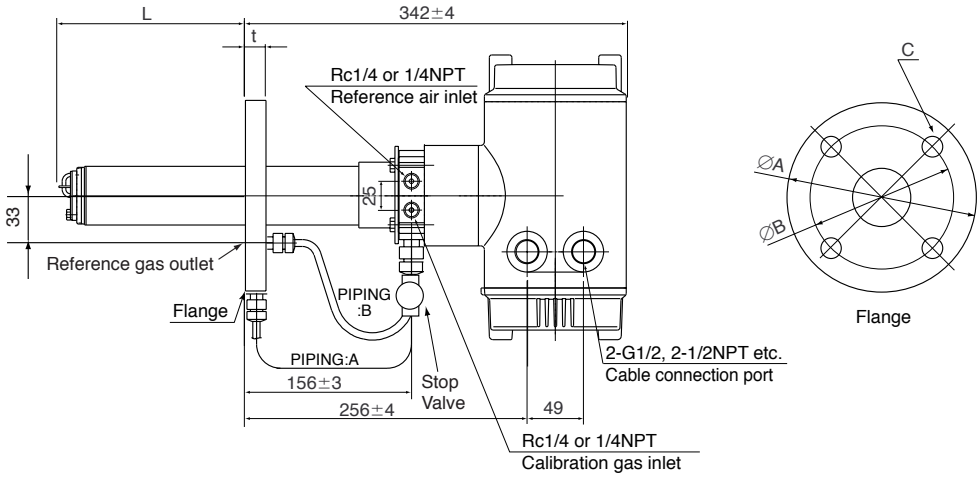
13. Westinghouse

● **ZR202G-□□□-□-W-P**

Flange : Westinghouse



	Model, Code	L	Flange					PIPING	Weight (kg)
			Specification	A	B	C	t		
	ZR202G-040-□-W	400	Westinghouse	155	127	4-∅15	14	A	Approx. 6
	ZR202G-070-□-W	700							Approx. 7
	ZR202G-100-□-W	1000							Approx. 8
	ZR202G-150-□-W	1500							Approx.10
	ZR202G-200-□-W	2000							Approx.12
	ZR202G-250-□-W	2500							Approx.14
	ZR202G-300-□-W	3000							Approx.15

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4. Piping

This chapter describes piping procedures in the three typical system configurations for EXAxt ZR

Integrated-type Zirconia High Temperature Humidity Analyzer.

- Ensure that each check valve, stop valve and joints used for piping are not leaking. Especially, if there is any leakage of the calibretion gas from piping and joints, it may cause clogging of the piping or incorrect calibration.
- Be sure to conduct leakage test after installing the piping.
- Basically, apply instrument air (dehumidified by cooling to the dew point -20° C or lower, and removing any dust, oil mist and the like) for the reference gas when piping.
- When the instrument uses natural convection for reference gas (Model ZR202G-□-□-□-C), ambient air near the probe is used for reference gas ; therefore the accuracy of analysis will be affected by ambient temperature changes or the like. If more accurate analysis is necessary, use instrument air (dehumidified by cooling to the dew point -20° C or lower, and removing any dust, oil mist and the like) for reference gas. Stable analyzing can be conducted when using instrument air.

4.1 Piping for System Configuration 1

The piping in System 1 is illustrated in Figure 4.1.

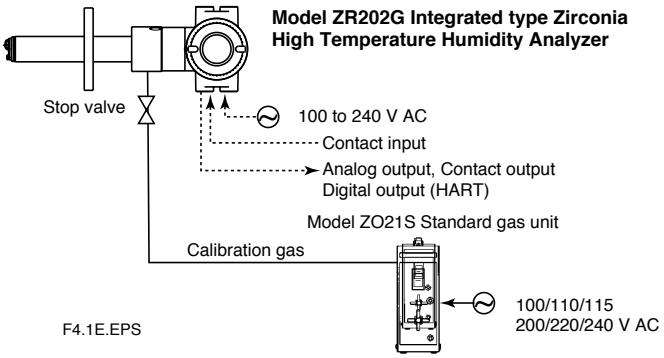

Figure 4.1 Piping in System 1

Piping in System 1 is as follows:

- Place a stop valve through the nipple at the calibration gas inlet of the equipment. Then mount a joint for a 6 mm (O.D.) x 4 mm (I.D.) soft tube at the stop valve connection hole of the inlet side (see Section 4.1.2). The tube is to be connected to this joint only during calibration.

CAUTION

- The stop valve should be connected directly to the equipment. If any piping is present between the analyzer and the stop valve, water may condense in the pipe, which may cause damage to the sensor by rapid cooling when the calibration gas is introduced.
- The reference gas should have an oxygen concentration identical to that of fresh air (21%).

4.1.1 Piping Parts for System Configuration 1

Check that the parts listed in Table 4.1 are provided.

Table 4.1 Piping Parts

Equipment	Piping location	Parts	Description	
Humidity Analyzer	Calibration gas inlet	Stop valve	(L9852CB or G7016XH) recommended by YOKOGAWA	
		Nipple *	Rc1/4 or 1/4 NPT	Commercially available
		Joint for tube connection	Rc1/4 (1/4NPT) for a ∅6×∅4mm soft tube	Commercially available
	Reference gas inlet	(Sealed up)	(when piping is required, refer to Section 4.1.3)	

Note: Parts marked with * are used when required.

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4.1.2 Connection to the Calibration Gas Inlet

When carrying out calibration, connect the piping (6(O.D) × 4(I.D.) mm tube) from the standard gas unit to the calibration gas inlet of the equipment. Mount the stop valve (of a quality specified by YOKOGAWA) through a nipple (found on the open market) as illustrated in Figure 4.2, and mount a commercially available joint at the stop valve tip. (The stop valve may be mounted on the equipment prior to shipping the equipment.)

Note 1 : Mount the stop valve in the vicinity of the equipment.

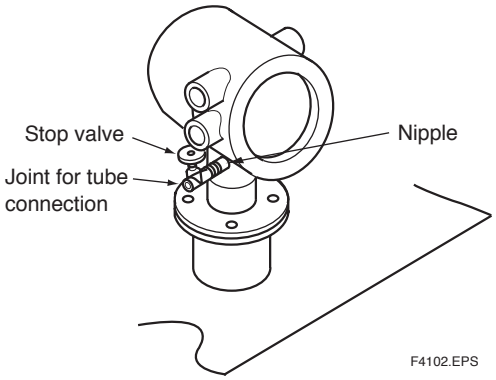

Figure 4.2 Connection to the Calibration Gas Inlet

4.1.3 Connection to the Reference Gas Inlet

- Normally, no piping is required for the reference gas inlet when the equipment uses natural convection for reference gas (models ZR202G-□-□-□-C). Leave the plug as it is. If the air around the probe is polluted and the necessary oxygen concentration (21 vol% O_2) cannot be obtained, make an instrument air piping as in Section 4.2, System 2.
- When the equipment uses instrument air for the reference gas, piping is required as described in Section 4.2, System 2 (models ZR202G-□-□-□-E or -P).

4.2 Piping for System Configuration 2

Piping in System 2 is illustrated in Figure 4.7.

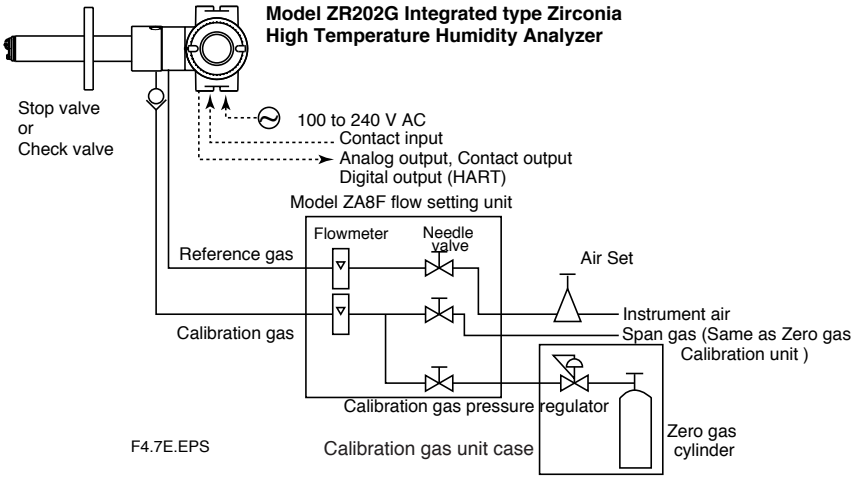

Figure 4.7 Piping for System 2

System 2 illustrated in Figure 4.7 requires piping as follows:

- Mount the stop valve or the check valve through a nipple to the reference gas inlet of the equipment.

4.2.1 Piping Parts for System Configuration 2

Check that the parts listed in Table 4.2 are provided.

Table 4.2 Piping Parts

Equipment	Piping location	Parts	Description
General-use Analyzer	Calibration gas inlet	Stop valve or check valve	Stop valve (L9852CB or G7016XH provided by YOKOGAWA), check valve (K9292DN or K9292DS) recommended by YOKOGAWA
		Nipple *	Rc1/4 or 1/4 NPT | Commercially available
		Zero gas cylinder	User´s scope
		Regulator valve	(G7013XF or G7014XF) recommended by YOKOGAWA
		Joint for tube connection	Rc1/4 or 1/4 NPT | Commercially available
	Reference gas inlet	Air set	(K9573XH/K9473XJ or G7004XF/K9473XG) recommended by YOKOGAWA
		Joint for tube connection	Rc1/4 or 1/4 NPT | Commercially available

Note: Parts marked with * are used when required.

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4.2.2 Piping for the Calibration Gas

This piping is to be installed between the zero gas cylinder and the ZA8F flow setting unit, and between the ZA8F flow setting unit and the ZR202G analyzer.

The cylinder should be placed in a calibration gas unit case or the like to avoid any direct sunlight or radiant heat so that the gas cylinder temperature does not exceed 40° C. Mount a pressure regulator (recommended by YOKOGAWA) on the cylinder.

Mount a stop valve or the check valve (recommended by YOKOGAWA) on the nipple (commercially available) at the calibration gas inlet of the equipment as illustrated in Figure 4.8. (The check valve or the stop valve may have been mounted on the equipment when shipped.) Connect the flow setting unit and the analyzer to a 6 mm (O.D.) × 4 mm (I.D.) (or nominal size 1/4 inch or larger) stainless steel pipe.

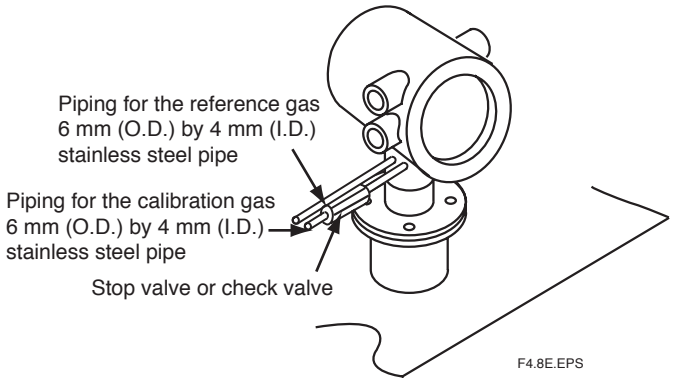


Figure 4.8 Piping for the Calibration Gas Inlet

4.2.3 Piping for the Reference Gas

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

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

Use a 6 mm (O.D.) × 4 mm (I.D.) (or nominal size 1/4 inch or larger) stainless steel pipe between the flow setting unit and the analyzer.

4.3 Piping for System Configuration 3

Piping in System 3 is illustrated in Figure 4.9. In System 3, calibration is automated; however, the piping is basically the same as that of System 2. Refer to Section 4.2.

Adjust secondary pressure of both the air set and the zero gas regulator so that these two pressures are approximately the same. The flow rate of zero and span gases (normally instrument air) are set by individual needle valve. After installation and wiring, check the calibration contact output (see Sec. 7.9.2), and adjust zero gas regulator and calibration gas needle valve so that zero gas flow is within the permitted range. Next check span gas calibration contact output and adjust air set so that span gas flow is within the permitted range.

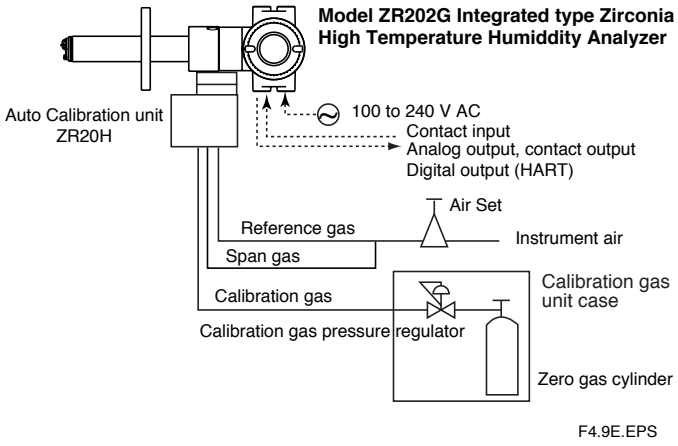
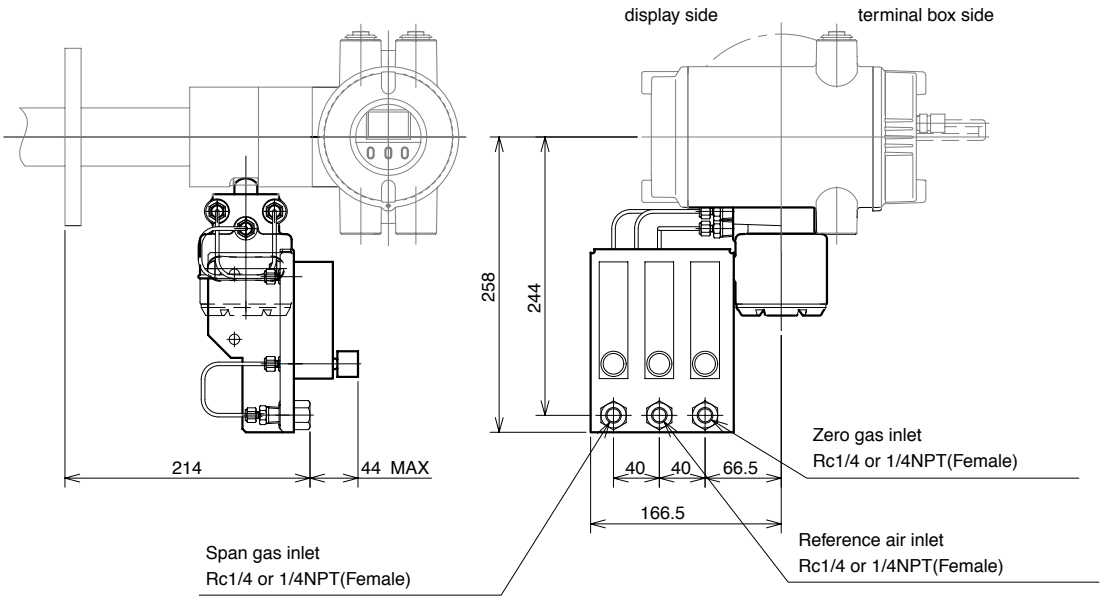


Figure 4.9 Piping for System 3

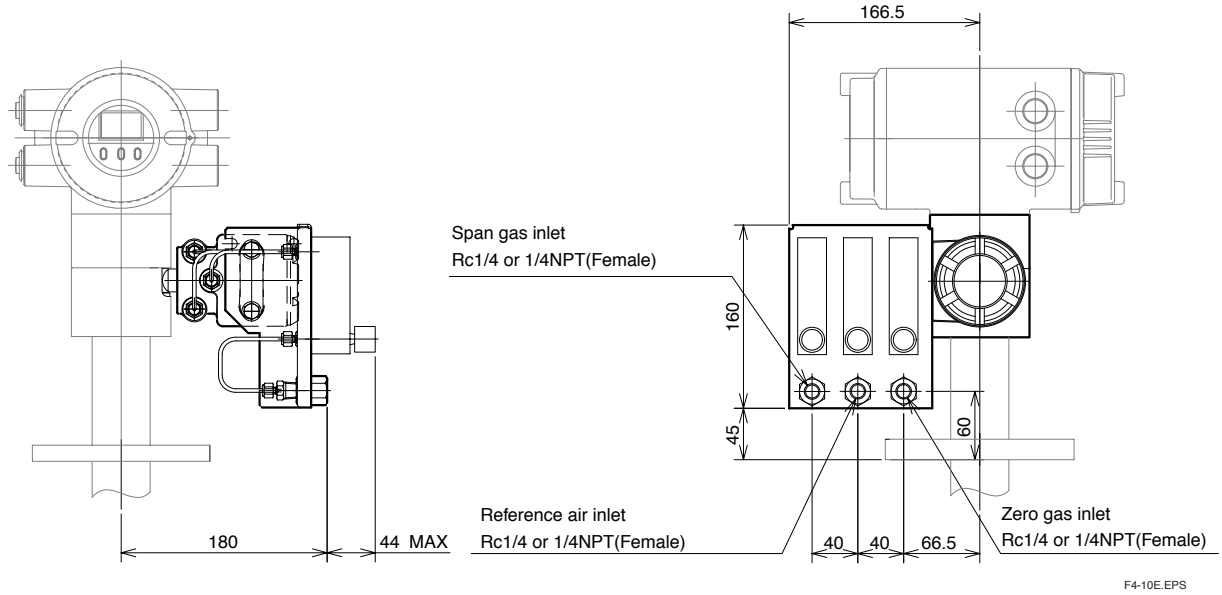
● Installation of ZR20H AutoCalibretion Unit

Unit: mm

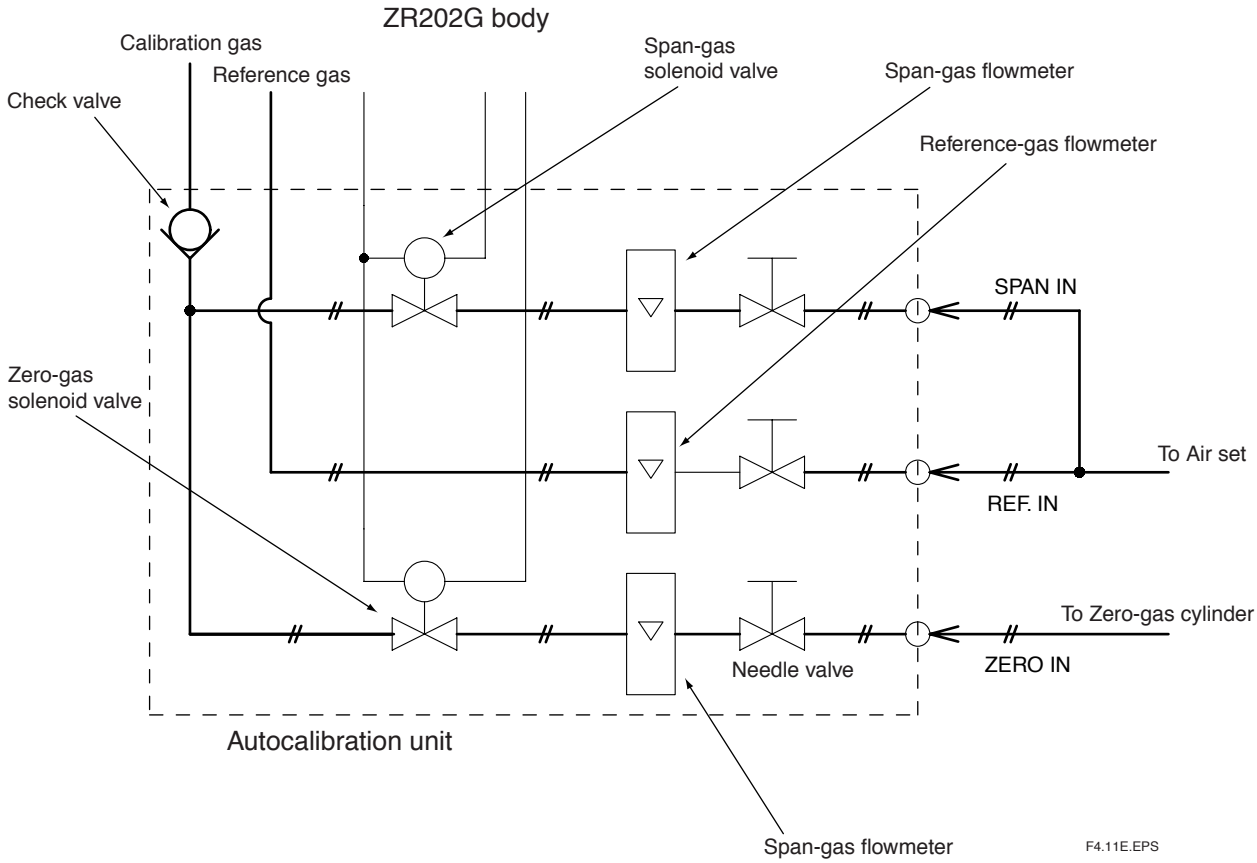
Horizontal mounting on the ZR202G (-A)



Vertical mounting on the ZR202G (-B)



Piping Diagram of ZR20H



5. Wiring

In this Chapter, the wiring necessary for connection to the EXAxtZR Integrated type Zirconia High-temperature Humidity Analyzer is described.

5.1 General

CAUTION

- Never supply current to the equipment or any other device constituting a power circuit in combination with the equipment, until all wiring is completed.
- This product complies with CE marking.
  Where compliance with CE marking is necessary, the following wiring procedure is necessary.

1. Install an external switch or circuit breaker to the power supply of the equipment.
2. Use an external switch or circuit breaker rated 5A and conforming with IEC 947-1 or IEC 947-3.
3. It is recommended that the external switch or circuit breaker be mounted in the same room as the equipment.
4. The external switch or circuit breaker should be installed within the reach of the operator, and marked as the power supply switch of this equipment.

Wiring procedure

Wiring should be made according to the following procedure:

1. Be sure to connect the shield of the shielded line to FG terminal of the analyzer.
2. The most outer sheath of the signal line and the power cable should be stripped off to the minimum necessary length.
3. Signal may be affected by noise emission when the signal lines, power cable and heater cable are located in the same conduit. When using a conduit, signal lines should be installed in a separate conduit from power and heater cables. Be sure to ground the metal conduit.
4. Install the attached two blind plugs to unused cable connection gland(s) of the equipment.
5. The cables indicated in Table 5.1 are used for wiring.
6. After completing the wiring, screw the cover in the terminal box body and secure it with a lock screw.

Table 5.1 Cable Specifications

Terminal name of equipment	Name	Need for shields	Cable type	Number of wires
L, N, ⏚	Power supply		CVV	2 or 3 *
AO+, AO-	Analog output	○	CVVS	2
DO-1, DO-2	Contact output		CVV	2 to 8
DI-1, DI-2, DI-C	Contact input		CVV	3

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Note *: When the case is used for protective grounding, use a 2-wire cable.

Note

- Select an appropriate cable O.D. to match the cable gland size.
- Protective grounding should have the grounding resistance of 100Ω or less (JIS Class 3 ground).
- Special cable length is required for HART communication For detail of the HART communication refer to IM11M12A01-51E HART Protocol Section 1.1.2 Communication line Requirement.

5.1.1 Terminals for the External Wiring

Remove the terminal cover on the opposite side of the display to gain access to the external wiring terminals.

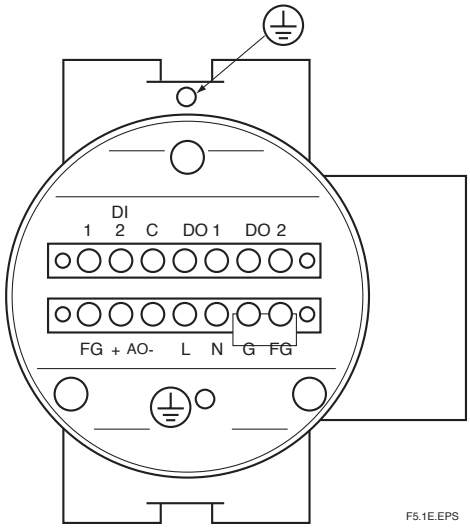
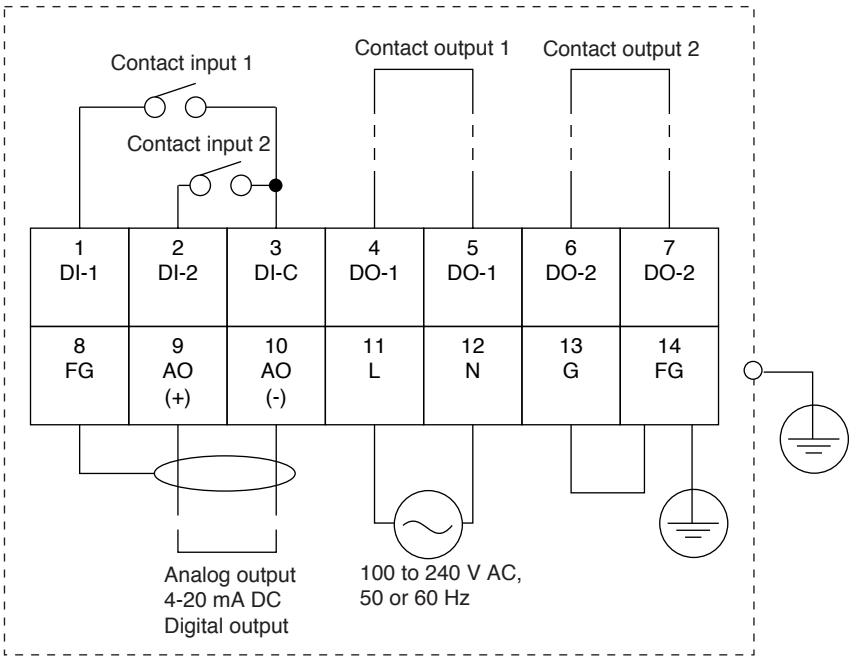


Figure 5.1 Terminals for External Wiring

5.1.2 Wiring

Make the following wiring for the equipment. It requires a maximum of four wiring connections as shown below.

(1) Analog output signal
(2) Power and ground
(3) Contact output
(4) Contact input



The protective grounding for the analyzer shall be connected either the protective ground terminal in the equipment or the ground terminal on the case.
Standard regarding grounding: Ground to earth, ground resistance: 100Ω or less.

F5.2E.EPS

Figure 5.2 Wiring Connection

5.1.3 Mounting of Cable Gland

For each wiring inlet connection of the equipment, mount the conduit appropriate for the screw size or a cable gland.

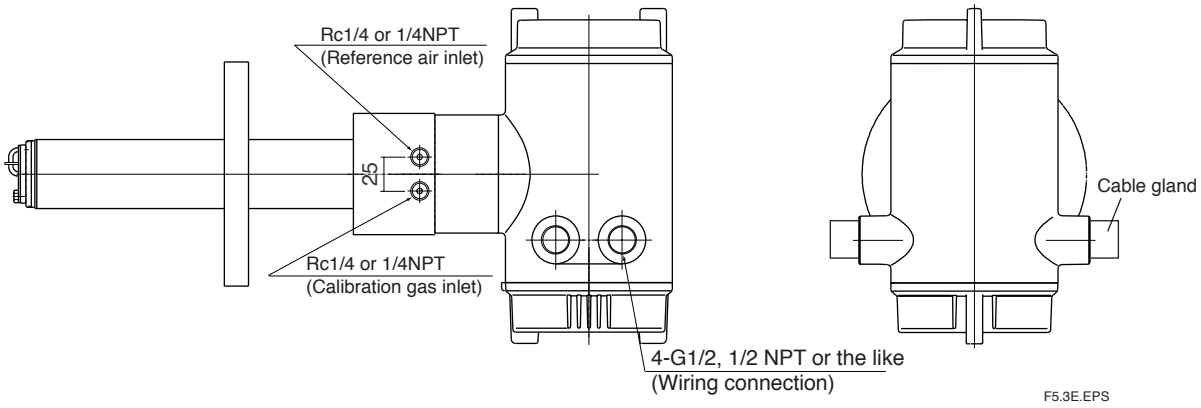


Figure 5.3 Cable Gland Mounting

5.2 Wiring for Analog Output

This wiring is for transmitting 4 to 20 mA DC output signals to a device, e.g. recorder. Maintain the load resistance including the wiring resistance of 550Ω or less.

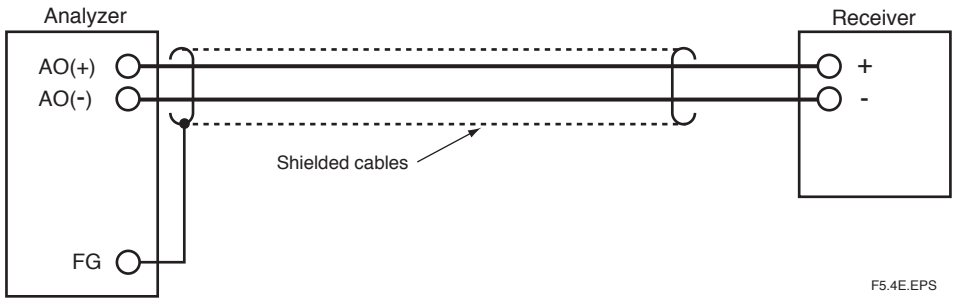


Figure 5.4 Wiring for Analog Output

5.2.1 Cable Specifications

Use a 2-core shielded cable for wiring.

5.2.2 Wiring Procedure

(1) M4 screws are used for the terminals. Use crimp-on terminals appropriate for M4 terminal screws for cable connections. Ensure that the cable shield is connected to the FG terminal of the equipment.
(2) Be sure to connect (+) and (−) polarities correctly.

CAUTION

- Before opening the detector cover, loosen the lock screw. If the screw is not loosened first, the screw will damage the cover and the terminal box will require replacement. When opening and closing the cover, remove any sand particles or dust to avoid gouging the thread.
- After screwing the cover on the equipment body, secure it with the lock screw.

5.3 Wiring Power and Ground Terminals

Wiring for supplying power to the analyzer and grounding the equipment.

