User's Manual

ZR22G and ZR802G Zirconia Oxygen/Humidity Analyzer

IM 11M12G01-02EN

YOKOGAWA
Yokogawa Electric Corporation

IM 11M12G01-02EN
2nd Edition

Introduction

Thank you for purchasing the ZR22G and ZR802G Zirconia Oxygen/Humidity Analyzer.

Please read the following respective documents before installing and using theZR22G and ZR802G Zirconia Oxygen/Humidity Analyzer.

The related documents are as follows.

General Specifications

Contents	Document number	Note
ZR22G, ZR802G, and ZR202G Zirconia Oxygen/Humidity Analyzer	GS 11M12G01-01EN	

* the "EN" in the document number is the language code.

User's Manual

Contents	Document number	Note
ZR22G and ZR802G Zirconia Oxygen/Humidity Analyzer	IM 11M12G01-02EN	(This manual)
ZR802G Zirconia Oxygen/Humidity Analyzer, Converter Start-up and Safety Precautions	IM 11M12G01-01Z1	When you use the ZR22S Explosion-proof detector, read this manual.

* the "EN" in the document number is the language code.

Technical Information

Contents	Document number	Note
ZR802G Zirconia Oxygen/Humidity Analyzer, Converter HART Communication	TI 11M12G01-61EN	
ZR802G Zirconia Oxygen/Humidity Analyzer, Converter MODBUS Communication	TI 11M12G01-62EN	

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http://www.yokogawa.com/an/zr802/download/

An exclusive User's manual might be attached to the products whose suffix codes or option codes contain the code "Z" (made to customer's specifications).Please read it along with this manual.

Zirconia Oxygen/Humidity Analyzer is an oxygen analyzer in general use, composed of ZR802G converter and ZR22G detector. However, when you place an order for ZR802G as a Humidity Analyzer, or you specify the Humidity Analyzer due to a change of specification requirements, ZR802G is provided as Humidity Analyzer.

In this User's Manual, ZR802G for the most part refers to an oxygen analyzer except when there is an explicit statement that the analyzer is used as a humidity analyzer.

Zirconia Oxygen Analyzer has been developed for combustion monitoring or control in various processes.

Zirconia Humidity Analyzer has been developed for humidity monitoring or control in various processes.

A wide variety of detectors and optional accessories are available to improve measurement accuracy and automate calibration. An optimal control system can be realized by selecting appropriate options.

Media No. IM 11M12G01-02EN 2nd Edition : Jun. 2021 (YK)

This user's manual describes the way of installation, operation, maintenance, and others about Zirconia Oxygen/Humidity Analyzer. Please note that some part of this manual may mention the products or system that you don't use.

Models and descriptions in this manual are listed below.

Models and descriptions in this manual

Model	Product Name	Description in this manual				
		Specification	Installation	Operation	Maintenance	CMPL
ZR22G	General use detector	○	○	○	○	○
ZR22G	High temperature detector (0.15m)	○	○	○	○	
ZR802G	Zirconia Oxygen/Humidity Analyzer, Converter	○	○	○	○	○
ZO21R	Probe protector	○	○			
ZO21P	High temperature probe adapter	○	○			○
ZH21B	Dust protector (only for Humidity analyzer)	○	○			
ZA8F	Flow setting unit (for manual calibration use)	○	○	○		
ZR40H	Automatic Calibration unit	○	○	○		○
-	Auxiliary ejector for high temperature use (Part No. E7046EC, E7046EN)	○	○			○
-	Calibration gas unit case (Part No. E7044KF)	○	○			
-	Check valve (Part No. K9292DN, K9292DS)	○	○			
-	Dust filter for the detector (Part No. K9471UA)	○	○			
-	Dust guard protector (Part No. K9471UC)	○	○			
ZO21S	Standard gas unit	○		○	○	○

CMPL: Customer Maintenance Parts List

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

Table of Contents

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

A: Read and completely understand before operating the equipment.
B: Read before operating the equipment, and refer to it whenever necessary.
C: Recommended to read it at least once.

■ For the safe use of this equipment

WARNING

Handle it with care. 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 sample 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.

CAUTION

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

- Do NOT allow the sensor (probe tip) to make contact with anything when installing the detector.
- Avoid any water dropping directly on the probe (sensor) of the detector 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 sample gas may damage the sensor.
- The detector (especially at the tip) becomes very hot. Be sure to handle it with gloves.

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 Separate type Oxygen 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 operation conditions before conducting analysis. Where necessary, set the instrument parameters for appropriate operation.
For details of setting data, refer to chapters 7 to 10.
When user changes the operation parameter, it is recommended to note down the changed setting data.

◆ Safety Precautions

Safety, Protection, and Modification of the Product

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

⚠ WARNING

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

⚠ CAUTION

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

CAUTION

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

NOTE

This symbol indicates information that complements the present topic.

This symbol indicates Protective Ground Terminal.

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

Warning and Disclaimer

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

■ Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

■ Drawing Conventions

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

Some screen images depicted in the user's manual may have different display positions or character types (e.g., the upper / lower case). Also note that some of the images contained in this user's manual are display examples.

In the figure listed in this manual, the example of the oxygen analyzer is shown mainly.
In the case of the humidity analyzer, unit indication may be different. Please read it appropriately.

■ Product Disposal:

The instrument should be disposed of in accordance with local and national legislation/regulations.

■ Trademark Acknowledgments

- All other company and product names mentioned in this user's manual are trademarks or registered trademarks of their respective companies.
- We do not use TM or ® mark to indicate those trademarks or registered trademarks in this user's manual.

◆ CE marking products

■ Authorized Representative in EEA

The Authorized Representative for this product in EEA is Yokogawa Europe B.V. (Euroweg 2, 3825 HD Amersfoort, The Netherlands).

■ Identification Tag

This manual and the identification tag attached on packing box are essential parts of the product.

Keep them together in a safe place for future reference.

■ Users

This product is designed to be used by a person with specialized knowledge.

■ How to dispose the batteries:

This is an explanation about the EU Battery Directive. This directive is only valid in the EU.

Batteries are included in this product. Batteries incorporated into this product cannot be removed by yourself. Dispose them together with this product.

Battery type: Manganese dioxide lithium battery

Notice:

The symbol (see above) means they shall be sorted out and collected as ordained in the EU Battery Directive.

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ZR22G and ZR802G
Zirconia Oxygen/Humidity Analyzer, Converter

IM 11M12G01-02EN 2nd Edition

CONTENTS

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1. Overview

Zirconia Oxygen/Humidity Analyzer is used to monitor and control the oxygen concentration in combustion gases, in boilers and industrial furnaces, for wide application in industries which consume considerable energy — such as steel, electric power, oil and petrochemical, ceramics, paper and pulp, food, or textiles, as well as incinerators and medium/small boilers. It can help conserve energy in these industries.
The Zirconia Oxygen/Humidity Analyzer, Converter also contributes to preservation of the earth's environment in preventing global warming and air pollution by controlling complete combustion to reduce CO2, SOx and NOx.

The ZR22G Separate type Detector uses a high-reliability Zirconia sensor, and its heater assembly can be replaced on site. The detector is mounted, for example, on the wall of a flue and can measure the gases directly.

For use in combustion gases at temperatures up to 1400°C, choose the general use 0.15 m long detector, which is combined with the ZO21P, the high temperature probe protector.

The Zirconia Humidity Analyzer is used to measure the humidity of hot gases continuously in driers which use hot gas or electricity as the heat source. It can also be used in a variety of manufacturing applications in humidifiers, as well as in driers, for humidity measurement and control. It can help improve productivity in these application fields.

The converter is equipped with an LCD touch screen which has various setting displays, a calibration display, oxygen concentration trend display, with easier operation and improvement of display functions. The converter is equipped with various standard functions such as measurement and calculation as well as maintenance functions including self-test. Analyzer calibration can also be fully automated — and the ZR40H, an automatic calibration unit, is available. Choose the detector version which best suits your needs so that an optimal combustion control system can be obtained.

Some examples of typical system configurations are illustrated below:

1.1 System Configuration

The system configuration should be determined by the conditions; e.g. whether calibration is to be automated, and whether flammable gas is present and requires safety precautions. The system configuration can be classified into three basic patterns as follows:

1.1.1 System 1

This is the simplest system consisting of a detector and a converter. This system can be implemented for monitoring oxygen concentration in the combustion gases of a package boiler, and can be implemented for monitoring humidity in a production process such as food production.

No piping is required for the reference gas (air) which is fed in at the installation site. The handy the ZO21S standard gas unit is used for calibration.

Zero gas from this unit and span gas (air) is sent to the detector through a tube which is connected during calibration.

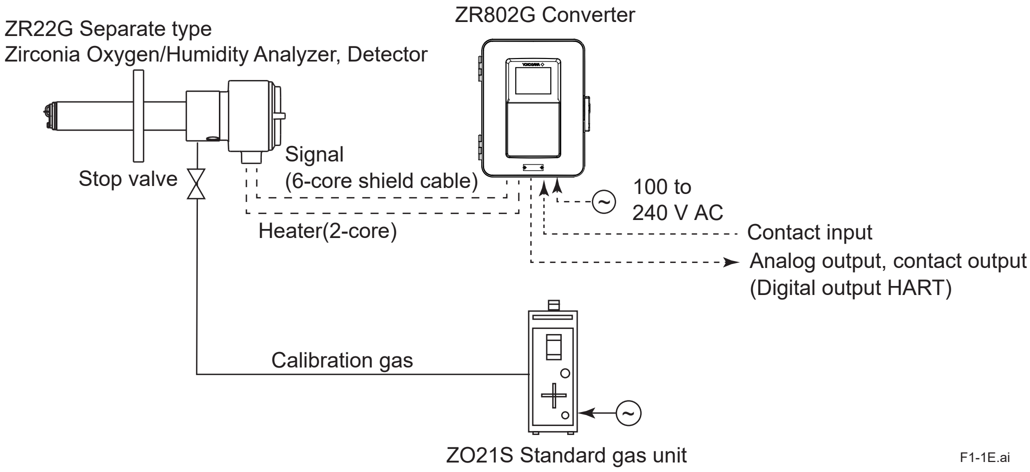


Figure1.1 System 1

NOTE

- As this system uses ambient air for the reference gas, measuring accuracy will be affected by the installation location.
- A needle (stop) valve should be connected to the calibration gas inlet of the detector. The valve should be fully closed unless calibration is in progress.

1.1.2 System 2

This system is for monitoring and controlling oxygen concentration in the combustion gases of a large-size boiler or heating furnace. Clean (dry) air (21 vol%O_2) is used as the reference gas and the span gas for calibration.

In case of humidity analyzer, this system is for accurate monitoring and controlling humidity when the installation environment is polluted with gases other than the air. Instrument air (clean and dry air of oxygen concentration 21%) is used for the reference gas and the span gas for calibration.

Zero gas is fed in from a cylinder during calibration. The gas flow is controlled by the ZA8F flow setting unit (for manual valve operation).

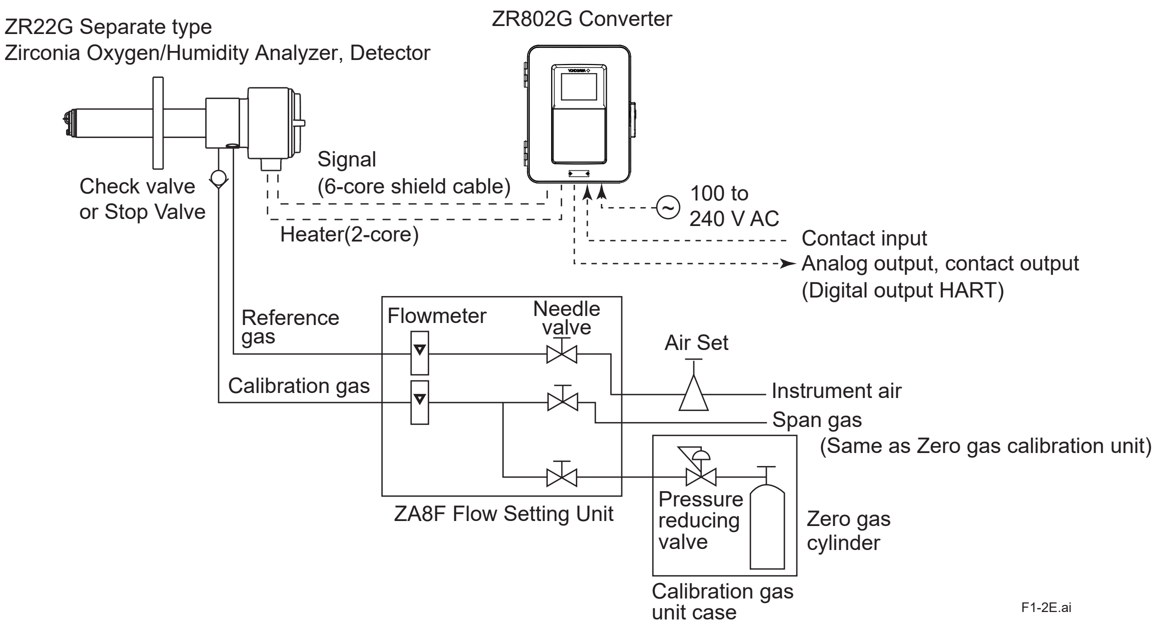
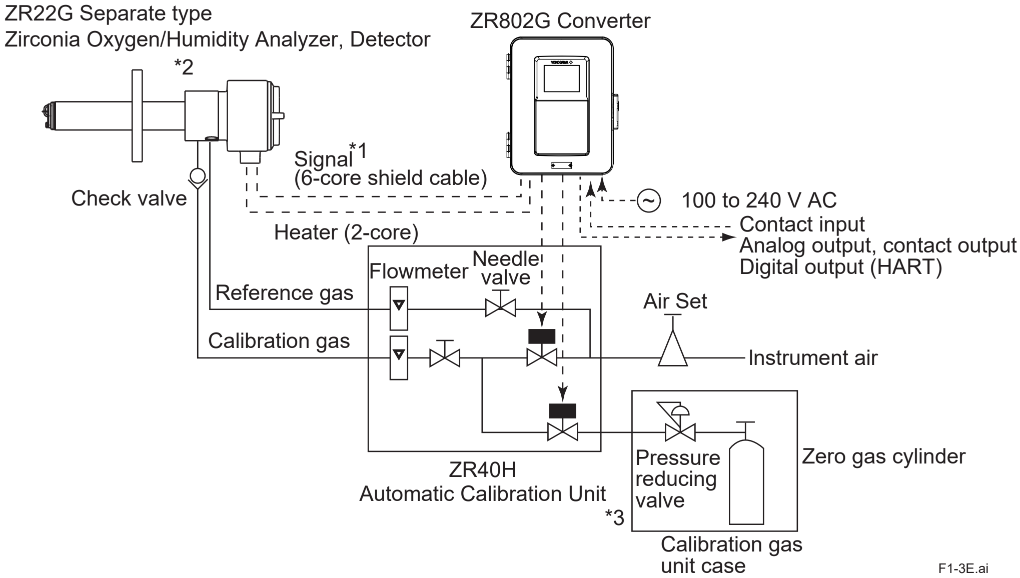


Figure1.2 System 2

1.1.3 System 3

This example, System 3, represents typical applications in large boilers and heating furnaces, where there is a need to monitor and control oxygen concentration. The reference gas and calibration-time span gas are (clean, dry) instrument air. Zero gas is supplied from a gas cylinder.

System 3 uses the ZR40H automatic calibration unit, with auto-switching of the calibration gas. A “combustible gas detected” contact input turns off power to the heater. There’s also contact output from the converter that can be used to operate a purge gas valve to supply air to the detector.



*1 Shield cable ; Use shielded signal cables, and connect the shield to the FG terminal of the converter.
*2 Select the desired probe from the Probe Configuration table on page 1-4.
*3 When a zirconia oxygen analyzer is used, 100% N_2 gas cannot be used as the zero gas. Use approximately 1% of O_2 gas (N_2-based).

Figure1.3 System 2

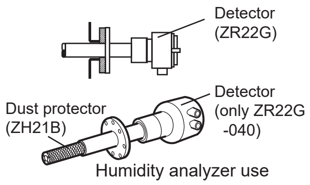
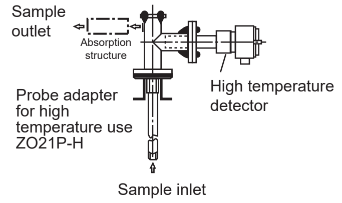
1.2 System Components

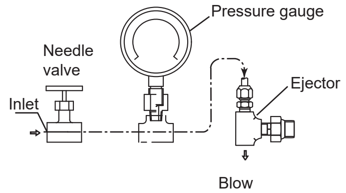
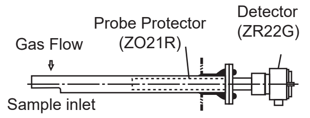
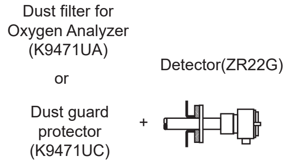
1.2.1 System Components

System Components	Separate type System config. Ex.1	Ex.2	Ex.3	Oxygen Analyzer	Humidity Analyzer
Model ZR22G Separate type Zirconia Oxygen Analyzers ,Detector	A	A	A	A	A
Model ZR802G Separate type Zirconia Oxygen Analyzer, Converter	A	A	A	A	A
Model ZO21P Adapter for High Temperature Probe of separate type Zirconia Oxygen Analyzer	B	B	B	B	
E7046EC, E7046EN Ejector Assembly for High temperature of separate type Oxygen Analyzer	B	B	B	B	
Model ZO21R Probe Protector for Zirconia Oxygen Analyzers	B	B	B	B	B
K9471UA Dust Filter for Oxygen Analyzer	B	B	B	B	
K9471UC Dust Guard Protector	B	B	B	B	B
ZH21B Dust protector (only for Humidity Analyzer)	B	B	B		B
Model ZO21S Standard Gas Unit	A			B	B
Model ZA8F Flow Setting Unit for manual calibration		A		B	B
Model ZR40H Automatic Calibration Unit for Separate type Oxygen Analyzer			A	B	B
L9852CB, G7016XH Stop Valve for Calibration gas line	A	(A)		B	B
K9292DN,K9292DS Check Valve for Calibration gas line		(A)	A	B	B
G7003XF/K9473XK, G7004XF/K9473XG Air Set		A	A	B	B
G7001ZC Zero gas Cylinder		A	A	B	B
G7013XF, G7014XF Pressure Reducing Valve for Gas Cylinder		A	A	B	B
E7044KF Case Assembly for Calibration gas Cylinder		A	A	B	B
Model ZR22A Heater Assembly (Spare Parts for Model ZR22G)				B	B

A: Items required for the above system example
B: To be selected depending on each application. For details, refer to corresponding chapter.
(A): Select either

1.2.2 Detectors and Accessories

<table>
<tr><th colspan="4">Sample gas temperature 0 to 700°C</th><th colspan="2">Sample gas temperature 700 to 1400°C</th></tr>
<tr><th>Mounting</th><th>Insertion length</th><th>General use Probe</th><th>Application</th><th>High temperature detector</th><th>Application</th></tr>
<tr><td>Horizontal to vertical</td><td>0.4 to 2 m</td><td rowspan="2">
</td><td rowspan="2">Boiler Heating furnace</td><td rowspan="6">

Temperature:
Probe material: SUS310S 800°C
Probe material: SiC 1400°C
Mounting: Vertical downwards
Insertion length: 1.0 m, 1.5 m
When duct pressure is atmospheric or negative, attach air ejector.
High temperature auxiliary ejector assembly (E7046EC, E7046EN)

</td><td rowspan="6">Heating furnace</td></tr>
<tr><td>Vertical</td><td>2.5 m or more</td></tr>
<tr><td>Horizontal to vertical</td><td>3 m or less</td><td>
</td><td>For pulverized coal boiler with gas flow velocity 10 m/sec or more</td></tr>
<tr><td>Horizontal to vertical</td><td>0.4 to 2 m</td><td rowspan="2">
</td><td rowspan="2">Black liquid recovery boiler
Cement Kiln</td></tr>
<tr><td>Vertical</td><td>2.5 m or more</td></tr>
</table>

2. Specifications

This chapter describes the specifications for the following:

ZR22G	General use separate type detector (See Section 2.2.1)
ZO21R	Probe protector (See Section 2.2.2)
ZH21B	Dust protector (See Section 2.2.3)
ZR22G (0.15 m)	High temperature separate type detector (See Section 2.3.1)
ZO21P	Adapter for High temperature probe (See Section 2.3.2)
ZR802G	Zirconia Oxygen/Humidity Analyzer, Converter (See Section 2.4)
ZA8F	Flow setting unit (See Section 2.5.1)
ZR40H	Automatic calibration unit (See Section 2.5.2)
ZO21S	Standard gas unit (See Section 2.6)

2.1 General Specifications

■ Standard Specifications (Oxygen Analyzer)

Measurement Object: Oxygen concentration in combustion exhaust gas and mixed gas (excluding inflammable gases)
Measurement System: Zirconia system
Measurement Range: 0.01 to 100 vol% O_2
Output Signal: 4 to 20 mA DC (maximum load resistance 550 Ω)
Setting Range: Any setting in the range of 0 to 5 through 0 to 100 vol% O_2 (in 1 vol% O_2), or partial range
Display Range: 0 to 100 vol% O_2
Warming-up Time: Approx. 20 min.
Repeatability: (Excluding the case where the reference gas is by natural convection) ± 0.5% F.S. ; range from 0 to 5 vol% O_2 or more and less than 0 to 25 vol% O_2 range ± 1% F.S. ; range from 0 to 25 vol% O_2 or more and up to 0 to 100 vol% O_2 range
Linearity: (Excluding standard gas tolerance and the case where the reference gas is by natural convection) (Use oxygen of known concentration (with in the measuring range) as the zero and span calibration gases.)
± 1% F.S.; 0 to 5 or more and less than 0 to 25 vol% O_2 range and sample gas pressure within ± 4.9 kPa
± 3% F.S.; 0 to 25 or more and less than 0 to 50 vol% O_2 range and sample gas pressure within ± 0.49 kPa
± 5% F.S.; 0 to 50 or more and up to 0 to 100 vol% O_2 range and sample gas pressure within ± 0.49 kPa
Drift: (Excluding the first two weeks in use and the case where the reference gas is by natural convection.)
Both zero and span ± 2% F.S. /month
Response Time: Response of 90% within 5 seconds.
(Measured after gas is introduced from calibration gas inlet and analog output starts changing.)
Safety, EMC, and RoHS conformity standards of ZR22G, ZR802G
Installation altitude: 2000 m or less
Installation category: (IEC61010); II
Pollution degree: (IEC61010); 2
Measurement category: O (other)

Note
· Installation category, called overvoltage category, specifies impulse withstanding voltage. Category II is for electrical equipment.
· Pollution degree indicates the degree of existence of solid, liquid, gas or other inclusions which reduce dielectric strength. Degree 2 is the normal indoor environment.

Safety :
ZR22G;
CE EN 61010-1
EN 61010-2-030
UL UL61010-1:2nd Edition
CSA CAN/CSA-C22.2 No. 61010-1
GB GB30439 Part 1
ZR802G;
CE EN 61010-1/A1
EN 61010-2-030
UL UL61010-1:3rd Edition, AMD1
UL61010-2-030:1st Edition
CSA CAN/CSA-C22.2 No. 61010-1+Amd1
CAN/CSA-C22.2 No. 61010-2-030
GB GB30439 Part 1
EMC:
CE EN 61326-1 Class A Table 2
EN 61326-2-3,
EN 61000-3-2
RCM EN 55011 Class A, Group 1
KC KN11 Class A Group1, KN61000-6-2
Note · This instrument is a Class A product, and it is designed for use in the industrial environment. Please use this instrument in the industrial environment only.
· Influence of immunity environment (Criteria A) : Output shift is specified within ±20% of F.S.

RoHS:
ZR22G; EN 50581
ZR802G; EN IEC 63000

Others:
REACH Regulation EC 1907/2006
Information of the WEEE Directive
This product is purposely designed to be used in a large scale fixed installations only and, therefore, is out of scope of the WEEE Directive. The WEEE Directive is only valid in the EU.

■ STANDARD SPECIFICATIONS (High Temperature Humidity Analyzer)

Measurement Object: Water vapor (in vol%) in mixed gases (air and water vapor)
Measurement System: Zirconia system
Measurement 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)
Setting Range: Any setting in the range
Oxygen; 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.
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 (Note)
Dew point; -40 to 164°C (Note)
(Note): These values are affected by temperature and absolute pressure, So accurate temperature and pressure values must be inputted to the converter.
Warming-up Time: Approx. 20 min.
Repeatability: (Excluding the case where the reference gas is by natural convection)
±1 vol% H_2O; Sample gas pressure 2 kPa or less
Linearity: (Excluding standard gas tolerance and the case where the reference gas is by natural convection)
(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 and the case where the reference gas is by natural convection.)
Both zero and span ± 3 vol%H_2O/month

Response Time: Response of 90% within 5 seconds. (Measured after gas is introduced from calibration gas inlet and analog output starts changing.)

Safety, EMC, and RoHS conformity standards of ZR22G, ZR802G

Installation altitude: 2000 m or less

Installation category: (IEC61010); II

Pollution degree: (IEC61010); 2

Note · Installation category, called overvoltage category, specifies impulse withstanding voltage. Category II is for electrical equipment.

· Pollution degree indicates the degree of existence of solid, liquid, gas or other inclusions which reduce dielectric strength. Degree 2 is the normal indoor environment.

Safety:

ZR22G;

CE EN 61010-1
EN 61010-2-030

UL UL61010-1:2nd Edition

CSA CAN/CSA-C22.2 No. 61010-1

GB GB30439 Part 1

ZR802G;

CE EN 61010-1/A1
EN 61010-2-030

UL UL61010-1:3rd Edition, AMD1
UL61010-2-030:1st Edition

CSA CAN/CSA-C22.2 No. 61010-1+Amd1
CAN/CSA-C22.2 No. 61010-2-030

GB GB30439 Part 1

EMC:

CE EN 61326-1 Class A Table 2
EN 61326-2-3,
EN 61000-3-2

RCM EN 55011 Class A, Group 1

KC KN11 Class A Group1, KN61000-6-2

Note · This instrument is a Class A product, and it is designed for use in the industrial environment. Please use this instrument in the industrial environment only.

· Influence of immunity environment (Criteria A) : Output shift is specified within ±20% of F.S.

RoHS:

ZR22G; EN 50581
ZR802G; EN IEC 63000

Others:

REACH Regulation EC 1907/2006

Information of the WEEE Directive

This product is purposely designed to be used in a large scale fixed installations only and, therefore, is out of scope of the WEEE Directive. The WEEE Directive is only valid in the EU.

2.2 General use Separate type Detector and Related Equipment

General use separate type detector ZR22G can be used in combination with the probe protector ZO21R (see Section "2.2.2 ZO21R Probe Protector").

In case of Humidity Analyzer, the “Detector with dust protector” consists of ZR22G general-use separate-type detector and ZH21B dust protector (refer to Section "2.2.3ZH21B Dust Protector").

2.2.1 ZR22G General use Separate type Detector

■ STANDARD SPECIFICATIONS (Oxygen Analyzer)

Sample Gas Temperature: 0 to 700°C (Probe only) It is necessary to mount the cell using Inconel cell-bolts when the temperature is greater than 600°C.
For high temperature sample gas (700 to 1400°C), apply 0.15 m length probe and High Temperature Probe Adapter ZO21P-H.

Sample Gas Pressure: - 5 to + 250 kPa (No pressure fluctuation in the furnace should be allowed.)
When the pressure in the furnace exceeds 3 kPa, it is recommended to use pressure compensated type.
When the pressure in the furnace exceeds 5 kPa, pressure compensated type is required.
For 0.15 m probe length, - 0.5 to + 5 kPa.

Note: When the detector is used in conjunction with a check valve and the ZA8F Flow Setting Unit, the maximum pressure of sample gas is 150 kPa.
When with a check valve and the ZR40H Automatic Calibration Unit, it is 200 kPa. If the pressure of your sample gas exceeds these limits, consult with Yokogawa.

Probe Length: 0.15, 0.4, 0.7, 1.0, 1.5, 2.0, 2.5, 3.0, 3.6, 4.2, 4.8, 5.4 m

Probe Material: SUS316

Ambient Temperature: -20 to +150°C

Reference Gas System: Natural Convection, Instrument Air, Pressure compensated (other than for probe length 0.15 m)

Instrument Air System (excluding Natural Convection) It is recommended to use air which has been dehumidified by cooling to dew point -20°C or less, and dust or oil mist are removed.
Supply gas pressure; Sample Gas pressure: +approx. 50 kPA
Sample gas pressure + approx. 150 kPA
(/CV: with check valve)
Consumption; Approx. 1 Nl/min

Wetted Material: SUS316, Zirconia, SUS304 or ASTM grade 304 (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.)

Terminal Box Case Material: Aluminum alloy

Terminal Box Paint Color:
Case and Cover; Mint green (Munsell 5.6BG3.3/2.9)

Finish: Polyurethane corrosion-resistance coating

Gas Connection: Rc1/4 or 1/4 NPT (Female)

Wiring Connection: G1/2, Pg 13.5, M20 × 1.5, 1/2 NPT

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°) and use a probe protector.

Weight:
Insertion length of 0.15 m: approx. 5 kg (JIS 5K 65) / approx. 10 kg (ANSI 150 4)
Insertion length of 0.4 m: approx. 6 kg (JIS 5K 65) / approx. 11 kg (ANSI 150 4)
Insertion length of 1.0 m: approx. 8 kg (JIS 5K 65) / approx. 13 kg (ANSI 150 4)
Insertion length of 1.5 m: approx. 10 kg (JIS 5K 65) / approx. 15 kg (ANSI 150 4)
Insertion length of 2.0 m: approx. 12 kg (JIS 5K 65) / approx. 17 kg (ANSI 150 4)
Insertion length of 3.0 m: approx. 15 kg (JIS 5K 65) / approx. 20 kg (ANSI 150 4)
Insertion length of 3.6 m: approx. 17 kg (JIS 5K 65) / approx. 22 kg (ANSI 150 4)
Insertion length of 4.2 m: approx. 19 kg (JIS 5K 65) / approx. 24 kg (ANSI 150 4)
Insertion length of 4.8 m: approx. 21 kg (JIS 5K 65) / approx. 26 kg (ANSI 150 4)
Insertion length of 5.4 m: approx. 23 kg (JIS 5K 65) / approx. 28 kg (ANSI 150 4)

■ STANDARD SPECIFICATIONS (High Temperature Humidity Analyzer)

Sample Gas Temperature: 0 to 700°C (Probe only)
It is recommended to mount the cell using inconel cell-bolts when the temperature is greater than 600°C.
Sample Gas Pressure: - 5 to + 20 kPa (When the pressure in the furnace exceeds 3 kPa, it is recommended to use pressure compensated type. When the pressure in the furnace exceeds 5 kPa, pressure compensated type is required.) No pressure fluctuation in the process should be allowed.
Probe Length: 0.4, 0.7, 1.0, 1.5, 2.0, 2.5, 3.0 m
Probe Material: SUS316
Ambient Temperature: -20 to +150°C
Reference Gas System: Natural Convection, Instrument Air System (excluding Natural Convection) It is recommended to use air which has been dehumidified by cooling to dew point -20°C or less, and dust or oil mist are removed.
Supply gas pressure; Sample Gas pressure: +approx. 50 kPA
Sample gas pressure + approx. 150 kPA (/CV: with check valve
Wetted Material: SUS316, Zirconia, SUS304 or ASTM grade 304 (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.)
Terminal Box Case: Material; Aluminum alloy
Terminal Box Paint Color:
Case and Cover; Mint green (Munsell 5.6BG3.3/2.9)
Finish: Polyurethane corrosion-resistance coating
Gas Connection: Rc1/4 or 1/4 NPT (Female)
Wiring Connection: G1/2, Pg 13.5, M20 × 1.5, 1/2 NPT
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 available.
When the probe insertion length exceeds 2.5 m, mount vertically downward (within ± 5°) and use a probe protector.

Weight:
Insertion length of 0.4 m: approx. 6 kg (JIS 5K 65) / approx. 11 kg (ANSI 150 4)
Insertion length of 1.0 m: approx. 8 kg (JIS 5K 65) / approx. 13 kg (ANSI 150 4)
Insertion length of 1.5 m: approx. 10 kg (JIS 5K 65) / approx. 15 kg (ANSI 150 4)
Insertion length of 2.0 m: approx. 12 kg (JIS 5K 65) / approx. 17 kg (ANSI 150 4)
Insertion length of 3.0 m: approx. 15 kg (JIS 5K 65) / approx. 20 kg (ANSI 150 4)

● Model and Codes

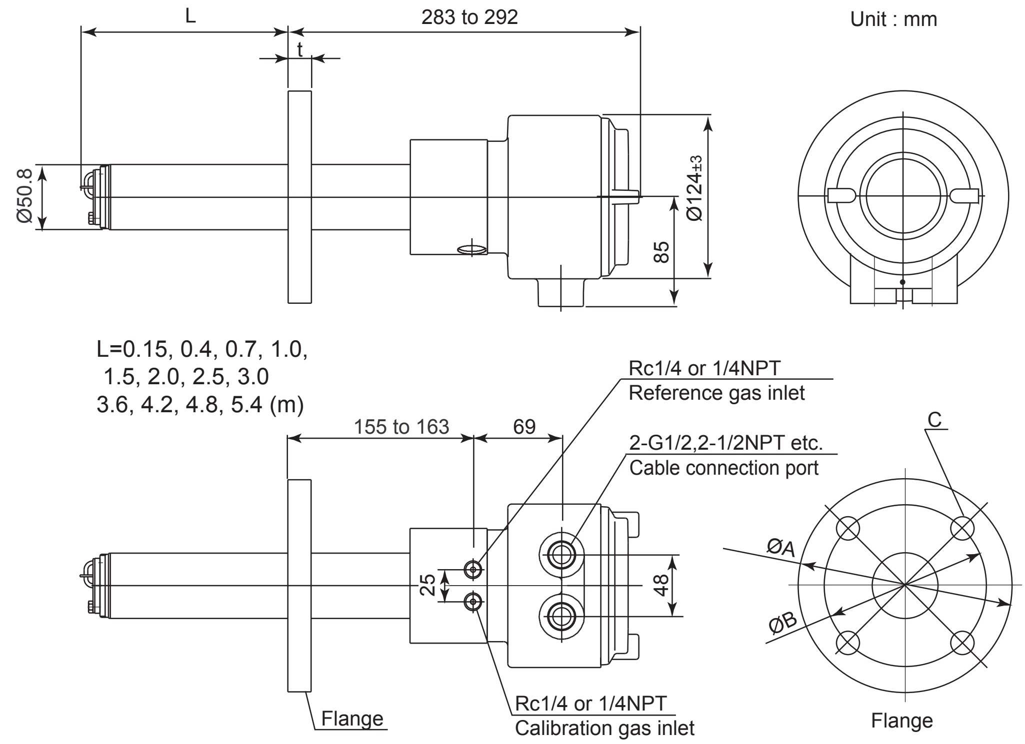
Style : S2

Model	Suffix code	Option code	Description
ZR22G	------------------------------------	----------	Zirconia Oxygen/Humidity Analyzer, Detector
Length	-015	----------	0.15 m (for high temperature use) (*1)
	-040	----------	0.4 m
	-070	----------	0.7 m
	-100	----------	1.0 m
	-150	----------	1.5 m
	-200	----------	2.0 m
	-250	----------	2.5 m (*2)
	-300	----------	3.0 m (*2)
	-360	----------	3.6 m (*2)
	-420	----------	4.2 m (*2)
	-480	----------	4.8 m (*2)
	-540	----------	5.4 m (*2)
Wetted material	-S	----------	Stainless steel
	-C	----------	Stainless steel with Inconel calibration gas tube (*10)
Flange (*3)	-A	----------	ANSI Class 150 2 RF
	-B	----------	ANSI Class 150 3 RF
	-C	----------	ANSI Class 150 4 RF
	-E	----------	DIN PN10 DN50 A
	-F	----------	DIN PN10 DN80 A
	-G	----------	DIN PN10 DN100 A
	-K	----------	JIS 5K 65 FF
	-L	----------	JIS 10K 65 FF
	-M	----------	JIS 10K 80 FF
	-P	----------	JIS 10K 100 FF
	-Q	----------	JIS 5K 32 FF (for high temperature use) (*4)
	-R	----------	JPI Class 150 4 RF
	-S	----------	JPI Class 150 3 RF
	-W	----------	Westinghouse
Reference gas	-C	----------	Natural convection
	-E	----------	External connection (Instrument air) (*11)
	-P	----------	Pressure compensated (*11)
Gas Thread	-R	----------	Rc1/4
	-T	----------	1/4NPT(Female)
Connection box thread	-P	----------	G1/2
	-G	----------	Pg13.5
	-M	----------	M20 x1.5
	-T	----------	1/2 NPT
	-Q	----------	Quick connect (*9)
Instruction manual	-J	----------	Japanese
	-E	----------	English
	-C	----------	Chinese
--	-A	----------	Always -A
Options		/C	Inconel bolt (*5)
	Valves	/CV	Check valve (*6)
		/SV	Stop valve (*6)
	Filter	/F1	Dust Filter (*7)
		/F2	Dust Guard Protector (*7)
	Tag plates	/SCT	Stainless steel tag plate (*8)
		/PT	Printed tag plate (*8)
	Standard	/EQ	EAC with PA (*12)
		/ER	EAC (*12)

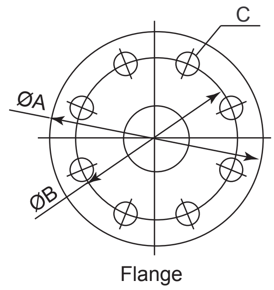
*1 Used with the ZO21P High Temperature Probe Adapter. Select flange (-Q).
*2 When installing horizontally the probe whose insertion length is 2.5 m or more, use the Probe Protector. Be sure to specifyZO21R-L-200-□. Specify the flange suffix code either -C or -K.
*3 The thickness of the flange depends on its dimensions.
*4 Not used in conjunction with —P (pressure compensation) for reference gas. The flange thickness does not conform to JIS specification
*5 Inconel probe bolts and U shape pipe are used. Use this option for high temperature use (ranging from 600 to 700 °C).
*6 Specify either /CV or /SV option code.
*7 Not used with the high temperature humidity analyzer.
*8 Specify either /SCT or /PT option code.
*9 Not waterproof, avoid rain. Operating maximum temperature is 80°C. Available only in the U.S.
*10 Recommended if sample gas contains corrosive gas like chlorine.
*11 Piping for reference gas must be installed to supply reference gas constantly at a specified flow rate.
*12 "/EQ" is EAC with Pattern Approval for Russia. "/ER" is EAC for Kazakhstan and Belarus.