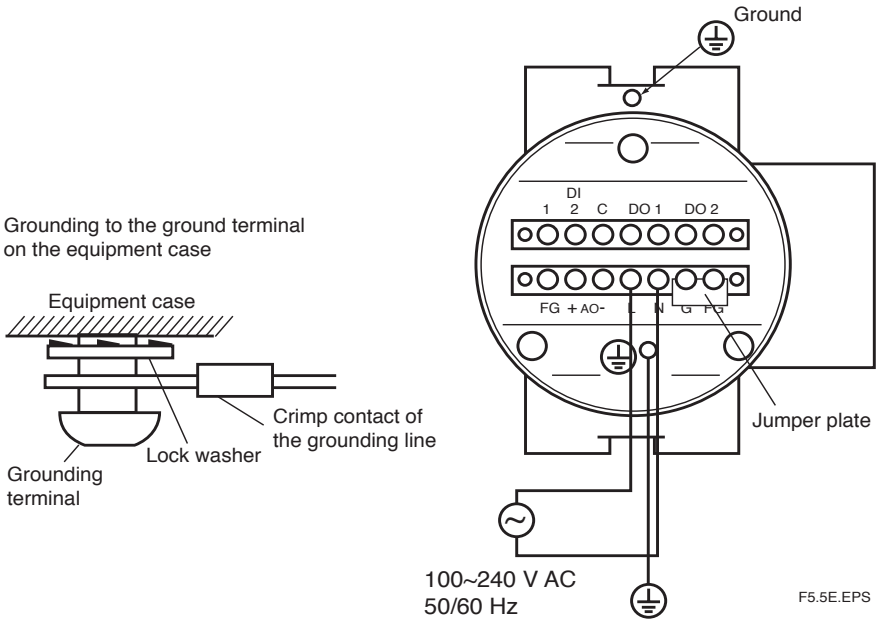


Figure 5.5 Power and Grounding Wiring

5.3.1 Wiring for Power Line

Connect the power wiring to the L and N terminals of the equipment. For a three-core cable, ground one core appropriately. Proceed as follows:

(1) Use a two-core or three-core shielded cable.
(2) M4 screws are used for the terminals. Use crimp-on terminals appropriate for M4 terminal screws for cable connections.

5.3.2 Wiring for Ground Terminals

The ground wiring of the analyzer should be connected to either the ground terminal of the equipment case or the terminal inside of the equipment. Proceed as follows:

(1) Keep the ground resistance of 100Ω or less (JIS Class D grounding).
(2) When connecting the ground wiring to the ground terminal of the equipment case, be sure that the lock washer is in contact with the case surface (see Figure 5.5.).
(3) Ensure that the jumper plate is connected between the G terminal and the FG terminal of the equipment.
(4) The size of external ground screw thread is M4. Each cable should be terminated corresponding crimp-on terminals.

5.4 Wiring for Contact Output

The equipment can output a maximum of two contact signals. These contact outputs can be used for different applications such as a low-limit alarm or high-limit alarm.

Do the contact output wiring according to the following requirements.

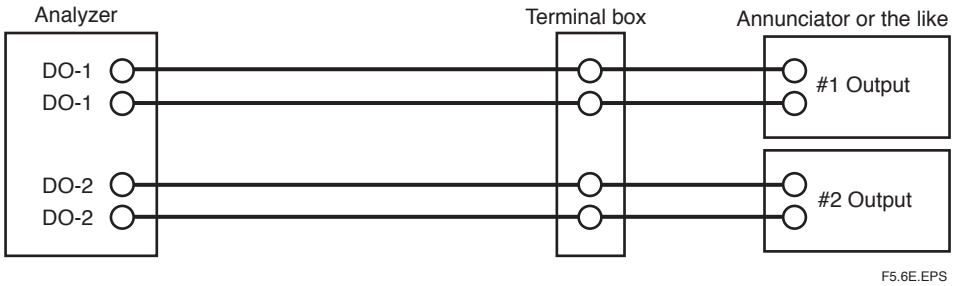


Figure 5.6 Contact Output Wiring

5.4.1 Cable Specifications

The number of wires in cable varies depending on the number of contacts used.

5.4.2 Wiring Procedure

(1) M4 screws are used for the terminals. Use crimp-on terminals appropriate for M4 terminal screws for cable connections.
(2) The contact output relays are rated 30 V DC 3 A, 250 V AC 3 A. Connect a load (e.g. pilot lamp and annunciator) within these limits.

5.5 Wiring for Contact Input

The converter can execute specified function when receiving contact signals.

To use these contact signals, proceed wiring as follows:

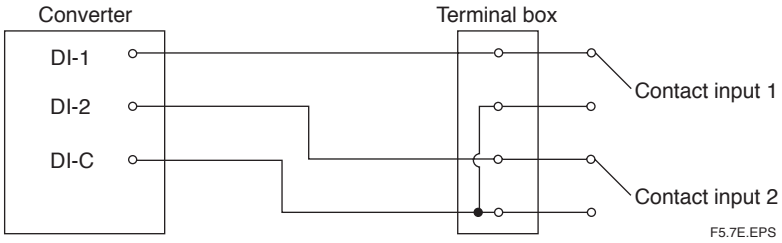


Figure 5.14 Contact Input Wiring

5.5.1 Cable Specifications

Use a 2-wire or 3-wire cable for this wiring. Depending on the number of input(s), determine which cable to use.

5.5.2 Wiring Procedure

(1) M4 screws are used for the terminals of the converter. Each wire in the cable should be terminated in the corresponding crimp-on terminal.
(2) The ON/OFF level of this contact input is identified by the resistance. Connect a contact input that satisfies the descriptions in Table 5.2.

Table 5.2 Identification of Contact Input ON/OFF

	Closed	Open
Resistance	200 Ω or less	100 kΩ or more

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6. Components

This chapter describes the names and functions of components for the major equipment of the EXAxt ZR Integrated type Zirconia High-temperature Humidity Analyzer.

6.1 ZR202G High-temperature Humidity Analyzer

6.1.1 Integrated-type High-temperature Humidity Analyzer

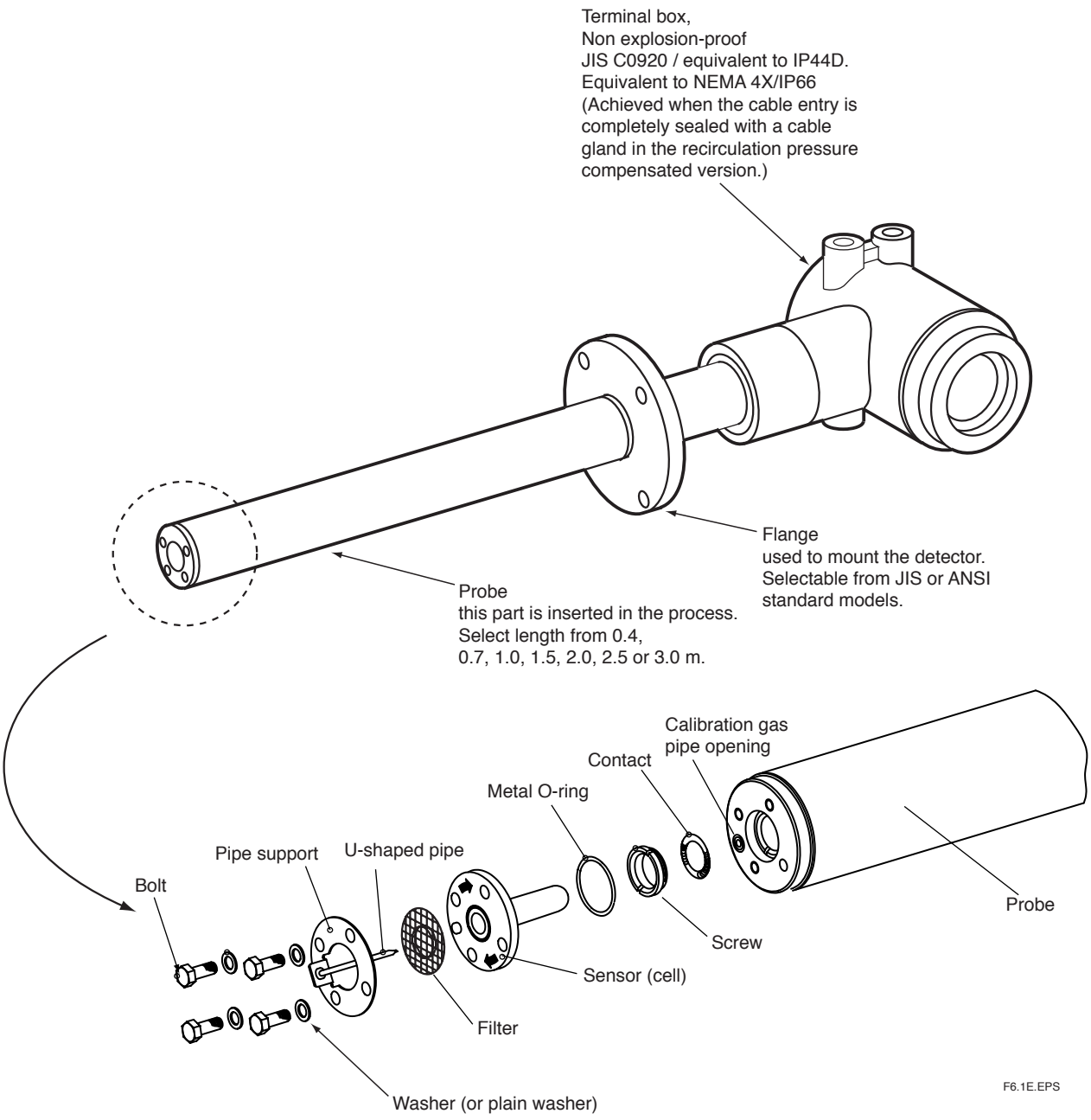


Figure 6.1 Integrated-type High-temperature Humidity Analyzer

6.2 ZA8F Flow Setting Unit and ZR20H Automatic Calibration Unit

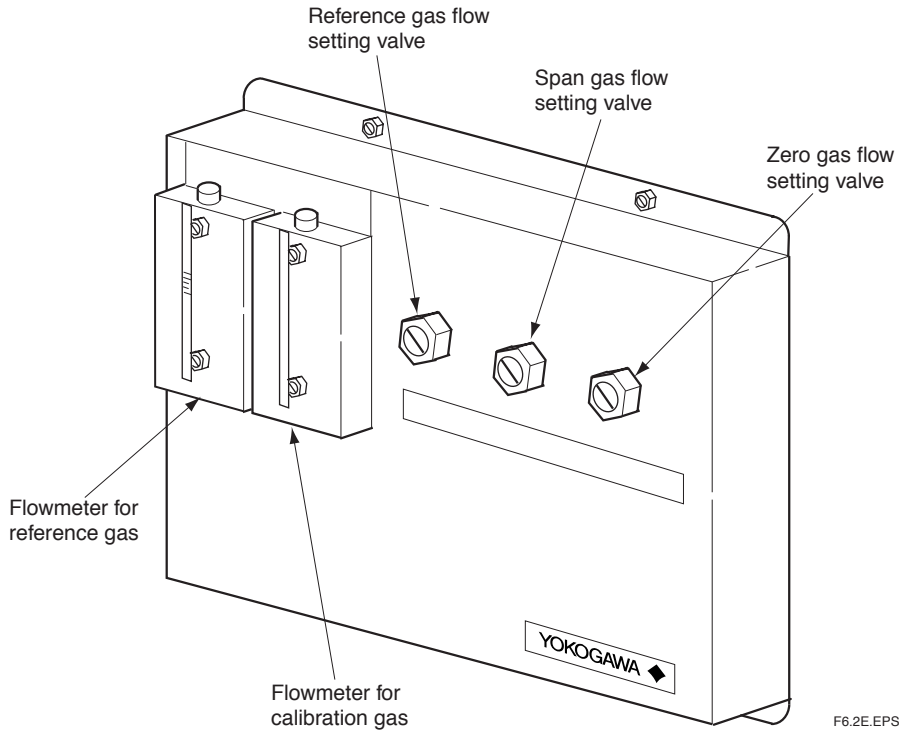


Figure 6.2 ZA8F Flow Setting Unit

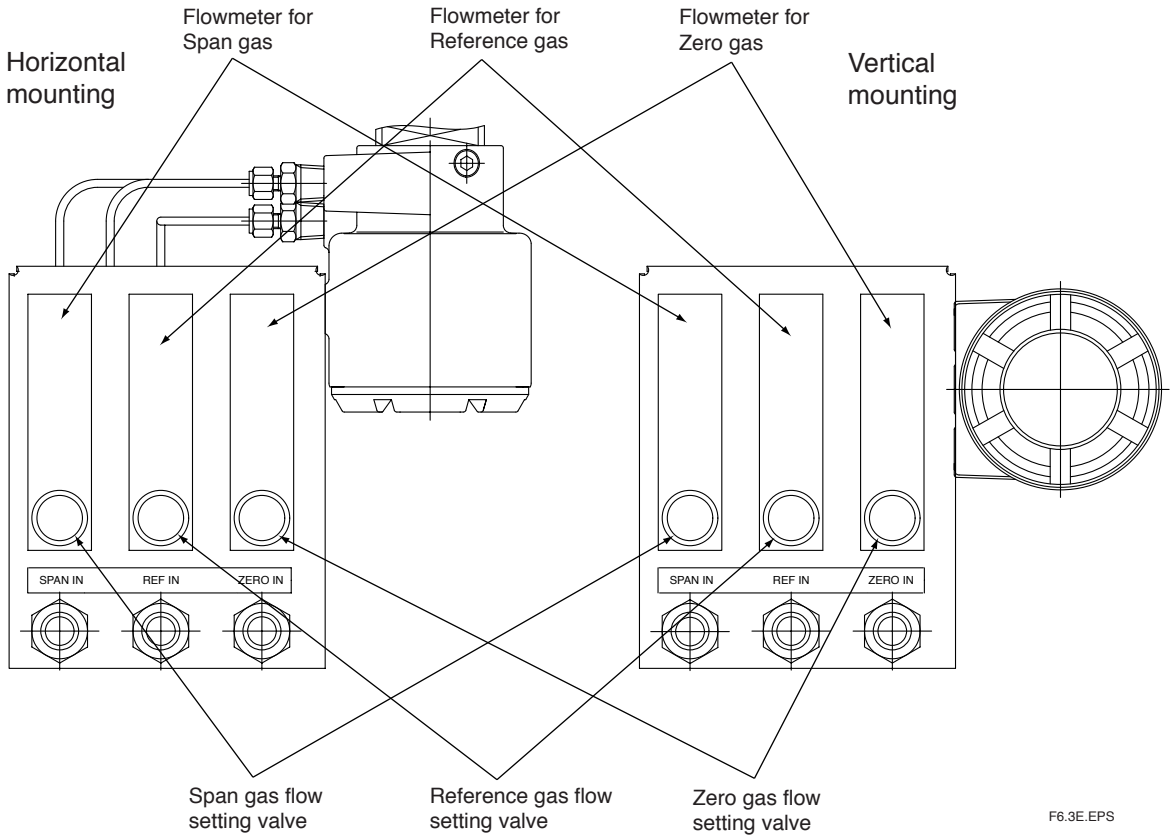


Figure 6.3 ZR20H Automatic Calibration Unit

7. Startup

The following describes the minimum operating requirements — from supplying power to the converter to analog output confirmation to manual calibration.

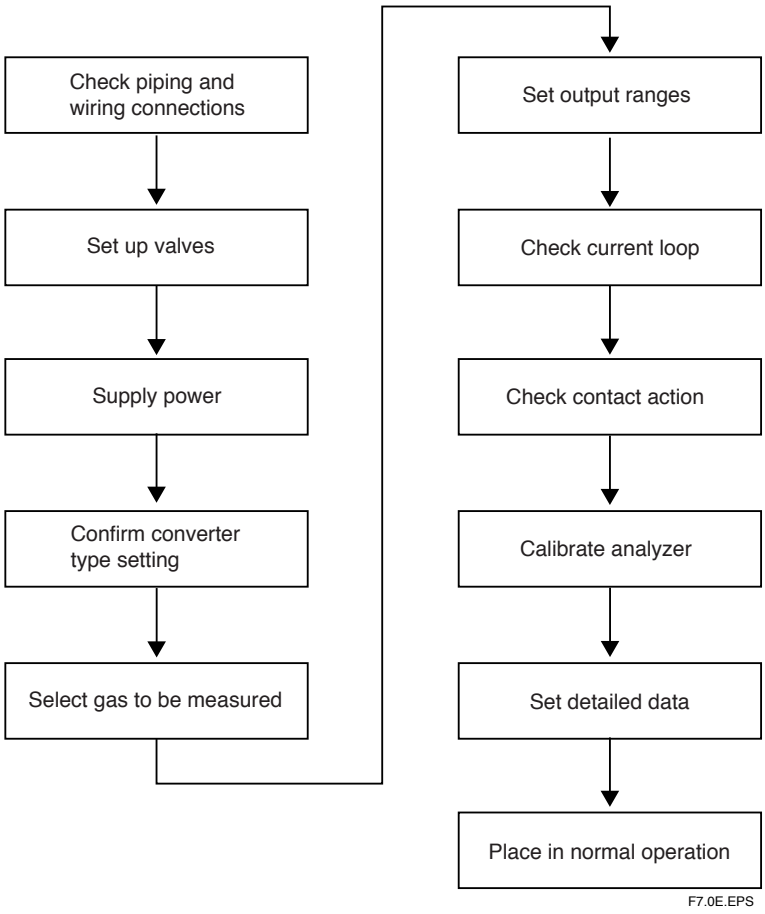


Figure 7.1 Startup Procedure

System tuning by the HART communicator, refer to IM 11M12A01-51E "HART Communication Protocol".

7.1 Checking Piping and Wiring Connections

Refer to Chapters 4 and 5, earlier in this manual, for piping and wiring confirmations.

7.2 Valve Setup

Set up valves and associated components used in the analyzer system as follows procedures:

(1) If a stop valve is used in the detector's calibration-gas inlet, fully close this valve.
(2) If instrument air is used as the reference gas, adjust the air-set secondary pressure so that an air pressure of measured gas pressure plus approx. 50 kPa (or measured gas pressure plus apporox. 150 kPa when a check valve is used, maximum pressure ration is 300 kPa) is obtained. Turn the reference-gas flow setting valve in the flow setting unit to obtain a flow of 800 to 1000 ml/min. (Turning the valve shaft counterclockwise increases the rate of flow. Before turning the valve shaft, if the valve has a lock nut, first loosen the lock nut.) After completing the valve setup, be sure to tighten the lock nut.

Note

The calibration-gas flow setting is described later. Fully close the needle valve in the flow setting unit.

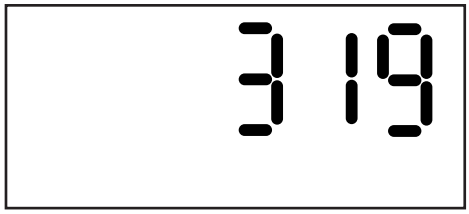
7.3 Supplying Power to Converter

CAUTION

To avoid temperature changes around the sensor, it is recommended that (rather than turning it on and off) the power be continuously supplied to the Humidity Analyzer if it is used in an application where it is used periodically.

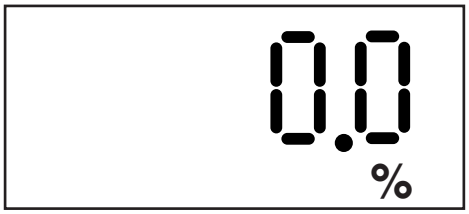
It is also recommended to flow a span gas (instrument air) beforehand.

Supply power to the converter. A display as in Figure 7.1, which indicates the detector's sensor temperature, then appears. As the heat in the sensor increases, the temperature gradually rises to 750° C. This takes about 20 minutes after the power is turned on, depending somewhat on the ambient temperature and the measured gas temperature. After the sensor temperature has stabilized at 750° C, the converter is in measurement mode. The display panel then displays the oxygen concentration as in Figure 7.2. This is called the basic panel display.



F7.1E.EPS

Figure 7.1 Display of Sensor Temperature During Warmup



F7.2E.EPS

Figure 7.2 Measurement Mode Display

7.4 Operation of Infrared Switch

7.4.1 Display and Switches

This equipment uses an infrared switch that enables operation with the cover closed. Figure 7.3 shows the infrared switch and the display. Table 7.1 shows the three switch (keys) and functions. Figure 7.3 shows the infrared switch and the display.

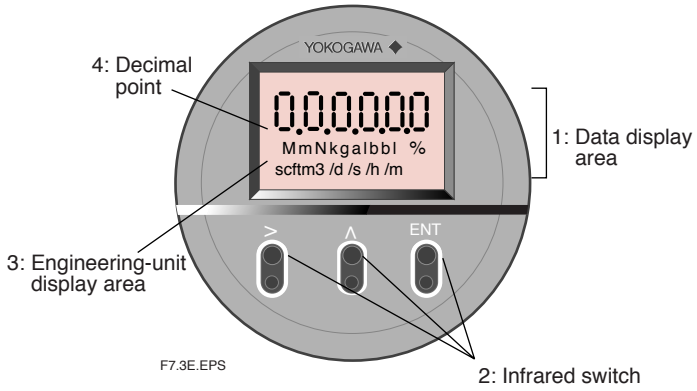


Figure 7.3 Infrared switch and the display

1. Data display area: Displays the humidity, set values, alarm numbers, and error numbers.
2. Infrared switch: Three switches perform data setting operations.
3. Engineering-unit display area: the percent sign appears when the humidity is displayed.
4. Decimal point: A decimal point is displayed.

Table 7.1 Switch and Function

Switch	Function
>	1. Moves the position of the digit to the right. If you continuously touch the key, the position of the digit will move continuously to the right, finally returning to the leftmost position after reaching the rightmost position of the digit. 2. Selects Yes or No. 3. When you touch this key together with the [ENT] key, the previous display then appears, or the operation will be cancelled.
^	Used to change values. If you continuously touch this key, the value of the digit will increase continuously, e.g., from 1 to 2 to 3 (for numeric data), or from A to B to C (for alphabetic characters), and finally return to its original value.
ENT	1. Used to change the basic panel display to the parameter selection display. 2. Used to enter data. 3. Advances the operation.

T7.1E.EPS

The three infrared switches are activated by completely touching the glass surface of the switch. To touch any of the keys continuously, first touch the surface and then completely remove your finger from the surface. Then touch it again.

Infrared switches consist of two elements: an infrared emitting element and an infrared receive element. Infrared light-waves from the element bounce on the operator's finger and are reflected back to the receive element, thereby causing the infrared switch to turn on and off, depending on the strength of the reflected light-waves. From these operating principles, carefully observe the following:

CAUTION

1. Be sure to put the equipment case cover back on. If this is not done, the infrared switch will not reflect the infrared light-waves, and a “dSPErr” error will be issued.
2. Before placing the equipment in operation, be sure to wipe off any moisture or dust on the glass surface if it is wet or dirty. Also make sure your fingers are clean and dry before touching the glass surface of the switch.
3. If the infrared switches are exposed to direct sunlight, they may not operate correctly. In such a case, change position of the display or install a sun cover.

7.4.2 Display Configuration

The parameter codes provided for the equipment are used to control the equipment display panels (see below). By selecting appropriate parameter codes, you can conduct calibration and set operation parameters. Figure 7.4 shows the configuration of display items. The parameter codes are listed in groups of seven; which are briefly described in Table 7.2.

To enter parameters, you first need to enter the password.

Touch the [**>**] key and [**ENT**] key at same time to revert to the main screen.

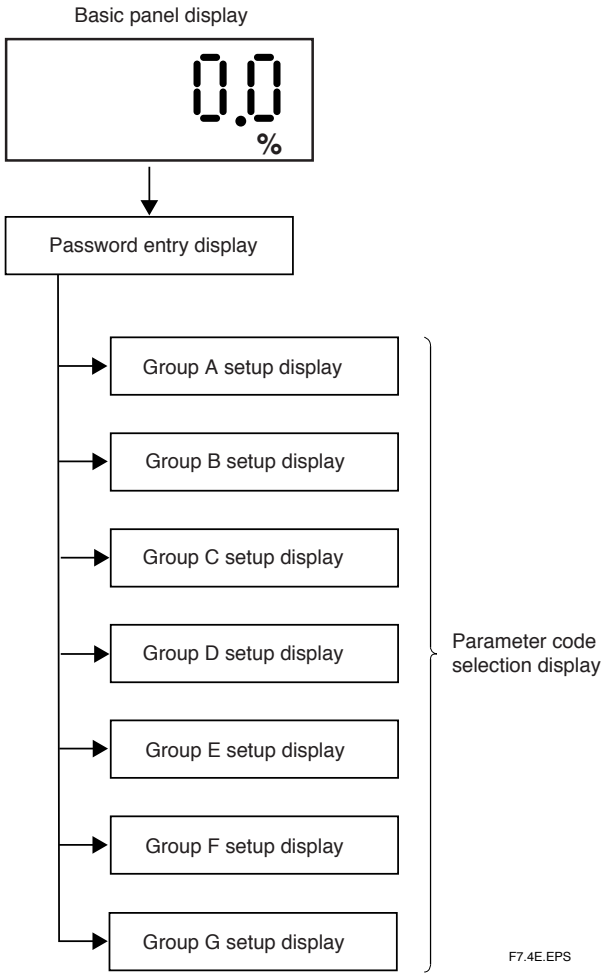


Figure 7.4 Display Configuration

Table 7.2 Display Functions

Display	Function and item to be set
Basic panel	Displays the oxygen concentration in normal operation, or displays the detector heater temperature while warming up. If an error or alarm arises, the corresponding error or alarm number appears.
Password entry	Enters the password for the parameter code selection display.
Group A setup	Displays detailed data, such as the cell voltage or temperature.
Group B setup	Sets and performs calibration and blowback.
Group C setup	Sets analog output.
Group D setup	Sets an alarm.
Group E setup	Sets the input and output contacts.
Group F setup	Selects the type of equipment and sets the parameters for computation.
Group G setup	Performs the current-loop or contact checks.

T7.2E.EPS

7.4.3 Entering Parameter Code Selection Display

This section briefly describes the password entry procedure for entering the parameter code selection display. The password is 1102 - it cannot be changed to a different password.

Switch operation			Display	Description
>	∧	ENT	21.0%	Warm-up is complete, and the basic panel is now displayed.
>	∧	ENT	PASSno	Continuously touch the [**ENT**] key for at least three seconds to display "PASSno."
>	∧	ENT	0000	Touch the [**ENT**] key again. This allows you to change the leftmost digit that is flashing.
>	∧	ENT	1000	Set the password 1102. If you touch the [∧] key, the digit that is flashing will be 1.
>	∧	ENT	1000	Touch the [**>**] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	1100	Touch the [∧] key to change the numeric value to 1.
>	∧	ENT	1100	Touch the [**>**] key again to move the position of the digit that is flashing to the right one more digit. Continuously touch the [**>**] key, and the position of the digit that is flashing will move continuously to the right.
>	∧	ENT	1102	Touch the [∧] key to change the numeric value to 2. Continuously touch [**>**] key, and the numeric value increases continuously
>	∧	ENT	1102	If you touch the [**ENT**] key, all the digits flash.
>	∧	ENT	A01	Touch the [**ENT**] key again to display A01 on the parameter-code selection display.

T7.4.3E.EPS

The symbol [ ] indicates that the key is being touched.

Light characters indicates that the digits are flashing.

CAUTION

- If no key is touched for at least 20 seconds during password entry, the current display will automatically switch to the basic panel display.
- If no key is touched for at least 10 minutes during parameter code selection, the current display will automatically switch to the basic panel display.

7.4.4 Selecting Parameter Codes

Table Parameter Code Selection

Switch operation			Display	Description
>	∧	ENT	A01	Password has been entered and the parameter code selection display has appeared. Character A is flashing, indicating that character A can be changed.
>	∧	ENT	A01	If you touch the [>] key once, the position of the digit that is flashing will move to the right. This allows you to change 0.
>	∧	ENT	A01	Touch the [>] key again to move the position of the digit that is flashing to the right one m ore digit. This enables you to change numeric character 1.
>	∧	ENT	A01	Touch the [>] key again to return the position of the digit that is flashing to A. Continuously touch the [>] key, and the position of the digit that is flashing will move continuously to the right.
>	∧	ENT	b01	If you touch the [∧] key once, character A will change to B.
>	∧	ENT	C01	Touch the [∧] key once to change to C.
>	∧	ENT	d01	Continuously touch the [>] key, and the value of the digit that is flashing will increase continuously, from D to E to F to G to A. Numeric values will change from 0 to 1 to 2 to 3 … to 8 to 9 and back to 0. However, numbers that are not present in the parameter codes, will be skipped. Each digit is changed independently. Even though a low-order digit changes from 9 to 0, a high-order digit will not be carried.
>	∧	ENT	Set Value	After you select the desired character, touch the [**ENT**] key. The set data will be displayed.

T7.4.4EEPS

The symbol [ ] indicates that the key is being touched. Light characters indicate that the digits are flashing.

7.4.5 Changing Set Values

(1) Selecting numeric values from among preset values

Switch operation			Display	Description
>	∧	ENT	0	The set value is displayed after the parameter code selection. An example of how to select either 0, 1, or 2 as the set value is given below. (The currently set value is 0.)
>	∧	ENT	1	Touch the [∧] key once to change the current value from 0 to 1.
>	∧	ENT	2	Touch the [∧] key again to change to the numeric value 2.
>	∧	ENT	0	If you touch the [∧] key again, the numeric value will return to 0. Continuously touch the key, and the numeric values will change continuously.
>	∧	ENT	C01	Display the desired numeric value and touch the [**ENT**] key. The display will then return to the parameter code selection

T7.4.5.1E.EPS

(2) Entering numeric values for the humidity and factors

Switch operation			Display	Description
>	∧	ENT	00.0	The set value is displayed after the parameter code selection. An example of entering "9.8" is given below. (The currently set value is 0.0)
>	∧	ENT	00.0	Touch the [>] key to move the position of the digit that is flashing to the digit to be changed. Continuously touch the [>] key, and the position of the digit that is flashing will move continuously to the right.
>	∧	ENT	09.0	Touch the [∧] key to set the numeric value 9. Continuously touch the [∧] key, and the numeric value will change in sequence from 0 to 1 to 2 to 3 … to 8 to 9 and back to 0.
>	∧	ENT	09.0	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	09.8	Touch the [∧] key to set the numeric value 8.
>	∧	ENT	09.8	After the numeric value appears, touch the [**ENT**] key.
>	∧	ENT	09.8	If you touch the [**ENT**] key again, the flashing stops and the current set value will be in effect.
>	∧	ENT	C11	Touch the [**ENT**] key once again to return to the parameter code selection display.

T7.4.5.2E.EPS

(3) If invalid numeric values are entered:

>	∧	ENT 	98.0	If an invalid numeric value (beyond the input range specified) is entered, "ERR" will appear for two seconds after touching the [**ENT**] key.
>	∧	ENT 	Err	
>	∧	ENT	00.0	"ERR" appears for two seconds, and the display returns to the first set value. Re-enter the numeric value.