EXTERNAL DIMENSIONS

1. Model ZR22G Separate type Zirconia Oxygen/Humidity Analyzer, Detectors



Flange	A	B	C	t
ANSI Class 150 2 RF	152.4	120.6	4 - Ø19	19
ANSI Class 150 3 RF	190.5	152.4	4 - Ø19	24
ANSI Class 150 4 RF	228.6	190.5	8 - Ø19	24
DIN PN10 DN50 A	165	125	4 - Ø18	18
DIN PN10 DN80 A	200	160	8 - Ø18	20
DIN PN10 DN100 A	220	180	8 - Ø18	20
JIS 5K 65 FF	155	130	4 - Ø15	14
JIS 10K 65 FF	175	140	4 - Ø19	18
JIS 10K 80 FF	185	150	8 - Ø19	18
JIS 10K 100 FF	210	175	8 - Ø19	18
JIS 5K 32 FF	115	90	4 - Ø15	5
JPI Class 150 4 RF	229	190.5	8 - Ø19	24
JPI Class 150 3 RF	190	152.4	4 - Ø19	24
Westinghouse	155	127	4 - Ø11.5	14



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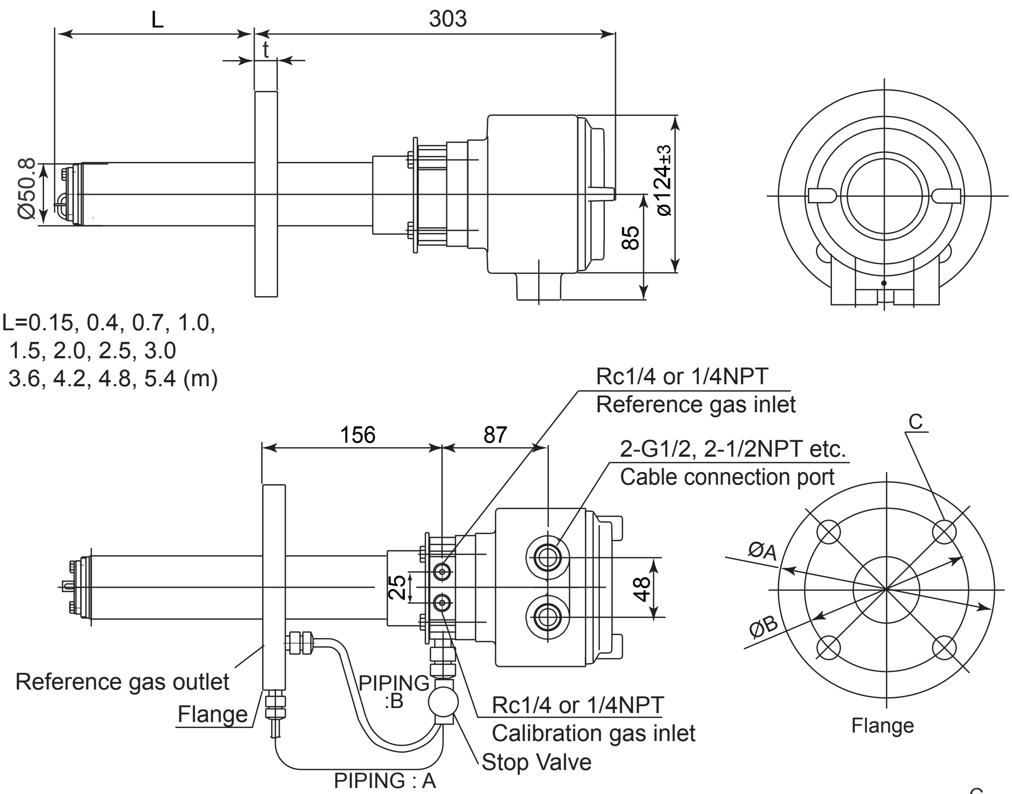
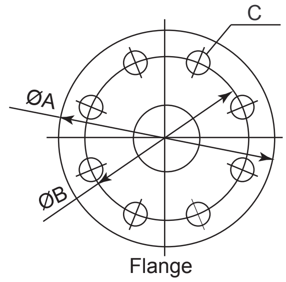
2. Model ZR22G...-P (with pressure compensation) Separate type Zirconia Oxygen Analyzer, Detectors



Flange	A	B	C	t	PIPING
ANSI Class 150 2 RF	152.4	120.6	4 - Ø19	19	A
ANSI Class 150 3 RF	190.5	152.4	4 - Ø19	24	B
ANSI Class 150 4 RF	228.6	190.5	8 - Ø19	24	B
DIN PN10 DN50 A	165	125	4 - Ø18	18	A
DIN PN10 DN80 A	200	160	8 - Ø18	20	B
DIN PN10 DN100 A	220	180	8 - Ø18	20	B
JIS 5K 65 FF	155	130	4 - Ø15	14	A
JIS 10K 65 FF	175	140	4 - Ø19	18	A
JIS 10K 80 FF	185	150	8 - Ø19	18	B
JIS 10K 100 FF	210	175	8 - Ø19	18	B
JPI Class 150 4 RF	229	190.5	8 - Ø19	24	B
JPI Class 150 3 RF	190	152.4	4 - Ø19	24	B
Westinghouse	155	127	4 - Ø11.5	14	A



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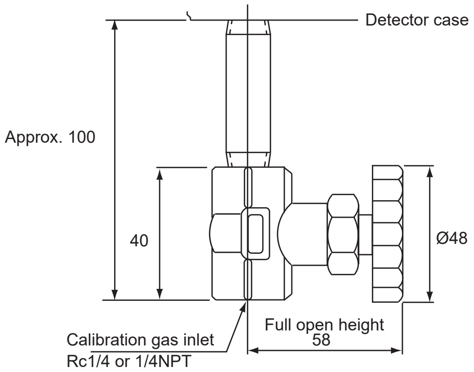
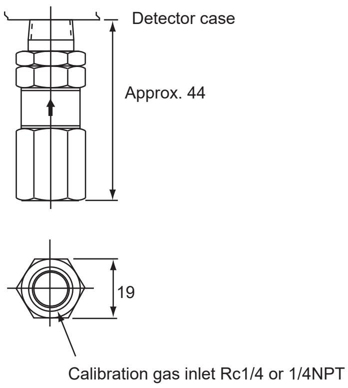
● Check Valve (option code /CV), Stop valve (option code /SV) -specified Calibration gas inlet

Unit: mm



with Stop Valve (option: /SV)



with Check Valve (option: /CV)

2.2.2 ZO21R Probe Protector

Used when sample gas flow velocity is approx. 10 m/sec or more and dust particles wears the detector in cases such as pulverized coal boiler of fluidized bed furnace (or burner) to protect the detector from wearing by dust particles. When probe insertion length is 2.5 m or more and horizontal installation, specify the ZO21R-L-200-☐*B to reinforce the probe.

Insertion Length: 1.05 m, 1.55 m, 2.05 m.

Flange: JIS 5K 65A FF equivalent. ANSI Class 150 4 FF (without serration) equivalent. However, flange thickness is different.

Material: SUS316 (JIS), SUS304 (JIS) or ASTM grade 304 (Flange)

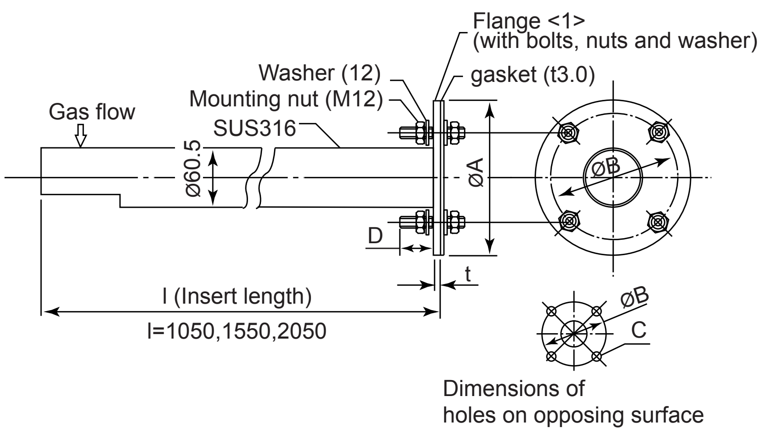
Weight: 1.05 m; Approx. 6/10/8.5 kg (JIS/ANSI),
1.55 m; Approx. 9/13/11.5 kg (JIS/ANSI),
2.05 m; Approx. 12/16/14.5 kg (JIS/ANSI)

Installation: Bolts, nuts, and washers are provided for detector, probe adapter and process-side flange.

● Model and Codes

Model	Suffix code			Option code	Description
ZO21R	-L			------	Probe Protector(0 to 700 °C)
Insertion length	-100 -150 -200			------ ------ ------	1.05 m (3.5 ft) 1.55 m (5.1 ft) 2.05 m (6.8 ft)
Flange (*1)		-J -A		------ ------	JIS 5K 65 FF ANSI Class 150 4 FF
Style code			*B	------	Style B

*1 Thickness of flange depends on dimensions of flange.



Flange<1>	A	B	C	t	D
JIS 5K 65 FF	155	130	4 - Ø15	5	40
ANSI Class 150 4 FF	228.6	190.5	8 - Ø19	12	50

2.2.3 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 or ANSI Class 150 4 FF (However, flange thickness is different)

Material: SUS 316(JIS), SUS304 (JIS) or ASTM grade 304 (flange)

Weight: Approximately 6kg (JIS), approximately 8.5kg (ANSI)

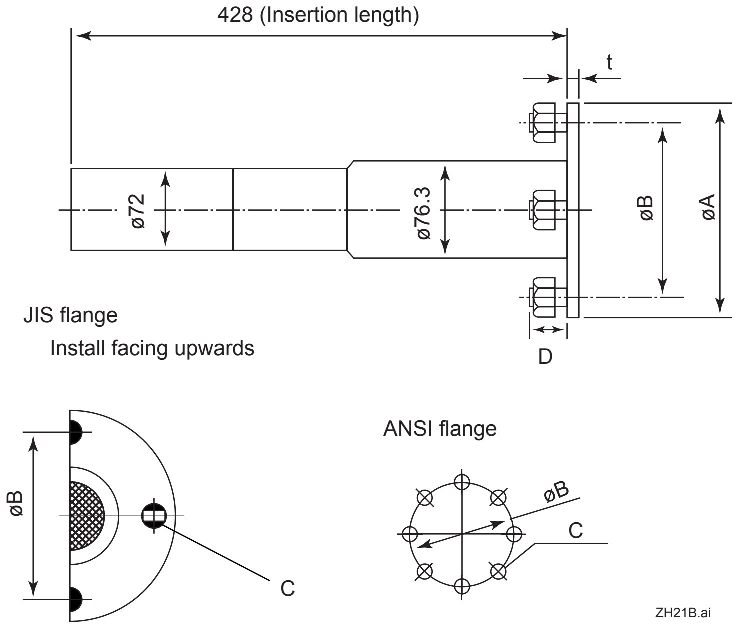
Mounting: Mounted on the probe or process flange with bolts and associated nuts and washers.

● Model and Codes

Model	Suffix code	Option code	Description
ZH21B	- - - - - - - - - - - - -	- - - - - -	Dust Protector (0 to 600 °C)
Insertion length	-40	- - - - - -	0.428 m
Flange (*1)	-J -A	- - - - - - - - - - - -	JIS 5K 80 FF (*1) ANSI Class 150 4B FF (*2)
Style code	*B	- - - - - -	Style B

Note: The flange thickness varies.
*1: Specify the probe ZR22G-040-□-K
*2: Specify the probe ZR22G-040-□-C

Unit: mm



Flange	A	B	C	t	D
JIS 5K 80 FF	180	145	4 - Ø19	12	40
ANSI Class 150 4B FF	228.6	190.5	8 - Ø19	12	50

2.3 Separate type Detector for High Temperature and Related Equipment

2.3.1 ZR22G (0.15m) Separate type Detector for High Temperature

Standard Specifications

Construction: Water-resistant, non-explosionproof

Probe length: 0.15 m

Terminal box: Aluminum alloy

Probe material: Probe material in contact with gas: SUS 316 (JIS) (Probe), SUS304 (JIS) or ASTM grade 304 (Flange), Zirconia (Sensor), Hastelloy B, (Inconel 600, 601)

Weight: Approx. 3 kg

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

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

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

Reference gas and calibration gas piping connection: Rc 1/4 or 1/4 NPT female

Cable inlet: G 1/2, Pg 13.5, M20 x 15, 1/2 NPT

Ambient temperature: -20 to 150°C

Sample gas temperature: 0 to 700°C (temperature at the measuring point of the sampling gas. 0 to 750°C or 0 to 1400°C when the probe adapter for high temperature is used.

Temperature of the probe adapter shall not exceed 300°C to protect the gasket and avoid the bolts seizing together.

Sample gas pressure: -0.5 to 5 kPa: when used at the range of more than 0 to 25 vol%O_2, -0.5 to 0.5 kPa. (An ejector assembly is required for negative pressure application.)

Model and Code: Refer to “Model and Codes” in page 2-5.

External Dimensions: Refer to the Figure in page 2-6.

2.3.2 ZO21P High Temperature Probe Adapter

Measuring O_2 in the high temperature gases (exceeds 700°C) requires a general use probe ZR22G of 0.15 m length and a high temperature probe adapter.

Sample gas temperature: 0 to 1400°C (when using SiC probe)
0 to 800°C (when using SUS 310S probe adapter)

Sample gas pressure: -0.5 to 5 kPa. When using in the range of 0 to 25 vol%O_2 or more, the sample gas pressure should be in the range of -0.5 to 0.5 kPa. (Where the sample gas pressure for the high temperature probe is negative, an ejector assembly is necessary.)

Insertion length: 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.5 m

Material in Contact with Gas: SUS 316 (JIS), SiC or SUS 310S, SUS304 (JIS) or ASTM grade 304 (flange)

Probe Material: SiC, SUS 310S (JIS)

Installation: Flange mounting (FF type or RF type)

Probe Mounting Angle: Vertically downward within ± 5° Where the probe material is SUS 310S, horizontal mounting is available.

Construction: Non explosion-proof. Rainproof construction

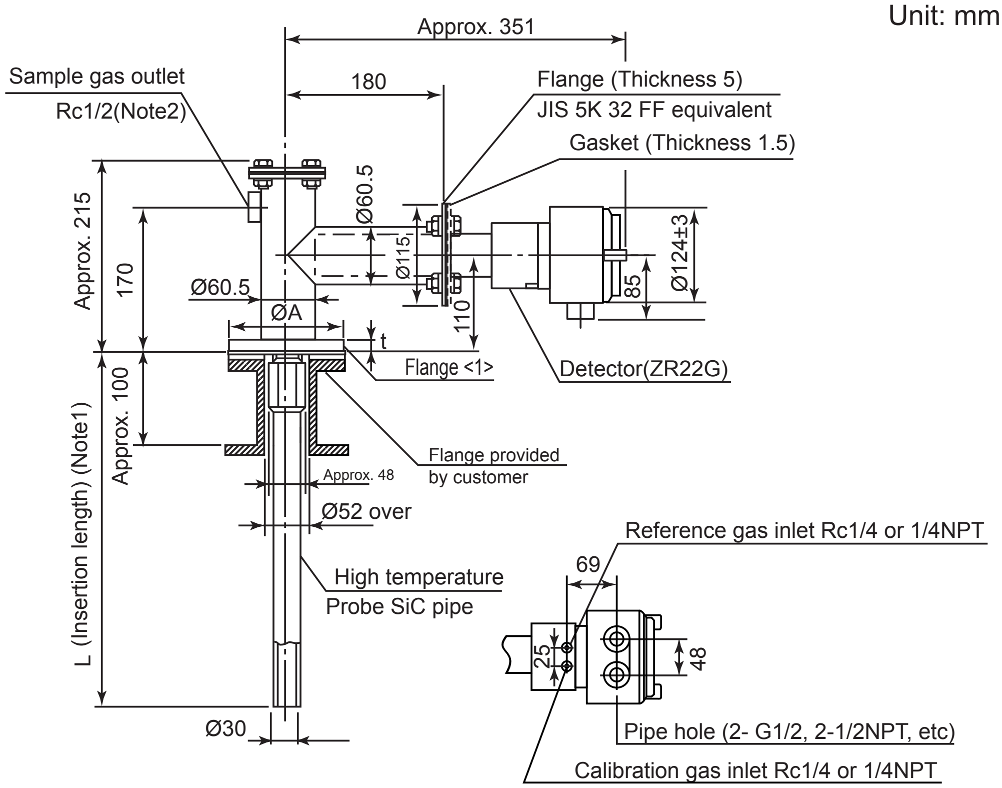
Weight(example): Insertion length of 1.0 m: approx. 5.3 kg (JIS) / approx. 11.3 kg (ANSI)
Insertion length of 1.5 m: approx. 5.8 kg (JIS) / approx. 11.8 kg (ANSI)

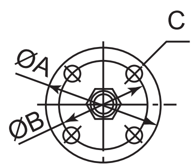
● Model and Codes

Model	Suffix code	Option code	Description
ZO21P	-H	-------	High Temperature Probe Adapter
Material	-A -B	------- -------	SiC SUS 310S (JIS)
Insertion length	-050 -060 -070 -080 -090 -100 -150	------ ------ ------ ------ ------ ------ ------	0.5 m 0.6 m 0.7 m 0.8 m 0.9 m 1.0 m 1.5 m
Flange	-J -N -M -L -A -R -Q -T -S -E	------- ------- ------- ------- ------- ------- ------- ------- ------- -------	JIS 5K 50 FF JIS 10K 65 FF JIS 10K 80 FF JIS 10K 100 FF ANSI Class 150 4 RF ANSI Class 150 2 1/2 RF ANSI Class 150 3 RF JPI Class 150 3 RF JPI Class 150 4 RF DIN PN10 DN50 A
Style code	*B	-------	Style B
Option	Ejector Tag plate	/EJ1 /EJ2 /SCT	Ejector Assy with E7046EC Ejector Assy with E7046EN Stainless steel tag plate

Note: For this high-temperature use probe adapter, be sure to specify the ZR22G probe of its insertion length 0.15 meters.

Unit: mm





(Note 1) L= 0.5、0.6、0.7、0.8、0.9、
1.0、1.5(m)

(Note 2) Sample gas outlet
(if the sample gas pressure is negative, connect the auxiliary ejector.)

Flange<1>	A	B	C	t
JIS 5K 50 FF	130	105	4 - Ø15	14
JIS 10K 65 FF	175	140	4 - Ø19	18
JIS 10K 80 FF	185	150	8 - Ø19	18
JIS 10K 100 FF	210	175	8 - Ø19	18
ANSI Class 150 4 RF	228.6	190.5	8 - Ø19	24
ANSI Class 150 3 RF	190.5	152.4	4 - Ø19	24
ANSI Class 150 2 RF	177.8	120.6	4 - Ø19	19
JPI Class 150 4 RF	229	190.5	8 - Ø19	24
JPI Class 150 3 RF	190	152.4	4 - Ø19	24
DIN PN10 DN50A	165	125	4 - Ø18	18

2.4 ZR802G Zirconia Oxygen/Humidity Converter

● Standard Specification (Oxygen Analyzer)

Display: LCD color display of size 320 by 240 dot with touchscreen
Analog Output:
Number of points; Two points (input-output isolation)
Out put signal;
- 4 to 20 mA DC linear or log can be selected (maximum loadresistance 550 Ω)
- HART7 Communication (maximum loadresistance 550 Ω)
- Burn out signal according to NAMUR NE43.

Output range;
Oxygen concentration; Any setting between 0 to 5 through 0 to 100 vol% O_2 in 1 vol% O_2, or partial range is available. For the log output, the minimum range value is fixed at 0.1 vol% O_2.
Output damping; 0 to 255 seconds. Hold/non-hold selection, preset value setting possible with hold.
Analog Input:
Number of points; one point (for Pressure compensated)
Input signal; 4 to 20 mA DC (maximum 40 mA)
- Converter power supply (standard) voltage; 16.6 to 25.2 V
- With no power supply (option)

Digital Communication:
HART7; AO1, 250 to 550 Ω
Ethernet (Modbus TCP); 10/100 Mbps, Cable length Max.100 m, grounding the shield
RS-485 (Modbus RTU); 115200/38400/9600 bps, Cable length Max.600 m (115200 bps) Max.1200 m (38400/9600 bps) grounding the shield
Contact Output:
Number of points; Four points (one is fail-safe,normally open)
- For DO-1/DO-2/DO-3, select either one, normally energized (normally closed) or normally de-energized (normally open) status. (Open when power is on.)
- DO-4 is fail-safe. (ON at Fault or Failure of NE107 setting), fixed normally energized (normally open, closed at power-off).

Contact capacity; 30VDC 3A or 250VAC 3 A (load resistance)
Function; Fault, High-high alarm, High alarm, Low-low alarm, Low alarm, Maintenance, Calibration, Range switching answer-back, Warm-up, Calibration gas pressure decrease (answer-back of contact input), Temperature high alarm, Blowback start, Flameout gas detection (answer-back of contact input), Calibration coefficient alarm, Startup power stabilization timeout alarm
Contact Input:
Number of points; Two points (No-voltage contact input or Transistor contact input)
On/Off detection;
- No-voltage contact input
  Resistivity value 200 Ω or less; closed
  Resistivity value 100 kΩ or above; open
- Transistor contact input
  Voltage -1 to +1 VDC; closed,
  Voltage value 4.5 to +25 VDC or above; open

Contact capacity; Off-state leakage current 3 mA or less
Function; Calibration gas pressure decrease alarm, Range switching, External calibration start, Flameout gas detection, (ON: heater shut-off and span calibration gas inflow), Blowback start, Reboot
Automatic Calibration Output: Two points (for dedicated automatic calibration unit ZH40H only)
Environmental condition:
Ambient Temperature; -20 to +55°C
Storage Temperature; -30 to +70°C
Humidity; 10 to 90% RH at 40°C (Non-condensing)
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; 47 to 63 Hz
Power Consumption: Max. 800 VA, approx. 330 VA for ordinary use.
Power supply 100V AC: Max. 160 VA (160 W), approx. 120 VA (approx. 100 W) for ordinary use
Power supply 230 V AC: Max 550 VA (370 W), approx. 260 VA (approx. 100 W)
Maximum Distance between Detector and Converter: Conductor two-way resistance must be 10 Ω or less (when a 1.25 mm^2 cable or equivalent is used, 300 m or less.)
Construction: NEMA/CSA TYPE 4X (IP66 equivalent) (with conduit holes completely sealed with a cable gland)
Wiring Connection: eight holes
Type; G1/2, M20 × 1.5mm, Pg13.5, 1/2NPT
Installation: Panel, wall or 2-inch pipe mounting
Material:
Case; Aluminum alloy
Window; Polycarbonate
Paint Color: Silver gray (Munsell 3.2PB7.4/1.2)
Finish: Polyurethane corrosion-resistance coating
Weight: Approx. 5 kg

Functions

Display Functions:
Value Display; Displays values of the measured oxygen concentration, etc
Graph Display; Displays trends of measured oxygen concentration and the test result from a cell resistance tester.
Data Display; Displays various useful data for maintenance, such as cell temperature, reference junction temperature, maximum/minimum oxygen concentration, or the like
Status Message; Indicates an alarm or error occurrence by flashing of the corresponding icon. Indicates status such as warming-up, calibrating, or the like by the marks.
Alarm Display; Alarm name, description, Countermeasures display at error occurrence, NAMUR NE107 compliant 4-symbol display
Calibration Functions:
Calibration method; Zero/span calibration (Either zero or span can be skipped)
Calibration mode;
- Automatic Calibration; Requires the ZR40H Automatic Calibration Unit. It calibrates automatically at specified intervals.
- Semi-automatic Calibration; Requires the ZR40H Automatic Calibration Unit. Input calibration direction on the touchscreen or contact, then it calibrates automatically afterwards.
- Manual Calibration; Calibration with opening/closing the valve of calibration gas in operation interactively with an LCD touchscreen.

Calibration gas setting;
- Zero calibration gas concentration setting range; 0.3 to 100 vol% O_2 (minimum setting; 0.01 vol% O_2)
- Span calibration gas concentration setting range; 4.5 to 100 vol% O_2 (minimum setting; 0.01 vol% O_2)

Use N_2-balanced mixed gas containing 0 to 10% scale of oxygen, and 80 to 100 % scale of oxygen for standard zero gas and standard span gas respectively.
Calibration interval; date/time setting (Max. 255 days)
Purging Function: Before warming up the detector, feed the span gas for the set period of time to drain condensed water out of the piping of calibration gas. Detector's warming-up starts after the set period of purging time elapses.
Blowback Function: To allow a periodic purging etc., open/close contact output in the set period of interval or time defined full/semi-automatically.
Fault:
Alarm Function; The occurrence of Fault alarm stops the power supply to the heater. Fault alarm keeps turning on until the power shuts down.
Type; Cell voltage failure, Heater temperature failure, A/D converter failure, Memory failure, Hardware error, data redundancy mismatch

Alarm:
Function; Alarm keeps turning on until potential causes of a problem are eliminated.
Type; Oxygen concentration alarm, Zero-point calibration coefficient alarm, Span-point calibration coefficient alarm, EMF stabilization time-up alarm, Cold junction temperature alarm, Thermocouple voltage alarm, Input current alarm, Battery low alarm, Input-pressure alarm, Cell resistance alarm
NAMUR NE 107 Alarm Display Function: Displays 4 warnings of NAMUR NE 107 standard;
F: Failure (Fault equivalent, Power supply to the heater shuts down.)
C: Function Check
S: Out of Specification
M: Maintenance Required

Data Logging Function: Stores following data to SD card or visualizes on the instrument display. SD cards which are recommended or equivalent must be supplied by customer,
Event display; Log of Alarms, Calibration Trend, Power-on history are displayed on the main unit.
Graph Display; Displays trends of test result of resistivity from a cell resistance tester
SD card output; Measurement log (date/time, oxygen concentration, cell e.m.f, test result from a cell resistance tester, cell condition, NE107 status, etc.) Maintenance report (setup value, calibration value etc.) can be saved to SD cards in CSV format. The stored data can be copied to other converter by outputting user-setting parameters to SD cards.

Sensor Self-diagnosis Function:
Calibration mode diagnose; Span/Zero compensation rate, cell response time, cell condition
Cell resistance test ; result from a cell resistance test without feeding calibration gas
- Measurement mode; auto cell resistance test, semi-auto cell resistance test,
- Cell resistance test setting; stabilization time (min. sec.) starting time (year/month/date/hour/minute) measurement interval (day/time)

Display and setting content:
Measuring Related Items: Oxygen concentration (vol% O_2), output current value
Display Items: Cell temperature (°C), thermocouple reference junction temperature (°C), maximum/minimum/average oxygen concentration (vol% O_2), cell e.m.f. (mV), cell internal resistance (Ω), cell condition (in four grades), heater on-time rate (%), calibration record (twenty times), time (year/month/day, hour/minute)
Calibration Setting Items: Span gas concentration (vol% O_2), zero gas concentration (vol% O_2), calibration mode (automatic, semi-automatic, manual), calibration type and method (zero-span calibration, zero calibration only, span calibration only), stabilization time (min. sec), calibration time (min. sec), calibration interval (day/hour), starting time (year/month/day, hour/minute)
Output Related Items: Analog output/output mode selection, output conditions when warming-up/maintenance/calibrating (during blowback)/abnormal, oxygen concentration at 4 mA/20 mA (vol% O_2), time constant.
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), oxygen concentration alarm hysteresis (vol% O_2), oxygen concentration alarm detection, alarm delay (seconds)
Contact Related Items: Selection of contact input 1 and 2, selection of contact output 1 to 3 (Fault, high-high alarm, high alarm, low alarm, low-low alarm, maintenance, calibrating, range switching, warming-up, calibration gas pressure decrease, temperature high alarm, temperature high alarm, pressure high alarm, pressure low alarm, test result from a cell resistance tester, alarm of a cell resistance tester, calibration coefficient alarm, cell e.m.f. stabilization time over blowback, flameout gas detection

● Standard Specification (High Temperature Humidity Analyzer)

Display: LCD color display of size 320 by 240 dot with touchscreen.

Analog Output:
Number of points; Two points (input-output isolation)
Out put signal;
- 4 to 20 mA DC linear or log can be selected (maximum loadresistance 550 Ω)
- HART7 Communication (maximum loadresistance 550 Ω)
- Burn out signal according to NAMUR NE43.

Out put range; Any setting between
- Oxygen concentration; 0 to 5 through 0 to 100 vol%O_2 in 1 vol%O_2, or partial range is available.
- Moisture quantity; 0 to 25 through 0 to 100 vol%H_2O, or partial range is available.
- Mixture ratio; 0 to 0.200 through 0 to 1.000 kg/kg, or partial range is available.
- Relative humidity; 0 to 5 through 0 to 100 vol%RH in 1 vol%RH, or partial range is available.

For the log output, the minimum range value is fixed at 0.1 vol%O_2.
Out put damping; 0 to 255 seconds. Hold/non-hold selection, preset value setting possible with hold.
Analog Input: Number of points; one point (thermal input)
Input signal; 4 to 20 mA DC (2-wire input, input resistance 250 Ω)
- Converter power supply (standard) voltage; 16.6 to 25.2 V
- With no power supply (option)

Digital Communication
HART7; AO1, 250 to 550 Ω
Ethernet (Modbus TCP); 10/100 Mbps, Cable length Max.100 m, grounding the shield
RS-485 (Modbus RTU); 115200/38400/9600 bps, Cable length Max.600 m (115200 bps) Max.1200 m (38400/9600 bps) grounding the shield
Contact Output:
Number of points; Four points (one is fail-safe,normally open)
- For DO-1/DO-2/DO-3, select either one, normally energized (normally closed) or normally de-energized (normally open) status. (Open when power is on.)
- DO-4 is fail-safe. (ON at Fault or Failure of NE107 setting), fixed normally energized (normally open, closed at power-off).

Contact capacity; 30VDC 3A or 250VAC 3 A (load resistance)
Function; Fault, High-high alarm, High alarm, Low-low alarm, Low alarm, Maintenance, Calibration, Range switching answer-back, Warm-up, Calibration gas pressure decrease (answer-back of contact input), Temperature high alarm, Blowback start, Flameout gas detection (answer-back of contact input), Calibration coefficient alarm, Startup power stabilization timeout alarm
Contact Input:
Number of points; Two points (No-voltage contact input or Transistor contact input)
On/Off detection;
- No-voltage contact input
  Resistivity value 200 Ω or less; closed
  Resistivity value 100 k Ω or above; open
- Transistor contact input
  Voltage -1 to +1 VDC; closed,
  Voltage value 4.5 to +25 VDC or above; open

Contact capacity; Off-state leakage current 3 mA or less
Function; Calibration gas pressure decrease alarm, Range switching, External calibration start, Flameout gas detection, (ON: heater shut-off and span calibration gas inflow), Blowback start, Reboot
Automatic Calibration Output: Two points (for dedicated automatic calibration unit ZR40H only)
Environmental condition:
Ambient Temperature; -20 to +55°C
Storage Temperature; -30 to +70°C
Humidity; 10 to 90% RH at 40°C(Non-condensing)
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; 47 to 63 Hz
Power Consumption: Max. 800 VA, approx. 330 VA for ordinary use.
Power supply 100V AC: Max. 160 VA (160 W), approx. 120 VA (approx. 100 W) for ordinary use

Power supply 230 V AC: Max 550 VA (370 W), approx. 260 VA (approx. 100 W) for ordinary use

Maximum Distance between Detector and Converter: Conductor two-way resistance must be 10 Ω or less (when a 1.25 mm^2 cable or equivalent is used, 300 m or less.)

Construction: NEMA/CSA TYPE 4X (IP66 equivalent) (with conduit holes completely sealed with a cable gland)

Wiring Connection: eight holes

Type: G1/2, M20 × 1.5mm, Pg13.5, 1/2NPT

Installation: Panel, wall or 2-inch pipe mounting

Material:

Case: Aluminum alloy

Window: Polycarbonate

Paint Color:

Door and Case; Silver gray (Munsell 3.2PB7.4/1.2)

Finish: Polyurethane corrosion-resistance coating

Weight: Approx. 5 kg

Functions

Value Display; Displays values of the measured oxygen concentration, etc

Graph Display; Displays trends of measured oxygen concentration and the test result from a cell resistance tester.

Data Display; Displays various useful data for maintenance, such as cell temperature, reference junction temperature, maximum/minimum oxygen concentration, or the like

Status Message; Indicates an alarm or error occurrence by flashing of the corresponding icon. Indicates status such as warming-up, calibrating, or the like by the marks.

Alarm Display; Alarm name, description, Countermeasures display at error occurrence, NAMUR NE107 compliant 4-symbol display

Calibration Functions:

Calibration method; Zero/span calibration (Either zero or span can be skipped)

Calibration mode;

- Automatic Calibration; Requires the ZR40H Automatic Calibration Unit. It calibrates automatically at specified intervals.
- Semi-automatic Calibration; Requires the ZR40H Automatic Calibration Unit. Input calibration direction on the touchscreen or contact, then it calibrates automatically afterwards.
- Manual Calibration; Calibration with opening/closing the valve of calibration gas in operation interactively with an LCD touchscreen.

Calibration gas setting;

- Zero calibration gas concentration setting range; 0.3 to 100 vol% O_2 (minimum setting; 0.01 vol% O_2)
- Span calibration gas concentration setting range; 4.5 to 100 vol% O_2 (minimum setting; 0.01 vol% O_2)

Use N_2-balanced mixed gas containing 0 to10% scale of oxygen for standard zero gas, and 80 to 100% scale of oxygen for standard span gas.

Calibration interval; date/time setting (maximum 255 days)

Purging function: Before warming up the detector, feed the span gas for the set period of time to drain condensed water out of the piping of calibration gas. Detector's warming-up starts after the set period of purging time elapses.

Blowback Function: To allow a periodic purging etc., open/close contact output in the set period of interval or time defined full/semi-automatically.

Alarm Function:

Fault:

Function; The occurrence of Fault alarm stops the power supply to the heater. Fault alarm keeps turning on until the power shuts down.

Type; Cell voltage failure, Heater temperature failure, A/D converter failure, Memory failure, Hardware error, data redundancy mismatch

Alarm:

Function; Alarm keeps turning on until potential causes of a problem are eliminated.

Type; Oxygen concentration alarm, Humidity alarm, Mixing-ratio alarm, relative humidity alarm, Zero-point calibration coefficient alarm, Span-point calibration coefficient alarm, EMF stabilization time-up alarm, Input-temperature alarm, Cold junction temperature alarm, Thermocouple voltage alarm, Input current alarm, Battery low alarm, Cell resistance alarm

NAMUR NE 107 Alarm Display Function:

Displays 4 warnings of NAMUR NE 107 standard;

F: Failure (Fault equivalent, Power supply to the heater shuts down.)
C: Function Check
S: Out of Specification
M: Maintenance Required

Data Logging Function: Stores following data to SD card or visualizes on the instrument display. SD cards which are recommended or equivalent must be supplied by customers,

- Event;Log of Alarms, Calibration Trend; Log of test result from a cell resistance test in a trend graph
- Graph Display; Displays trends of test result of resistivity from a cell resistance tester
- Measurement log saved to SD card (date/time, oxygen concentration, cell e.m.f, test result from a cell resistance tester, cell condition, NE107 status, etc.) Maintenance report (setup value, calibration value etc.) can be saved to SD cards in CSV format. The stored data can be copied to other converter by outputting the data of user-setting parameters to SD cards.
- Data logging cycle ; selectable, 1 sec. X 8 (days), 2 sec. x 16 (days), 5 sec. x 40 (days)

Sensor Self-diagnosis Function:

Calibration mode:

Calibration mode diagnose; Span/Zero compensation rate, cell response time, cell condition

Cell resistance test ; result from a cell resistance test without feeding calibration gas

- Measurement mode; auto cell resistance test, semi-auto cell resistance test,
- Cell resistance test setting; stabilization time (min. sec.) starting time (year/month/date/hour/minute) measurement interval (day/time) .

Display and setting content:

Measuring Related Items: Oxygen concentration (vol% O_2), moisture quantity (vol% H_2O), mixture ratio (kg/kg), relative humidity (%RH) and dew point (°C)

Display 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 (Ω), cell condition (in four grades), heater on-time rate (%), calibration record (twenty times), time (year/month/day, hour/minute)

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

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

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 lowalarm/ low-low alarm limit values (vol% H_2O), mixture ratio high alarm/high-high alarm limit value (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 alarm detection, alarm delay (seconds).

Contact Related Items: Selection of contact input 1 and 2, selection of contact output 1 to 3 (Fault, high-high alarm, high alarm, low alarm, low-low alarm, maintenance, calibrating, range switching, warming-up, calibration gas pressure decrease, temperature high alarm, temperature low alarm, pressure high alarm, pressure low alarm, test result from a cell resistance tester, alarm of a cell resistance tester, calibration coefficient alarm, cell e.m.f. stabilization time over, blowback, flameout gas detection

● Model and Codes

Model	Suffix code	Option code	Description
ZR802G	- - - - - - - - - - - -	- - - - - - - - - -	Zirconia Oxygen/Humidity Analyzer, Converter
Converter thread	-P -G -M -T	- -	G1/2 Pg 13.5 M20 x 1.5 mm 1/2 NPT
Display communication	-H -M -E	- -	HART HART+Modbus RS485 HART+Modbus Ethernet
—	-N	- - - - - - - - - -	Always -N
—	-N	- - - - - - - - - -	Always -N
Option		/SCT /H /CJ /AI /RC /BR	Stainless steel tag plate Hood, sun shield hood Cold junction temperature compensation (with Pt1000 resistance thermometer) (*1) Analog input with no power supply Rugged Coating (Epoxy + Urethane Coating) Wall mounting Bracket for ZR402G replacement

(*1) Connect the supplied Pt1000 resistance thermometer for cold junction temperature compensation to CJ terminal, when /CJ is specified.

<Items specified at order>

1. High temperature humidity analyzer
   When the use for high temperature humidity analyzer is not specified, the product is shipped as an Oxygen Analyzer.
2. TAGNO. (only if necessary)
   You can create TAGNO. (tag number) with alphanumeric characters described in the next table. 16 characters at maximum can be used.
   If you specify TAGNO., it is displayed on the instrument screen, and is printed on the stainless name plate/tag label affixed to the instrument.

Symbol	-	Hyphen	.	Period
		Space (*1)	_	Underscore
	=	Equal	+	Plus
	/	Slash	:	Colon
	(	Left parenthesis	)	Right parenthesis
	#	Hash	!	Exclamation mark
Number	0, 1, 2, 3, 4, 5, 6, 7, 8, 9			
Upper case alphabetics	A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z			
lower case alphabetics	a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z			

(*1) Spaces at the head and tail are removed. The string is left-squeezed.

3. Language
   English,Chinese, German, French, Portuguese, Japanese

● STANDARD ACCESSORIES

Item	Q'ty	Description
Fuse	1	Parts No. A1113EF
Mounting bracket (standard)	1	(Note 1)
Bolt for mounting bracket	4	M6x10 mm
Washer for mounting bracket	4	for M6
Bolt for pipe mounting	4	M6x70 mm
Screws for pipe mounting	2	M6x100 mm
Tag label (standard)	1	(Note 2)

(Note 1) When /BR or /RC is specified, the included mounting brackets are different from the standard accessories according to the specifications.