T7.4.5.3E.EPS

7.5 Confirmation of Equipment Type Setting

This equipment can be used for both the Oxygen Analyzer and the Humidity Analyzer. If you choose optional specification /HS at the time of purchase, the equipment is set for the Humidity Analyzer.

Before setting the operating data, be sure to check that the desired model has been set. Note that if the equipment type setting is changed after operating data are set, the operating data that have been set are then initialized and the default settings remain. Set the equipment type with parameter code F01. See Table 10.7, later in this manual.

CAUTION

Note that if the equipment type is changed, operation data that have already been set are initialized (reverting to the default setting).

Table 7.3 Equipment Type Setting

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	F01	Touch the [∧] key to switch to Group F. If an unwanted alphabetic character after F has been entered, continuously touch the [>] key to return to the original.
>	∧	ENT	0	Touch the [**ENT**] key for confirmation. If 0 (zero) is entered, the oxygen analyzer is already set. If 1 (one) is entered, the humidity analyzer has been set. Change the setting following the steps below.
>	∧	ENT	0	Continuously touch the [∧] key, and the position of the digit will change from 1 to 0 to 1 to 0. Release the [**ENT**] key when 0 is displayed.
>	∧	ENT	0	Touch the [**ENT**] key. The numeric value will flash.
>	∧	ENT	0	Touch the [**ENT**] key again to stop the numeric value from flashing.
>	∧	ENT	F01	Touch the [**ENT**] key once again, and the display will change to the parameter code.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display. (This is not required if you proceed to make another setting.) (The displayed numeric charactores indicate the measurment gas concentration.)

T7.3E.EPS

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

7.6 Setting Display Item

Display items are those items that are displayed on the basic panel display. Parameter code A00 or F08 is used to set the display items as shown in the table below. If the humidity analyzer /HS option was specified at the time of purchase, the equipment is a humidity analyzer. For other than the above, the equipment is set to oxygen concentration at the factory before shipment. If mix ratio is to be measured, change the existing setting as follows.

Additionally, when humidity analyzer is selected in the Detector Type Setting in the previous section, the display item will be humidity if data initialization is performed.

Table 7.4 Display Items

Values set with A00 or F08	Items displayed on the basic panel display
0	Indicates the oxygen concentration.
1	Indicates the humidity.
2	Indicates the mix ratio.
3	Displays an item for the current output. If the output damping has been set for the current output, values involving the output damping are displayed.

T7.4.EPS

Table 7.5 Display Item Setting Procedure

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	A01	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	A00	Touch the [∧] key to change the parameter code to 0. The number will change from 1 to 2 to 3 9 and back to 0.
>	∧	ENT	0	Touch the [**ENT**] key to display the current set value.
>	∧	ENT	2	Set the mix ratio. Touch the [**ENT**] key to change the number to 2.
>	∧	ENT	2	Touch the [**ENT**] key. The number 2 will be flashing.
>	∧	ENT	2	Touch the [**ENT**] key again to stop flashing.
>	∧	ENT	A00	Touch the [**ENT**] key to return to the parameter code selection display.
>	∧	ENT	0.000	Touch the [>] and [**ENT**] keys simultaneously to return to the basic panel display on which the mix ratio appears.

The symbol ( ) indicates that the corresponding keys are being touched, and the light characters indicate flashing.

T7601.EPS

7.7 Current Output Setting

7.7.1 Analog Output Setting

Select any one of the analog output settings — oxygen, humidity, and mixing ratio. If the /HS option was specified at the time of purchase, the equipment is a humidity analyzer. For other than this setting, the analyzer is an oxygen analyzer. If mixed measurement is required, change the existing output setting as follows. Use parameter code C01 for the setting (see Table 7.6). When the humidity analyzer is specified in the above setting for the type of detector, the analog output will be set to "humidity" if data initialization is performed.

Table 7.5.1 Analog Output Setting Procedure

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧ 	ENT	C01	Change the parameter code to C01.
>	∧	ENT 	0	The current set value, in this case, 0: oxygen concentration, is displayed.
>	∧	ENT	1	Touch the [∧] key to set the number 1 for humidity setting.
>	∧ 	ENT 	1	Touch the [**ENT**] key. The numeric value will be flashing.
>	∧	ENT 	1	Touch the [**ENT**] key again to stop flashing.
>	∧	ENT 	C01	Touch the [**ENT**] key to return to the parameter code selection display.

T7501.EPS

The symbol () indicates that the corresponding keys are being touched, and the light characters indicate flashing.

7.7.2 Output Range Setting

This section describes how to set the analog output range.

(1) To provide an oxygen concentration, use parameter code C11 to set the minimum oxygen concentration at 4 mA, and use parameter code C12 to set the maximum oxygen concentration at 20 mA.
(2) To provide a humidity output, use parameter code C13 to set the minimum humidity at 4 mA, and use parameter code C14 to set the maximum humidity at 20 mA.
(3) To provide a mix ratio, use parameter code C15 to set the minimum mix ratio at 4 mA, and use parameter code C14 to set the maximum mixing ratio at 20 mA.

Refer to Table 7.6 for the parameter codes. For more details, consult Section 8.1,"Current Output Settings," later in this manual.

Table 7.6 Parameter codes for analog output range

Parameter code	Set value	
C01	0	Oxygen concentration
	1	Humidity
	2	Mix ratio
C11	Minimum oxygen concentration (at 4 mA)	
C12	Maximum oxygen concentration (at 20 mA)	
C13	Minimum humidity (at 4 mA)	
C14	Maximum humidity (at 20 mA)	
C15	Minimum mix ratio (at 4 mA)	
C16	Maximum mix ratio (at 20 mA)	

T7.6.EPS

7.7.3 Minimum Current (4 mA) and Maximum Current (20 mA) Settings

This section describes how to set the humidity readings corresponding to 4 mA and 20 mA to 30% H_2O and 80% H_2O respectively.

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	C01	Set the humidity reading at 4 mA. Change the parameter code to C13. Touch the [∧] key to switch to Group C.
>	∧	ENT	C01	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	C11	Touch the [∧] key to enter the number 1.
>	∧	ENT	C11	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	C13	Touch the [∧] key to enter the number 3.
>	∧	ENT	000	Touch the [**ENT**] key to display the current set value. The humidity 0% H_20 is now being displayed.
>	∧	ENT	000	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	030	Touch the [∧] key to enter the number 3.
>	∧	ENT	030	If you touch the [**ENT**] key, all the digits flash.
>	∧	ENT	030	Touch the [**ENT**] key again to stop flashing.
>	∧	ENT	C13	Touch the [**ENT**] key to return to the parameter code selection display.
>	∧	ENT	C13	Set the humidity reading at 20 mA. Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	C14	Touch the [∧] key to change the number 3 in C13 to "4."
>	∧	ENT	025	Touch the [**ENT**] key to display the current set value.
>	∧	ENT	025	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	085	Touch the [∧] key to change the number 2 in C25 to "8."
>	∧	ENT	085	Touch the [>] key to move the position of the digit that is flashing to the right.
>	∧	ENT	080	Touch the [∧] key to change the number 5 in C85 to "0." The number changes from 5 to 6 . to 9 to 0.
>	∧	ENT	080	If you touch the [**ENT**] key, all the digits flash.
>	∧	ENT	080	Touch the [**ENT**] key again to stop flashing.
>	∧	ENT	C14	If you touch the [**ENT**] key again, the parameter code selection display will appear.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display. (This is not required if you proceed to make another setting.) (The displayed numeric characters indicate the humidity of the measurement gas.)

The symbol ( ) indicates that the corresponding keys are being touched, and the light characters indicate flashing.

T7701.EPS

7.8 Checking Current Loop

The set current can be output as an analog output. This enables the checking of wiring between the converter and the receiving instrument. Current loop checking is performed using parameter code G01.

Table 7.7 Checking Current Loop

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	G01	Touch the [∧] key to switch to Group G.
>	∧	ENT	00.0	Touch the [**ENT**] key. The output current remains preset with the output-hold feature (Section 2.3).
>	∧	ENT	10.0	Touch the [∧] key to set the numeric value 1 (to set a 10-mA output).
>	∧	ENT	10.0	Touch the [**ENT**] key to have all the digits flash.
>	∧	ENT	10.0	Touch the [**ENT**] key again to stop the flashing. A 10-mA output is then issued.
>	∧	ENT	G01	Touch the [**ENT**] key once again to switch to the parameter code selection display. At that point, the output current returns to the normal value.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display.

T7.7E.EPS

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

7.9 Checking Contact I/O

Conduct a contact input and output check as well as an operation check of the solenoid valves for the optional automatic calibration unit.

Table 7.8 Parameter Codes for Checking Contact I/O

Check item	Parameter code	Set value and contact action	
Contact output 1	**G11**	0	Open
		1	Closed
Contact output 2	**G12**	0	Open
		1	Closed
Automatic calibration solenoid valve (zero gas)	**G15**	0	Off
		1	On
Automatic calibration solenoid valve (span gas)	**G16**	0	Off
		1	On
Contact input 1	**G21**	0	Open
		1	Closed
Contact input 2	**G22**	0	Open
		1	Closed

T7.8E.EPS

7.9.1 Contact Output Check

Follow Table 7.9 to check the contact output. The table uses an example with contact output 1.

Table 7.9 Checking Contact Output

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	G01	Touch the [∧] key to switch to Group F.
>	∧	ENT	G01	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	G11	Touch the [∧] key to enter 1.
>	∧	ENT	0	Touch the [**ENT**] key to have 0 flash. The contact is then open.
>	∧	ENT	1	Touch the [∧] key to set 1 (one).
>	∧	ENT	1	Touch the [**ENT**] key. The flashing continues.
>	∧	ENT	1	Touch the [**ENT**] key again to stop the flashing, and the contact will be closed.
>	∧	ENT	G11	Touch the [**ENT**] key once again to switch to the parameter code selection display. The contact then returns to the original state.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display. (This is not required if you proceed to make another setting.) (The displayed numeric characters indicate the measurement gas concentration.)

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

T7.9E.EPS

WARNING

- If you conduct an open-close check for the contact output 2, Error 1 (cell voltage failure) or Error 2 (heater temperature abnormal) will occur. This is because the built-in heater power of the detector, which is connected to contact output 2, is turned off during the above check. So, if the above error occurs, reset the equipment or turn the power off and then back on to restart (refer to Section 10.4, “Reset,” later in this manual).

7.9.2 Checking Calibration Contact Output

The calibration contacts are used for the solenoid valve drive signals for the Automatic Calibration Unit. This output signal enables you to check the equipment operation. Check the flowmeter gas flow for that operation.

Follow the steps in Table 7.10. The table uses an example with a zero-gas solenoid valve.

Table 7.10 Checking Calibration Contact Output

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	G01	Touch the [∧] key to switch to Group G.
>	∧	ENT	G01	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	G11	Touch the [∧] key to enter 1.
>	∧	ENT	G11	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	G15	Touch the [∧] key to enter 5.
>	∧	ENT	0	Touch the [**ENT**] key to have 0 flash. The solenoid valve remains closed.
>	∧	ENT	1	Touch the [∧] key to enter 1.
>	∧	ENT	1	Touch the [**ENT**] key. The flashing continues.
>	∧	ENT	1	Touch the [**ENT**] key again to stop the flashing, and the solenoid valve will be open to let the calibration gas flow.
>	∧	ENT	G15	Touch the [**ENT**] key once again to switch to the parameter code selection display. The solenoid valve will then be closed.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display. (This is not required if you proceed to make another setting.) (The displayed numeric characters indicate the measurement gas concentration.)

T7.10E.EPS

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

7.9.3 Checking Input Contacts

Follow Table 7.11 to check the input contacts. The table uses an example with input contact 1.

Table 7.11 Checking Input Contacts

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	G01	Touch the [∧] key to switch to Group G.
>	∧	ENT	G01	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	G21	Touch the [∧] key to enter 2.
>	∧	ENT	0	Touch the [**ENT**] key. 0 is displayed with the contact open. If the contact is closed, the display will be 1 (one). This enables you to check whether or not the wiring connections have been properly made or not.
>	∧	ENT	G21	Touch the [>] key together with the [**ENT**] key to return to the basic panel display.

T7.11E.EPS

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

7.10 Calibration

The converter is calibrated in such a way that the actual zero and span gases are measured and those measured values are used to agree with the oxygen concentrations in the respective gases.

There are three types of calibration procedures available:

(1) Manual calibration conducting zero and span calibrations, or either of these calibrations in turn.
(2) Semi-automatic calibration which uses the infrared switches or a contact input signal and conducts calibration operations based on a preset calibration time and stable time.
(3) Automatic calibration conducted at preset intervals.

Manual calibration needs the ZA8F Flow Setting Unit to allow manual supply of the calibration gases. Semi-automatic and automatic calibrations need the Automatic Calibration Unit to allow automatic supply of the calibration gases. The following sections set forth the manual calibration procedures. For details on semi-automatic and automatic calibrations, consult Chapter 9, "Calibration," later in this manual

7.10.1 Calibration Setup

Set the following three items before carrying out a calibration. Parameter codes for these set items are listed in Table 7.12.

(1) Mode setting
There are three calibration modes: manual, semi-automatic, and automatic. Select the desired mode. This section uses manual mode for calibration.
(2) Oxygen concentration in zero gas
Enter the zero-gas oxygen concentration for calibration.
(3) Oxygen concentration in span gas
Enter the span-gas oxygen concentration for calibration. If instrument air is used, enter 21 vol% O_2. When using the ZO21S Standard Gas Unit (for use of the atmospheric air as a span gas), use a hand-held oxygen analyzer to measure the actual oxygen concentration, and then enter it.

CAUTION

If instrument air is used for the span gas, dehumidify the air to a dew point of -20° C and remove any oil mist or dust.

Incomplete dehumidifying or unclean air will have an adverse effect on the measurement accuracy.

Table 7.12 Calibration Parameter Codes

Set item	Parameter code	Set value
Mode	B03	0: Manual calibration
		1: Semi-automatic calibration
		2: Automatic calibration
Zero-gas oxygen concentration	B01	Enter oxygen concentration.
Span-gas oxygen concentration	B02	Enter oxygen concentration.

T7.12E.EPS

Table 7.13 Calibration Setup Procedure

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	b01	Set the zero-gas concentration. Switch the parameter code to B01. Here, set 0.98%.
>	∧	ENT	001.00 %	Touch the [**ENT**] key to display the currently set value.
>	∧	ENT	001.00 %	Touch the [>] key to move the position of the digit that is flashing to 1.
>	∧	ENT	000.00 %	Touch the [∧] key to change to 0.
>	∧	ENT	000.00 %	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	000.90 %	Touch the [∧] key to change the numeric value to 9.
>	∧	ENT	000.90 %	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	000.98 %	Touch the [∧] key to change the numeric value to 8.
>	∧	ENT	000.98 %	Touch the [**ENT**] key to have all the digits flash.
>	∧	ENT	000.98 %	Touch the [**ENT**] key again to stop the flashing.
>	∧	ENT	b01	Touch the [**ENT**] key once again to switch to the parameter code selection display.
Set the span-gas concentration by above procedure, set 21 % to B02.				
>	∧	ENT	b03	Next, set the calibration mode. Switch the parameter code to B03.
>	∧	ENT	0	Touch the [**ENT**] key to display the currently set value. If it is 0, you can leave it as is. If it is other than 0, change it to 0 (zero).
>	∧	ENT	0	Touch the [**ENT**] key. The numeric value will flash.
>	∧	ENT	0	Touch the [**ENT**] key again to stop the flashing.
>	∧	ENT	b03	Touch the [**ENT**] key once again to switch to the parameter code selection display.
>	∧	ENT	Basic panel display	Touch the [>] key together with the [**ENT**] key to return to the basic panel display. (This is not required if you proceed to make another setting.) (The displayed numeric characters indicate the measurement gas concentration.)

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing.

T7.13E.EPS

7.10.2 Manual Calibration

The following describes how to perform a calibration.

7.10.2.1 Preliminary

Before performing a manual calibration, be sure that the ZA8F Flow Setting Unit zero-gas flow valve is fully closed. Open the zero-gas cylinder pressure regulator so that the secondary pressure equals measured gas plus approx. 50 kPa (or measured gas pressure plus approx. 150 kPa when a check valve is used, maximum pressure rating is 300 kPa.).

7.10.2.2 Performing Calibration

This manual assumes that the instrument air is the same as the reference gas used for the span gas. Follow the steps below to conduct manual calibration. When using the ZO21S Standard Gas Unit (for use of the atmospheric air as a span gas), use a hand-held oxygen analyzer to measure the actual oxygen concentration, and then enter it.

Table 7.14 Performing Calibration

Switch operation			Display	Description
>	∧	ENT	A01	Display after the password has been entered.
>	∧	ENT	b10	Switch the parameter code to B01. (The key operations for this procedure are omitted.)
>	∧	ENT	CAL	Touch the [**ENT**] key, and CAL will be displayed. [Cancel] Touch the [>] key and [**ENT**] key together to return to the B10 display.
>	∧	ENT	CAL	If you touch the [**ENT**] key again, "**CAL**" then flashes. [**Cancel**] If you touch the [>] key and [**ENT**] key together, the display will return to the B10 display.
>	∧	ENT	SPAn Y	If you touch the [**ENT**] key again, "**SPAn Y**" appears (Y is flashing). If you omit the span calibration, touch the [>] key, and change "**Y**" to "**N.**" If you touch the [**ENT**] key, the display then jumps to "**ZERO Y.**"
>	∧	ENT	21.00 %	Touch the [**ENT**] key to display the calibration-gas value, in other words, the span-gas concentration set in Section 7.10.1, "**Calibration Setup.**" To cancel the above, touch the [>] key and [**ENT**] key together. Then the display returns to "**SPAN Y.**"
>	∧	ENT	OPEn /20.84	If you touch the [**ENT**] key, "**OPEN**" and the currently measured value are displayed alternately. Open the Flow Setting Unit span-gas flow valve and adjust the span-gas flow to 600 ± 60 ml/min. To do this, loosen the valve lock nut and gently turn the valve control (shaft) counterclockwise. Check the calibration gas flowmeter for confirmation. If the automatic calibration unit is connected, open the span—gas solenoid valve, and the measured value changes to the span-gas value. When the display becomes stable, proceed to the next step. To cancel the above, touch the [>] key and [**ENT**] key together. Then the display returns to "**SPAN Y.**"
>	∧	ENT	20.84 %	If you touch the [**ENT**] key, all the digits flash. At that point, no calibration is conducted yet.
>	∧	ENT	ZEro Y	If you touch the [**ENT**] key again, the flashing stops and "**Zero Y**" appears. Close the span-gas flow valve. Secure the span-gas lock nut for leakage. If the automatic calibration unit is connected, close the span-gas solenoid valve. If zero-gas calibration is omitted, touch the [>] key to change Y to N. Next, if you touch the [**ENT**] key, the display jumps to "**CALEND.**"
>	∧	ENT	0.98 %	Touch the [**ENT**] key to display the calibration gas value. This value must be the zero-gas concentration set in Section 7.10.1, "Calibration Setup," earlier in this manual. To cancel the above, touch the [>] key and [**ENT**] key together. Then the display returns to "**ZERO Y.**"

The symbol [ ] indicates that the corresponding keys are being touched, and the light characters indicate flashing. T7.14E-1.EPS

Table 7.14 Performing Calibration (Continued)

Switch operation			Display	Description
>	∧	ENT	OPEn /0.89	If you touch the [**ENT**] key, "**OPEN**" and the currently measured value are displayed alternately. Open the Flow Setting Unit zero-gas flow valve and adjust the zero-gas flow to 600 ± 60 ml/min. To do this, loosen the valve lock nut and gently turn the valve control (shaft) counterclockwise. Check the calibration gas flowmeter for confirmation. If the automatic calibration unit is connected, open the zero—gas solenoid valve, and then the measured value changes to the zero-gas value. When the display becomes stable, proceed to the next step. To cancel the above, touch the [>] key and [**ENT**] key together. Then the display returns to "**ZERO Y.**"
>	∧	ENT	0.89	If you touch the [**ENT**] key, all the digits flash. At that point, no calibration is conducted yet.
>	∧	ENT	CALEnd	Touch the [**ENT**] key again to get the measured value to agree with the zero-gas concentration. Close the zero-gas flow valve. Secure the valve lock nut for leakage during measurement. If the automatic calibration unit is connected, close the span—gas solenoid valve. "**CALEND**" flashes during the output hold time. If "output hold" is specified in the Output Hold setting," it remains as an analog output (see Section 8.2). When the preset output hold time is up, the calibration is complete.
>	∧	ENT	b10	The output hold time is set to 10 minutes at the factory. If you touch both the [>] key and [**ENT**] key at the same time during the preset Output Hold Time, the calibration is aborted and the parameter code selection display appears.
>	∧	ENT	Basic panel display	If you touch the [>] key and [**ENT**] key together, then the basic panel display appears.

T7.14E-2.EPS

The above "**display**" is a result of switch operations.

The symbol [ ] indicates the keys are being touched, and the light characters indicate "**flashing.**"

"/" indicates that the characters are displayed alternately.

[**Cancel**] indicates the procedure to stop the key operations.

8. Detailed Data Setting

8.1 Current Output Setting

This section describes setting of the analog output range. Table 8.1 shows the parameter codes for each setting item and set values.

Table 8.1 Display Items

Set item	Parameter code	Set value
Current output	C01	0: Oxygen concentration 1: Humidity 2: Mixing ratio
Output mode	C03	0: Linear 1: Logarithm
Min. oxygen concentration	C11	Oxygen concentration reading corresponding to 4 mA
Max. oxygen concentration	C12	Oxygen concentration reading corresponding to 20 mA
Min. humidity	C13	Humidity reading corresponding to 4 mA
Max. humidity	C14	Humidity reading corresponding to 20 mA
Min. mixing ratio	C15	Mixing ratio at 4 mA
Max. mixing ratio	C16	Mixing ratio at 20 mA
Output damping coefficient	C30	0 to 255 seconds

T8.1.1.EPS

CAUTION

When you select logarithmic mode in Section 8.1.3, “Output Mode,” later in this manual, the oxygen concentration, humidity reading, and mixing ratio remain constant at 0.1% O_2, 0.1% H_2O and 0.01 kg/kg respectively.

8.1.1 Minimum and Maximum Settings Corresponding to 4 mA and 20 mA

Set the output items for oxygen concentration reading, humidity reading and mixing ratio corresponding to 4 mA and 20 mA. When the **oxygen concentration** was selected with parameter code C01, use parameter codes C11 and C12 for the minimum and maximum settings; when the **humidity** setting was selected with parameter code C01, use parameter codes C13 and C14 for those settings; and when the **mix ratio** setting was selected with parameter code C01, use parameter codes C15 and C16 for those settings.

Oxygen concentration setting range

The minimum concentration of oxygen for the minimum current (4 mA) is 0% O_2 or 6% to 76% O_2. The maximum concentration of oxygen for the maximum current (20 mA) ranges from 5% to 100% O_2, and must be at least 1.3 times the concentration of oxygen set for the minimum.

Setting example 1

If the setting (for a 4 mA current) is 10% O_2, you must set the oxygen concentration for the maximum (20 mA) point at more than 13% O_2.

Setting example 2

If the setting (for a 4 mA current) is 75% O_2, you must set the oxygen concentration for the maximum (20 mA) point at 98% O_2 or greater, (75 × 1.3% O_2). (Numbers after the decimal point are rounded up.)

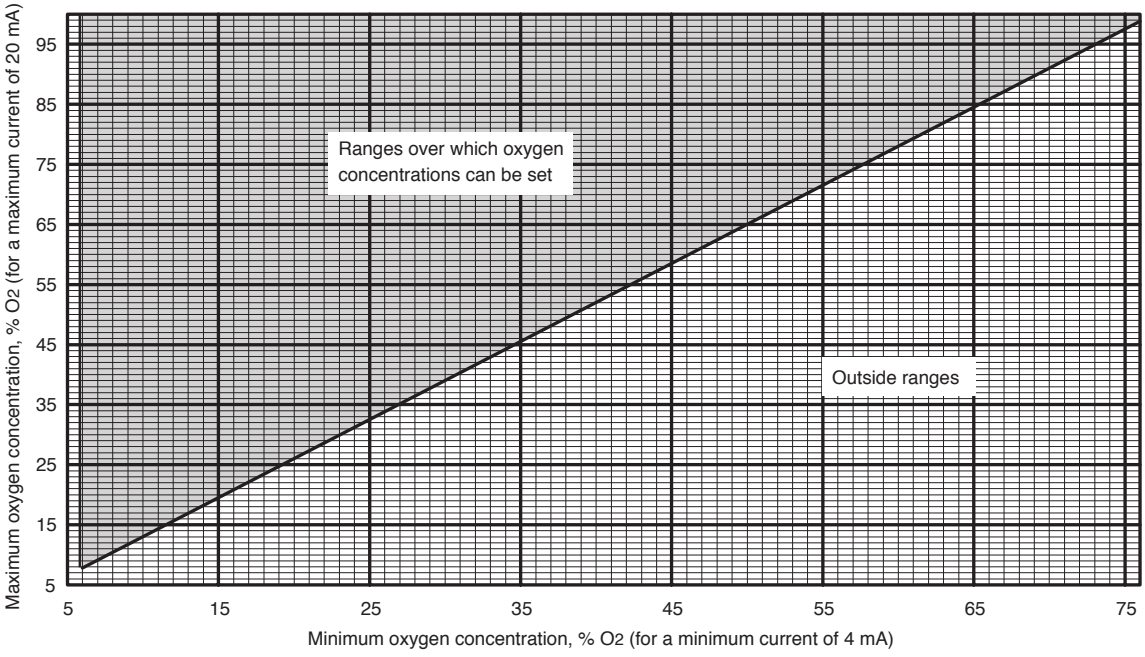


Figure A Max. and Min. Oxygen Concentration Set Ranges

Humidity setting range

The minimum humidity is set to 0% H_2O or ranges from 26 to 100% H_2O. The maximum humidity ranges from 25% to 100% H_2O, and must be greater than 0.8 times plus 23 the humidity set for the minimum.

Setting example 1

If the setting (for a 4 mA current) is 0% H_2O, you must set the maximum (20 mA) point at more than 25% H_2O.

Setting example 2

If the setting (for a 4 mA current) is 26% H_2O, you must set the maximum (20 mA) point at more than 44% H_2O, (26 $\times$ 0.8 + 23% H_2O). (Numbers after the decimal point are rounded up.)

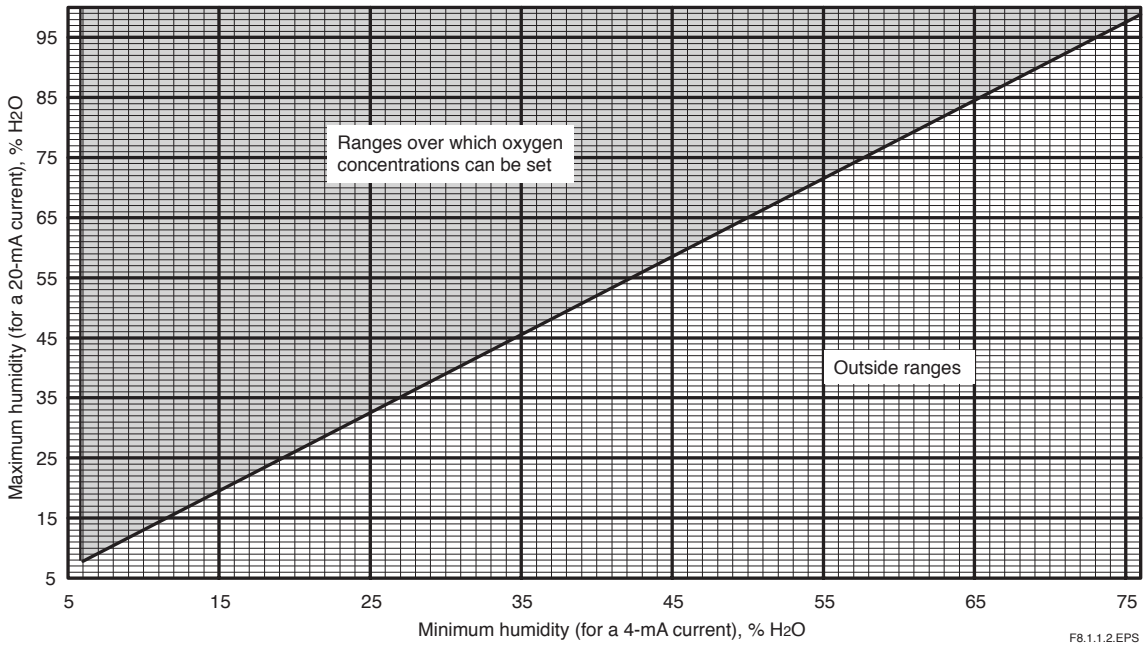


Figure B Max. and Min. Humidity Set Ranges

"Mix ratio" setting range

The minimum mix ratio is set to 0 kg/kg or ranges from 0.201 to 0.625 kg/kg. The maximum mix ratio setting ranges from 0.2 to 1.0 kg/kg, and must be greater than 1.3 times plus 0.187 the mix ratio set for the minimum.

Setting example 1

If the setting (for a 4 mA current) is 0 kg/kg, you must set the maximum (20 mA) point at more than 0.2 kg/kg.

Setting example 2

If the setting (for a 4 mA current) is 0.201 kg/kg, you must set the maximum (20 mA) point at more than 0.449 kg/kg, (0.201 × 1.3 + 0.187 kg/kg). (Numbers after the decimal point are rounded up.)

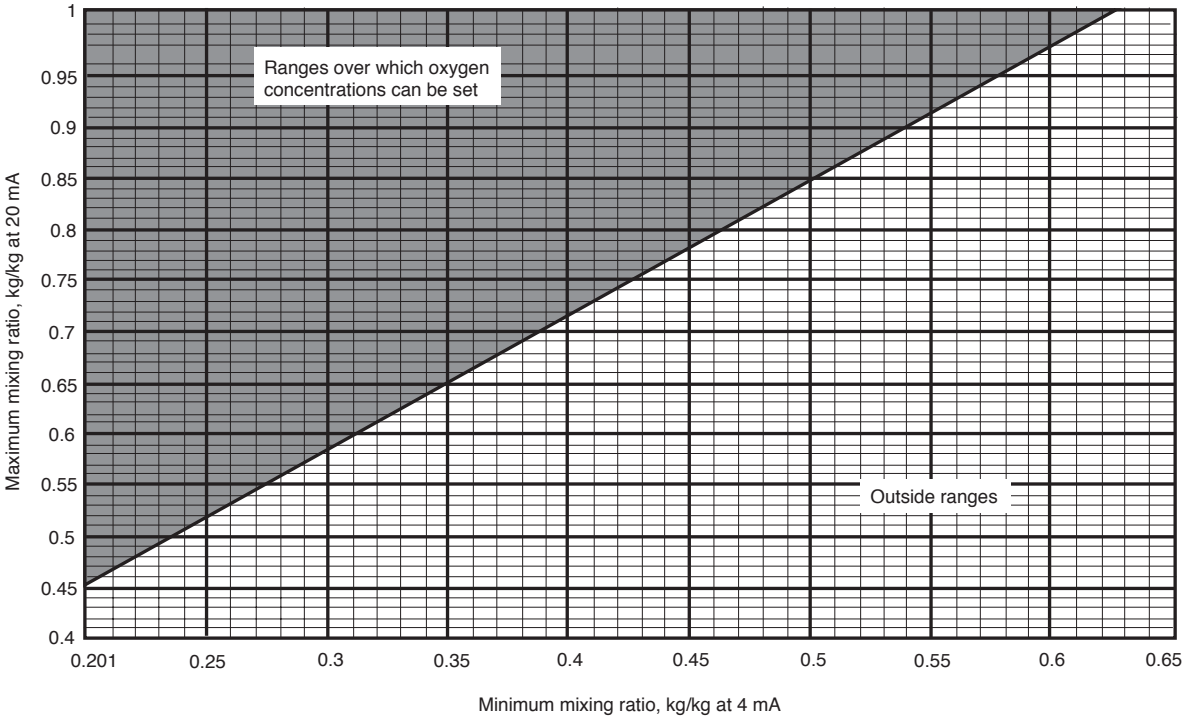


Figure C Max. and Min. Mix Ratio Set Ranges

8.1.2 Entering Output Damping Constants

If a measured value which is adversely affected by rapid changes in the process is used as the basis for control, frequent on-off actions of the output may result. To avoid this, the analyzer allows the setting of output damping constants ranging from 0 to 255 seconds.

8.1.3 Selection of Output Mode

There are two output modes available: linear mode and logarithmic mode. Select the either mode for your desired analog output vs. measured value characteristics.

CAUTION

- When you select logarithmic mode, the minimum output remains constant at 0.1% O_2, and the humidity remains set to 0.1% H_2O and mixing ratio is set to 0.01 kg/kg, regardless of the set values. Set value of C11 to C16 remains unchanged.

8.1.4 Default Values

When the analyzer is delivered or data are initialized, the output current settings are by default as shown in Table 8.2.

Table 8.2 Output Current Default Values

Item	Default setting
Min. oxygen concentration	0% O_2
Max. oxygen concentration	25% O_2
Minimum humidity	0% H_2O
Maximum humidity	25% H_2O
Minimum ratio setting	0 kg/kg
Maximum ratio setting	0.2 kg/kg
Output damping constant	0 (seconds)
Output mode	Linear

T8.1.4.1E.EPS

8.2 Output Hold Setting

The “output hold” functions hold an analog output signal at a preset value during the equipment´s warm-up time or calibration or if an error arises.

Table 8.3 shows the analog outputs that can be retained and the individual states.

Table 8.3 Current Output Parameter Codes

Equipment status / Output hold values available	During warm-up	Under maintenance	Under calibration	On Error occurrence
4 mA	○			
20 mA	○			
Without hold feature		○	○	○
Retains output from just before occurrence		○	○	○
Set value (2.4 to 21.6 mA)	○	○	○	○

○ : The output hold functions are available.

T8201E.EPS

8.2.1 Definition of Equipment Status

(1) Warming up

“Warming up” is the time required after applying power until the sensor temperature stabilizes at 750° C, and the equipment is in the measurement mode. This status is that the sensor temperature is displayed on the basic panel.

(2) Under maintenance

“Under maintenance” is the time from when a valid password is entered in the basic panel display to enable the parameter code selection display until the display goes back to the basic panel display

(3) “Under calibration” (see Chapter 9, Calibration)

In the manual calibration, proceed with the calibration operation with the parameter code B10 to display the span-gas confirmation display for the first span calibration, thus starting the calibration time when the [ENT] key is touched. After a series of calibrations is complete and the preset output stabilization time has elapsed, the calibration time will be up. Figure 8.1 shows the definition of “under calibration” in the manual calibration.

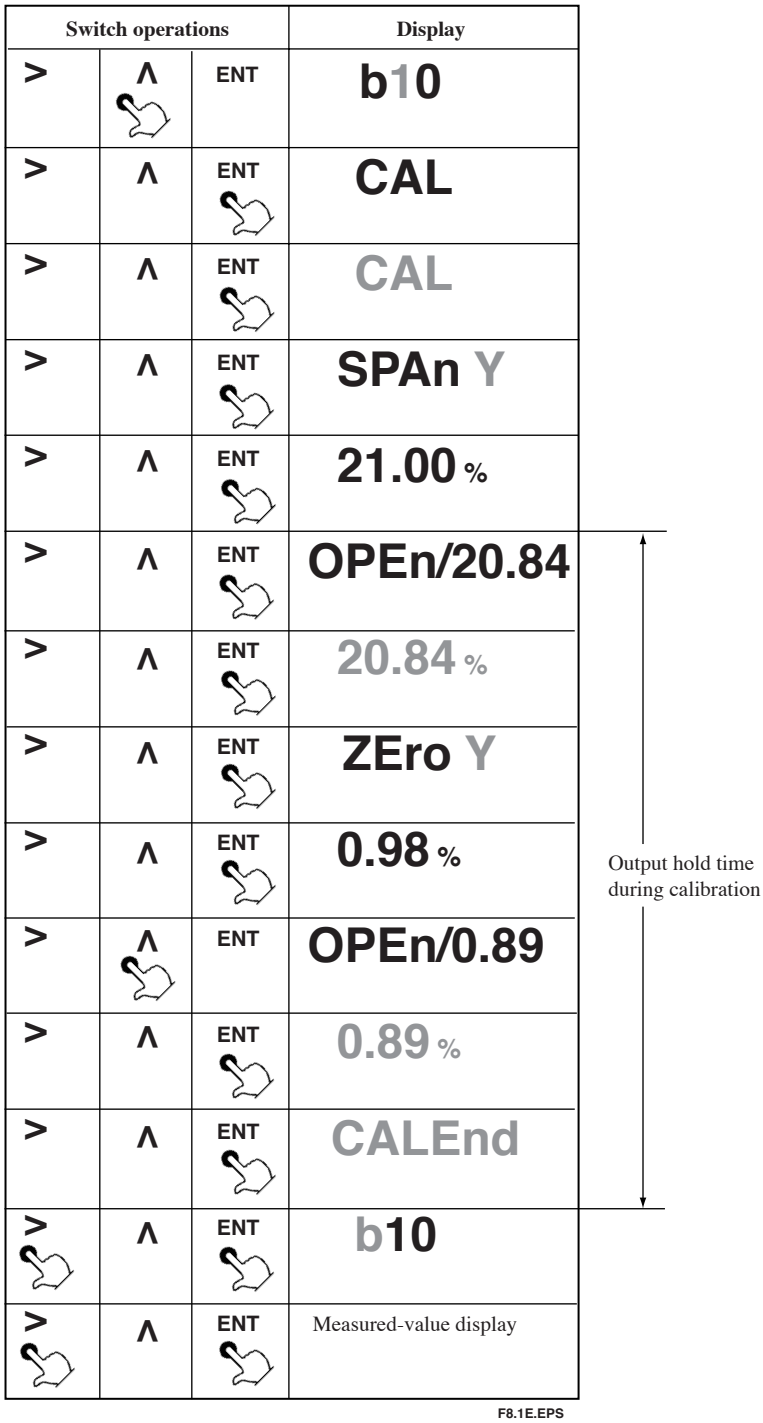


Figure 8.1 Definition of during calibration

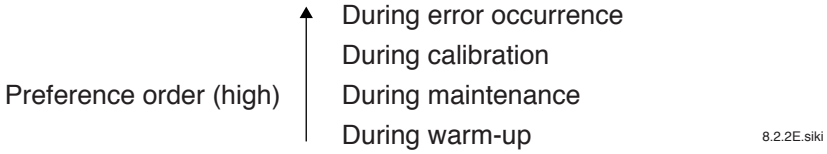
During semi-automatic calibration, “under calibration” is the time, starting when a calibration instruction is executed with an infrared switch or a contact input, to make a series of calibrations, until the preset output stabilization time elapses.

During automatic calibration, “under calibration” is the time, starting when automatic calibration is carried out at the calibration start time, until the preset output stabilization time elapses.

(4) “Error” appears when Error 1 to Error 4 are being issued

8.2.2 Preference Order of Output Hold Values

The output hold value takes the following preference order:



For example, if the output current is set to 4 mA for “under maintenance”, and no output-hold output for during calibration is preset, the output is held at 4 mA during the “ under maintenance” display. However, the output hold is released at the time of starting the calibration, and the output will be again held at 4 mA after completing the calibration and when the output stabilization time elapses.

8.2.3 Output Hold Setting

Table 8.4 lists parameter codes with set values for individual set items.

Table 8.4 Parameter Codes for Output Holding

Set items	Parameter code	Set value
During warm-up	C04	0: 4 mA 1: 20 mA 2: Holds Set value
During maintenance	C05	0: Without hold feature 1: Last measured value.. 2: Holds set values.
During calibration	C06	0: Without hold feature 1: Last measured value. 2: Holds set values.
During error occurrence	C07	0: Without hold feature 1: Last measured value. 2: Holds set values.

T8.5E.EPS

8.2.4 Default Values

When the analyzer is delivered or data are initialized, the output current settings are by default as shown in Table 8.5.

Table 8.5 Output Current Default Values

Status	Output hold (min. and max. values)	Preset value
During warm-up	4 mA	4 mA
Under maintenance	Holds output at value just before maintenance started.	4 mA
Under calibration or blow-back	Holds output at value just before starting calibration or "blow-back."	4 mA
On Error occurrence	Holds output at a preset value.	3.4 mA

T8.6E.EPS

8.3 Alarm Setting

The analyzer provides four alarms — high-high, high, low, and low-low alarms - settable with measured values. The following sections describe the alarm operations and setting procedures for the oxygen concentration, humidity, and mixing ratio.

8.3.1 Alarm Values

(1) High-high and high alarm values
High-high alarms and **high** alarms are issued when they are **set to be detected**, and if the measured values exceed the preset values.

(2) Low and low-low alarm values
Low alarms and **low-low** alarms are issued when they are **set to be detected**, and if the measured values are lower than the preset values..

8.3.2 Alarm Output Actions

If the measured values of the oxygen concentration fluctuate between normal (steady-state) values and alarm setpoints, there may often be a lot of alarm-output issuing and canceling. To avoid this, set the delayed time and allow for hysteresis for alarm canceling uneÆ¥0the alarm output conditions, as Figure 8.2 shows. When the delay time is set, an alarm will not be issued so quickly even though the measured value differs from the steady-state and enters the alarm setpoint range. If the measured value remains within the alarm setpoint range for a certain period of time (for the preset delay time), an alarm will result. On the other hand, a similar way as in the above will be done each time the measured value returns to the steady state from the alarm setpoint range (canceling the alarm status). If hysteresis is set, alarms will be canceled when the measured value is less than or more than the preset hysteresis values. If both the delay time and hysteresis are set, an alarm will be issued if the measured value is in the alarm setting range and the delay time has elapsed. When the alarm is reset (canceled), it is required that the measured value be beyond the preset hysteresis value and that the time is after the preset delayed time. Refer to Figure 8.2 for any further alarm output actions. The delay time and hysteresis settings are common to all alarm points.

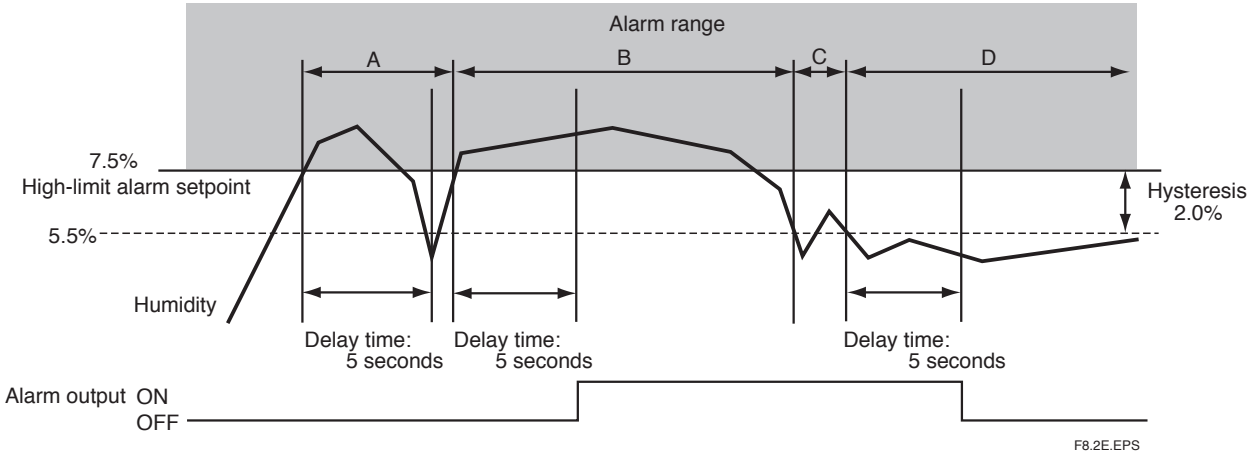


Figure 8.2 Alarm Output Action

In the example in Figure 8.2, the high-limit alarm point is set to 7.5% H_2O, the delayed time is set to five seconds, and hysteresis is set to 2% H_2O.

Alarm output actions in this figure are expressed as follows:

(1) Although the measured value “A” has exceeded the high-limit alarm setpoint, “A” falls lower than the high-limit alarm setpoint before the preset delayed time of five seconds elapses. So, no alarm is issued.
(2) The measured value “B” exceeds the high-limit alarm setpoint and the delayed time has elapsed during that measurement. So, an alarm results.
(3) Although the measured value “C” has fallen lower than the hysteresis set value, that measurement exceeds the hysteresis set value before the preset delayed time has elapsed. So, the alarm is not canceled.
(4) The measured “D” has fallen below the hysteresis set value and the preset delayed time during measurement has elapsed, so the alarm is canceled.

8.3.3 Alarm Setting Procedure

Set the alarm setpoints following Table 8.6 listing parameter codes.

Table 8.6 Alarm Parameter Codes

Set item	Parameter code	Set value	
Oxygen concentration high-high alarm setpoint	D01	0-100% O_2	
Oxygen concentration high-alarm setpoint	D02	0-100% O_2	
Oxygen concentration low-alarm setpoint	D03	0-100% O_2	
Oxygen concentration low-low-alarm setpoint	D04	0-100% O_2	
Humidity high-high alarm setpoint	D05	0-100% H_2O	
Humidity high-alarm setpoint	D06	0-100% H_2O	
Humidity low-alarm setpoint	D07	0-100% H_2O	
Humidity low-low-alarm setpoint	D08	0-100% H_2O	
Mixing ratio high-high alarm setpoint	D11	0-1 kg/kg	
Mixing ratio high-alarm setpoint	D12	0-1 kg/kg	
Mixing ratio low-alarm setpoint	D13	0-1 kg/kg	
Mixing ratio low-low-alarm setpoint	D14	0-1 kg/kg	
Oxygen concentration alarm hysteresis	D30	0-9.9% O_2	
Humidity hysteresis	D31	0-9.9% H_2O	
Mixing ratio hysteresis	D32	0-0.1 kg/kg	
Delay alarm action	D33	0-255 seconds	
Oxygen concentration high-high alarm detection	D41	0:	Not detected
		1:	Detected
Oxygen concentration high-alarm detection	D42	0:	Not detected
		1:	Detected
Oxygen concentration low-alarm detection	D43	0:	Not detected
		1:	Detected
Oxygen concentration low-low-alarm detection	D44	0:	Not detected
		1:	Detected
Humidity high-high alarm detection	D45	0:	Not detected
		1:	Detected
Humidity high-alarm detection	D46	0:	Not detected
		1:	Detected
Humidity low-alarm detection	D47	0:	Not detected
		1:	Detected
Humidity low-low-alarm detection	D48	0:	Not detected
		1:	Detected
Mixing ratio high-high alarm detection	D51	0:	Not detected
		1:	Detected
Mixing ratio high-alarm detection	D52	0:	Not detected
		1:	Detected
Mixing ratio low-alarm detection	D53	0:	Note detected
		1:	Detected
Mixing ratio low-low-alarm detection	D54	0:	Not detected
		1:	Detected

T8.3.3.1.EPS

CAUTION

Even with alarms set, if “Not detected” has been set in the above alarm detection, no alarm is issued. Be sure to set “Detected” in the above alarm detection if you use alarm features.

8.3.4 Default Values

When the analyzer is delivered, or if data are initialized, the alarm set values are by default as shown in Table 8.7.

Table 8.7 Alarm Setting Default Values

Set item	Set value
Oxygen concentration high-high alarm setpoint	100% O_2
Oxygen concentration high-alarm setpoint	100% O_2
Oxygen concentration low-alarm setpoint	0% O_2
Oxygen concentration low-low alarm setpoint	0% O_2
Humidity high-high alarm setpoint	100% H_2O
Humidity high-alarm setpoint	100% H_2O
Humidity low-alarm setpoint	0% H_2O
Humidity low-low alarm setpoint	0% H_2O
Mixing ratio high-high alarm setpoint	1 kg/kg
Mixing ratio high-alarm setpoint	1 kg/kg
Mixing ratio low-alarm setpoint	0 kg/kg
Mixing ratio low-low alarm setpoint	0 kg/kg
Oxygen concentration hysteresis	0.1% O_2
Humidity hysteresis	0.1% H_2O
Mixing ratio hysteresis	0.001 kg/kg
Delayed time	3 seconds
High-high alarm detection	Not detected
High-alarm detection	Not detected
Low-alarm detection	Not detected
Low-low alarm detection	Not detected

T8.3.4.1.EPS

8.4 Output Contact Setup

8.4.1 Output Contact

Mechanical relays provide contact outputs. Be sure to observe relay contact ratings. (For details, see Section 2.1, General Specifications.) The operation modes of each contact output are as follows. Output contact 1 enables the selection of an open or closed contact when the contact is "operated". For output contact 2, contact remains closed. The relay for output contact 1 is energized when its contacts are closed and vice versa. Accordingly, when no power is supplied to the equipment, those contacts remain open. In addition, the relay for output contact 2 is energized when the corresponding contact is open and de-energized when that contact is closed.

Table 8.8 Setting Output Contacts

	Operating state	When no power is applied to this equipment
Output contact 1	Open (deenergized) or closed (energized) selectable.	Open
Output contact 2	Closed (deenergized) only.	Closed

T8.9E.EPS

8.4.2 Setting Output Contact

Set the output contacts following Table 8.9.

Table 8.9 Parameter Codes for Output Contact Setting

Set item	Parameter code	Set value	
Output contact 1			
Operation	E10	0	Operated in closed status. (Normally deenergized)
		1	Operated when open. (Normally energized) (Note 1)
Error	E20	0	Not operated if an error occurs.
		1	Operated if an error occurs.
High-high limit alarm	E21	0	Not operated if a high-high limit alarm occurs.
		1	Operated if a high-high limit alarm occurs. (Note 2)
High-limit alarm	E22	0	Not operated if a high-limit alarm occurs.
		1	Operated if a high-limit alarm occurs. (Note 2)
Low-limit alarm	E23	0	Not operated if a low-limit alarm occurs.
		1	Operated if a low-limit alarm occurs.
Low-low limit alarm	E24	0	Not operated if a low-low limit alarm occurs.
		1	Operated if a low-low limit alarm occurs. (Note 2)
Maintenance	E25	0	Not operated during maintenance.
		1	Operated during maintenance (see Section 8.2.1).
Calibration	E26	0	Not operated during calibration.
		1	Operated during calibration (see Section 8.2.1).
Range change	E27	0	Not operated when changing ranges.
		1	Operated when changing ranges. (Note 3)
Warm-up	E28	0	Not operated during warming up.
		1	Operated during warming up.
Calibration-gas pressure drop	E29	0	Not operated while a calibration-gas pressure drop contact is being closed.
		1	Operated while a calibration-gas pressure drop contact is being closed. (Note 4)
Unburnt gas detection	E32	0	Not operated while a unburnt gas detection contact is being closed.
		1	Operated while a unburnt gas detection contact is being closed. (Note 5)

T8.10E.EPS

Note 1: Output contact 2 remains closed.

Note 2: For the high-high alarm, the concentration alarm must be preset (see Section 8.3).

Note 3: Range change answer-back signal. For this action, the range change must be preset during the setting of input contacts (Section 8.5).

Note 4: Calibration gas pressure decrease answer-back signal. Calibration gas pressure decrease must be selected beforehand during the setting of input contacts.

Note 5: Non-combusted gas detection answer-back signals. “Non-combusted gas” detection must be selected during the setting of input contacts.

WARNING

- Output contact 2 is linked to the detector’s heater power safety switch. As such, if output contact 2 is on, the heater power stops and an Error 1 (cell voltage abnormal) or Error 2 (heater temperature abnormal) occurs.

8.4.3 Default Values

When the analyzer is delivered, or if data are initialized, output contacts are by default as shown in Table 8.10.

Table 8.10 Output Contact Default Settings

Item	Output contact 1	Output contact 2
High-high-limit alarm		
High-limit alarm		
Low-limit alarm		
Low-low-limit alarm		
Error		○
Warm-up	○	
Output range change		
Calibration		
Maintenance	○	
High-limit temperature alarm		
Calibration-gas pressure drop		
Unburnt gas detection		
Operating contact status	Open	Closed (fixed)

○ : Present

T8.11E.EPS

Note

The above blank boxes indicate the items have been set off.

8.5 Input Contact Settings

The equipment input contacts execute set functions by accepting a remote contact signal. Table 8.11 shows the functions executed by a remote contact signal.

Table 8.11 Input Contact Functions

Set item	Function
Calibration-gas pressure decreased	While the contact signal is on, neither semi-automatic nor automatic calibration is possible.
Measuring range change	While contact input is On, range of Analog Output is switched as follows: When analog output range is set to "Humidity", then output range is switched to 0 to 100% H_2O. When analog output range is set to "Mixing ratio", then output range is switched to 0 to 1 kg/kg. When analog output range is set to "Oxygen", then range is switched to 0 to 25% O_2.
Calibration start	If the contact signal is applied, semi-automatic calibration starts (only if the semi-automatic or automatic mode has been setup). Calibration is started with an applied one-second time interval single-output contact signal. Even if a continuous contact signal is applied, a calibration is not repeated. If you want to perform a second calibration, turn the contact signal off and then back on.
Unburnt gas detection	If the contact signal is on, the heater power will be switched off. (A one-second time interval single-output signal is available as a contact signal.) If this operation starts, the sensor temperature decreases and an error occurs. To restore it to normal, turn the power off and then back on, or reset the analyzer.

T8.5.0.1.EPS

CAUTION

To conduct a semi-automatic calibration, be sure to set **Calibration setup mode** to "**Semi-Auto**" or "**Auto**."

8.5.1 Setting Input Contact

To set the input contacts, follow the parameter codes given in Table 8.12.

Table 8.12 Parameter Codes for Input Contact Settings

Set item	Parameter code	Set value
Input contact 1 (function)	E01	0: Invalid 1: Calibration gas-pressure decrease 2: Measuring range change 3: Calibration 4: Unburnt gas detection
Input contact 2 (function)	E02	0: Invalid 1: Calibration gas-pressure decrease 2: Measuring range change 3: Calibration 4: Unburnt gas detection
Input contact 1 (action)	E03	0: Operated when closed 1: Operated when open
Input contact 2 (action)	E04	0: Operated when closed 1: Operated when open

T8.13E.EPS

8.5.2 Default Values

When the analyzer is delivered, or if data are initialized, both input setting are invalid, and operated when closed.

8.6 Input Contact Settings

8.6.1 Setting Input Contact

The following describe how to set the date-and-time. Automatic calibration works following this setting.

Use parameter code “F10” to set the date-and-time.

Table 8.13 Data-and-time Settings

Switch operations			Display	Brief description
∧	∧	ENT	F10	Select the parameter code "**F10.**"
>	∧	ENT	00.01.01	If you touch the [**ENT**] key, the current date will be displayed. The display on the left indicates the date - January 1, 2000. To set June 21, 2000, follow the steps below:
>	∧	ENT	00.01.01	Touch the [>] to move the position of the digit that is flashing to the right.
>	∧	ENT	00.06.01	Touch the [∧] key to change to 6.
>	∧	ENT	00.06.01	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	00.06.21	Touch the [∧] to change to 2.
>	∧	ENT	00.06.21	Touch the [>] key to move the position of the digit that is flashing to the right one digit.
>	∧	ENT	07.18	Let the rightmost character flash, and touch the [>] key to display the time. Continuously touch the [>] key, then the date and time are alternately displayed. Displayed on the left is 7:18 a.m.
Omitted here.				
>	∧	ENT	14.30	Touch the keys and enter the current time in same way as the date has been entered, on a 24-hour basis. 2:30 p.m. Displayed on the left means 2:40 p.m.
>	∧	ENT	14.30	If you touch the [**ENT**] key, all the digits flash.
>	∧	ENT	14.30	Touch the [**ENT**] key again to set the time.
>	∧	ENT	F10	If you touch the [>] and [**ENT**] keys together, the parameter code selection display appears.

T8.14E.EPS

The symbol ( ) indicates that the key is being touched. Light characters indicate that the digits are flashing.

8.6.2 Setting Periods over which Maximum and Minimum Values Are Monitored and Average Values are Calculated.

The equipment enables the display of oxygen concentration average values and maximum and minimum values under measurement (see Section 10.1, later in this manual). The following section describes how to set the periods over which oxygen concentration average values are calculated and maximum and minimum values are monitored.

8.6.2.1 Procedure

Use the parameter-code table below to set the average, maximum and minimum oxygen concentration values. Periods over which average is calculated and periods over which maximum and minimum values are monitored can be set, ranging from 1 to 255 hours. If the set ranges are beyond the limits specified, an "ERR" will be displayed.

Table 8.14 Parameter Codes for Average, Maximum and Minimum Values

Set item	Parameter code	Set range	Units
Periods over which average values are calculated	F11	1 to 255	Hours
Periods over which maximum and minimum values are monitored	F12	1 to 255	Hours

T8.15E.EPS

8.6.2.2 Default Value

When the analyzer is delivered, or if data are initialized, periods over which average values are calculated are set to one hour, and periods over which maximum and minimum values are monitored are set to 24 hours.

8.6.3 Setting Measurement Gas Temperature and Pressure

The analyzer calculates the moisture content contained in exhaust gases and saturated water vapors from the entered gas temperature and pressure to obtain the relative humidity and dew point. Enter the exhaust gas temperature and pressure (absolute pressure) necessary for the calculation (see Section 10.1 later in this manual).

CAUTION

The critical temperature of the saturated water vapor pressure is 374°C. If a gas temperature exceeding 370°C is entered, no correct calculation will be obtained.

8.6.3.1 Setting Procedure

To set the gas temperature and pressure, follow the parameter code table for fuel setting. If you set a value exceeding the setting ranges, an error, ERR will result.

Table 8.15 Fuel Setting Default Value

Set item	Parameter code	Set value	Engineering units
Exhaust gas temperature	F13	0 to 3000	°C
Exhaust gas pressure	F14	0 to 300	kPa abs.

T8.6.3.1.1.EPS

8.6.3.2 Default Values

When the analyzer is delivered or data are initialized, the parameters are by default as shown in Table 8.16.

Table 8.16 Parameter Codes for Exhaust Gas Temperature and Pressure Settings

Set item	Default setting
Exhaust gas temperature	300°C
Exhaust gas pressure	101.33 kPa abs.

T8.6.3.2.1.EPS

8.6.4 Setting Purging

Purging is to remove condensed water in the calibration gas pipe by supplying a span calibration gas for a given length of time before warm-up of the detector. This prevents cell breakage during calibration due to condensed water in the pipe.

Open the solenoid valve for the automatic calibration span gas during purging and after the purge time has elapsed, close the valve to start warm-up.

Purging is enabled when the cell temperature is 100° C or below upon power up and the purge time is set in the range of 1 to 60 minutes.

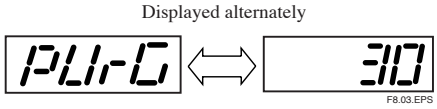


Figure 8.3 Display during Purging

8.6.4.1 Procedure

Use the parameter-code table below to set the purging time.

The allowable input ranges from 0 to 60 minutes.

Table 8.17 Parameter Code

Set item	Parameter code	Set range	Units
Purging time	F15	0 to 60	minutes

T8.17E.EPS

8.6.4.2 Default Value

When the analyzer is delivered, or if data are initialized, purging time is set to 0 minutes.

9. Calibration

The following describes the calibration procedures for the ZR202G Zirconia High-temperature Humidity Analyzer (integrated model).

9.1 Calibration Briefs

9.1.1 Measurement Principle of Zirconia Humidity Analyzer

A solid electrolyte such as zirconia allows the conduction of oxygen ions at high temperatures. 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, oxygen ions flow from a high partial-oxygen pressure to a low partial-oxygen pressure, causing a voltage. When a sample gas introduced into the zirconia-plated element with the measurement electrode, and air (21.0 vol% O_2) is flowed through the reference electrode, an electromotive force (mV) is produced between the two electrodes, governed by Nernst's equation as follows:

$E = - (RT/nF) \log_e (y/a)$ ..... Equation (1)

where, R = Gas constant
T = Absolute temperature
n : 4
F = Faraday's constant
y = O_2 vol% on the zirconia element measurement electrode
a = O_2 vol% to 21.0 vol % O_2 on the zirconia element reference electrode

The humidity analyzer uses a sample gas composed of water vapor and air.

(A) For the vol% H_2O measurement
x : Assuming that H_2O vol% in a mixed gas is measured:

$y = (100 - x) \times 0.21$ ..... Equation (2)
From the above equations (1) and (2), we obtain:

$E = -K \log y/a = -K\log [(100 - x) \times 0.21 /21]$
$= - K \log (1 - 0.01 x)$ ..... Equation (3)
where, K = Constant
Using the above equation (3), we can calculate the water vapor in vol% from the electromotive force.