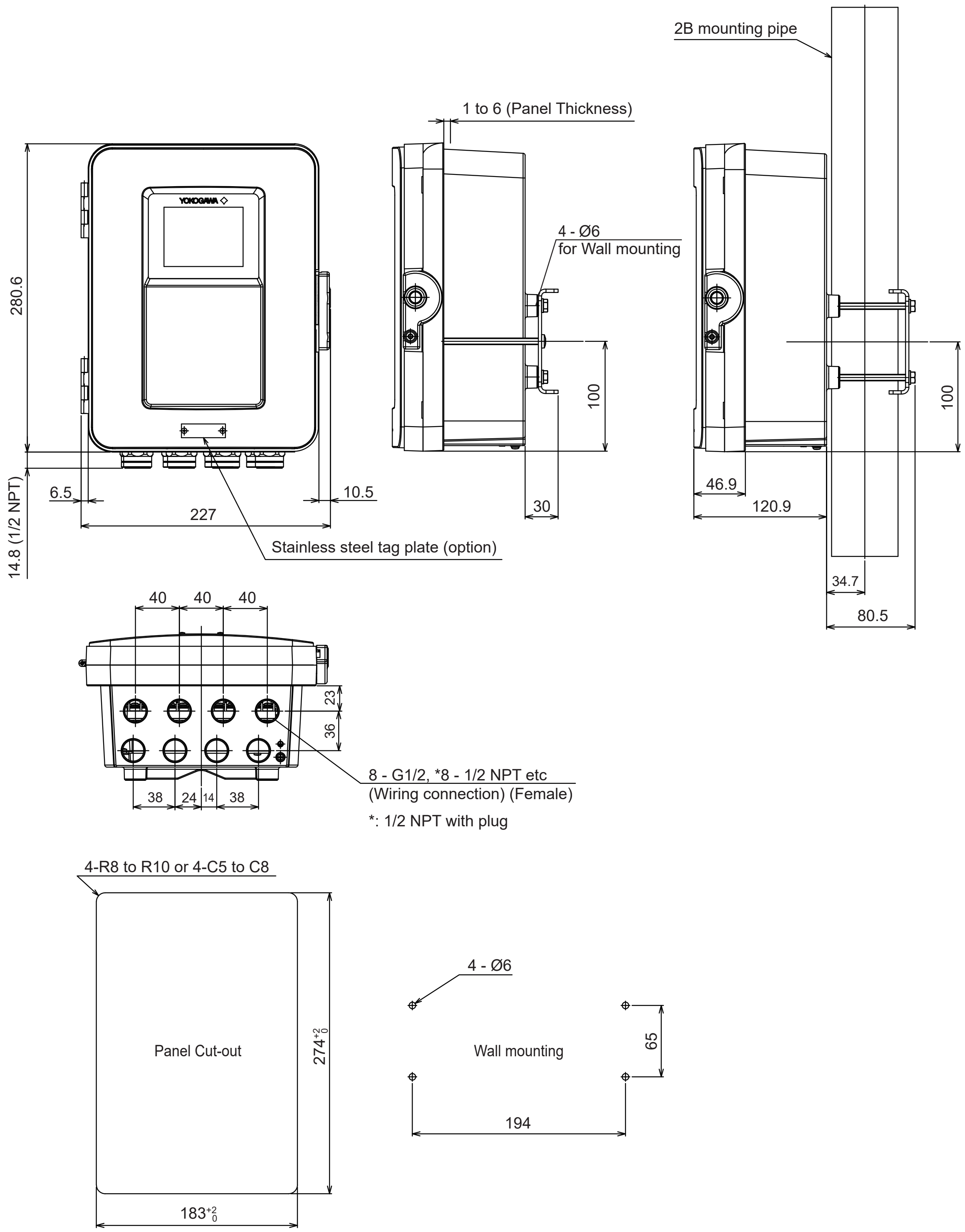
(Note 2) Tag label is included when suffix code except for /SCT is specified.
A blank label is included when no TAGNO. is specified.

● SD card (supplied by customer)

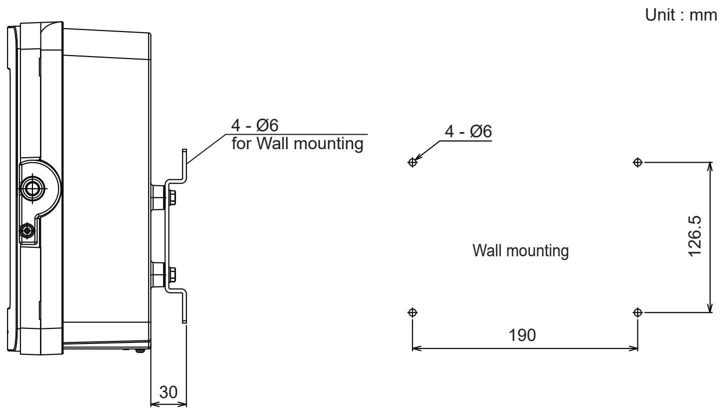
Item	Q'ty	Parts No.	Description
SD card	1	773001	1 GB Customer may provide. 128 MB or above SD or SDHC

● External Dimensions

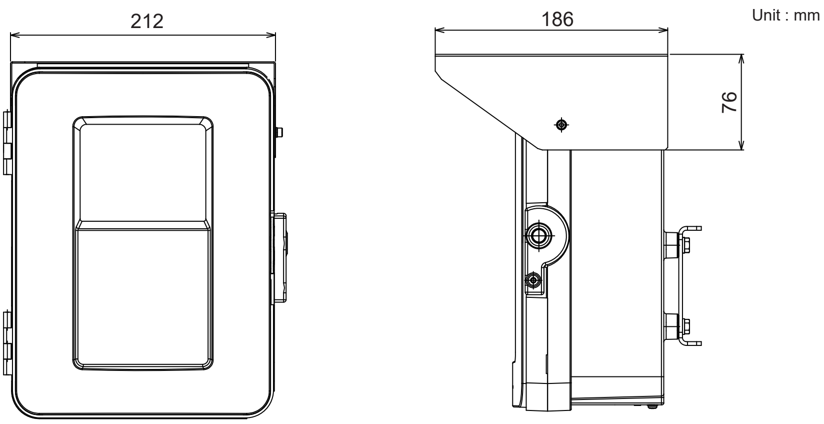
Unit: mm



● **With Replacement Bracket (option code /BR, ZR402G replacement Wall mounting Bracket)**



● **With sun shield hood (option code /H)**



2.5 ZA8F Flow Setting Unit and ZR40H Automatic Calibration Unit

2.5.1 ZA8F Flow Setting Unit

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

This unit consists of a flowmeter and flow control valves to control the flow rates of calibration gas and reference gas.

Standard Specifications

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

Tube Connections: Rc1/4 or 1/4FNPT

Reference Gas pressure: Clean air supply of sample gas pressure plus approx. 50 kPaG (or sample gas pressure plus approx. 150 kPa G when a check valve is used). Pressure at inlet of the Flow Setting Unit.(Maximum 300 kPaG)

Air Consumption: Approx. 1.5 l/min

Weight: Approx. 2.3 kg

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

NOTE

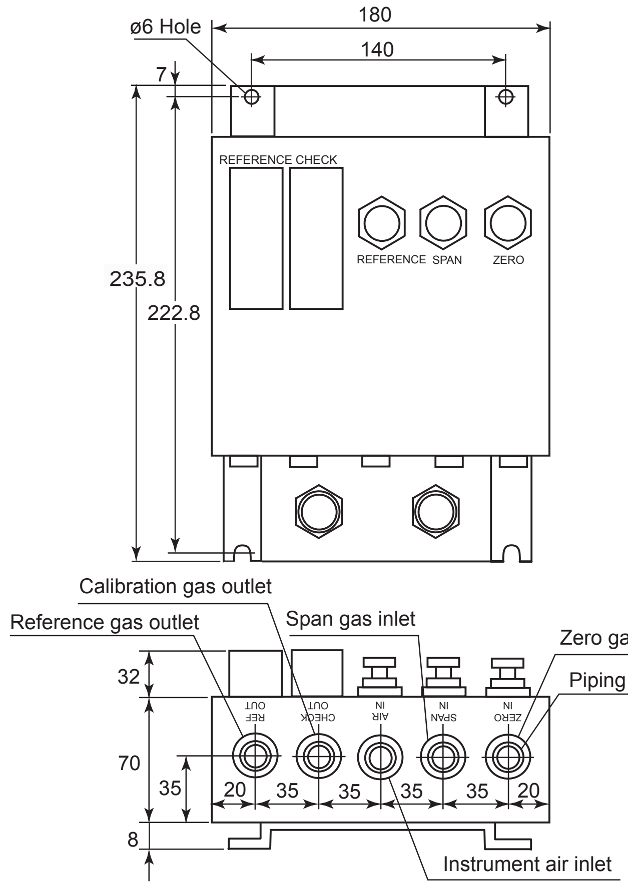
Use instrument air for span calibration gas, if no instrument air is available, contact YOKOGAWA.

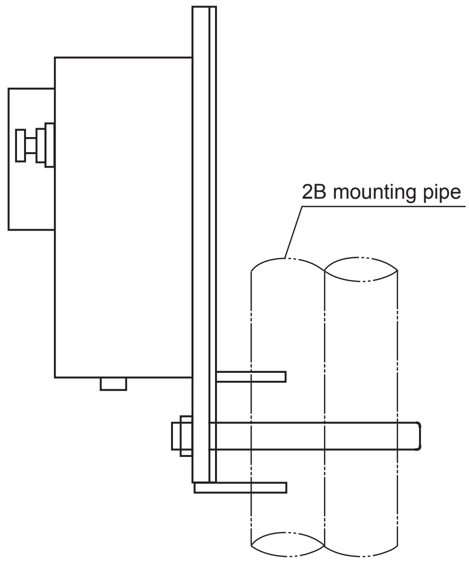
● Model and Codes

Model	Suffix code	Option code	Description
ZA8F	--------	---------	Flow setting unit
Joint	-J -A	--------- ---------	Rc 1/4 With 1/4 NPT adapter
Style code	*C	---------	Style C

● External Dimensions

Unit : mm

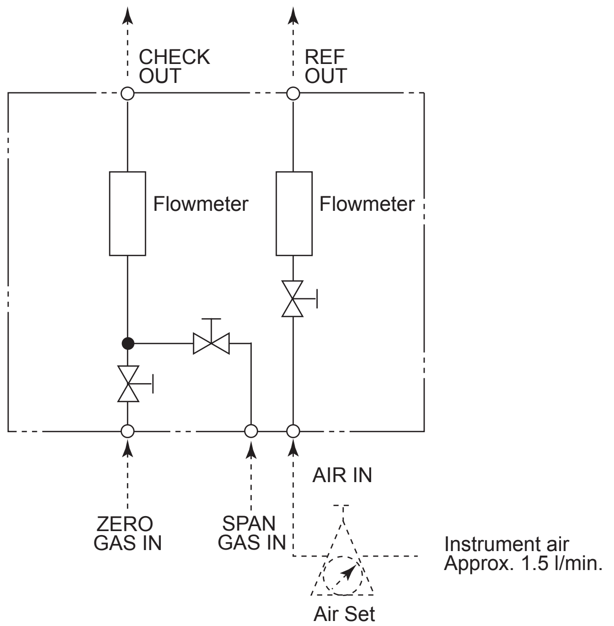




Model	Piping connection port A
ZA8F-J*C	5 - Rc1/4
ZA8F-A*C	5 - 1/4NPT

Weight : Approx. 2.3 kg

PIPNG INSIDE THE FLOW SETTING UNIT



Air pressure ;
without check valve ; sample gas pressure + approx.50 kPaG
with check valve ; sample gas pressure + approx.150 kPaG

F13-14E.ai

2.5.2 ZR40H 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). It can also be used for safety purge when unburned gas is detected.

● Specifications

Used when auto calibration is required for the separate type and instrument air is provided.
The solenoid valves are provided as standard.

Construction: Dust-proof and rainproof construction:
NEMA4X/IP67-only for case coating solenoid valve, not flowmeter (excluding flowmeter)

Mounting: 2-inch pipe or wall mounting, no vibration

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

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

Piping Connection: Refer to Model and Codes

Power Supply: 24 V DC (from ZR402G), Power consumption; Approx.1.3W

Reference Gas Pressure: Sample gas pressure plus approx. 150 kPa (690 kPa max.), (Pressure at inlet of the Automatic Calibration Unit)

Air Consumption: Approx. 1.5 l/min

Weight: Approx. 3.5 kg

Ambient Temperature: -20 to +5°C, no condensation or freezing

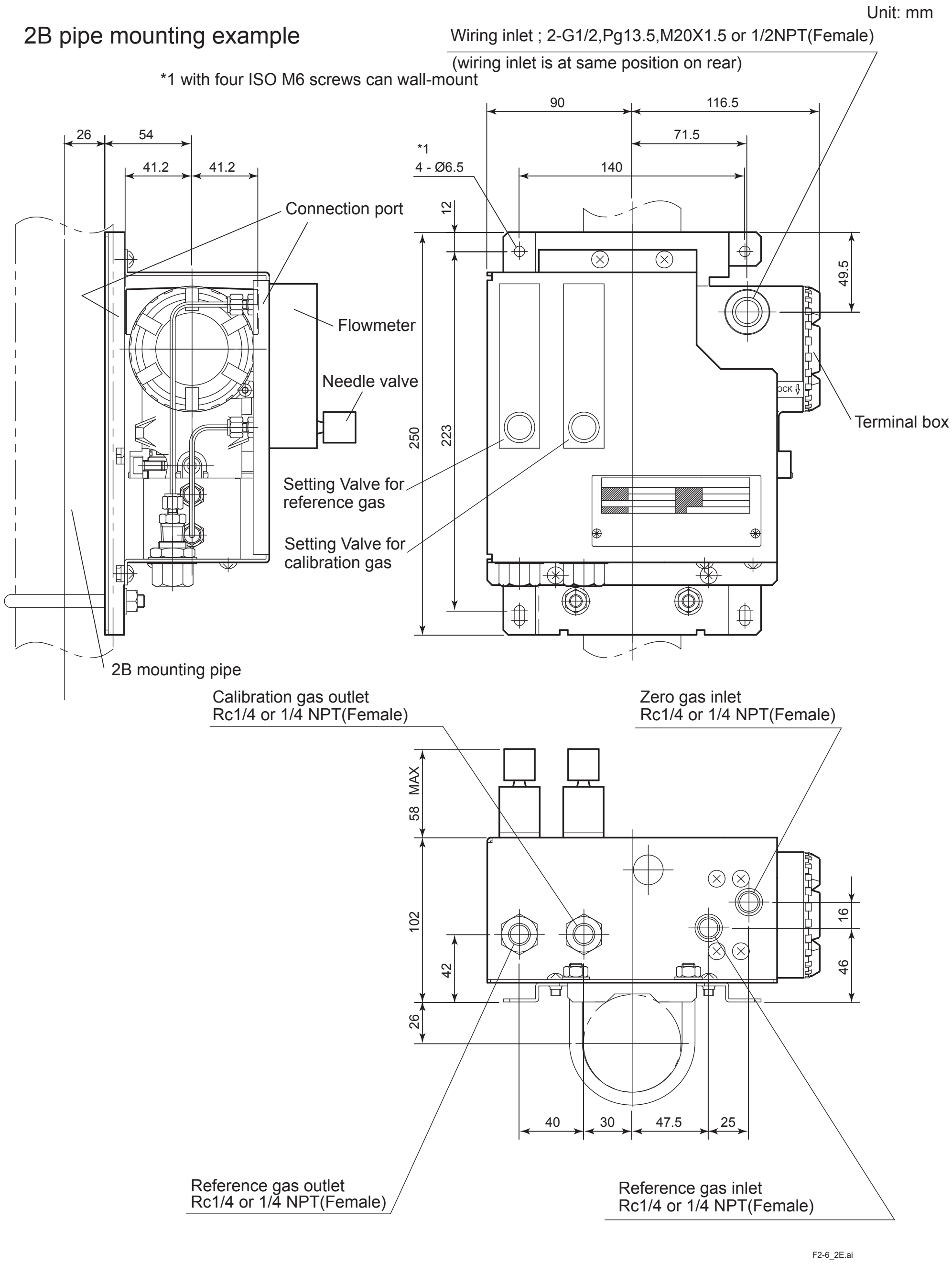
Ambient Humidity: 0 to 95%RH

Storage Temperature: -30 to 65°C

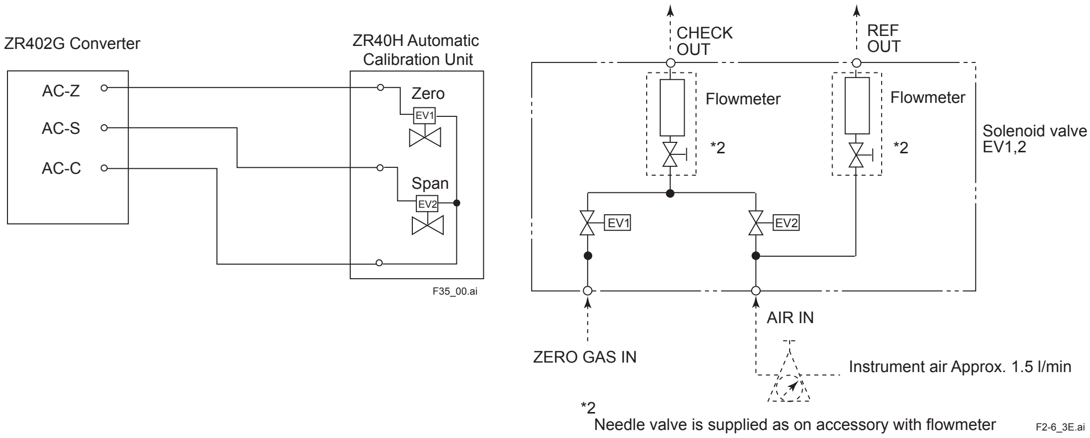
● Model and Codes

Model	Suffix code	Option code	Description
ZR40H	-------------	--------	Automatic calibration unit for ZR402G
Gas piping connection	-R -T	-------- --------	Rc 1/4 1/4 NPT
Wiring connection	-P -G -M -T	-------- -------- -------- --------	Pipe connection (G1/2) Pg 13.5 M20 x 1.5 mm 1/2 NPT
—	-A	--------	Always -A

External Dimensions



● Piping Diagram



2.6 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.

The ZO21S does not conform to CE marking.

● 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 provided): E7050BA

Capacity: 1 L

Filled pressure: Approx. 686 kPaG (at 35°C)

Composition: 0.95 to 1.0 vol%O_2 + N_2 balance

Power Supply: 100, 110, 115, 200, 220, 240 V AC ±10%, 50/60 Hz

Power Consumption: Max. 5 VA

Case material: SPCC (cold rolled steel sheet)

Paint Color: Mainframe; Munsell 2.0 GY3.1/0.5 equivalent
Cover; Munsell 2.8 GY6.4/0.9 equivalent

Piping: Ø6 x Ø4 mm flexible tube connection

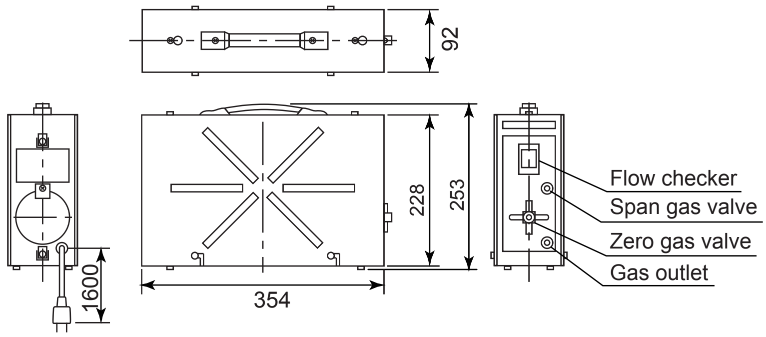
Weight: Approx. 3 kg

● Model and Codes

Model	Suffix code	Option code	Description
ZO21S	-----------	-------------	Standard gas unit
Power supply	-2 -3 -4 -5 -7 -8	------------- ------------- ------------- ------------- ------------- -------------	200 V AC 50/60 Hz 220 V AC 50/60 Hz 240 V AC 50/60 Hz 100 V AC 50/60 Hz 110 V AC 50/60 Hz 115 V AC 50/60 Hz
Panel	-J -E	------------- -------------	Japanese version English version
Style code	*A	-------------	Style A

● External Dimensions

Unit: mm



Zero gas cylinder (6 cylinder): E7050BA

F2-7E.ai

2.7 Other Equipments

2.7.1 Dust Filter for the Detector (K9471UA)

This filter is used to protect the detector sensor from a corrosive dust components or high velocity dust in recovery boilers and cement kilns.

Sample gas flow rate is needed to be 1 m/sec or more to replace gas inside zirconia detector.