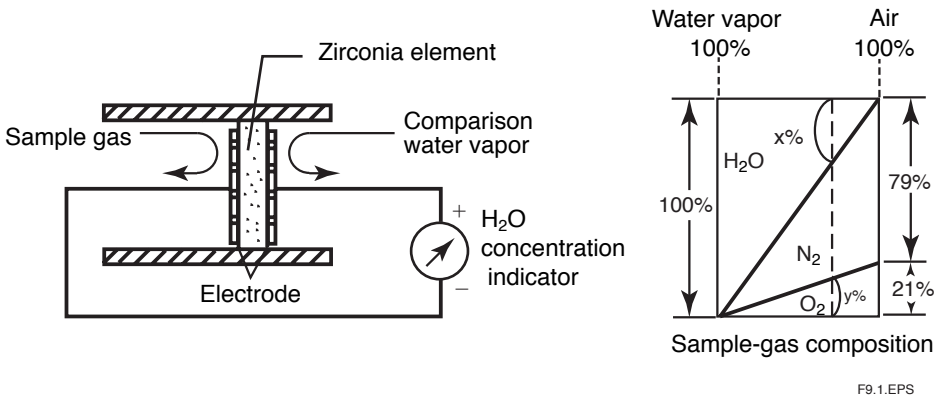


Figure 9.1 Schematic Diagram of Measurement Principle

(B) For the "mixing ratio" measurement

Assuming that the mixing ratio is r kg/kg, then "r" can be calculated from the value of H_2O vol% as follows:

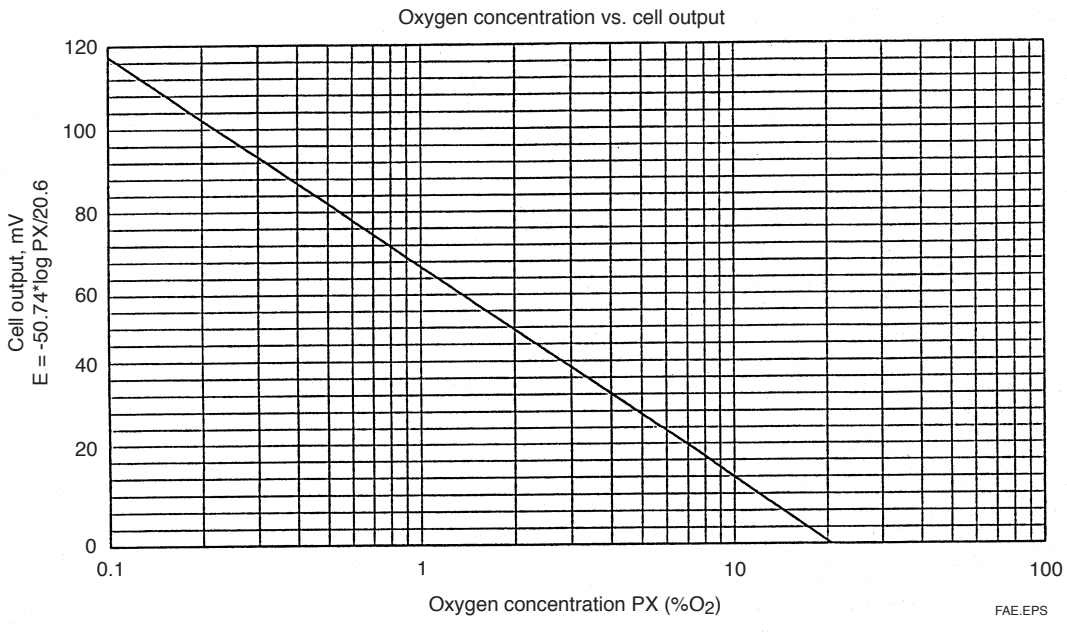
$r = 0.622 \times x/(100 - x)$ …… Equation (4)

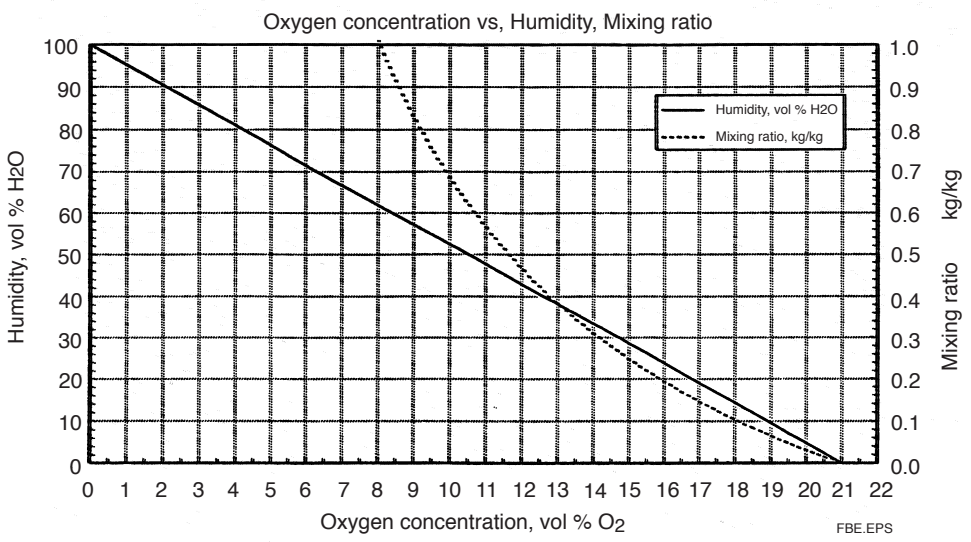
From the above equations (1), (2) and (4), we obtain:

$E = -K \log y/a = -K \log \{0.622 \times 21/(0.622 + r)/21\}$
$= -K \log 0.622/(0.622 + r)$ … …… Equation (5)

where, K = Constant

With Equation (5), we can obtain the mixing ratio r kg/kg from the electromotive force.





9.1.2 Calibration Gas

A gas with a known oxygen concentration is used for calibration. Normal calibration is performed using two different gases: a zero gas of low oxygen concentration and a span gas of high oxygen concentration. In some cases, only one of the gases needs to 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_2 with a balance of nitrogen gas (N_2). The span gas widely used is clean air (at a dew-point temperature below -20°C and free of oily mist or dust, as in instrument air).

For best accuracy, as the span gas use oxygen whose concentration is near the top of the measurement range, in a nitrogen mixture.

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 two-point calibration using two gases: zero and span. Cell electromotive forces for a span gas with an oxygen concentration p1 and a zero gas with an oxygen concentration p2 are measured while determining the calibration curve passing between these two 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×100 (%) on the basis of A, B and C shown in Figure 9.2 and a span correction ratio of C/A×100 (%). If the zero-point correction ratio exceeds the range of 100±30 % or the span correction ratio becomes larger than 0±18 %, calibration of the sensor becomes impossible.

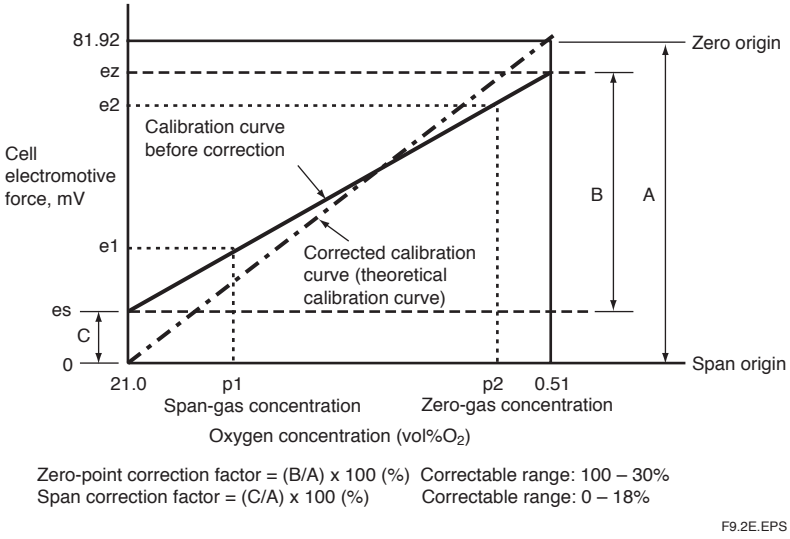


Figure 9.2 Calculation of a Two-point Calibration Curve and Correction Factors using Zero and Span Gases

Figure 9.3 shows a one-point calibration using only a span gas. In this case, only the cell electromotive force for a span gas with oxygen concentration p1 is measured. The cell electromotive force for the zero gas is carried over from a previous measurement to obtain the calibration curve. The principle of calibration using only a span gas also applies to the one-point calibration method using a zero gas only.

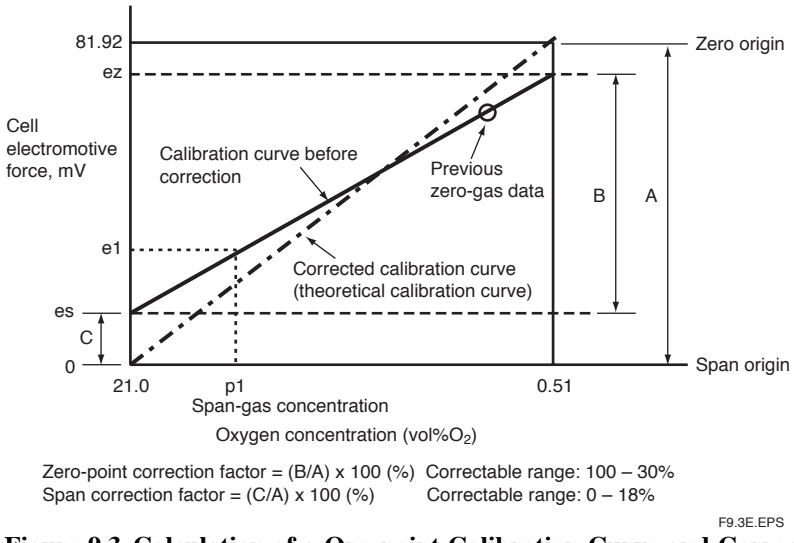


Figure 9.3 Calculation of a One-point Calibration Curve and Correction Factors using a Span Gas

9.1.4 Characteristic Data from a Sensor Measured During Calibration

During calibration, calibration data and sensor status data (listed below) are acquired. However, if the calibration is not properly conducted (an error occurs in automatic or semi-automatic calibration), these data are not collected in the current calibration.

These data can be observed using parameter codes A20 to A22, and A50 to A79. For an explanation and the operating procedures of individual data, consult Section 10.1,

"Detailed Display."

(1) Record of span correction factor
Recorded the past ten span correction factors.
(2) Record of zero correction factors
Recorded the past ten zero correction factors.
(3) Response time
You can monitor the response time provided that a two-point calibration has been done in semi-automatic or automatic calibration.
(4) Cell's internal resistance
The cell's internal resistance gradually increases as the cell (sensor) deteriorates. You can monitor the values measured during the latest calibration. However, these values include the cell's internal resistance and other wiring connection resistance. So, the cell's degrading cannot be estimated from these values only.
When only a span calibration has been made, these values will not be measured, and previously measured values will remain.
(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 four levels.

9.2 Calibration Procedures

CAUTION

Calibration should be made under normal operating conditions (if the probe is connected to a dryer, the analyzer will undergo calibration under the operating conditions of the dryer). To make a precise calibration, conduct both zero-point and span calibrations.

9.2.1 Calibration Setting

The following sets forth the required calibration settings:

9.2.1.1 Mode

There are three calibration modes available:

(1) Manual calibration which allows zero and span calibrations or either one manually in turn;

(2) Semi-automatic calibration which lets calibration start with the touchpanel or a contact input, and undergoes a series of calibration operations following preset calibration periods and stabilization time; and

(3) Automatic calibration which is carried out automatically following preset calibration periods.

Calibrations are limited by the following mode selection:

- **When manual calibration is selected:**
  Manual calibration only can be conducted. (This mode does not allow semi-automatic calibration with a contact input nor automatic calibration even when its start-up time has reached.)

- **When semi-automatic calibration is selected:**
  This mode enables manual and semi-automatic calibrations to be conducted.
  (The mode, however, does not allow automatic calibration even when its start-up time has reached.)

- **When automatic calibration is selected:**
  This calibration can be conducted in any mode.

9.2.1.2 Calibration Procedure

Select both span and zero calibrations or span calibration only or zero calibration only. Usually select span and zero calibrations.

9.2.1.3 Zero-gas Concentration

Set the oxygen concentration for zero-point calibration. Enter the oxygen concentration for the zero gas in the cylinder used.

9.2.1.4 Span-gas Concentration

Set the oxygen concentration for span calibration. If instrument air is used as the span gas, enter 21 %O_2.

When using the ZO21S Standard Gas Unit (for use of the atmospheric air as a span gas), use a hand-held oxygen analyzer to measure the actual oxygen concentration, and then enter it.

CAUTION

(1) When instrument air is used for the span calibration, remove the moisture from the instrument air at a dew-point temperature of -20°C and also remove any oily mist and dust from that air.

(2) If dehumidifying is not enough, or if foul air is used, the measurement accuracy will be adversely affected.

9.2.1.5 Calibration Time

- **When the calibration mode is in manual:**
  First set the **output stabilization time**. This indicates the time required from the end of calibration to entering a measurement again. This time, after calibration, the measurement gas enters the sensor to set the time until the output returns to normal. The output remains held after completing the calibration operation until the output stabilization time elapses. The calibration time set ranges from 00 minutes, 00 seconds to 60 minutes, 59 seconds. For more details, consult Section 8.3,"Setting Output Hold." When the calibration mode is semi-automatic, set the output stabilization time and calibration time. The calibration time is the time required from starting the flow of the calibration gas to reading out the measured value. The set calibration time is effective in conducting both zero and span calibrations. The calibration-time set ranges from 00 minutes, 00 seconds to 60 minutes, 59 seconds. Figure 9.4 shows the relationship between the calibration time and output stabilization time.

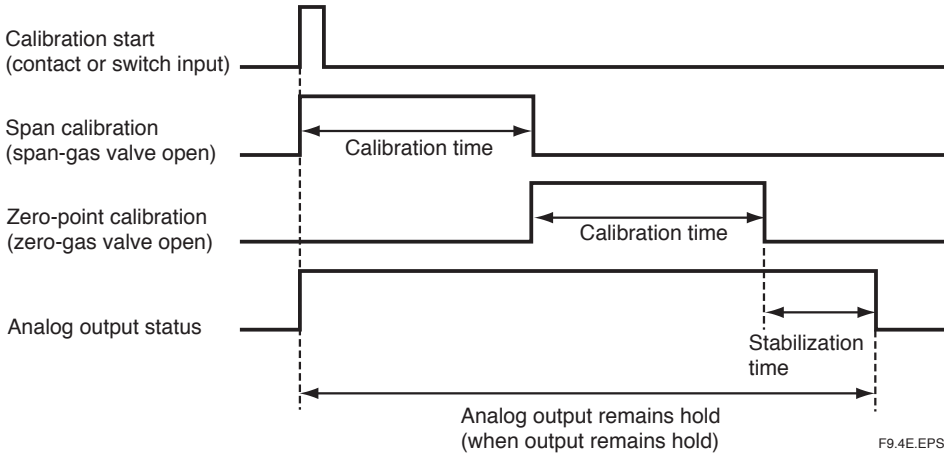


Figure 9.4 Calibration and Output-stabilization Time Settings

When the calibration mode is in automatic:
In addition to the above output stabilization time and calibration time, set the interval, start date, and start time.

Interval means the calibration intervals ranging from 000 days, 00 hours to 255 days, 23 hours.

Set the first calibration day and the start-calibration time to the start date and start time respectively. After the first calibration is carried out, the next calibration will be executed according to the preset calibration intervals.

9.2.1.6 Setting

When setting calibration timing requirements, bear the following precautions in mind:

CAUTION

(1) If the calibration interval is shorter than the sum of stabilization time plus calibration time, the second calibration start time will conflict with the first calibration. In such a case, the second calibration will not be conducted. (When both zero and span calibrations are to be performed, the calibration time is double that required for a single (zero or span) calibration.)
(2) For the same reason, if the calibration start time conflicts with manual calibration or semi-automatic calibration, the current calibration will not be conducted.
(3) If the calibration time conflicts with maintenance service or blowback operations, calibration will start after completing the maintenance service or blowback operations (see Section 8.2.1, earlier in this manual).
(4) If 000 days, 00 hours are set for the calibration intervals, only the first calibration will be conducted; a second or later calibration will not be conducted.
(5) If a past date is set to the calibration start day, no calibration will be conducted.

Table 9.1 Parameter Codes for Calibration Setting

Set Item	Parameter code	Set value	Engineering unit
Zero-gas concentration	B01	Set Zero-gas concentration	$\%O_2$
Span-gas concentration	B02	Set Span-gas concentration	$\%O_2$
Calibration mode	B03	0 : Manual calibration 1 : Semi-automatic and manual 2 : Automatic, semi-automatic, and manual	
Output stabilization	B04	0 minutes 0 seconds to 60 minutes 59 seconds	MM.SS
Calibration time	B05	0 minutes 0 seconds to 60 minutes 59 seconds	MM.SS
Calibration period	B06	0 days 0 hours to 255 days 23 hours	Date and time
Start date and time	B07	Date and time of first calibration	YY.MM.DD.HH.MM
Calibration procedure	B08	0 : Zero and span 1 : Span only 2 : Zero only	

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9.2.1.7 Default Values

When the analyzer is delivered, or if data are initialized, the calibration settings are by default, as shown in Table 9.2.

Table 9.2 Default Settings for Calibration

Item	Default Setting
Calibration mode	Manual
Calibration procedure	Span - zero
Zero-gas (oxygen) concentration	1.00%
Span-gas (oxygen) concentration	21.00%
Output hold (stabilization) time	10 minutes, 00 seconds
Calibration time	10 minutes, 00 seconds
Calibration interval	30 days, 00 hours
Start day and time	00 (YY) 01 (MM) 01(DD) 00:00

T9.2.EPS

9.2.2 Calibration

9.2.2.1 Manual Calibration

For manual calibration, consult Section 7.10, “Calibration”, earlier in this manual.

9.2.2.2 Semi-automatic Calibration

(1) Calibration startup using infrared switches

Table 9.3 Semi-automatic Calibration Procedure

Switch operation			Display	Brief description
>	∧	ENT	b11	Change the parameter code to B11. (Previous operations omitted)
>	∧	ENT	SA-CAL	Touch the [**ENT**] key to display "**SA-CAL**" (Semi Auto CAL).
>	∧	ENT	SPAn /20.84	Touch the [**ENT**] key again to open the span-gas solenoid valve. The span gas then flows. "**SPAN**" and the currently measured value are alternately displayed. If the "**output hold**" is set, the output hold will start at this time.
>	∧	ENT	ZEro /0.89	When the set calibration time elapses, the span-gas solenoid valve closes automatically, the zero-gas solenoid valve opens and the zero gas flows. "**ZERO**" and the currently measured value are displayed alternately.
>	∧	ENT	CALEnd	End when the set calibration time elapses, the zero-gas solenoid valve then closes automatically. The "CALEND" flashes until the set output stabilization time elapses.
>	∧	ENT	**Basic panel display**	When the output stabilization time elapses, the basic panel display then appears. Output holding will be released.

T9.3E.EPS

When "CAL Err" appears, a calibration coefficient alarm (alarm 6 or 7) may have occurred.
Press [ENT] key to return to basic panel display. Check the alarm number. Refer to Subsection 12.2.2.2, Alarm 6, or Subsection 12.2.2.3, Alarm 7, remove the cause, and then recalibrate the instrument.

The symbol ( ) indicates that the key is being touched. Light characters indicate that the digits are flashing.
“/” indicates that both are displayed alternately.

(2) To start calibration using an input contact, follow these steps:

- Make sure that Calibration start has been selected in the Input contacts display (see Section 8.5, earlier in this manual).
- Apply an input contact to start calibration.

(3) To stop calibration midway, follow these steps:

(1) Touch the [>] key and [ENT] key together. The calibration will stop and the output stabilization time will be set up.

(2) Touch the [>] key once again to return to the basic panel display and the analyzer will be in normal measurement.

9.2.2.3 Automatic Calibration

No execution operations are required for automatic calibration. Automatic calibration starts in accordance with a preset start day and time. Calibration is then executed at preset intervals.

CAUTION

Before conducting a semi-automatic or automatic calibration, run the automatic calibration unit beforehand to obtain a calibration flow of 600 ± 60 ml/min.

10. Other Functions

10.1 Detailed Display

Select the desired parameter code to display the detailed operation data (see Table 10.1, “Parameter Codes for Detailed Operation Data.”

Table 10.1 Parameter Codes for Detailed Operation Data

Parameter code	Item	Engineering unit	Code	Item	Engineering unit
A00	Selection of display items				
	0: Oxygen concentration		A50	Span-gas ratio 0	%
	1: Oxygen analyzer (0.0)		A51	Span-gas ratio 1	%
	2: Oxygen analyzer (0.0)		A52	Span-gas ratio 2	%
	3: Analog output selected		A53	Span-gas ratio 3	%
A01	Oxygen concentration	% O_2	A54	Span-gas ratio 4	%
A02	Humidity	% H_2O	A55	Span-gas ratio 5	%
A03	Mixing ratio	kg/kg	A56	Span-gas ratio 6	%
A04	Relative humidity	%	A57	Span-gas ratio 7	%
A05	Dew point	℃	A58	Span-gas ratio 8	%
A06			A59	Span-gas ratio 9	%
A07	Cell temperature	℃	A60	Zero-gas ratio 0	%
A08	Cold-junction temperature	℃	A61	Zero-gas ratio 1	%
A09	Meas. gas temperature	℃	A62	Zero-gas ratio 2	%
A10			A63	Zero-gas ratio 3	%
A11	Cell voltage	mV	A64	Zero-gas ratio 4	%
A12	TC voltage	mV	A65	Zero-gas ratio 5	%
A15	Cold-junction voltage	mV	A66	Zero-gas ratio 6	%
A16	Output current	mA	A67	Zero-gas ratio 7	%
A20	Cell response time	Seconds	A68	Zero-gas ratio 8	%
A21	Cell internal resistance	Ω	A69	Zero-gas ratio 9	%
A22	Cell robustness		A70	Calibration history 0	YY.MM.DD/HH.MM
A23	Heater on-time ratio	%	A71	Calibration history1	YY.MM.DD/HH.MM
A24	Oxygen concentration (with time constant)	% O_2	A72	Calibration history 2	YY.MM.DD/HH.MM
A25	Humidity (with time constant)	% H_2O	A73	Calibration history 3	YY.MM.DD/HH.MM
A26	Mixing ratio (with time constant)	kg/kg	A74	Calibration history 4	YY.MM.DD/HH.MM
A30	Max. oxygen concentration	% O_2	A75	Calibration history 5	YY.MM.DD/HH.MM
A31	Occurrence of maximum oxygen concentration	YY.MM.DD/HH.MM	A76	Calibration history 6	YY.MM.DD/HH.MM
A32	Min. oxygen concentration	% O_2	A77	Calibration history 7	YY.MM.DD/HH.MM
A33	Occurrence of minimum oxygen concentration	YY.MM.DD/HH.MM	A78	Calibration history 8	YY.MM.DD/HH.MM
A34	Average oxygen concentration	% O_2	A79	Calibration history 9	YY.MM.DD/HH.MM
A35	Maximum humidity	% H_2O	A80	Time	YY.MM.DD/HH.MM
A36	Occurrence of maximum humidity	YY.MM.DD/HH.MM	A90	Software revision	
A37	Minimum humidity	% H_2O			
A38	Occurrence of minimum humidity	YY.MM.DD/HH.MM			
A39	Average humidity	% H_2O			
A40	Maximum mixing ratio	kg/kg			
A41	Occurrence of maximum mixing ratio	YY.MM.DD/HH.MM			
A42	Minimum mixing ratio	kg/kg			
A43	Occurrence of minimum mixing ratio	YY.MM.DD/HH.MM			
A44	Average mixing ratio	kg/kg			

Note: The blank parameter codes above are not used in the High-temperature Humidity analyzer.

T10.1.EPS

10.1.1 Oxygen Concentration

The oxygen concentration in the process gas is displayed (consult Section 9.1.1, earlier in this manual).

10.1.2 Humidity

The moisture content contained in air is displayed where the process gas contains water vapors and air (refer to Section 9.1.1, earlier in this manual).

10.1.3 Mixing Ratio

Where the process gas contains water vapors and air, their mixing ratio is displayed (refer to Section 9.1.1, earlier in this manual).

10.1.4 Relative Humidity

The relative humidity "U" may be obtained using the following theoretical equation (JIS Z 8806).

$$U = \frac{e}{e_s} \times 100$$

where, e = Water vapor pressure of moist air

e_s = Saturated water vapor

Since the gas-pressure ratio is equal to the volume ratio, the above equation may be expressed mathematically by:

$$U = P \times H / e_s \times 100$$

where, P = Gas pressure

H = Humidity (volume ratio)

The saturated water vapor pressure e_s is determined by a gas temperature, so the relative humidity can be obtained by entering the parameters. Use parameter F13 for temperature entry. Use parameter F14 for pressure entry.

10.1.5 Dew Point

The dew point is the temperature at which a water vapor pressure in the moist air is equal to the saturated water vapor pressure.

The water vapor pressure in the moist air can be obtained from the gas pressure and volume ratio (= pressure ratio), as given below.

$$e = P \times H$$

where, e = Water vapor pressure in moist air

P = Gas pressure

H = Humidity (volume ratio)

Use the above equation to find the water vapor in the moist air, and use the theoretical equation (JIS Z 8806) to obtain the temperature at which that water vapor is equal to the saturated water vapor pressure.

10.1.6 Cell Temperature

The cell temperature can be obtained from the thermoelectromotive force and cold junction temperature; normally 750°C is displayed.

10.1.7 Process Gas Temperature

A process gas temperature set with parameter code F13 is displayed.

10.1.8 Cold Junction Temperature

This is the internal (where the electronics is installed) temperature of equipment, which compensates for the cold junction temperature for a thermocouple measuring the cell temperature. If this temperature exceeds 85°C, the electronics may fail. If the internal temperature exceeds this, take countermeasures to reduce the temperature such as by not exposing the equipment to radiation.

10.1.9 Cell Voltage

The cell (sensor) voltage will be an index to determine the amount of degradation of the sensor. The cell voltage corresponds to the oxygen concentration currently being measured. If the indicated voltage approximates the ideal value (corresponding to the measured oxygen concentration), the sensor will be assumed to be normal.

The ideal value of the cell voltage (E), when the oxygen concentration measurement temperature is controlled at 750°C., may be expressed mathematically by:

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

where, Px: Oxygen concentration in the process gas

Pa: Oxygen concentration in the reference gas, (21% O_2)

Table 10.2 Oxygen Concentration Vs. Cell Voltage, (cell temperature: 750°C)

$\%O_2$	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

$\%O_2$	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

$\%O_2$	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

$\%O_2$	100
mv	-34.4

T10.2E.EPS

10.1.10 Thermocouple Voltage

The cell temperature is measured with a Type K (chromel-alumel) thermocouple. The thermocouple cold junction is located in the detector terminal box. The cell temperature and the thermocouple voltage (including the voltage corresponding to the cold junction temperature) are displayed.

10.1.11 Cold Junction Voltage

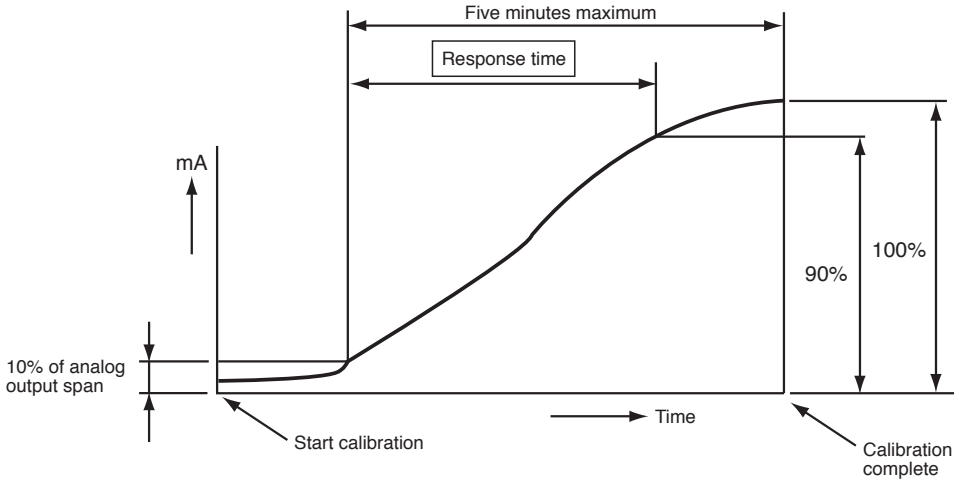
This equipment uses temperature-measurement ICs that measure the cold junction temperatures. The voltage measured by those ICs is displayed.

10.1.12 Current Output

The analog output current is displayed.

10.1.13 Response Time

The cell's response time is obtained in the procedure shown in Figure 10.1. If only either a zero-point or span calibration has been carried out, the response time will not be measured just as it will not be measured in manual calibration.



The response time is obtained after the corrected calibration curve has been found. The response time is calculated, starting at the point corresponding to 10% of the analog output up to the point at 90% of the analog output span. That is, this response time is a 10 to 90% response.

F10.1E.EPS

Figure 10.1 Functional Drawing of Response Time

10.1.14 Internal Resistance of Cell

A new cell (sensor) indicates its internal resistance of 200 Ω maximum. As the cell degrades, so will the cell's internal resistance increase. The degradation of the cell cannot be found only by changes in cell's internal resistance, however. Those changes in the cell's internal resistance will be a hint to knowing the sensor is degrading. The updated values obtained during the calibration are displayed.

10.1.15 Robustness of a Cell

The robustness of a cell is an index for predicting the remaining life of a sensor and is expressed as one of four time periods during which the cell may still be used:

(1) more than a year

(2) more than six months

(3) more than three months

(4) less than one month

The above four time periods are tentative and only used for preventive maintenance, not for warranty of the performance.

This cell's robustness can be found by a total evaluation of data involving the response time, the cell's internal resistance, and calibration factor. However, if a zero or span calibration was not made, the response time cannot be measured. In such a case, the cell's robustness is found except for the response time.

Table 10.3 Cell Robustness and Service Life

Cell robustness	Cell s service life
5	One year min.
3	Six months min.
2	Three months min.
1	One month max.

T10.3.EPS

10.1.16 Heater On-Time Ratio

The probe sensor is heated to and maintained at 750° C. When the measured gas temperature is high, the amount of heater ON-time decreases.

10.1.17 Oxygen Concentration (with time constant), Humidity (with time constant), and Mixing Ratio (with time constant)

When the output damping is specified in the mA-output range setting, the corresponding time constant is also displayed.