● Standard specification

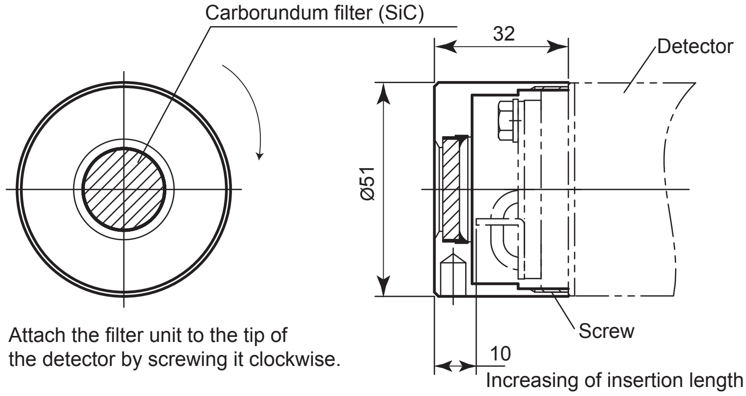
Applicable detector: Standard-type detector for general use (the sample gas flow should be approximately perpendicular to the probe.)

Mesh: 30 microns

Material: Carborundum (Filter), SUS316 (JIS)

Weight: Approx. 0.2 kg

Part No.	Description
K9471UA	Filter
K9471UX	Tool



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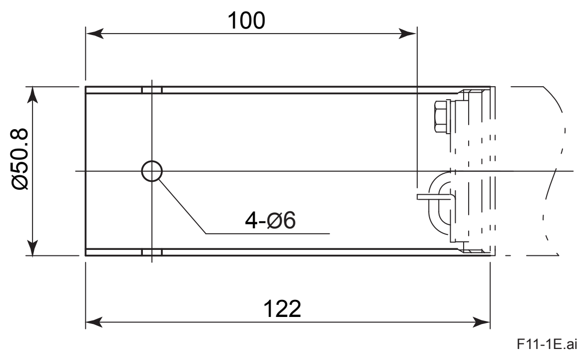
2.7.2 Dust Guard Protector (K9471UC)

Recommended to be used when sample gas is likely to flow directly into the cell due to its flow direction in the stack or the like, flammable dust may go into the cell, or water drops are likely to fall and remain in the cell during downtime or the like due to the installation position.

Material: SUS316

Weight: Approx. 0.3 kg



2.7.3 Ejector Assembly for High Temperature (E7046EC, E7046EN)

This ejector assembly is used where pressure of sample gas for high temperature detector is negative. This ejector assembly consists of an ejector, a pressure gauge assembly and a needle valve.

● Standard Specifications

Ejector

Ejector Inlet Air Pressure: 29 to 69 kPa G

Air Consumption: Approx. 30 to 40 l/min

Suction gas flow rate: 3 to 7 l/min

Connection: Rc1/4, SUS304 (JIS)

Tube Connection: Ø6 / Ø4 mm or 1/4 inch copper tube (stainless tube)

Pressure Gauge Assembly

Material in Contact with Gas: SUS316 (JIS)

Case Material: Aluminum alloy (Paint color; black)

Scale: 0 to 100 kPaG

Connection: R1/4 or 1/4NPT, SUS304 (JIS) (with Bushing G3/8 x R1/4 or 1/4NTP)

Needle Valve

Connection: Rc1/4 or 1/4FNPT

Material: SUS316 (JIS)

(Note) Pipe and connections are not provided.

Part No.	Description
E7046EC	Ejector; Ø6 / Ø4 TUBE joint, Pressure gauge; R1/4, Needle valve; Rc1/4: SUS304 (JIS)
E7046EN	Ejector; 1/4 TUBE joint, Pressure gauge; 1/4NPT(M), Needle valve; 1/4FNPT : SUS304 (JIS)

< Pressure setting for the ejector assembly for high temperature use >

Pressure supply for the ejector assembly should be set so that the suction flow of the sample gas becomes approximately 5 l/min.

To set this, proceed as follows:

(1) In Graph 4, draw a horizontal line from the 5 l/min point. on the vertical axis (Suction flow: Qg) toward the gas pressure line to be used, to find the point of intersection.
Draw a line vertically down from the point of intersection to the axis to find the drive pressure, P (at the ejector entrance).

(2) In Graph 1, determine Po (pressure setting) from L (the distance between the ejector and the pressure gauge).

(3) Open the needle valve to supply air for the ejector to the pressure gauge until it indicates the pressure setting, Po.

NOTE

Qg (the suction flow) may require change according to the conditions of use. Refer to Section "3.2.1 Usage of the High Temperature Probe Adapter (ZO21P-H)" and Section "4.1.4 Piping to the High Temperature Probe Adapter" for details.

Graph explanation

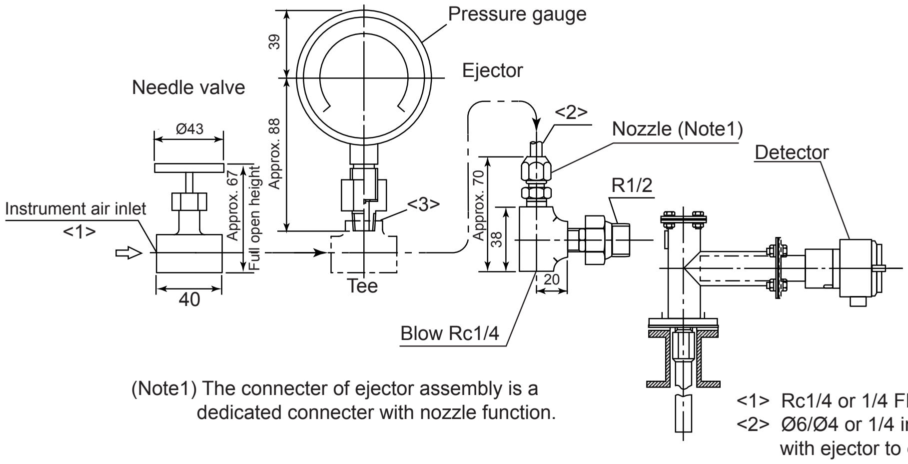
(1) Graph 1 is to compensate for pressure loss in piping between the ejector and the pressure gauge, and find Po (pressure setting).

(2) Graph 2 shows correlation between P (drive pressure) and Qa (air consumption).

(3) Graph 3 shows correlation between P (drive pressure) and Pg (suction pressure; when the sample gas inlet of the ejector is closed).

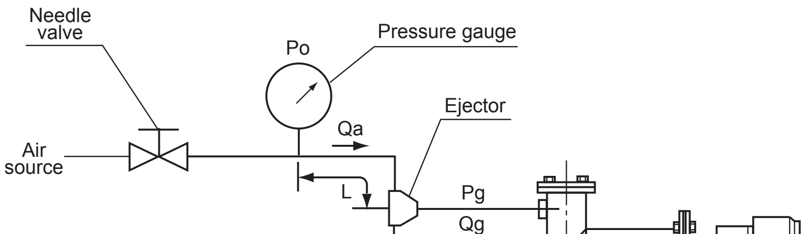
(4) Graph 4 shows correlation between P (drive pressure) and Qg (suction flow) for each gas pressure.

Pressure gauge assembly

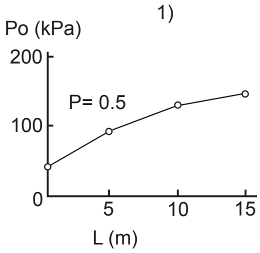


(Note1) The connecter of ejector assembly is a dedicated connecter with nozzle function.

<1> Rc1/4 or 1/4 FNPT
<2> Ø6/Ø4 or 1/4 inch copper tube (stainless) with ejector to connect
<3> R1/4 or 1/4 NPT

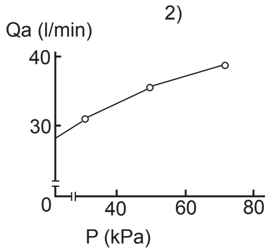


1)



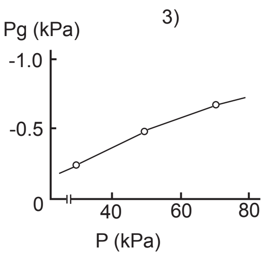
Pressure setting characteristics

2)



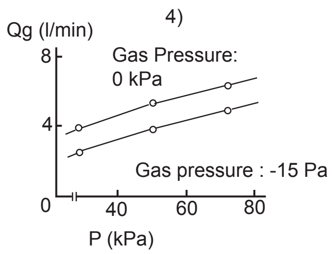
Air consumption characteristics

3)



Suction pressure characteristics

4)



Suction flow characteristics

Po	(kPa)	: Pressure setting
P	(kPa)	: Drive pressure (at the ejector entrance)
Pg	(kPa)	: Suction pressure
Qa	(l/min)	: Air consumption
Qg	(l/min)	: Suction flow
L	(m)	: Distance between the ejector and the pressure gauge

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2.7.4 Stop Valve (L9852CB, G7016XH)

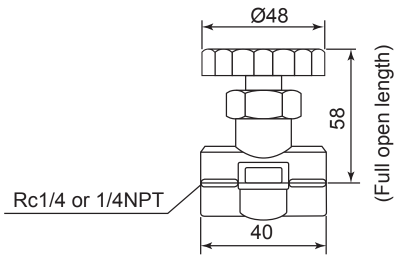
This valve mounted on the calibration gas line in the system to allow for manual calibration. This is applies to the system configuration shown for system 1 in section 1.

Standard Specifications

Connection: Rc 1/4 or 1/4 NPT(F)
Material: SUS 316 (JIS)
Weight: Approx. 150 g

Part No.	Description
L9852CB	Joint: Rc 1/4, Material: SUS316 (JIS)
G7016XH	Joint: 1/4 NPT, Material: SUS316 (JIS)

Unit: mm



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2.7.5 Check Valve (K9292DN, 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 2 and 3) system configuration .

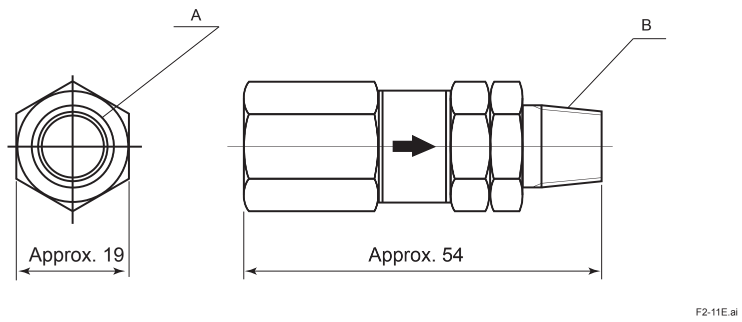
This valve prevents the sample gas from entering the calibration gas line. Although it functions as a stop valve, operation is easier than a stop valve as it does not require opening/closing at each calibration.

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

● Standard Specifications

Connection: Rc1/4 or 1/4NPT(F)
Material: SUS304 (JIS)
Pressure: 70 kPa G or more and 350 kPa G or less
Weight: Approx. 90 g

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



2.7.6 Air Set

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

● Standard Specifications

G7003XF, K9473XK

Primary Pressure: Max. 1 MPa G
Secondary Pressure: 0.02 to 0.2 MPa G
Connection: Rc1/4 or 1/4NPT(F) with joint adapter
Weight: Approx.1 kg

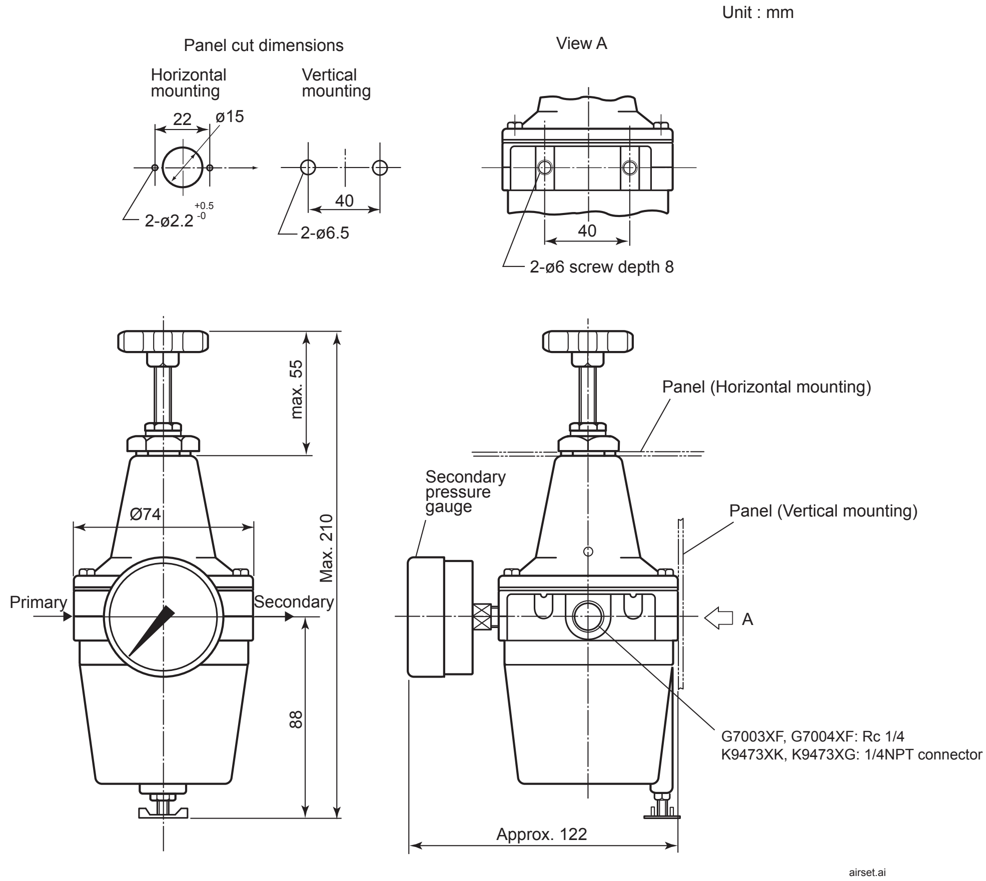
Part No.	Description
G7003XF	Joint: Rc 1/4, Material: Zinc alloy
K9473XK	Joint: 1/4 NPT(F) with adapter, Material: Zinc alloy, Adapter: SUS 316

G7004XF, K9473XG

Primary Pressure: Max. 1 MPa G
Secondary Pressure: 0.02 to 0.5 MPa G
Connection: Rc1/4 or 1/4NPT(F) with joint adapter
Weight: Approx. 1 kg

Part No.	Description
G7004XF	Joint: Rc 1/4, Material: Zinc alloy
K9473XG	Joint: 1/4 NPT(F) with adapter, Material: Zinc alloy, Adapter: SUS 316

● External Dimensions



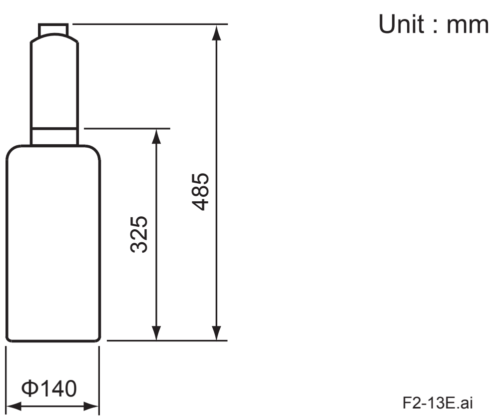
2.7.7 Zero Gas Cylinder (G7001ZC)

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
Weight:	Approx. 6 kg

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

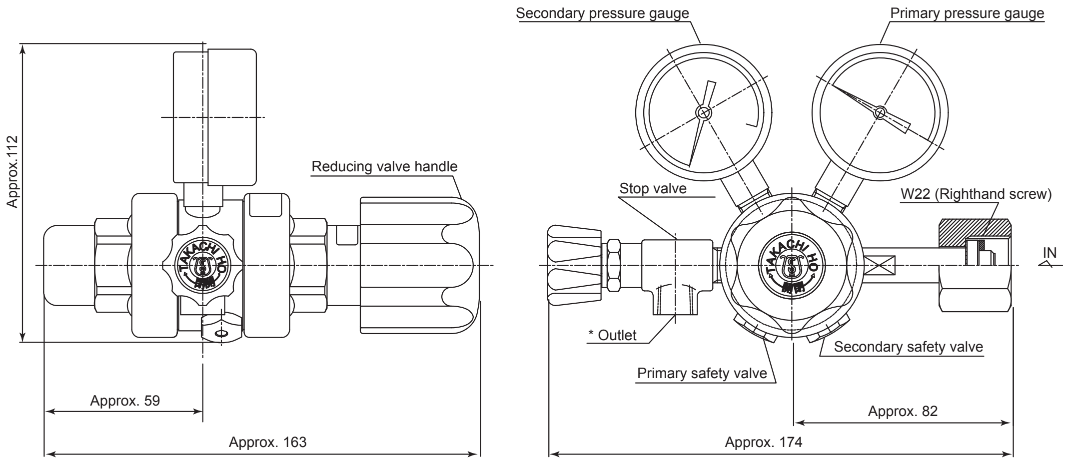


2.7.8 Cylinder Pressure Reducing Valve (G7013XF, G7014XF)

This pressure reducing 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 1/4NPT(F)
Material:	Brass body



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

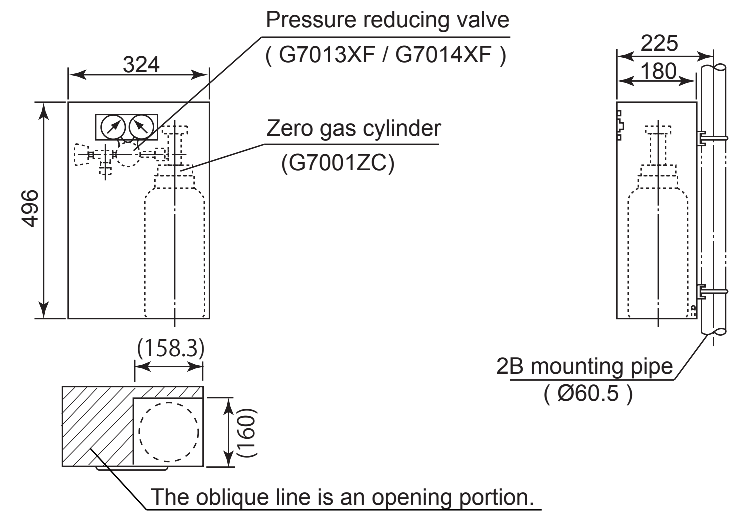
2.7.9 Case Assembly for Calibration Gas Cylinder (E7044KF)

This case assembly is used to store the zero gas cylinders.

● Standard Specifications

Installation:	2B pipe mounting
Material:	SPCC (Cold rolled steel sheet)
Case Paint:	Baked epoxy resin, Jade green (Munsell 7.5 BG 4/1.5)
Weight:	Approx. 10 kg with gas cylinder

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



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

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2.7.10 ZR22A Heater Assembly

● Model and Codes

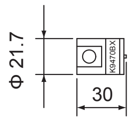
Style: S2

Model	Suffix code	Option code	Description
ZR22A	---------	-----------	Heater Assembly for ZR22G
Length (*1)	-015 -040 -070 -100 -150 -200 -250 -300	----------- ----------- ----------- ----------- ----------- ----------- ----------- -----------	0.15 m 0.4 m 0.7 m 1 m 1.5 m 2 m 2.5 m 3 m
Jig for change	-A -N	----------- -----------	with Jig (*2) None
Reference gas (*3)	-A -B -C	----------- ----------- -----------	Natural convention, External connection (Instrument air) Pressure compensated (for ZR22G S2) Pressure compensated (for ZR22G S1)

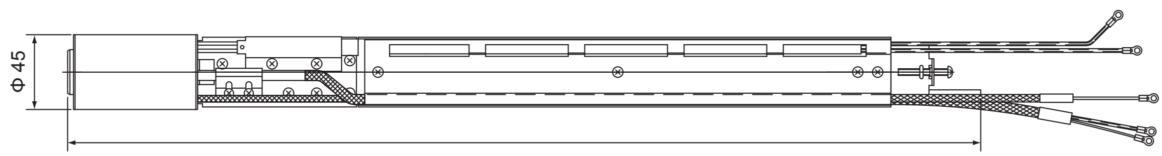
*1 Suffix code of length should be selected as same as ZR22G installed.
*2 Jig part no. is K9470BX to order as a parts after purchase.
*3 Select appropriately among “-A”, “-B”, “-C” according to the reference gas supply method and style.
(Note) The heater is made of ceramic, do not drop or subject it to pressure stress.