10.1.18 Maximum Oxygen Concentration, Humidity, and Mixing Ratio

The maximum oxygen concentration and the time of its occurrence during the period specified in the Averaging display are displayed. If the setup period elapses, the maximum oxygen concentration that has been displayed so far will be cleared and a new maximum oxygen concentration will be displayed. If the setup period of time is changed, the current maximum oxygen concentration will be displayed (for more details, see Section 8.6.2 earlier in this manual).

10.1.19 Minimum Oxygen Concentration, Humidity, and Mixing Ratio

The minimum oxygen concentration and the time of its occurrence during the period specified in the Averaging display are displayed. If the setup period elapses, the minimum oxygen concentration that has been displayed so far will be cleared and a new minimum oxygen concentration will be displayed. If the setup period of time is changed, the current minimum oxygen concentration will be displayed (for more details, see Section 8.6.2 earlier in this manual).

10.1.20 Average Oxygen Concentration, and Mixing Ratio

The average oxygen concentration during the periods over which average values are calculated is displayed. If the setup period elapses, the average oxygen concentration that has been displayed so far will be cleared and a new average oxygen concentration will be displayed. If the setup period of time is changed, the current average oxygen concentration will be displayed (for more details, see Section 8.6.2 earlier in this manual).

10.1.21 Span-gas and Zero-gas Correction Ratios

Span-gas and zero-gas correction ratios for the past ten calibrations are recorded to enable you to check the degradation of the sensor (cell). If the correction ratio is beyond the limits as shown in Figure 10.2, the sensor should no longer be used.

These ratios can be found by calculating the data as shown below.

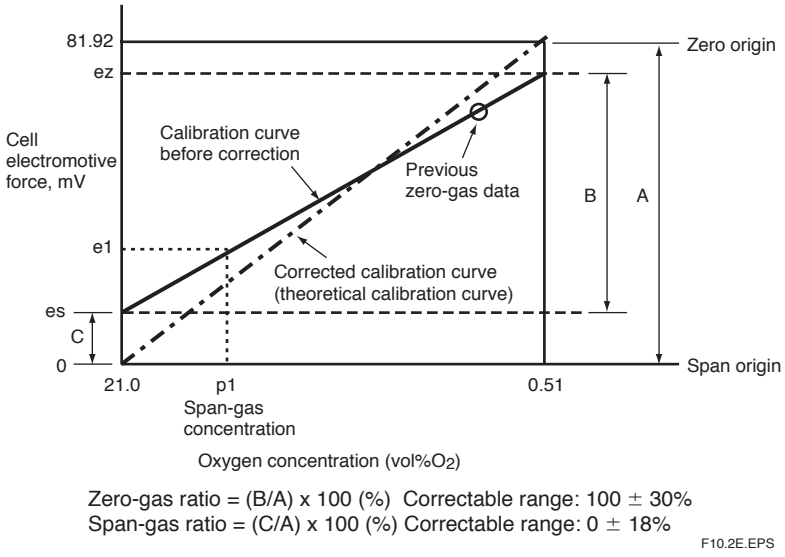


Figure 10.2

10.1.22 History of Calibration Time

The calibration-conducted dates and times for the past ten calibrations are stored in memory.

10.1.23 Time

The current date and time are displayed. These are backed up by built-in batteries, so no adjustment is required after the power is switched off. The following shows an example of displaying June 21, 2000, 3 : 06 p.m.

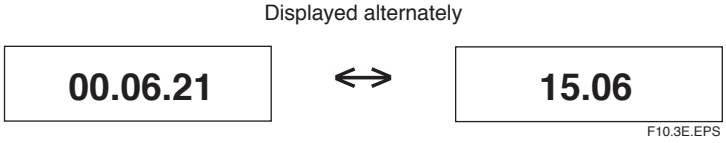


Figure 10.3 Date-and-time Display

10.1.24 Software Revision

The revision (number) of the software installed is displayed.

10.2 Operational Data Initialization

Individual set data initialization enables you to return to the default values set at the time of delivery. There are two types of initializations: an all set-data initialization and a parameter-code-based initialization. Table 10.7 lists the initialization items by a parameter code, and default values.

Table 10.4 Parameter Codes for Initialization

Parameter code	Data to be initialized
F30	All data
F31	Data in Group A
F32	Data in Group B
F33	Data in Group C
F34	Data in Group D
F35	Data in Group E
F36	Data in Group F

T10.4EPS

CAUTION

If the above group F is initialized with parameter code F36, items corresponding to parameter codes F01, F08 and F10 will not be initialized.

10.3 Initialization Procedure

Follow the table below to initialize parameters. The password for initialization is 1255.

Table 10.5 Initialization Procedure

Switch operation			Display	Description
>	∧	ENT	F30	Enter the parameter code for the item to be initialized. The following show an example of entering "**F30.**" (Previous needed operations are omitted.)
>	∧	ENT	0000	Touch the [**ENT**] key to switch to the password entry display.
>	∧	ENT	1000	Enter the password **1255** for initialization.
>	∧	ENT	1000	
>	∧	ENT	1200	
>	∧	ENT	1200	
>	∧	ENT	1250	
>	∧	ENT	1250	
>	∧	ENT	1255	
>	∧	ENT	1255	After you enter the password and then touch the [**ENT**] key, all the digits flash.
>	∧	ENT	USr Go	Touch the [**ENT**] key again to display "**USR GO.**"
>	∧	ENT	USr Go	Touch the [**ENT**] key once more. All the digits then flash for two to three seconds, and data initialization starts.
>	∧	ENT	F30	The initialization is complete, and the parameter code selection display then appears.

T10.5E.EPS

The symbol ( ) indicates that the key is being touched.

Light characters indicate that the digits are flashing.

WARNING

- Do not attempt to turn off the equipment power during initialization (while "USR GO" is flashing).

10.4 Reset

Resetting enables the equipment to restart. If the equipment is reset, the power is turned off and then back on. In practical use, the power remains on, and the equipment is restarted under program control. Resetting will be possible in the following conditions:

(1) Error 1 if the cell voltage is defective

(2) Error 2 if a temperature alarm occurs

(3) Error 3 if the A/D converter is defective

(4) Error 4 if an EEPROM write error occurs

For details on error occurrence, consult Chapter 12, “Troubleshooting,” later in this manual.

If any of the above problems occurs, the equipment turns off the power to the detector heater. To cancel the error, reset the equipment following the steps below, or turn the power off and then back on.

Note: Make sure that before resetting or restarting the power that there is no problem with the equipment.

CAUTION

If a problem arises again after the resetting, turn the power off and troubleshoot the problem by consulting the Troubleshooting chapter later in this manual. When there is no error, the Basic panel display will appear.

Table 10.6 Resetting

Switch operation			Display	Brief description
>	^	ENT	Err-01 /------	If an error occurs, the error number and "------" are displayed alternately, as given on the left.
>	^	ENT	PASSno	Hold down the [**ENT**] key for at least three seconds.
>	^	ENT	0000	Touch the [**ENT**] key again to switch to the password entry display.
>	^	ENT	1000	Enter the password 1102.
Intermediate switch operations omitted.				
>	^	ENT	1102	
>	^	ENT	A01	
>	^	ENT	G01	Change the parameter code to "**G30.**"
>	^	ENT	G01	
>	^	ENT	G30	
>	^	ENT	All the digits light up.	Touch the [**ENT**] key to execute resetting.

T10.5aE.EPS

The symbol ( ) indicates that the key are light characters indicate "flashing".
"/" indicate that the characters are displayed alternately.

Note

• Parameters of blank item are not used for High Temperature Humidity Analyzer.

Table 10.7 Parameter Codes
Display-related Items in Group A

Parameter code	Item	Engineering unit	Code	Item	Engineering unit
A00	Selection of display items				
	0: Oxygen concentration		A50	Span-gas ratio 0	%
	1: Oxygen analyzer (0.0)		A51	Span-gas ratio 1	%
	2: Oxygen analyzer (0.0)		A52	Span-gas ratio 2	%
	3: Analog output selected		A53	Span-gas ratio 3	%
A01	Oxygen concentration	% O_2	A54	Span-gas ratio 4	%
A02	Humidity	% H_2O	A55	Span-gas ratio 5	%
A03	Mixing ratio	kg/kg	A56	Span-gas ratio 6	%
A04	Relative humidity	%	A57	Span-gas ratio 7	%
A05	Dew point	℃	A58	Span-gas ratio 8	%
A06			A59	Span-gas ratio 9	%
A07	Cell temperature	℃	A60	Zero-gas ratio 0	%
A08	Cold-junction temperature	℃	A61	Zero-gas ratio 1	%
A09	Meas. gas temperature	℃	A62	Zero-gas ratio 2	%
A10			A63	Zero-gas ratio 3	%
A11	Cell voltage	mV	A64	Zero-gas ratio 4	%
A12	TC voltage	mV	A65	Zero-gas ratio 5	%
A15	Cold-junction voltage	mV	A66	Zero-gas ratio 6	%
A16	Output current	mA	A67	Zero-gas ratio 7	%
A20	Cell response time	Seconds	A68	Zero-gas ratio 8	%
A21	Cell internal resistance	Ω	A69	Zero-gas ratio 9	%
A22	Cell robustness		A70	Calibration history 0	YY.MM.DD/HH.MM
A23	Heater on-time ratio	%	A71	Calibration history 1	YY.MM.DD/HH.MM
A24	Oxygen concentration (with time constant)	% O_2	A72	Calibration history 2	YY.MM.DD/HH.MM
A25	Humidity (with time /time constant)	% H_2O	A73	Calibration history 3	YY.MM.DD/HH.MM
A26	Mixing ratio (with time /time constant)	kg/kg	A74	Calibration history 4	YY.MM.DD/HH.MM
A30	Max. oxygen concentration	% O_2	A75	Calibration history 5	YY.MM.DD/HH.MM
A31	Occurrence of maximum oxygen concentration	YY.MM.DD/HH.MM	A76	Calibration history 6	YY.MM.DD/HH.MM
A32	Min. oxygen concentration	% O_2	A77	Calibration history 7	YY.MM.DD/HH.MM
A33	Occurrence of minimum oxygen concentration	YY.MM.DD/HH.MM	A78	Calibration history 8	YY.MM.DD/HH.MM
A34	Average oxygen concentration	% O_2	A79	Calibration history 9	YY.MM.DD/HH.MM
A35	Maximum humidity	% H_2O	A80	Time	YY.MM.DD/HH.MM
A36	Occurrence of max. humidity	YY.MM.DD/HH.MM	A90	Software revision	
A37	Minimum humidity	% H_2O			
A38	Occurrence of min. humidity	YY.MM.DD/HH.MM			
A39	Average humidity	% H_2O			
A40	Maximum mixing ratio	kg/kg			
A41	Occurrence of max. mixing ratio	YY.MM.DD/HH.MM			
A42	Occurrence of minimum min. mixing ratio	kg/kg			
A43	Occurrence of min. mixing ratio	YY.MM.DD/HH.MM			
A44	Average mixing ratio	kg/kg			

Note1: "/" indicates that both are displayed alternately.

Note2: Parameter codes with no items in the above table are not used in the humdity analyzer.

T10.6A.EPS

Calibration-related Items in Group B

Code	Item	Tuning	Engineering unit	Default setting
B01	Zero-gas concentration	0.3 to 100	% O_2	1% O_2
B02	Span-gas concentration	4.5 to 100	% O_2	21% O_2
B03	Calibration mode	0: Manual calibration 1: Semi-automatic and manual calibration 2: Automatic, semi-automatic, and manual calibration		Manual calibration
B04	Output stabilization time	0 minutes, 0 seconds to 60 minutes, 59 seconds	MM.SS	10 minutes, 0 seconds
B05	Calibration time	0 minutes, 0 seconds to 60 minutes, 59 seconds	MM.SS	10 minutes, 0 seconds
B06	Calibration period	0 days 0 hours to 255 days 23 hours	DD.HH	30 days, 0 hours
B07	Start time		YY.MM.DD/HH.MM	00.01.01.00.00
B08	Calibration	0: Zero and span 1: Span only 2: Zero only		Zero and span
B09	Calibration concentration measurement	Display only	% O_2	
B10	Manual calibration			
B11	Semi-automatic calibration			

T10.6B.EPS

Output-related Items in Group C

Code	Item	Tuning	Engineering unit	Default setting
C01	Analog output	0: Oxygen concentration 1: Humidity 2: Mixed ratio		Humidity
C03	Output mode	0: Linear 1: Logarithm		Linear
C04	Output during warm-up up	0: Held at 4 mA 1: Held at 20 mA 2: Set value remains held.		Held at 4 mA.
C05	Output during maintenance	0: Not held 1: Held output just before maintenance service. 2: Set value remains held.		Held output just before maintenance service.
C06	Output during calibration	0: Not held 1: Held output just before calibration. 2: Set value remains held.		Held output just before calibration.
C07	Output in abnormal state	0: Not held 1: Held output just before abnormal state occurs. 2: Set value remains held.		Held output at a preset value.
C11	Min. oxygen concentration	See Section 8.1.	% O_2	0% O_2
C12	Max. oxygen concentration	See Section 8.1.	% O_2	25% O_2
C13	Minimum humidity	See Section 8.1.	% H_2O	0% H_2O
C14	Maximum humidity	See Section 8.1.	% H_2O	25% H_2O
C15	Minimum mixing ratio	See Section 8.1.	kg/kg	0 kg/kg
C16	Maximum mixing ratio	See Section 8.1.	kg/kg	0.2kg/kg
C30	Output damping factor	0 to 255	Seconds	0 second
C31	Set value during warm-up	2.4 to 21.6	mA	4 mA
C32	Set value during maintenance	2.4 to 21.6	mA	4 mA
C33	Set value during calibration	2.4 to 21.6	mA	4 mA
C34	Set value in abnormal state	2.4 to 21.6	mA	3.4 mA

T10.6C.EPS

Alarm-related Items in Group D

Code	Item	Tuning	Engineering unit	Default setting
D01	Oxygen concentration, high-high alarm setpoint	0 to 100	% O_2	100% O_2
D02	Oxygen concentration, high-limit alarm setpoint	0 to 100	% O_2	100% O_2
D03	Oxygen concentration, low-limit alarm setpoint	0 to 100	% O_2	0% O_2
D04	Oxygen concentration, low-low alarm setpoint	0 to 100	% O_2	0% O_2
D05	Humidity, high-high alarm setpoint	0 to 100	%H_2O	100% H_2O
D06	Humidity, high-alarm setpoint	0 to 100	% H_2O	100 % H_2O
D07	Humidity, low-alarm setpoint	0 to 100	% H_2O	0 % H_2O
D08	Humidity, low-low alarm setpoint	0 to 100	% H_2O	0 % H_2O
D11	Mixing ratio, high-high alarm setpoint	0 to 1	kg/kg	1 kg/kg
D12	Mixing ratio, high-alarm setpoint	0 to 1	kg/kg	1 kg/kg
D13	Mixing ratio, low-alarm setpoint	0 to 1	kg/kg	0 kg/kg
D14	Mixing ratio, low-low alarm setpoint	0 to 1	kg/kg	0 kg/kg
D30	Oxygen concentration alarm hysteresis	0 to 9.9	% O_2	0.1% O_2
D31	Humidity alarm hysteresis	0 to 9.9	% H_2O	0.1 % H_2O
D32	Mixing ratio alarm hysteresis	0 to 0.1	kg/kg	0.001 kg/kg
D33	Delayed alarm action	0 to 255	Seconds	3 seconds
D41	Oxygen concentration, high-high alarm detection	0: Not detected 1: Detection		Not detected
D42	Oxygen concentration, high-limit alarm detection	0: Not detected 1: Detection		Not detected
D43	Oxygen concentration, low-limit alarm detection	0: Not detected 1: Detection		Not detected
D44	Oxygen concentration, low-low alarm detection	0: Not detected 1: Detection		Not detected
D45	Humidity, high-high alarm detection	0: No detection 1: Detection		No detection
D46	Humidity, high-alarm detection	0: No detection 1: Detection		No detection
D47	Humidity, low-alarm detection	0: No detection 1: Detection		No detection
D48	Humidity, low-low alarm detection	0: No detection 1: Detection		No detection
D51	Mix ratio, high-high alarm	0: No detection 1: Detection		No detection
D52	Mix ratio, high-alarm detection	0: No detection 1: Detection		No detection
D53	Mix ratio, low-alarm	0: No detection 1: Detection		No detection
D54	Mix ratio, low-low alarm detection	0: No detection 1: Detection		No detection

T10.6D.EPS

Contact-related Items in Group E

Code	Item	Tuning	Engineering unit	Default setting
E01	Selection of input contact 1	0: Invalid 1: Calibration gas pressure drop 2: Measurement range change 3: Calibration start 4: Detection of non-combusted gas		Invalid
E02	Selection of input contact 2	0: Invalid 1: Calibration gas pressure drop 2: Measurement range change 3: Calibration start 4: Detection of non-combusted gas		Invalid
E03	Selecting action of input contact 1	0: Action with closed contact 1: Action with open contact		Action with closed contact
E04	Selecting action of input contact 2	0: Action with closed contact 1: Action with open contact		Action with closed contact
E10	Selecting action of output contact 1	0: Action with open contact (normally energized) 1: Action with closed contact (normally deenergized)		Action with closed contact
E20	Output contact 1 error	0: No action 1: Action		No action
E21	Output contact 1, high-high alarm	0: No action 1: Action		No action
E22	Output contact 1, high-limit alarm	0: No action 1: Action		No action
E23	Output contact 1, low-limit alarm	0: No action 1: Action		No action
E24	Output contact 1, low-low alarm	0: No action 1: Action		No action
E25	Output contact 1, during maintenance	0: No action 1: Action		Action
E26	Output contact 1, during calibration	0: No action 1: Action		No action
E27	Output contact 1, measurement range change	0: No action 1: Action		No action
E28	Output contact 1, during warm up	0: No action 1: Action		Action
E29	Output contact 1, calibration gas pressure decrease	0: No action 1: Action		No action
E32	Output contact 1, detection of non-combusted gas	0: No action 1: Action		No action

T10.6E.EPS

Equipment Setup and Others in Group F

Code	Item	Tuning	Engineering unit	Default setting
F01	Equipment setup	0: Oxygen analyzer 1: Humidity analyzer		Not initialized
F02				
F04	Selection of temperature units	0: degree C 1: degree F		degree C
F05	Selection of pressure units	0: kPa 1: psi		kPa
F08	Selection of display items	0: Oxygen concentration 1: Humidity 2: Mixed ratio 3: Item selected with analog output		Humidity
F10	Date		YY.MM.DD/HH.MM	
F11	Period over which average values are calculated	1 to 255 hours	Hours	One hour
F12	Period over which max. and min. values are monitored	1 to 255 hours	Hours	24 hours
F13	Process gas temperature	0 to 3000	°C	300 °C
F14	Process gas pressure	0 to 300	kPa abs.	101.33 kPa abs.
F20				
F21				
F22				
F23				
F30	Initializing all data			
F31	Initializing data in group A			
F32	Initializing data in group B			
F33	Initializing data in group C			
F34	Initializing data in group D			
F35	Initializing data in group E			
F36	Initializing data in group F			

T10.6F.EPS

Inspection-related Items in Group G

Code	Item	Tuning	Engineering unit	Default setting
G01	mA-output loop	4 to 20	mA	4 mA
G11	Output contact 1	0: Open 1: Closed		Open
G12	Output contact 2	0: Open 1: Closed		Open
G15	Automatic calibration solenoid valve (zero)	0: Off 1: On		Off
G16	Automatic calibration solenoid valve (span)	0: Off 1: On		Off
G21	Input1 contact	0: Open 1: Closed		
G22	Input2 contact	0: Open 1: Closed		
G30	Reset			

T10.6G.EPS

10.5 Handling of the ZO21S Standard Gas Unit

The following describe how to flow zero and span gases using the ZO21S Standard Gas Unit. Operate the ZO21S Standard Gas Unit, for calibrating a system classified as System 1, according to the procedures that follow.

10.5.1 Standard Gas Unit Component Identification

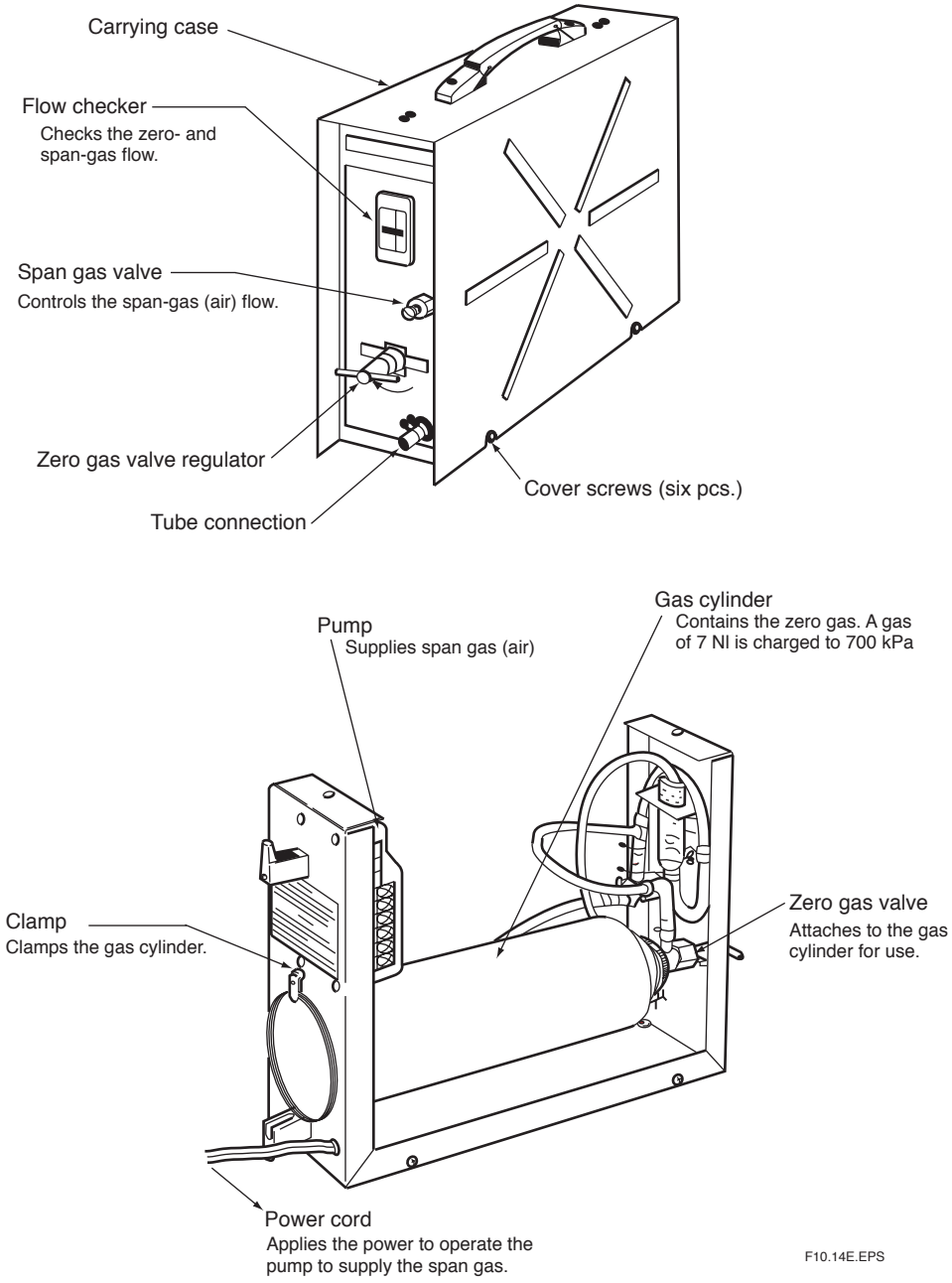


Figure 10.4 Standard Gas Unit Component Identification

10.5.2 Installing Gas Cylinders

Each ZO21S Standard Gas Unit comes with six zero-gas cylinders including a spare. Each gas cylinder contains 7-liters of gas with a 0.95 to 1.0 vol%O_2 (concentration varies with each cylinder) and nitrogen, at a pressure of 700 kPaG (at 35° C).

The operating details and handling precautions are also printed on the product. Please read them beforehand.

To install the gas cylinder, follow these steps:

(1) Attach the zero gas valves onto the gas cylinder. First, turn the valve regulator of the zero gas valves 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 mouthpiece of the gas cylinder. (If screw connection is proper, you can turn the screw manually. Do not use any tool.) When the gasket comes in contact with the mouthpiece 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 attached to the unit with six screws. So, loosen the screws and lift them 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 valves 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 using the parameter code B01 as a zero-gas oxygen concentration. Also check that no piping is disconnected.

Thus, the work of installing a gas cylinder is completed. However, gases in the cylinders cannot immediately flow out after these procedures. To discharge the gases, it is necessary for the needle in the zero gas valves to puncture a hole in the gas cylinder (see Section 10.5.3).

10.5.3 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 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 (21 vol% O_2 for clean air). When using the ZO21S Standard Gas Unit (for use of the atmospheric air as a span gas), use a hand-held oxygen analyzer to measure the actual oxygen concentration, and then enter it.

<Flow of span gas (air)>

The standard gas unit is used only when manual calibration is employed.

Therefore, the timing for flowing span gas (air) is included in the manual calibration flowchart described in Section 7.10.2, earlier in this manual. For operation of the converter, see Section 7.10.2.

(1) When the "OPEN" and "the measured oxygen concentration" are alternately displayed 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 ± 60 ml/min using the span gas valve "AIR" (the flow check ball stops floating on the green line when the valve is slowly opened). To rotate the valve shaft, loosen the lock nut and turn it using a flat-blade screwdriver. Turning the valve shaft counterclockwise increases the flow rate.
(3) After adjusting the flow rate, tighten the valve lock nut.
(4) After the measured oxygen concentration is stabilized, touch the [ENT] key, then all the digits flash. Touch the [ENT] key again to display "ZERO Y" Disconnect the power cord to stop the pump.

<Flow of zero gas>

Touch the [ENT] key to display a zero-gas value set with the parameter code B01. Touch the [ENT] key again to flash "OPEN" and the "measured oxygen concentration" alternately. To cause the zero gas flow, follow these steps:

(1) Use the needle of the zero gas valve "CHECK GAS" to puncture a hole in the gas cylinder installed as described in Section 10.5.2. Fully clockwise turn the valve regulator by hand.
(2) Next, adjust the flow rate to 600 ± 60 ml/min (the flow check ball stops floating on 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. Monitor the flow check and, when the ball's position changes greatly, readjust the valve.
(3) Touch the [ENT] key after the measured oxygen concentration becomes stable. Then all the digits flash. Touch the [ENT] key again so that the "CALEND" flashes.

Note

Be sure not to terminate the calibration in progress because of a shortage of gas in the cylinder. Each gas cylinder is operable for nine minutes or more provided the gas is discharged at the specified rate.

Therefore, if your calibration time is estimated at four minutes, you can operate the zero-point calibration twice.

(4) Stop the zero-gas flow. Turn the zero-gas valve regulator fully clockwise. If this valve regulator is not properly adjusted, the needle valve will not close completely and a cylinder gas may leak. When the output stabilization time elapses, the calibration is complete.

<Treatment after completion of calibration>

(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.

WARNING

Store the standard gas unit with the gas cylinder mounted where the ambient temperature does not exceed 40° C. Otherwise, the gas cylinder may explode. Store the spare gas cylinders under the same condition.

10.6 Methods of Operating Valves in the ZA8F Flow Setting Unit

The ZA8F Flow Setting Unit is used as the calibration equipment for a system conforming to System 2. Calibration in such a system is to be manually operated. So, you have to operate the valve of the Flow Setting each time calibration is made (starting and stopping the calibration gas flow and adjusting the flow rate).

This applies even if you are using the ZR20H Auto Calibration Unit.

10.6.1 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 equals [measurement gas pressure plus approx. 50 kPa] (or measured gas pressure plus approx.150 kPa when acheck valve is used maximum pressure rating is 300 kPa.).
(2) Check that the oxygen concentration of the zero gas and span gas (instrument air 21 vol% O_2) in the cylinder is set for the converter.

10.6.2 Operating the Span Gas Flow Setting Valve

The following description is given assuming that instrument air, the same as the reference gas, is used as the span gas. For more details, see Section 7.10.2, “Manual Calibration,” earlier in this manual.

(1) When “OPEN” and the measured oxygen concentration appear alternately during the span calibration, open the span gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ± 60 ml/min.
Loosen the lock nut if the valve shaft has a lock nut, and turn the valve regulator slowly counterclockwise. To check the flow rate, use the calibration flow meter. If the measurement gas pressure is extremely high, adjust the measurement gas pressure to obtain pressures (listed in Table 10.8) ± 10%.

Table 10.8

Measurement gas pressure, (kPa)	50	100	150	200	250
Flow rate, (ml/min.)	500	430	380	350	320

T10.6.2.EPS

(2) Adjust the flow rate. After the measured oxygen concentration has stabilized, touch the [ENT] key, then all the digits will flash. Touch the [ENT] key again to display “ZERO Y”

(3) Close the span gas flow setting valve to stop the span gas (air) flow. If the valve shaft has a lock nut, be sure to tighten the lock nut to prevent any leakage of span gas into the sensor during measurement.

10.6.3 Operating the Zero Gas Flow Setting Valve

Operate the zero gas flow setting valve during zero-point calibration in the following procedures:

(1) When the "OPEN" and the measured oxygen concentration appearalternately during calibration, open the zero gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ± 60 ml/min. To rotate the valve shaft, loosen the lock nut if the valve shaft has a lock nut, and slowly turn it counterclockwise.

(2) To check the flow rate, use an appropriate calibration gas flow meter. If the measurement gas pressure is extremely high, adjust the measurement gas pressure to obtain pressures (listed in Table 10.9) ± 10%.

Table 10.9

Measurement gas pressure, kPa	50	100	150	200	250
Flow rate, ml/min.	500	430	380	350	320

T10.6.3.EPS

(3) Adjust the flow rate. After the measured oxygen concentration is stabilized, touch the [ENT] key, then all the digits will flash. Touch the [ENT] key again to flash "CAL END"

(4) Close the zero gas flow setting valve to stop the zero gas flow. Be sure to tighten the lock nut if valve shaft has a lock nut to prevent any leakage of zero gas into the sensor during measurement. When the stabilization time elapses, the zero calibration will be complete.

10.6.4 Operation After Calibration

No special operation of the instrument is needed after calibration. However, it is recommended that the pressure regulator for the zero-gas cylinders be closed because calibration is not required so often.