● External Dimensions

Jig for change
(K9470BX)



Unit : mm



Model & Codes	L	Weight (kg)
ZR22A-015	302	Approx. 0.5
ZR22A-040	552	Approx. 0.8
ZR22A-070	852	Approx. 1.2
ZR22A-100	1152	Approx. 1.6
ZR22A-150	1652	Approx. 2.2
ZR22A-200	2152	Approx. 2.8
ZR22A-250	2652	Approx. 3.4
ZR22A-300	3152	Approx. 4.0

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3. Installation

This chapter describes installation of the following equipment:

3.1 Installation of General-purpose Detector

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

(1) Easy and safe access to the detector for checking and maintenance work.

(2) An ambient temperature of not more than 150°C, and the terminal box should not be affected by radiant heat.

(3) A clean environment without any corrosive gases.

NOTE

A natural convection type detector (model ZR22G-□-□-□-C), which uses ambient air as reference gas, requires that the ambient oxygen concentration be constant.

(4) No vibration.

(5) The sample gas satisfies the specifications described in Chapter “2. Specifications”.

(6) No sample gas pressure fluctuations.

3.1.1 Probe Insertion Hole

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

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

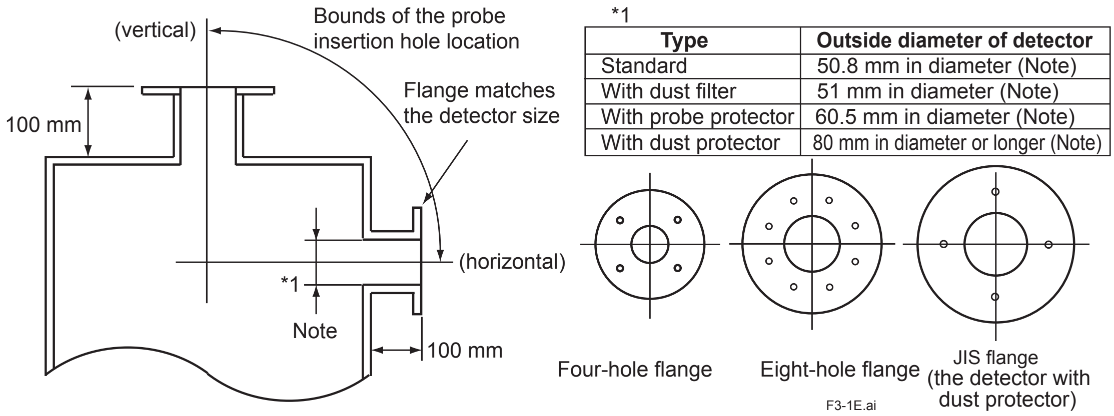
CAUTION

- 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 Illustrates an example of the probe insertion hole.” 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 gas outlet on the detector flange. If the flange gasket blocks the outlet, the detector cannot conduct pressure compensation. Where necessary, make a notch in the flange gasket. Confirm the external dimensions of the detector in Section 2.2 before installation.
- The sensor (zirconia cell) at the tip of the detector 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 mount the probe with the tip higher than the probe base.

(2) If the probe length is 2.5 meters or more, the detector should be mounted vertically (no more than a 5° tilt).

(3) The detector probe should be mounted at right angles to the sample gas flow or the probe tip should point downstream.



Type	Outside diameter of detector
Standard	50.8 mm in diameter (Note)
With dust filter	51 mm in diameter (Note)
With probe protector	60.5 mm in diameter (Note)
With dust protector	80 mm in diameter or longer (Note)

(Note) When using the detector with pressure compensation, ensure that the flange gasket does not block the reference gas 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 Section 2.2 before installation.
When using the detector with ZH21B dust protector the diameter of the hole should be 80mm or larger.

Figure 3.1 Illustrates an example of the probe insertion hole.

3.1.2 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.
- 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 sample 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 bolts) at the tip of the detector are not loose. If a dust filter (see Section “2.7.1 Dust Filter for the Detector (K9471UA)”) is used, make sure it is properly attached to the detector.
Refer to Section “3.1.3 Installation of the Dust Filter (K9471UA), Dust Guard Protector (K9471UC), Probe Protector ZO21R” for installation of the dust filter.

(2) Where the detector is mounted horizontally, the calibration gas inlet and the reference gas inlet should face downward.

3.1.3 Installation of the Dust Filter (K9471UA), Dust Guard Protector (K9471UC), Probe Protector ZO21R

CAUTION

- The dust filter is used to protect the Zirconia sensor from corrosive dust or a high concentration of dust such as in utility boilers and cement kilns. If a filter is used in combustion systems other than these, it may have adverse effects such as response delay. These combustion conditions should be examined carefully before using a filter.
- The dust filter requires gas flow of 1 m/sec or faster at the front surface of the filter.

When you specify option code /F1, the detector is shipped with the dust filter mounted.
Follow this procedure replace the filter on the detector . It is recommended that you read Chapter "11. Inspection and Maintenance" prior to filter mounting, for it is necessary to be familiar with the detector's construction, especially the sensor assembly.

(1) Mount the dust filter assembly by putting it on the end of the detector and screw the assembly clockwise. Put a hook pin wrench (K9471UX), Ø52 to Ø55 in diameter, into the hole on the assembly to fasten or remove it.
Apply a heat-resistant coating (see Note 1) to the threads on the detector.
When remounting filter assembly after having once removed it from the detector, reapply the heat-resistant coating.

Note 1: As the detector is heated to 700°C, it is recommended to use heat-resistant coating on the threads to prevent seizing up. Name of the heat-resistant coating material: NEVER SEEZ Nickel Special".

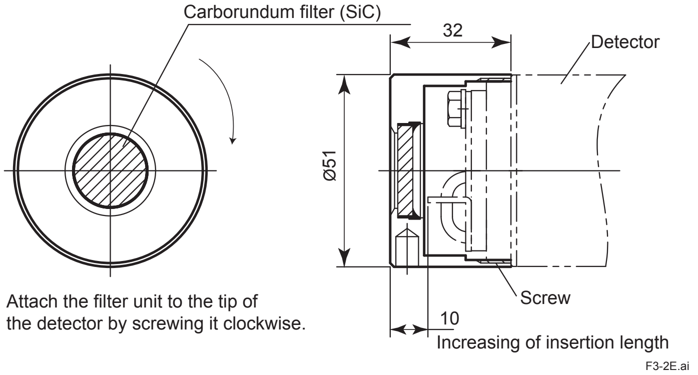


Figure 3.2 Installation of the dust filter

< Procedures for installing the dust guard protector (K9471UC)>

The ZR22G detector is shipped with the dust guard protector when the option code / F2 is specified in case of ordering the detector. The protector should be used when preventing dusts and water drops from lowering the detector performance is desired.
Screw the protector on the top of the detector so as to cover the top. When attaching or detaching the protector, perform by hooking holes of its side with a hook pin wrench for Ø52 to Ø55 hole (Pin diameter 4.5 mm: P/N K9741UX or the like) or by pass a screwdriver through the holes.
When re-attaching the protector after detaching it, apply the "NEVER SEEZ Nickel Special" to it.

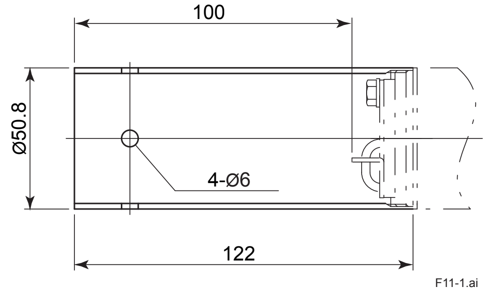


Figure 3.3

<Detector with a probe protector (Model ZO21R-L-☐☐☐-☐ *B for enhance forth>

The detector is used with a probe protector to support the probe (ZR22G) when the probe length is 2.5 m or more and it is mounted horizontally.

(1) Put a gasket (provided by the user) between the flanges, and mount the probe protector in the probe insertion hole.

(2) Make sure that the sensor assembly mounting screws (four bolts) at the tip of the detector are not loose.

(3) Mount the detector so that the reference gas and calibration gas inlet faces downward.

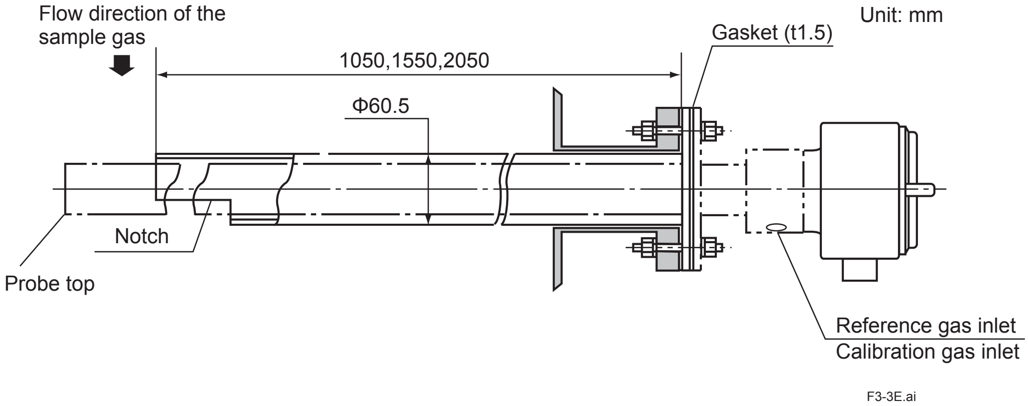


Figure 3.4 Probe protector (supporting the mounting strength)

<Detector with a probe protector (Model ZO21R-L-☐☐☐-☐ *B for dust wear protect>

The detector is used with a probe protector to prevent the sensor from being worn by dust particles when there is a high concentration of dust and gas flow exceeds 10 m/sec (pulverized coal boiler or fluidized-bed furnace).

(1) Put a gasket (provided by the user) between the flanges, and mount the probe protector in the probe insertion hole. The probe protector should be installed so that the notch is downstream of the sample gas flow.

(2) Make sure that the sensor assembly mounting screws (four bolts) at the probe tip are not loose.

(3) Where the detector is mounted horizontally, the reference gas and calibration gas inlet should face downward.

CAUTION

When the probe protector is used in the ZR22G with pressure compensation (-P), instrument air leaking from the probe protector may affect the measured value.

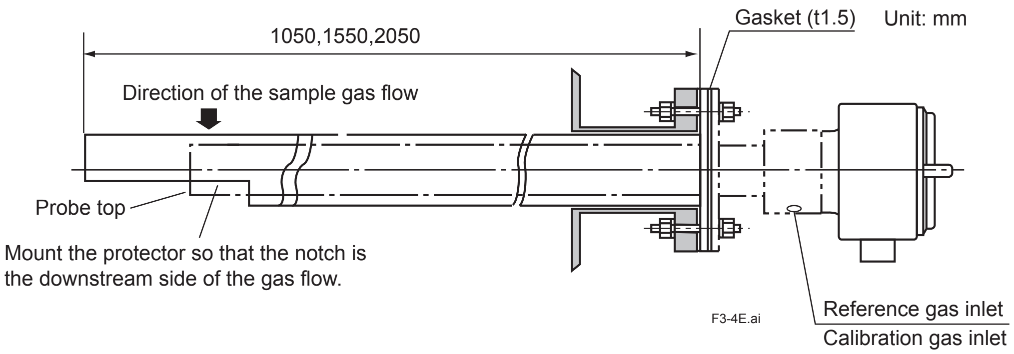


Figure 3.5 Mounting of detector with a probe protector

3.1.4 Installation of ZH21B Dust Protector

(1) Put the gasket that is provided by the user 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.

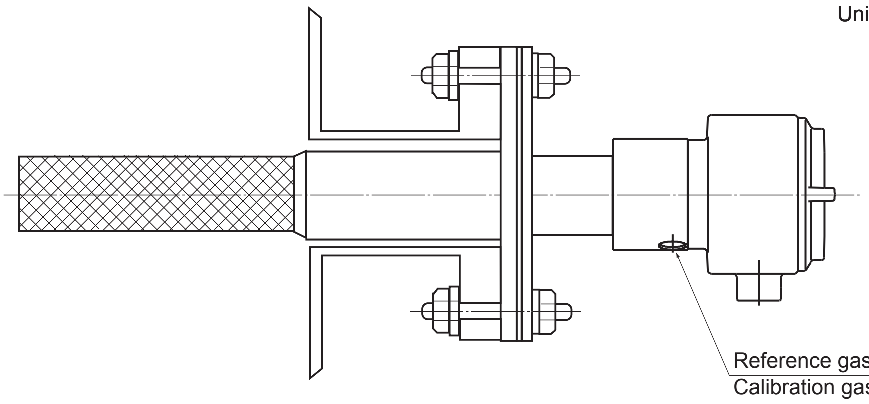


Figure 3.6 **Installation of the dust filter**

3.2 Installation of High Temperature Detector (ZR22G-015)

This detector is used with the High Temperature Probe Adapter (Model ZO21P-H) when the temperature of sample gas exceeds 700°C, or when it is required due to maintenance spaces.

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

(1) Easy and safe access to the detector for checking and maintenance work.

(2) Ambient temperature of not more than 150°C and the terminal box should not be exposed to radiant heat.

(3) A clean environment without any corrosive gases.

(4) No vibration.

(5) The sample gas should satisfy the specifications described in Chapter 2.

3.2.1 Usage of the High Temperature Probe Adapter (ZO21P-H)

During analysis, the surface temperature of the probe adapter should be within the range from more than the dew point of the sample gas and 300°C or less to prevent ejector clogging, gasket deterioration or bolt scoring.

Where the dew point of the sample gas is not known, keep within the range of more than 200°C to less than 300°C.

The temperature shall be measured at the probe in the probe adapter and the surface of the blind flange at the opposite side.

When the surface temperature is not within the above range, the following measures can be taken to change the temperature.

<When the surface temperature exceeds 300°C>

(1) When the furnace pressure is negative, lower the pressure setting to reduce induction flow of the sample gas.
Refer to Section “2.7.3 Ejector Assembly for High Temperature (E7046EC, E7046EN)”, Ejector Assembly for High Temperature, for the setting of induction flow. When you reduce induction flow, ensure that the ejector inducts air when the furnace pressure fluctuates.

(2) When the furnace pressure is positive, close the needle valve for the sample gas outlet to reduce the exhaust gas flow. Refer to Section “4.1.4 Piping to the High Temperature Probe Adapter”, Piping to the High Temperature Probe Adapter.

(3) When the probe adapter is surrounded by a heat insulator, remove the heat insulator. Ensure that the temperature of the probe adapter does not fall below the dew point of the gas in winter.

(4) To prevent temperature rises due to radiant heat, insert heat insulator between the wall of the furnace and the probe adapter.

(5) To prevent temperature rises from thermal conduction, place the mounting flange as far from the wall of the furnace as possible.

<When the surface temperature is less than 200°C or below the dew point of the sample gas>

(1) When the furnace pressure is negative, raise the pressure setting to increase induction flow of the sample gas.
Refer to Section “2.7.3 Ejector Assembly for High Temperature (E7046EC, E7046EN)”, Ejector Assembly for High Temperature, for the setting of induction flow.
If there is much dust in the gas, the ejector may become clogged as induction flow increases.

(2) When the furnace pressure is positive, open the needle valve of the sample gas outlet to increase the gas flow.
Refer to Section “4.1.4 Piping to the High Temperature Probe Adapter”, Piping to the High Temperature Probe Adapter.

(3) Warm the probe adapter. Refer to Section “4.1.4 Piping to the High Temperature Probe Adapter”, Piping to the High Temperature Probe Adapter.

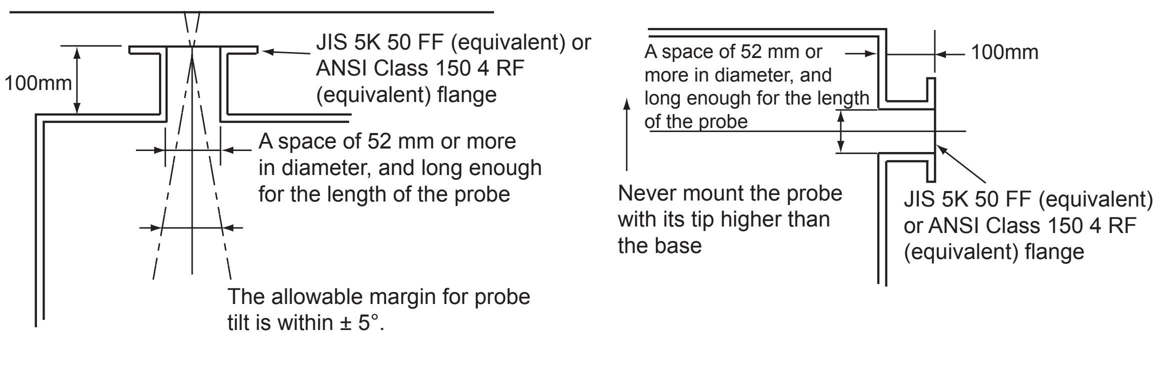
(4) When the surface temperature is still less than 200°C or below the dew point of the sample gas, even if the above measures have been taken, warm the probe adapter using a heat source such as steam.

3.2.2 Probe Insertion Hole

A high temperature detector consists of a ZR22G-015 Detector and ZO21P High Temperature Probe Adapter. When forming the probe insertion hole, the following should be taken into consideration:

(1) If the probe is made of silicon carbide (SiC), the probe hole should be formed so that the probe is mounted vertically (within ± 5° tilt).

(2) In the case where the probe is made of stainless steel and the probe adapter (ZO21P-H-B) is to be mounted horizontally, the probe hole should be formed so that the probe tip is not higher than the probe base.
Figure 3.7 illustrates examples of the probe insertion hole.



An SiC probe shall be mounted vertically.

Horizontal mounting is used with a SUS probe.

F3-5E.ai

Figure 3.7 Examples of the probe insertion hole

3.2.3 Mounting of the High Temperature Detector

CAUTION

- Ceramic (zirconia) is used in the sensor (cell) portion on the detector probe tip. Care should be taken not to drop the detector during installation.
- The same applies to a probe made of silicon carbide (SiC).
- A gasket should be used on the flange surface to prevent gas leakage. The gasket material should be selected depending on the characteristics of the sample gas. It should be heatproof and corrosion-proof. The parts, which should be supplied by the user, are listed in Table 3.1.

Table 3.1 Accessories for mounting high temperature probe adapter

Mounting flange specification	Parts name	Q'ty	Note
JIS 5K 50 FF (equivalent)	Gasket	1	Heatproof and corrosion-proof
	Bolt (M12 by 50)	4	
	Nut (M12)	4	
	Washer (for M12)	8	
ANSI Class 150 4RF (equivalent)	Gasket	1	Heatproof and corrosion-proof
	Bolt (M16 by 60)	8	
	Nut (M16)	8	
	Washer (for M16)	16	

A high temperature detector should be mounted as follows:

(1) It is recommended to mount the detector vertically. When it is impossible due to the physical arrangements and the detector is mounted horizontally, ensure that the probe tip be placed no higher than the probe base.

(2) When mounting a high temperature probe adapter, be sure to insert a gasket between the flanges to prevent gas leakage. When the furnace pressure is negative, ensure that there is no leakage of air into the detector.

(3) When mounting the detector in a position other than vertical, the cable inlet should face downward.

(4) When installing the detector in a low-temperature location such as in the open air, cover the probe adapter including the ejector with a heat insulator (e.g. ceramic wool) to keep it warm and to prevent condensation of drain on the ejector.