11. Inspection and Maintenance

This chapter describes the inspection and maintenance procedures for the EXAxtZR Zirconia High-temperature Humidity Analyzer (integrated model) to maintain its measuring performance and normal operating conditions.

CAUTION

When checking the detector, carefully observe the following:

(1) Do NOT touch the probe if it has been in operation immediately just before being checked. (The sensor at the tip of the probe heats up to 750° C during operation. If you touch it, you will get burned.)

(2) Do not subject the probe to shock or cool it rapidly.
The sensor is made of ceramic (zirconia). If the detector is dropped or bumped into something, the sensor may be damaged and no longer work.

(3) Do not reuse a metal O-ring to seal the cell assembly. If you replace the cell or remove it from the probe for checking, be sure to replace the metal O-ring. Otherwise, the process gas may leak, and then the leaking corrosive gas will cause the built-in heater or thermocouple to go open circuit, or the detector may corrode.

(4) Handle the probe with care so that the dust-filter mounted screws on the tip of the probe do not hurt your finger(s).

(5) Before opening or closing the terminal box, first remove dust, sand, or the like from the terminal box cover.

11.1 Inspection and Maintenance of the Detector

11.1.1 Cleaning the Calibration Gas Tube

The calibration gas, supplied through 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.

To clean the tube, follow these steps:

(1) Remove the detector from the installation assembly.

(2) Following Section 11.1.2, later in this manual, remove the four bolts (and associated spring washers) that tighten the sensor assembly, and the pipe support as well as the U-shaped pipe with filter.

(3) Use a rod 2 to 2.5 mm in diameter to clean the calibration gas tube inside the probe. In doing this, keep air flowing from the calibration gas inlet at about 600 ml/min and insert the rod into the tube (3-mm inside diameter).
However, be careful not to insert the rod deeper than 40 cm.

(4) Clean the U-shaped pipe. The pipe can be rinsed with water. However, it should be dried out thoroughly before reassembly.

(5) Restore all components you removed for cleaning. Follow Section 11.1.2 to restore all components in their original positions. Be sure to replace the O-ring(s) with new ones.

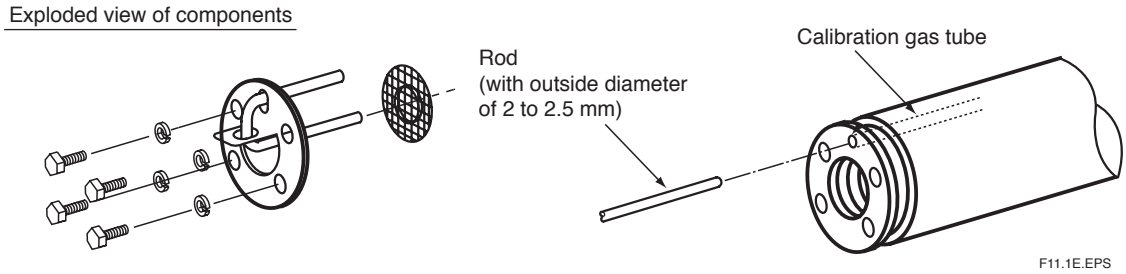


Figure 11.1 Cleaning the Calibration Gas Tube

11.1.2 Replacing the Sensor Assembly

The performance of the sensor (cell) deteriorates as its surface becomes soiled during operation. Therefore, you have to replace the sensor when its life expectancy expires, for example, when it can no longer satisfy a zero-gas ratio of 100±30 % or a span-gas ratio of 0±18 %. In addition, the sensor assembly is to be replaced if it becomes damaged and can no longer operate during measurement.

If the sensor becomes no longer operable (for example, due to breakage), investigate the cause and remedy the problem as much as possible to prevent recurrence.

CAUTION

- If the sensor assembly is to be replaced, allow enough time for the detector to cool down from its high temperature. Otherwise, you may get burned. If the cell assembly is to be replaced, be sure to replace the metal O-ring and the contact together. Additionally, even in a case where the cell is not replaced, if the contact becomes deformed and cannot make complete contact with the cell, replace the contact.
- If there is any corroded or discolored area in the metal O-ring groove in which the contact is embedded, sand the groove with sandpaper or use a metal brush, and then sand further with a higher grade of sandpaper (no. 1500 or so), or use an appropriate metal brush to eliminate any sharp protrusions on the groove. The contact's resistance should be minimized.
- Use sensor assemblies manufactured in or after Sept. 2000: the serial number on the side of the sensor assembly should be 0J000 or later (for example: 0K123, 1AA01 etc.)

1. Identifying parts to be replaced

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, metal O-ring and contact together at the same time. If required, also replace the U-shaped pipe, bolts, filter, and associated spring washers.

2. Removal procedures

(1) Remove the four bolts and associated washers from the tip of the detector probe.
(2) Remove the U-shaped pipe support together with the U-shaped pipe. Remove the filter also.
(3) Pull the sensor assembly toward you while turning it clockwise. Also, remove the metal O-ring between the assembly and the probe.
(When replacing the assembly, be careful not to allow any flaws on the tip of the probe with which the metal O-ring comes in contact (the surface with which the sensor flange also comes in contact. Otherwise, the measurement gas will not be sealed.)
(4) Use tweezers to pull the contact out of the groove.
(5) Clean the sensor assembly, especially the metal O-ring contact surface to remove any contaminants adhering to that part. If you can use any of the parts from among those removed, also clean them up to remove any contaminants adhering to them.
(Once the metal O-ring has been tightened, it can no longer be used. So, be sure to replace it.)

3. Part assembly procedure

(1) First, install 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 properly so that it forms a solid contact.

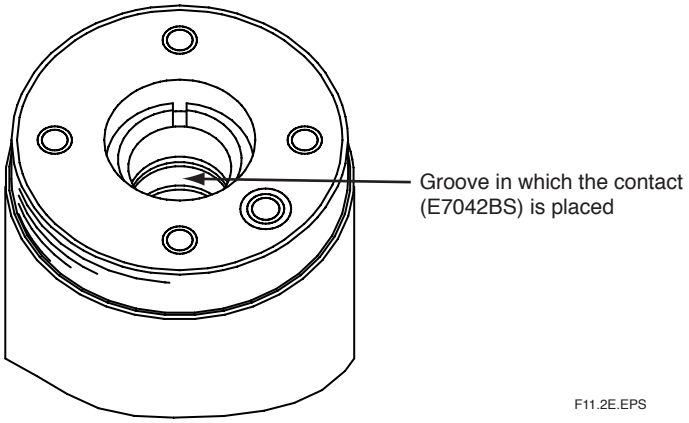


Figure 11.2 Installing the Contact

(2) Next, make sure that the O-ring groove on the flange surface of the sensor is clean. Install the metal O-ring in that O-ring groove, and then insert the sensor in the probe while turning it clockwise. After inserting it until the metal O-ring comes in contact with the probe's O-ring contact surface, properly align the U-shaped-pipe insertion holes with the bolt openings.

(3) Attach the U-shaped pipe to its support with filter, then fully insert the U-shaped pipe, filter and its support into the probe.

(4) Coat the threads of the four bolts with antiseize grease and then screw them in along with the washers. First, tighten the four bolts uniformly by hand, and then use a torque wrench to tighten all areas of the metal O-ring uniformly, that is, to make sure the sensor flange is perfectly horizontal to the O-ring's working face in the probe. This is done by tightening first one bolt and then its opposing bolt each 1/8 turn, and then one of the other bolts followed by its opposing bolt, each also 1/8 turn.
This continues in rotating fashion until they are all fully tightened with the torque wrench preset to approximately 5.9 N•m. If they are not uniformly tightened, the sensor or heater may be damaged.
Replacement of the sensor assembly is now complete. Install the detector and restart operation. Calibrate the instrument before making a measurement.

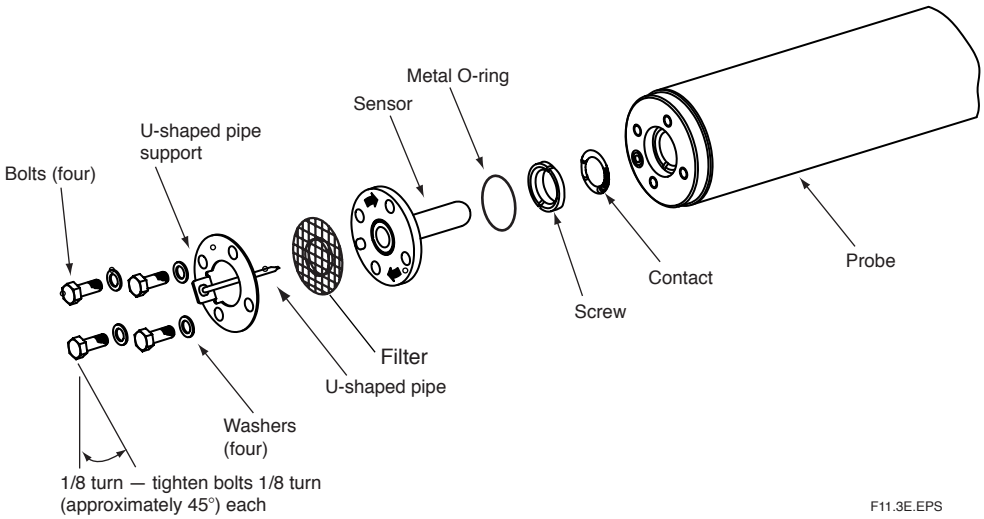


Figure 11.3 Exploded View of Sensor Assembly

CAUTION

Optional Inconel bolts have a high coefficient of expansion. If excess torque is applied while the bolts are being tightened, abnormal strain or bolt breakage may result. So, tighten the bolts following the instructions given above.

11.1.3 Replacement of the Heater Unit

This section describes the replacement procedure for the heater unit.

The sensor or ceramic heater-furnace core internal structure is subject to fracturing, so do NOT subject it to strong vibrations or shock. Additionally, the heater unit reaches high temperatures and is subjected to high voltages.

So, maintenance services should be performed after the power is off and the heater unit temperature has returned to normal room temperature.

For detail, refer to IM11M12A01-21E “Heater Assembly”.

Note

If the heater strut assembly can not be removed because a screw has fused to its thread, one of our service representatives can fix it.

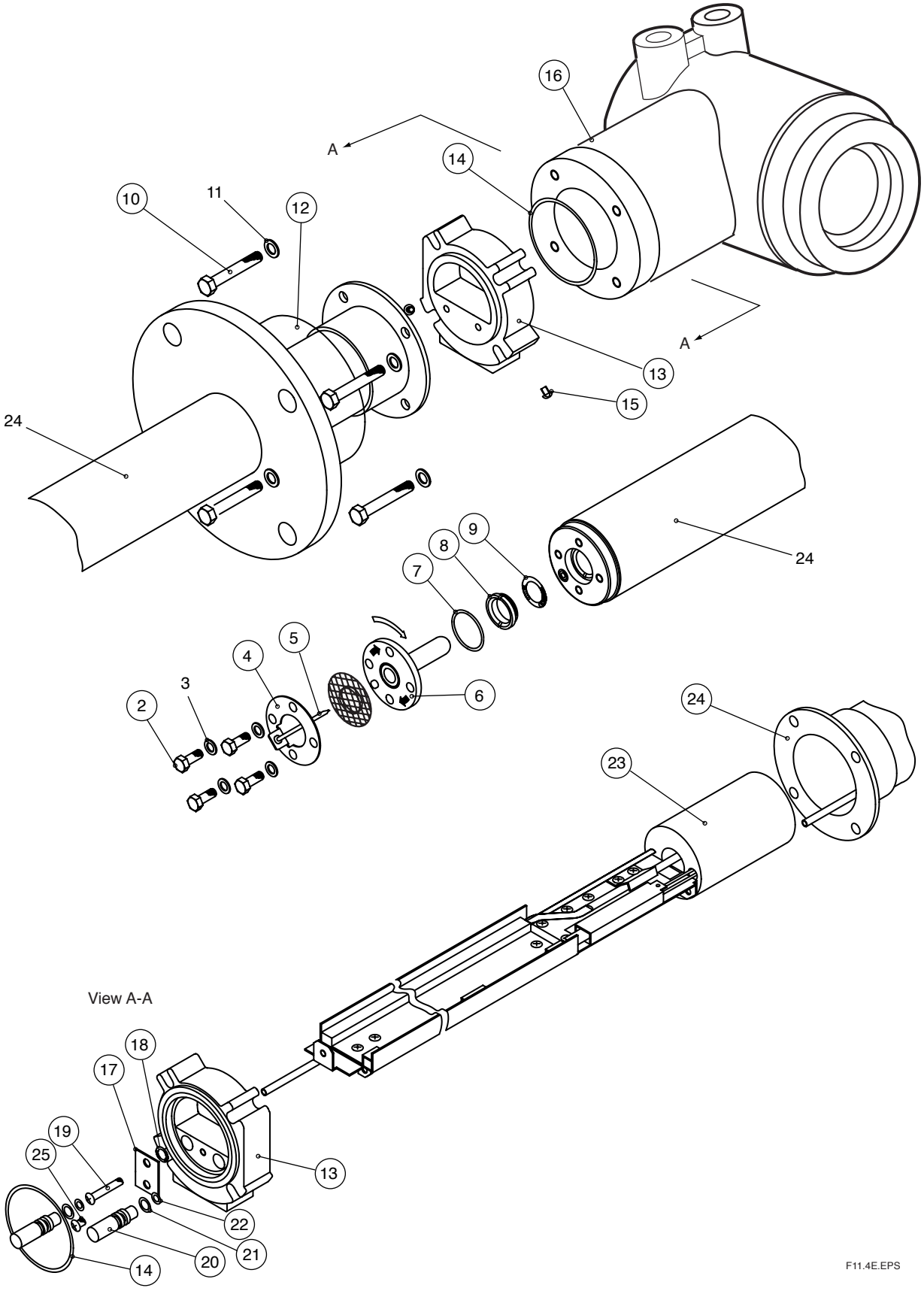


Figure 11.4 Exploded View of Detector

Replacement of heater strut assembly

Refer to Figure 11.4 as an aid in the following discussion.

Remove the cell assembly (6), following Section 11.1.2, earlier in this manual.

Remove the two screws (15) that tighten the cover (12) and slide it to the flange side. Remove the four bolts (10) to remove the converter (16). Then remove the three connectors to which leadwire from the heater and thermocouple is connected.

Loosen Screw (19) until Heater Strut Assembly (23) plate can be removed.

There's no need to remove O-ring (18) which prevents Screw (19) from coming out.

Pull out connector (13).

Loosen and remove the screw (8) with a special wrench (part no. K9470BX or equivalent) and then remove the heater strut assembly (23) from the detector (24).

To reassemble the heater strut assembly, reverse the above procedure:

Insert the heater strut assembly (23) into the detector (24), while inserting the calibration pipe in the detector (24) into the heater section in the heater strut assembly (23) as well as in the bracket hole. Coat the screw (8) with grease (NEVER-SEEZ: G7067ZA) and tighten the screw (8) with a special tool (part no. K9470BX or equivalent) with a tightening torque of 12N•m ± 10 %.

Next, to install the O-rings (22) on the calibration-gas and reference-gas pipes, disassemble the connector (13) in the following procedure:

First, remove the screw (25) and then remove the plate (17) and two caps (20).

If the O-ring (22) remains in the hole, pull them out from the back. Pass the heater and thermocouple leadwire through the connector (13). Also, pass the calibration-gas and reference-gas pipes through the opening of the connector (13). If the O-ring (22) fails, replace it with a new one.

Push the two caps (20) into the associated opening of the connector (13).

Insert the plate (17), aligning it with the groove of the cap (20), and tighten it with the screw (25). If you attempt to insert the calibration-gas and reference-gas pipes into the connector (13) without disassembling the connector (13), the O-ring may be damaged. Tighten Screw (19) in Heater Strut Assembly (23) until connector (13) can't move.

Reassemble in reverse order to the above disassembly procedure.

When installing the cell assembly (6), replace the metal O-ring (7) with a new one.

11.1.4 Replacement of O-ring

The detector uses three different types of O-rings (14), (21), and (22). One O-ring alone (14), or two O-rings (21) and (22) are used. (For a pressure-compensating model, two O-rings are used for individual uses. Two O-rings (21) and (22) are used for reference-gas sealing and require periodic replacement.

11.1.5 Stopping and Re-starting Operation

<Stopping Operation>
When operation is stopped, take care of the followings so that the sensor of the detector cannot become unused.

CAUTION

When operating an instrument such as boiler or industrial furnace is stopped with the zirconia oxygen analyzer operation, moisture can condensate on the sensor portion and dusts may stick to it.

If operation is restarted in this condition, the sensor which is heated up to 750° C firmly fix the dusts on itself. Consequently, the dusts can make the sensor performance very lower. If a large amount of water is condensed, the sensor can be broken and never re-useful.

To prevent the above nonconformity, take the following action when stopping operation.

(1) If possible, keep on supplying the power to converter and flowing reference air to the sensor.
If impossible to do the above, remove the detector.
(2) If unavoidably impossible to supply the power and removing the detector, keep on following air at 600ml/min into the calibration gas pipe.

<Restarting Operation>
When restarting operation, be sure to flow air, for 5-10 minutes, at 600ml/min into the calibration gas pipe before supplying the power to converter.

11.2 Inspection and Maintenance of the Converter

The converter does not require routine inspection and maintenance. If the converter does not work properly, in most cases it probably comes from problems or other causes.

11.2.1 Replacing Fuses

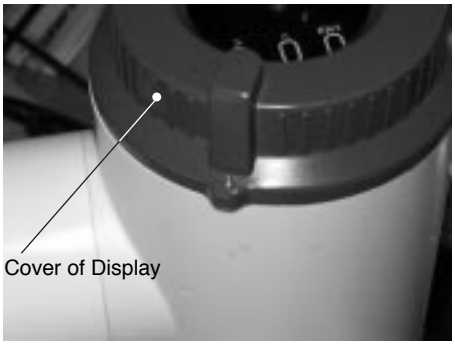
This equipment incorporates a fuse. If the fuse blows out, turn off the equipment power and replace it in the following procedure.

CAUTION

If a replaced fuse blows out immediately, there may be a problem in the circuit. Check the circuit carefully to find out why the fuse has blown.

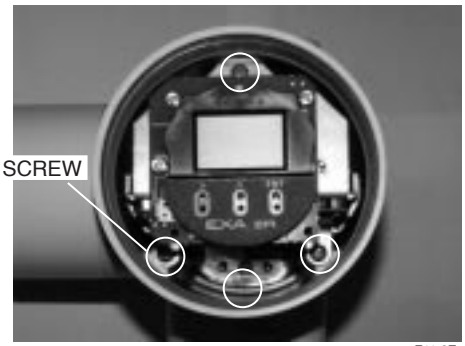
Before removing the electronics, touch the grounded metal part to discharge any static electricity.

(1) Remove the display cover (Figure 11.5).
(2) Remove the three screws that are located toward you, among the four screws shown in Figure 11.6. Loosen the remaining one.
(3) Move the electronics up to remove it.



F11.5E.EPS

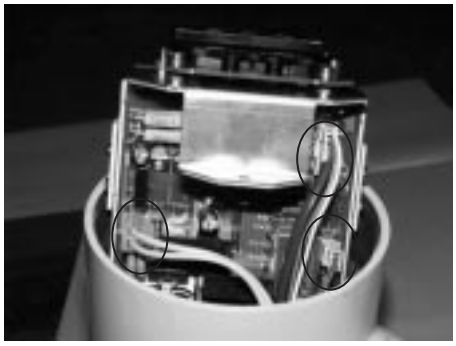
Figure 11.5 Lock Screw



F11.6E

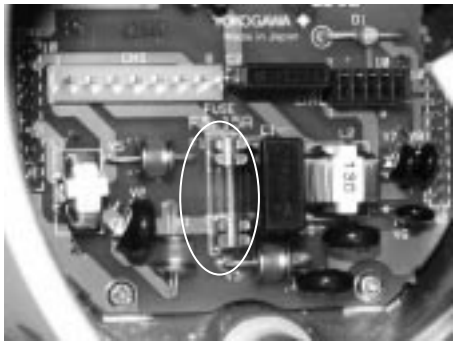
Figure 11.6 Location of Screw

(4) Disconnect the three connectors from the printed-circuit board, as shown in Figure 11.7, by holding the connector housing. Do not pull the leadwire out to remove the connectors, otherwise, disconnection may result.
(5) Remove the electronics completely to gain access to the fuse on the bottom of the equipment case (Figure 11.8).
(6) Replace the fuse with a new one.



F11.7E.EPS

Figure 11.7 Locations of Connectors



F11.8E.EPS

Figure 11.8 Location of Fuse

(7) To restore the electronics, reverse the above removal procedures.
When restoring the electronics, do not get leadwire jammed in any part of the unit.
(8) Place the electronics and the printed-circuit board on which the fuse is installed properly; these are directly connected with connectors.
(9) Tighten the four screws in their positions.
(10) Replace and tighten the display cover properly. If the cover is not tightened sufficiently, the infrared switches will not operate correctly.

■ Fuse rating

Check the rating of the fuse and that it satisfies the following :

Maximum rated voltage	: 250 V
Maximum rated current	: 3.15 A
Type	: Time-lag fuse
Standards	: UL-, CSA- and VDE-approved
Part number	: A1113EF

11.3 Replacement of Flowmeter for ZR20H Autocalibration Unit

(1) Remove pipe holding piping connection.
(2) Remove bolts holding flowmeter, and replace it. A white back plate (to make the float easy to see) is attached. The end of the pin holding down the back plate must be on the bracket side.
(3) Replace piping, and fix M6 bolts between brackets. *1

*1 : When disassembling and reassembling, mark original positions, and tighten an extra 5-10° when reassembling. After tightening, do a liquid leakage test.

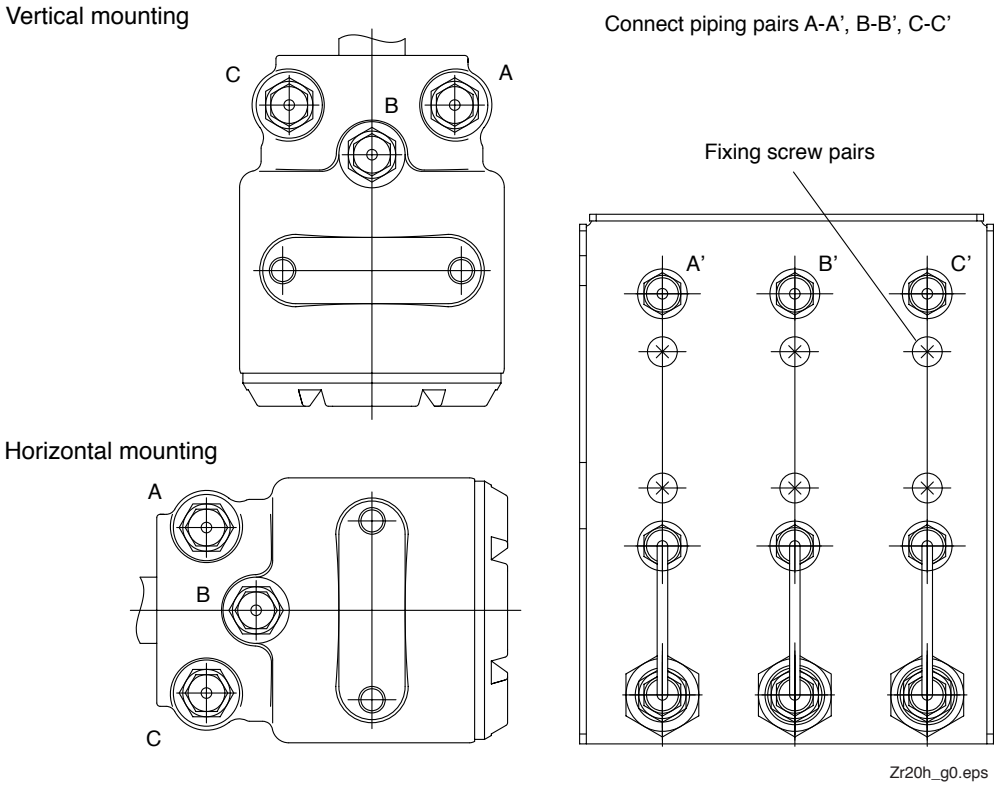


Figure 11.9 Fixing Flowmeter

12. Troubleshooting

This chapter describes errors and alarms detected by the self-diagnostic function of the converter. This chapter also describes the check and restoration methods to use when problems other than the above occur.

12.1 Displays and Measures to Take When Errors Occur

12.1.1 What is an Error?

An error is detected if any abnormality is generated in the detector or the converter, e.g., in the cell (sensor) or heater in the detector, or the internal circuits in the converter. If an error occurs, the converter performs the following:

(1) Stops the supply of power to the heater in the detector to insure system safety.
(2) Causes an error indication in the display to start blinking to notify of an error generation (Figure 12.1).
(3) Sends an output contact if the error is set up for "Output contact setup" for that contact (refer to Section 8.4, "Output Contact Setup").
(4) Changes the analog output status to the one set in "Output hold setting" (refer to Section 8.2, "Output Hold Setting").
When the display shown in Figure 12.1 appears, pressing the error indication brings up a description of the error (Figure 12.2). The content of errors that are displayed include those shown in Table 12.1.

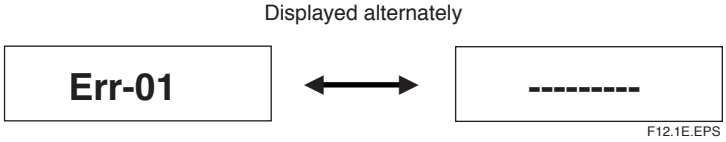


Figure 12.1

Table 12.1 Types of Errors and Reasons for Occurrence

Error	Type of error	Reason for Occurrence
Error-1	Cell voltage failure	The cell (sensor) voltage signal input to the converter falls below -50 mV.
Error-2	Heater temperature failure	The heater temperature does not rise during warm-up, or it falls below 730 °C or exceeds 780 °C after warm-up is completed.
Error-3	A/D converter failure	The A/D converter fails in the internal electrical circuit in the converter.
Error-4	Memory failure	Data properly are not written into memory in the internal electrical circuit in the converter.

T12.1E.EPS

12.1.2 Measures to Take When an Error Occurs

12.1.2.1 Error-1: Cell Voltage Failure

Error-1 occurs when the cell (sensor) voltage input to the converter falls below -50 mV (corresponding to about 200% O_2). The following are considered to be the causes for the cell voltage falling below -50 mV:

(1) Continuity failure between the sensor assembly electrode and the contact

(2) Damage or deterioration of the sensor assembly

(3) Improper connection between the sensor and the electronics.

(4) Wiring failure inside the detector

(5) Abnormality in the converter electronics

<Locating cause the failure, and countermeasures>

1) Turn off the power to the equipment.
2) Remove the sensor assembly from the probe. Check for dirty or corroded sensor parts, including electrode and contact.
3) If the contact part is normal, the sensor assembly may be damaged or deteriorated. Replace the sensor assembly. In this case, be sure to replace the metal O-ring and contact.
4) If Error-1 still occurs, check that the sensor and the electronics are properly connected.
5) Remove the probe to gain access to the two connectors (four connectors for the optional automatic calibration unit), as indicated in Figure 12.2. Check these connectors are properly connected.
6) If Error-1 still occurs, the electronics may be defective. Contact your local Yokogawa service or sales representative.

12.1.2.2 Error-2: Heater Temperature Failure

This error occurs if the detector heater temperature does not rise during warm-up, or if the temperature falls below 730° C or exceeds 780° C after warm-up is completed.

Causes considered for cases where Error-2 occurs independently are shown below.

(1) Faulty heater in the probe (heater wire breakage)

(2) Faulty thermocouple in the probe

(3) Failure in the converter electronics

<Locating cause of failure, and countermeasures>

(1) Turn off the power to the analyzer.

(2) Remove the probe from the analyzer. Also remove all the connectors between the converter and probe. Measure the resistance of the heater wire (yellow wire) from the probe as indicated in Figure 12.2. The heater unit is normal if the resistance is lower than about 90Ω. If the resistance is higher than that value, the heater unit may be defective. In this case, replace the heater unit (refer to Section 11.1.3, "Replacement of the Heater Unit").

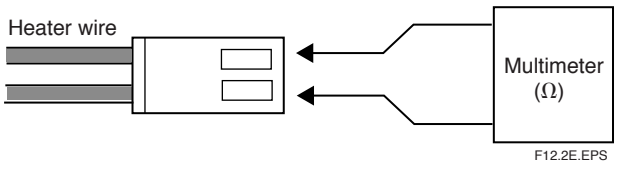


Figure 12.2

(3) Next, check the resistance of the thermocouple from the probe. Use a multimeter to measure the thermocouple resistance between terminal 3 (red cable connected) and terminal 4 (white cable connected) as indicated in Figure 12.3.
The thermocouple is normal if the resistance is 5Ω or less. If the value is higher than 5Ω, the thermocouple wire may be broken or about to break. In this case, replace the heater unit (refer to Section 11.1.3, "Replacement of the Heater Unit").

CAUTION

- Measure the thermocouple resistance value after the difference between the probe tip temperature and the ambient temperature decreases to 50° C or less. If the thermocouple voltage is large, accurate measurement cannot be achieved.

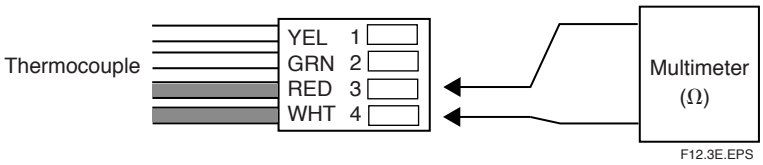


Figure 12.3

(4) If the inspection indicates that the thermocouple is normal, the electronics may be defective. Consult your local Yokogawa service or sales representative.

12.1.2.3 Error-3: A/D Converter Failure/Error-4: Writing-to-memory Failure

• A/D Converter Failure

It is suspected that a failure has occurred in the A/D converter mounted in the converter electronics.

• Writing-to memory Failure

It is suspected that a failure has occurred in an operation writing to the memory (EEPROM) mounted in the converter electronics.

<Locating cause the failure, and countermeasures>

Turn off the power to the converter once and then restart the converter. If the converter operates normally after restarting, an error might have occurred due to a temporary drop in the voltage (falling below 85 V, the least amount of voltage required to operate the converter) or a malfunction of the electronics affected by noise. Check whether or not there is a failure in the power supply system or whether the converter and detector are securely grounded.

If the error occurs again after restarting, a failure in the electronics is suspected. Consult the service personnel at Yokogawa Electric Corporation.

12.2 Displays and Measures to Take When Alarms are Generated

12.2.1 What is an Alarm?

When an alarm occurs, the alarm indication blinks in the display to notify of the alarm (Figure 12.4). Pressing the alarm indication displays a description of the alarm. Alarms include those shown in Table 12.2.

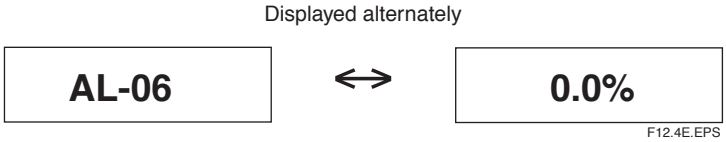


Figure 12.4

Table 12.2 Types of Alarms and Reasons

Alarm	Type of alarm	Reason for occurrence
Alarm 1 through 3	Oxygen concentration alarm concentration alarm humidity, and mixing ratio alarms	Occurs when a measured value exceed or falls below the set alarm value (refer to Section 8.3, "Alarm Setting").
Alarm 6	Zero-point calibration coefficient alarm	Generated when the zero correction factor is out of the range of 100 ± 30% in automatic and semiautomatic calibration (refer to Section 9.1.3, "Compensation").
Alarm 7	Span-point calibration coefficient alarm	Generated when the span correction factor is out of the range of 0 ± 18% in automatic and semiautomatic calibration (refer to Section 9.1.3, "Compensation").
Alarm 8	EMF stabilization time-up	Generated when the cell (sensor) voltage is not stabilized even after the calibration time is up in automatic and semiautomatic calibration.
Alarm 10	Cold junction temperature alarm	Occurs when an equipment internal temperature exceeds 85°C.
Alarm 11	Thermocouple voltage alarm	Generated when thermocouple voltage exceeds 42.1 mV (about 1020°C) or falls below -5 mV (about -170°C).
Alarm 13	Battery low alarm	Internal battery needs replacement.

T12.2E.EPS

If an alarm occurs, such measures as turning off the heater power are not carried out. The alarm is released when the cause for the alarm is eliminated. If the analyzer power is turned off after an alarm occurs, and then turned on before the cause of the alarm is eliminated, the alarm will occur again. However, alarms 6, 7, and 8 (alarms related to calibration) are not generated unless calibration is executed.

12.2.2 Measures Taken When Alarms Occur

12.2.2.1 Alarms 1 through 3: Oxygen Concentration, Humidity, and Mixing Ratio Alarms

These alarms occur when a measured value exceeds an alarm setpoint or falls below it. For more details, see Section 8.3, “Alarm Setting,” earlier in this manual.

12.2.2.2 Alarm 6: Zero-point Calibration Coefficient Alarm

In calibration, this alarm is generated when the zero correction factor is out of the range of 100 ±30% (refer to Section 9.1.3, “Compensation”). The following can be considered the causes for this:

(1) The zero-gas oxygen concentration does not agree with the value of the zero-gas concentration set (refer to Section 9.2.1,“Calibration Setup”). Otherwise, the span gas is used as the zero gas.
(2) The zero-gas flow is out of the specified flow (600 ± 60 mL/min).
(3) The sensor assembly is damaged and so cell voltage is not normal.

<Locating cause of failure, and countermeasures>

(1) Confirm the following and carry out calibration again: If the items are not within their proper ranges, correct them.
   a. If the indication for "Zero gas conc." is selected in "Calibration setup," the set value should agree with the concentration of zero gas actually used.
   b. The calibration gas tubing should be constructed so that the zero gas does not leak.

(2) If no alarm is generated as a result of carrying out re-calibration, it is suspected that improper calibration conditions were the cause of the alarm in the preceding calibration. In this case, no specific restoration is necessary.

(3) If an alarm is generated again as a result of carrying out re-calibration, deterioration of or damage to the sensor assembly is suspected as the cause of the alarm. Replacement of the cell with a new one is necessary. However, before replacement, carry out the following:
   Check the cell voltages when passing the zero gas and span gas.
   a. Display the cell voltage with the parameter code A11.
   b. Check whether or not the value of the displayed cell voltage is very different from the theoretical value at each oxygen concentration. Confirm the theoretical values of the cell voltage in Table 12.3. Although it cannot be generally specified as to what extent the difference from the theoretical value is allowed, consider it to be approximately ±10 mV.

Table 12.3 Oxygen Concentration and Cell Voltage Oxygen concentration

Oxygen concentration (% O_2)	Cell voltage (mV)
1%	67.1
21%	0

T12.3.EPS

(4) Confirm whether deterioration of or damage to the sensor assembly that caused the alarm has occurred abruptly during the current calibration in the following procedure:
   Check the history of the span gas ratio with the parameter codes A50 and A51.
   Check the history of the zero gas ratio with the parameter codes A60 through A69.
   The larger the parameter code number, the older the displayed data. Changes in deterioration of the sensor can be seen.

(5) If deterioration of the sensor assembly has occurred abruptly, it may show that the check valve, which prevents moisture in the furnace from getting into the calibration gas tubing, has failed. If the gas in the furnace gets into the calibration gas tubing, it condenses and remains in the gas tubing. The sensor assembly is considered to be broken for the reason that the condensation is blown into the sensor assembly by the calibration gas during calibration and so the cell cools quickly.

(6) If the sensor assembly has been gradually deteriorating, check the sensor assembly status in the following procedure:
   a. Display "Cell resistance" by specifying the parameter code A21. A new cell will show a cell resistance value of 200Ω or less. On the other hand, a cell (sensor) that is approaching the end of its service life will show a resistance value of 3 to 10 kΩ.
   b. Display "Cell robustness" by specifying the parameter code A22. A good cell (sensor) will show "5," "Life > 1 year" (refer to Section 10.1.15).

12.2.2.3 Alarm 7: Span Calibration Coefficient Alarm

In calibration, this alarm is generated when the span gas ratio is out of the range of 0 ± 18% (refer to Section 9.1.3, "Compensation").

The following are suspected as the cause:

(1) The oxygen concentration of the span gas does not agree with the value of the span gas set "Calibration setup."
(2) The flow of the span gas is out of the specified flow value (600 ± 60 mL/min).
(3) The sensor assembly is damaged and the cell voltage is abnormal.

<Locating cause of failure, and countermeasures>

(1) Confirm the following and carry out calibration again:
If the items are not within their proper states, correct them.
a. If the display "Span gas conc." is selected in "Calibration setup," the set value should agree with the concentration of span gas actually used.
b. The calibration gas tubing should be constructed so that the span gas does not leak.
(2) If no alarm is generated as a result of carrying out re-calibration, it is suspected that improper calibration conditions were the cause of the alarm in the preceding calibration. In this case, no specific restoration is necessary.
(3) If an alarm is generated again as a result of carrying out re-calibration, deterioration of or damage to the cell (sensor) is suspected as the cause of the alarm.
Replacement of the cell with a new one is necessary.
However, before replacement, carry out the procedure described in step (3) and later of <Search for cause of failure and taking measure> in Section 12.2.2.2, "Alarm 6: Zero-point Calibration Coefficient Alarm."

12.2.2.4 Alarm 8: EMF Stabilization Time Over

This alarm is generated if the sensor (cell) voltage has not stabilized even after the calibration time is up for the reason that the calibration gas (zero gas or span gas) has not filled the sensor assembly of the detector.

<Cause of alarm>

(1) The flow of the calibration gas is less than normal (a specified flow of 600 ± 60 mL/min).
(2) The length or thickness of the calibration gas tubing has been changed (lengthened or thickened).
(3) The measuring gas flows toward the tip of the probe.
(4) The sensor (cell) response has deteriorated.

<Locating cause of failure, and countermeasures>

(1) Carry out calibration by passing the calibration gas at the specified flow (600 ± 60 mL/min) after checking that there is no leakage in the tubing.
(2) If calibration is carried out normally, perform a steady operation without changing the conditions.
If the error occurs again, check whether or not the reason is applicable to the following and then replace the sensor assembly.

• A lot of dust and the like may be sticking to the tip of the sensor. If dust is found, clean and remove the dust (see Section 11.1.1).
In addition, if an error occurs in calibration even after the sensor assembly is replaced, the influence of measured gas flow may be suspected. Do not let the measured gas flow toward the tip of the detector probe, for example, by changing the mounting position of the detector.

12.2.2.5 Alarm 10: Cold Junction Temperature Alarm

The equipment incorporates a temperature sensor. An alarm is issued when the sensor temperature exceeds 85° C. If internal temperature of this equipment exceeds 85° C, the electronics may fail.

<Locating cause of failure, and countermeasures>

This equipment can be used at ambient temperatures up to 55° C. If the ambient temperatures may exceed the limits, take appropriate measures — such as applying heat insulating material to the furnace walls, and adding a sun shield to keep out direct sunlight.

If this alarm occurs even when the ambient temperature is under 55° C, the electronics may be defective. Contact your local Yokogawa service or sales representative.

12.2.2.6 Alarm 11: Thermocouple Voltage Alarm

This alarm is generated when the emf (voltage) of thermocouple falls below -5 mV (about -170° C) or exceeds 42.1 mV (about 1020° C).

(1) A failure of the thermocouple at the detector occurred.
(2) A failure of the electrical circuits occurred.

<Search for cause of failure and taking measure>

(1) Turn off the power to the analyzer.
(2) Remove the probe from the analyzer. Also remove all the connectors between the converter and probe. Measure the resistance of the heater wire (yellow wire) from the probe as indicated in Figure 12.5. The heater unit is normal if the resistance is lower than about 90Ω. If the resistance is higher than that value, the heater unit may be defective. In this case, replace the heater unit (refer to Section 11.1.3, “Replacement of the Heater Unit”).

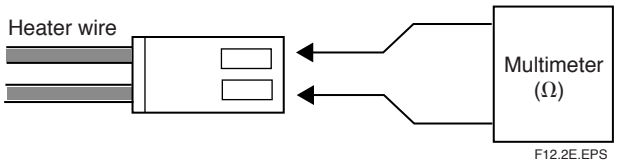


Figure 12.5

(3) Next, check the resistance of the thermocouple from the probe. Use a multimeter to measure the thermocouple resistance between terminal 3 (red cable connected) and terminal 4 (white cable connected) as indicated in Figure 12.6.

The thermocouple is normal if the resistance is 5Ω or less. If the value is higher than 5Ω, the thermocouple wire may be broken or about to break. In this case, replace the heater unit (refer to Section 11.1.3, “Replacement of the Heater Unit”).

CAUTION

- Measure the thermocouple resistance value after the difference between the probe tip temperature and the ambient temperature decreases to 50°C or less. If the thermocouple voltage is large, accurate measurement cannot be achieved.

Figure 12.6

(4) If the inspection indicates that the thermocouple is normal, the electronics may be defective. Consult your local Yokogawa service or sales representative.

12.2.2.7 Alarm 13: Battery Low Alarm

An internal battery is used as backup for the clock. After this alarm occurs, removing power from the instrument may cause the clock to stop but should not affect stored parameters. The internal clock is used for blowback scheduling; if you use this then after a battery alarm occurs (until the battery is replaced) be sure to check / correct the date and time every time you turn on the power.

<Corrective action>
When the battery low alarm occurs, remember that the battery cannot be replaced by the user. Contact your Yokogawa service representative.

Note

Battery life varies with environmental conditions.
* If power is applied to the instrument continuously, then the battery should not run down, and life is typically about ten years. However the battery will be used during the time interval between shipment from the factory and installation.
* If power is not applied to the instrument, at normal room temperatures of 20 to 25°C then battery life is typically 5 years, and outside this range but within the range -30 to +70°C then battery life is typically 1 year.

12.3 Countermeasures When the Measured Value Shows 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 will be described.

(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 shows abnormal values.

12.3.1 Measured Value Higher Than True Value

<Causes and Countermeasures>
(1) The measuring gas pressure becomes higher.

When the process gas pressure is higher than that in calibration by △p (kPa), the measured oxygen concentration value X (vol% O_2) may be expressed mathematically by:

$$X = Y[1 + (\triangle p/101.30)]$$

where, Y = Measured oxygen concentration value at the same pressure as in calibration (vol% O_2)

If an increment of the measured value by a pressure change cannot be neglected, appropriate measures must be taken. Observe the following points for possible improvement in each process.

- Can the facility's characteristics be improved so that a pressure change does not occur?
- Can a calibration be conducted under the average process gas pressure (internal pressure of a dryer)?

(2) Moisture content in a reference gas changes (increases) greatly.

If air at the analyzer installation site is used for the reference gas, a large change of moisture in the air may cause an error in the measured oxygen concentration value (vol% O_2). If this error cannot be ignored, use a gas in which moisture content is constant, such as instrument air in almost dry condition as a reference gas.

(3) Calibration gas (span gas) is leaking in the sensor.

If the span gas is leaking in the sensor because of a failure of the valve provided in the calibration gas tubing system, the measured value shows a value a little higher than normal.

Check the valves (needle valves, check valves, solenoid valves for automatic calibration, or the like, in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in fully closed states. In addition, check the tubing joints for leakage.

(4) The reference gas is mixing into the measuring gas and vice versa.

When such mixing occurs, since the deference between oxygen partial pressures on the sensor anode and cathode sides becomes smaller, the measured value shows a lower value. See Section 11.1.2 to check that the sensor has been properly installed. An error which does not indicate Error-1 may occur in the sensor. If the sensor assembly is loose, or if there is any damage to the O-ring, the measured gas will leak into the reference gas or vice versa. Because of a low oxygen partial pressure between the reference and measurement sides, the oxygen concentration reading is high, and the humidity reading is low. In this case, the sensor assembly needs to be reinstalled (see Section 11.1.2). In such a case, be sure to remove the O-ring and replace it with a new one. In addition, if any crack is found, replace the sensor assembly with a new one (see Section 11.1.2, earlier in this manual).

CAUTION

See the cell robustness in function A22 for sensor quality.

12.3.2 Measured Value Lower Than True Value

<Causes and Countermeasures>

(1) The measuring gas pressure becomes lower.
If an increment of the measured value due to pressure change cannot be neglected, take appropriate measures (see Section 11.1.1 (1)).

(2) Moisture content in a reference gas changes (decreases) greatly.
Changes in the moisture content contained in the instrument air will cause an error of the humidity measurement (vol% H_2O or kg/kg). If this error cannot be ignored, use a gas in which the moisture content is constant, such as instrument air in almost dry condition, as a reference gas.

(3) The calibration gas (zero gas) is leaking in the detector.
If the zero gas is leaking in the detector because of a failure of the valve in the calibration gas tubing system, the measured value will show a slightly lower value than normal.

Check the valves in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in the fully closed state.

12.3.3 Measurements Sometimes Show Abnormal Values

<Causes and Countermeasures>

(1) Noise may be mixing in with the converter from the detector output wiring.
Check whether the converter and detector are securely grounded.
Check whether or not the signal wiring is laid along other power cords.

(2) The converter may be affected by noise from the power supply.
Check whether or not the converter power is supplied from the same outlet, switch, or breaker as other power machines and equipment.

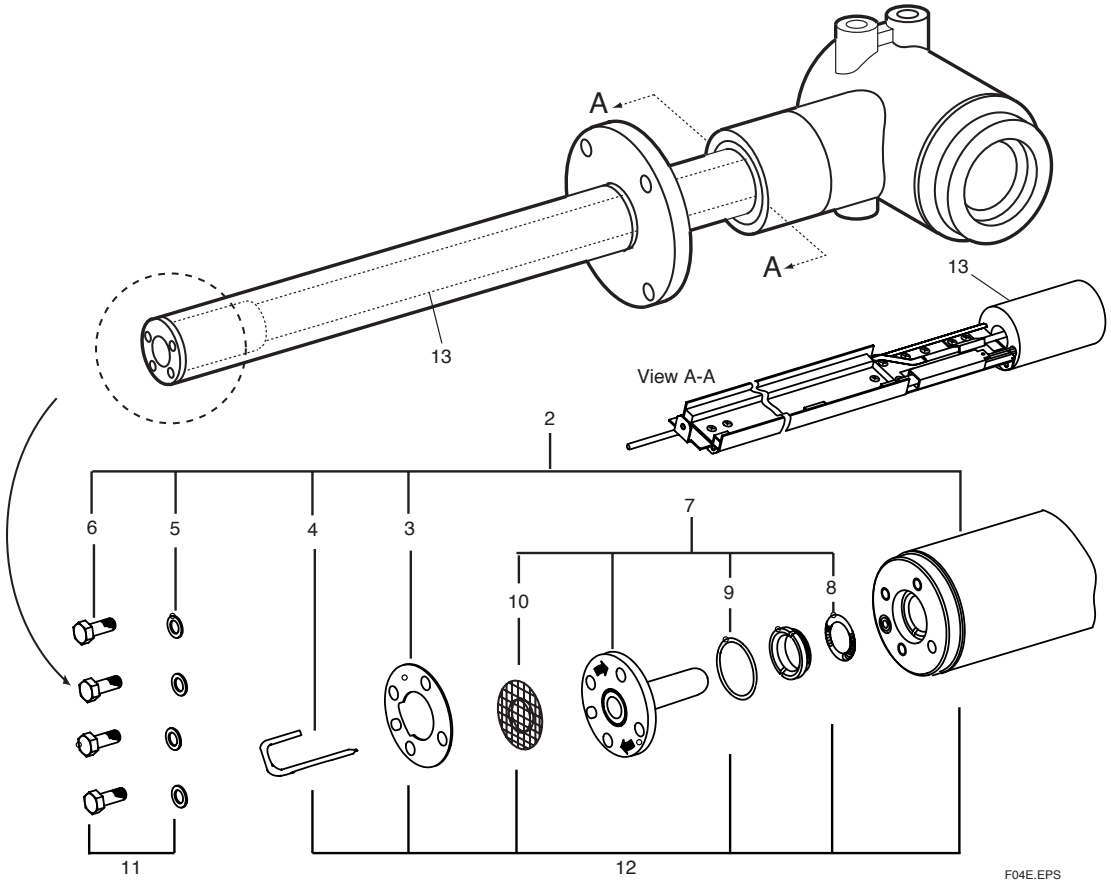
(3) Poor wiring contact
If there is poor contact in the wiring, the sensor voltage or thermocouple emf (voltage) may vary due to vibration or other factors.
Check whether or not there are loose points in the wiring connections or loose crimping (caulking) at the crimp-on terminal lugs.

(4) There may be a crack in the sensor or leakage at the sensor-mounting portion.
If the indication of the measured value varies in synchronization with the pressure change in the furnace, check whether or not there is a crack in the sensor or whether the sensor flange is sticking tightly to the probe-attaching face with the metal O-ring squeezed.

(5) There may be leakage in the calibration gas tubing
In the case of a negative process inner pressure, if the indication of the measured value varies with the pressure change in the furnace, check whether or not there is leakage in the calibration gas tubing.

Customer Maintenance Parts List

Model ZR202G
Zirconia High Temperature Humidity Analyzer (Integrated type)



Item	Parts No. MS-code	Qty.	Description
2	----------	1	Detector Assembly
3	E7042BR	1	Plate
4	K9470BM	1	Pipe
	K9473AN	1	Pipe for Option code "/C"
5	E7042DW	4	Washer (SUS316 stainless steel)
6	G7109YC	4	Bolt (M5x12, SUS316 stainless steel)
	K9470BK	4	Bolt (M5x12, inconel) for Option code "/C"
7	—	1	Cell Assembly
	ZR01A01-01		1 piece
	ZR01A01-02		2 pieces
	ZR01A01-05		5 pieces
	ZR01A01-10		10 pieces
8	E7042BS	1	Contact
9	K9470BJ	1	Metal O-ring
10	E7042AY	1	Filter Assembly
11	----------		Bolt and Washeres
	K9470ZF	1	G7109YC 3 4 + E7042DW 3 4
	K9470ZG	1	K9470BK 3 4 + E7042DW 3 4 for Option code "/C"
12	----------		Calibration Tube Assembly
	K9470ZK	1	Calibration Tube Assembly
	K9470ZL	1	Calibration Tube Assembly for Option code "/C"
13	ZR202A-□□□-□-A	1	Heater Assembly

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CMPL 11M12A01-05E
1 st Edition : Aug.2000(YK)
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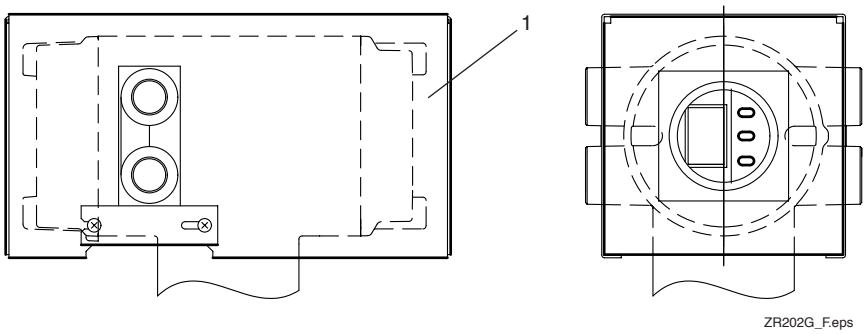
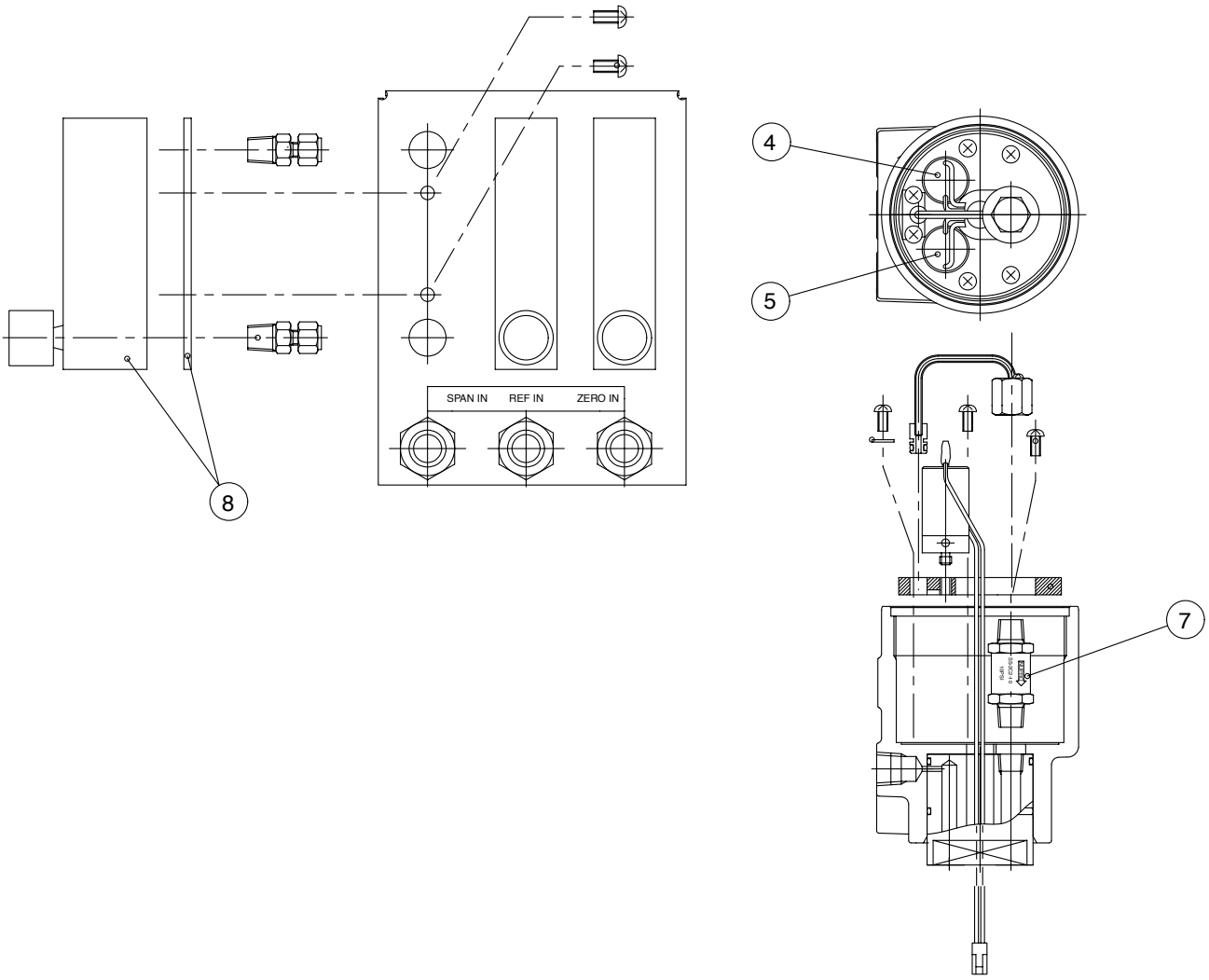
Hood for ZR202G



Item	Parts No.	Qty.	Description
1	K9472UF	1	Hood

Customer Maintenance Parts List

Model ZR20H
Integrated type Zirconia Oxygen Analyzer/
High Temperature Humidity Analyzer,
Automatic Calibration Unit



Item	Part No.	Qty	Description
8	K9473XC	1	Flowmeter

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CMPL 11M12A01-12E
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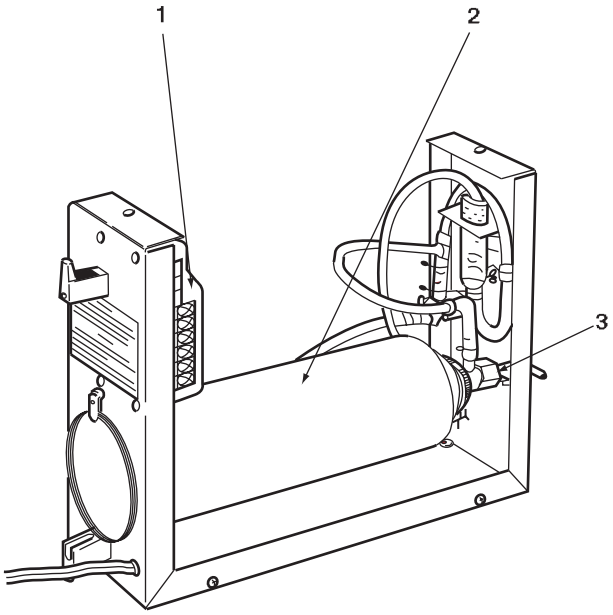
2nd Edition : Aug. 2001 (YK)

Customer Maintenance Parts List

Model ZO21S
Zirconia Oxygen Analyzer/ High Temperature Humidity Analyzer, Standard Gas Unit



Item	Part No.	Qty	Description
1	–	1	Pump (see Table 1)
2	E7050BA	1	Zero Gas Cylinder (x6 pcs)
3	E7050BJ	1	Needle Valve

Table 1

Power	Pump
AC 100V 110 115	E7050AU
AC 200V 220 240	E7050AV

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Revision Record

Manual Title : Model ZR202G Integrated type Zirconia High Temperature Humidity Analyzer
Manual Number : IM 11M12A01-05E

Edition	Date	Remark (s)
1st	Nov. 2000	Newly published
2nd	Mar. 2001	Revised Section 2.1.2 Some parts of MS Code changed, Sun shield hood external dimensions added; 2.2 ZA8F Flow setting unit style changed, adjusting pressure value changed when a check valve is used, ZR20H Autocalibration unit added; 3.3 Installation of ZR20H added; 4.3 Piping procedure for system 3 revised; 6.2 Names of ZR20H added; 7.2 Pressure value changed when a check valve is used; 10.6.1 Pressure value changed when a check valve is used; 11.1 Some parts of maintenance procedure changed; Sun shield hood added to CMPL 11M12A01-05E ZR20H Autocalibration unit added to CMPL 11M12A01-12E
3rd	Sept. 2001	Revised Section 1.2 Model ZR202A Heater Assembly added ; 2.2.1 ZA8F Flow setting Unit error correction ; 2.4.7 Model ZR202A Heater Assembly ; 8.5 Table 8.11 Input Contact Functions changed ; 11.1.3 Reference document added to Replacement of the Heater Unit ; Heater Assembly added to CMPL 11M12A01-05E ; CMPL 11M12A01-12E Model ZR20H changed ;
4th	July. 2003	Notation of flange specification unified G7004XF/K9473XG Airset added ; CMPL 11M12A01-05E Cell assembly parts no. changed, revised to 4th edition.
5th	Apr.2005	Revised Section Introduction Added description regarding modification ; 1.2.1 “ System Components” Changed part numbers of air set in table ; 2.1.2 Changed safety and EMC conforming standards and paint colors ; 2.2.2 Changed Finish color ; 2.3 Added discription “ Non CE Mark ” ; 2.4.3 “ Air Set” Changed part numbers and drawing of air set ; 4.2.1 “ Piping Parts for System 2” Change part numbers of air set in Table 4.2

Edition	Date	Remark (s)	
6th	Sep. 2006	Revised Section	
		2.4.3	"Air Set," Part No. K9473XH or K9473XJ, Standard Specification:
			Changed descriptions partly;
			"Air Set,"Part No. G7004XF or K9473XG, Standard Specification:
			Changed descriptions partly;
		2.4.5	"Cylinder Regulator Valve (Part No. G7013XF or G7014XF)", Standard
			Specifications; Changed descriptions partly and drawing;
		4.4	"Piping for the Detector with Pressure Compensation": Deleted Section.
		5.3	"Wiring Power and Ground Terminals": Added description in Figure 5.5;
		5.3.2	"Wiring for Ground Terminals": Added item (4);
		7.4.5	"Changing Set Values": Changed description in table (1);
		7.9.2	"Checking calibration Contact Output": Changed description in table 7.10;
		8.2.2	"Preference Order of Output Hold Value": Deleted "or blow back";
		8.2.3	"Output Hold Setting": Table 8.4, Parameter code C06, "maintenance" should read "calibration".;
		8.2.4	"Default Values": Revised Table 8.5;
		8.4.1	"Output Contact": Made some corrections;
		8.4.2	"Setting Output Contact":
			Revised Table 8.9;
			WARNING: Deleted second warning;
		9.2.2.2	"Semi-automatic Calibration": Table 9.3, Added note;
		10.4	Table 10.6, Contact-related Items in Group E. Deleted some codes;
		12.2.1	"What is an Alarm?": Table 12.2, Added Alarms 11 and 13;
		12.2.2.2	Alarm 6: Changed descriptions;
		12.2.2.3	Alarm 7: Changed descriptions;
		• p. 12-7 and 12-8,	
			Added Sections 12.2.2.6 and 12.2.2.7;
		• CMPL 11M12A01-05E: Changed part numbers of Items 4 and 12.	