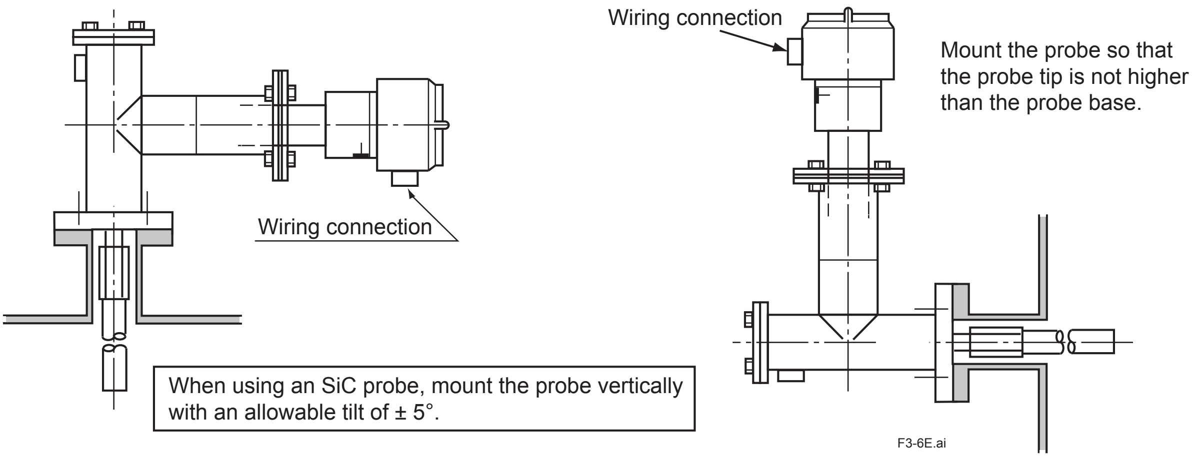


Figure 3.8 Mounting of the High Temperature Detector

3.3 Installation of the ZR802G Converter

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

(1) Readability of the indicated values of oxygen concentration or messages on the converter display. Easy and safe access to the converter for operating keys on the panel.

(2) Easy and safe access to the converter for checking and maintenance work.

(3) An ambient temperature of not more than 55°C and little change in temperature (recommended within 15°C in a day).

(4) The normal ambient humidity (recommended between 40 to 75%RH) and without any corrosive gases.

(5) No vibration.

(6) Near to the detector.

(7) Not in direct rays of the sun. If the sun shines on the converter, prepare the hood (/H) or other appropriate sunshade.

■ Mounting of the Converter

The converter can be mounted on a pipe (nominal JIS 50A: O.D. 60.5 mm), a wall or a panel. The converter can be mounted at an angle to the vertical, however, it is recommended to mount it on a vertical plane.

Mount the converter as follows.

<**Pipe Mounting**>

(1) Prepare a vertical pipe of sufficient strength (nominal JIS 50A: O.D. 60.5 mm) for mounting the converter. (Converter weighs approximately 6 kg.)

(2) Mount the converter on the pipe. Fix it firmly on the pipe in the procedure described in Figure3.9.

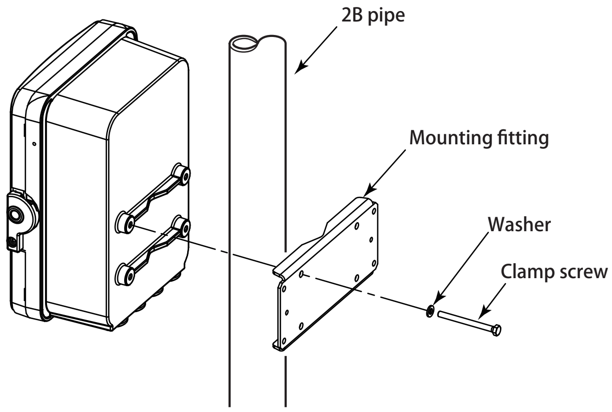
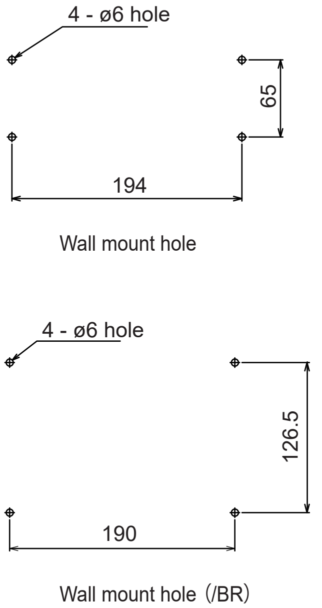


Figure 3.9 Pipe Mounting

<Wall Mounting>

(1) Drill mounting holes through the wall as shown in Figure 3.10.



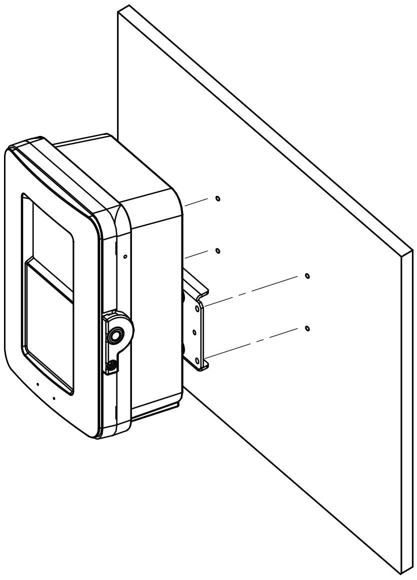
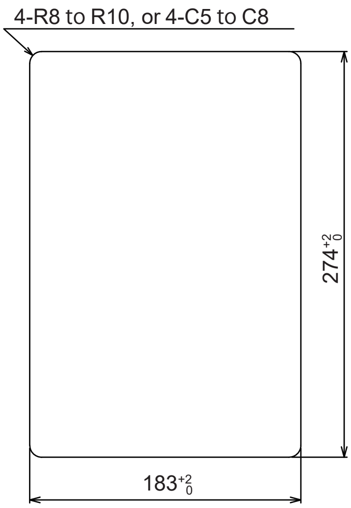


Figure 3.10 Mounting holes **Figure 3.11 Wall Mounting**

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

<Panel Mounting>

(1) Cut out the panel according to Figure 3.12.



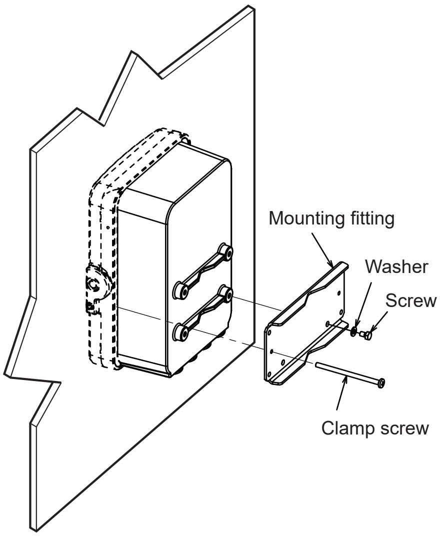


Figure 3.12 Panel cutout sizes **Figure 3.13 Panel mounting**

(2) Remove the fitting from the converter by loosening the four screws.

(3) Insert the converter case into the cutout hole of the panel.

(4) Attach the mounting fitting which is once removed in step (2) again to the converter.

(5) Firmly fix the converter to the panel. Fully tighten the two clamp screws to hold the panel with the fitting.

3.4 Installation of ZA8F Flow Setting Unit

The following should be taken into consideration:

(1) Easy access to the unit for checking and maintenance work.

(2) Near to the detector or the converter

(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.

■ Mounting of ZA8F Flow Setting Unit

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

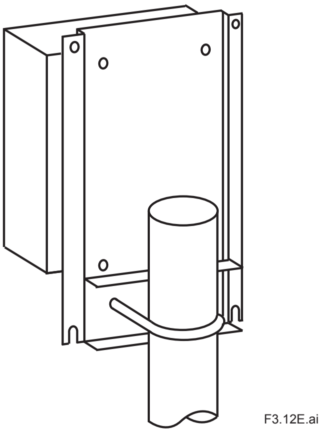


Figure 3.14 Pipe Mounting

<Wall Mounting>

(1) Make a hole in the wall as illustrated in Figure 3.15.

(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.

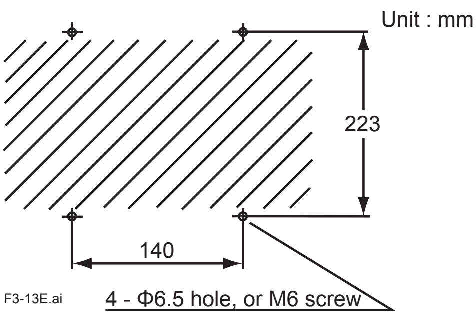


Figure 3.15 Mounting holes

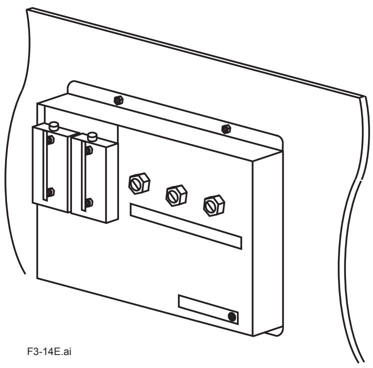


Figure 3.16 Wall mounting

3.5 Installation of ZR40H Automatic Calibration Unit

The following should be taken into consideration:

(1) Easy access to the unit for checking and maintenance work.

(2) Near to the detector or 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.

■ Mounting of ZR40H Automatic Calibration Unit

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

<Pipe Mounting>

(1) Prepare a vertical pipe of sufficient strength (nominal JIS 50A: O.D. 60.5 mm) for mounting of automatic calibration unit. (The unit weights approximately 3.5 kg.)

(2) Mount the automatic calibration unit on the pipe by tightening the nuts with the U-bolt so that the metal fitting is firmly attached to the pipe.

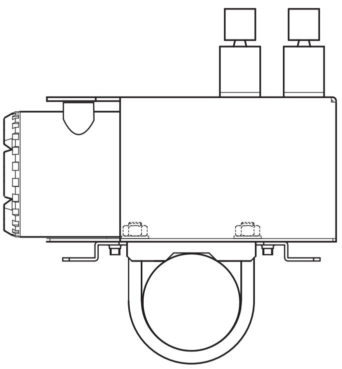


Figure 3.17 Pipe Mounting

<Wall Mounting>

(1) Make a hole in the wall as illustrated in Figure 3.18.

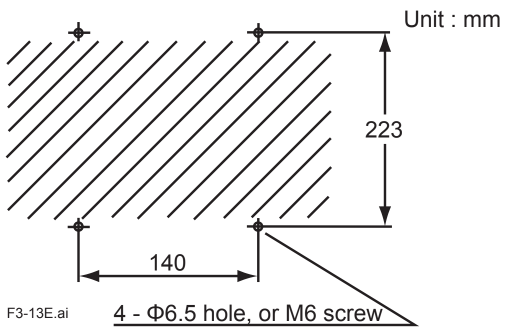


Figure 3.18 Mounting holes

(2) Mount the automatic calibration unit. Remove the U-bolt from the automatic calibration unit and attach the unit on the wall with four screws. When setting it with M5 bolts, use washers.

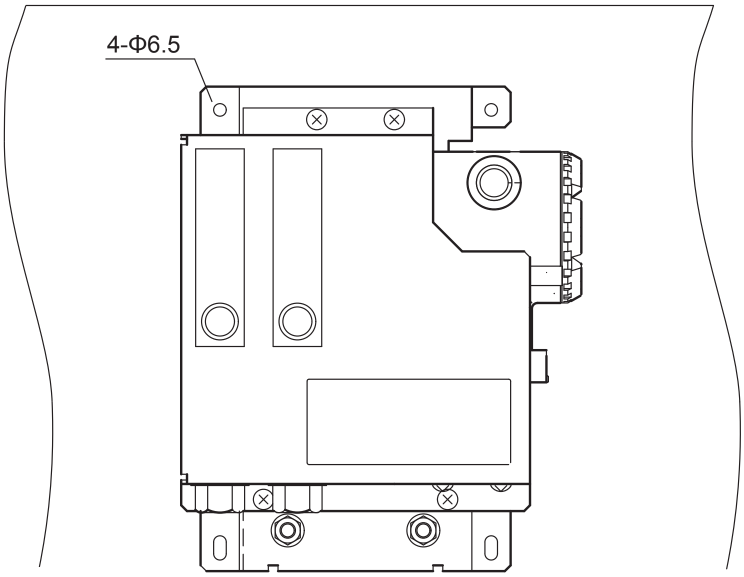


Figure 3.19 Wall Mounting

3.6 Installation of the Case Assembly (E7044KF)

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

The following should be taken into consideration:

(1) Easy access for cylinder replacement

(2) Easy access for checking

(3) Near to the detector or converter as well as the flow setting unit.

(4) The temperature of the case should not exceed 40°C due to rays of the sun or radiated heat.

(5) No vibration

■ Mounting

Mount case assembly 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 case assembly. (The sum of the case assembly and the calibration gas cylinder weighs approximately 4.2 kg.)

(2) Mount the case assembly on the pipe by tightening the nuts with the U-bolt so that the metal fitting is firmly attached to the pipe.

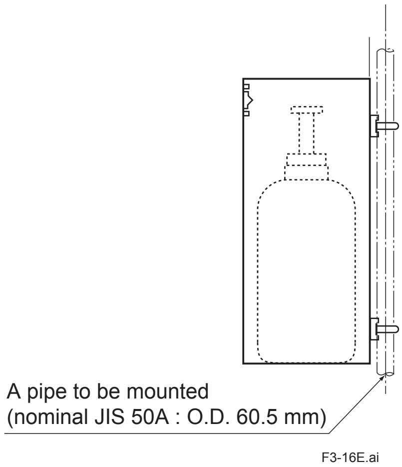


Figure 3.20 Pipe Mounting

3.7 Insulation Resistance Test

Even if the testing voltage is not so great that 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 confirm that insulation resistance is 20 MΩ or more.

Remove wiring from the converter and the detector.

(1) Connect a Insulation Resistance meter (Power Supply OFF) between the crossover wiring and the grounding terminal. For polarity, set the crossover wiring to (+) and the ground terminal to (-).

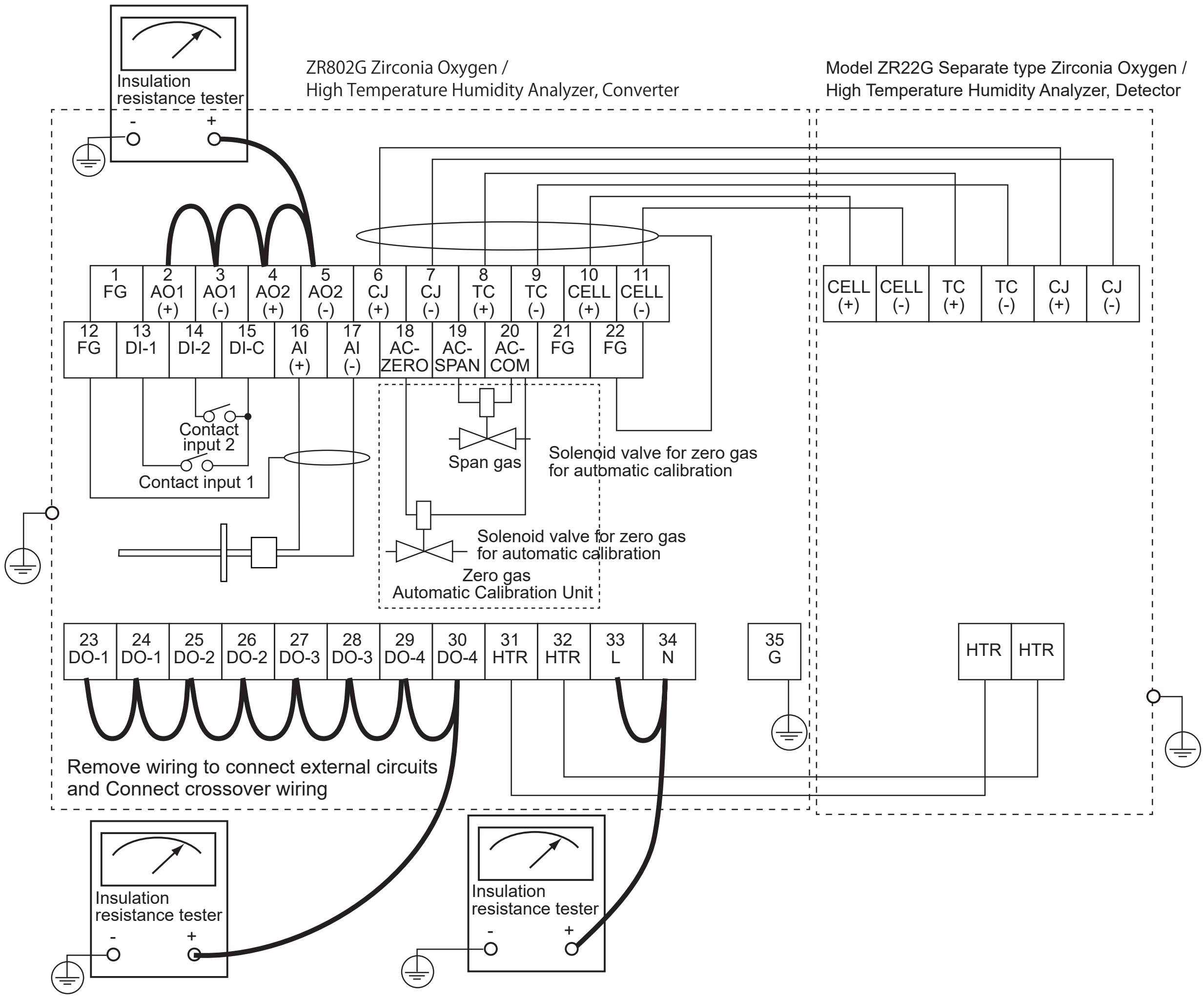
(2) Measure Insulation Resistance by setting Power Supply of Insulation Resistance meter to ON.

(3) After testing, remove Insulation Resistance gauge and connect a 100 k Ω resistor between the crossover wiring and grounding. Discharge the battery for more than a second. Do not touch the terminals with bare hands while discharging.

(4) You can perform similar tests between the heater terminal and ground, between contact output terminal and ground, and between the analogue output terminal and ground.

(5) Contact input terminal/sensor input terminal is isolated, but Insulation Resistance testing is abort because the voltage of the surge protection arrester between the terminal and ground is low.

(6) After completing all tests, put back the wiring in place.



Insulation resistance tester
ZR802G Zirconia Oxygen / High Temperature Humidity Analyzer, Converter
Model ZR22G Separate type Zirconia Oxygen / High Temperature Humidity Analyzer, Detector
1 FG
2 AO1 (+)
3 AO1 (-)
4 AO2 (+)
5 AO2 (-)
6 CJ (+)
7 CJ (-)
8 TC (+)
9 TC (-)
10 CELL (+)
11 CELL (-)
12 FG
13 DI-1
14 DI-2
15 DI-C
16 AI (+)
17 AI (-)
18 AC-ZERO
19 AC-SPAN
20 AC-COM
21 FG
22 FG
CELL (+)
CELL (-)
TC (+)
TC (-)
CJ (+)
CJ (-)
Contact input 2
Contact input 1
Span gas
Solenoid valve for zero gas for automatic calibration
Solenoid valve for zero gas for automatic calibration
Zero gas
Automatic Calibration Unit
23 DO-1
24 DO-1
25 DO-2
26 DO-2
27 DO-3
28 DO-3
29 DO-4
30 DO-4
31 HTR
32 HTR
33 L
34 N
35 G
HTR
HTR
Remove wiring to connect external circuits and Connect crossover wiring
Insulation resistance tester
Insulation resistance tester

Figure 3.21

4. Piping

This chapter describes piping procedures based on three typical system configurations for Zirconia Oxygen/Humidity Analyzer.

- Ensure that each check valve, stop valve and joint used for piping do not allow leakage. Especially, if there is any leakage of the calibration gas from pipes and joints, it may cause clogging of the pipes or incorrect calibration.
- Be sure to conduct leakage test after 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 the instrument uses natural convection for reference gas, ambient air near the detector is used for reference gas; therefore the accuracy of analysis will be affected by ambient humidity changes or the like. If more accurate analysis is necessary, use instrument air (dehumidified 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 1

The piping in System 1 is illustrated in Figure 4.1.

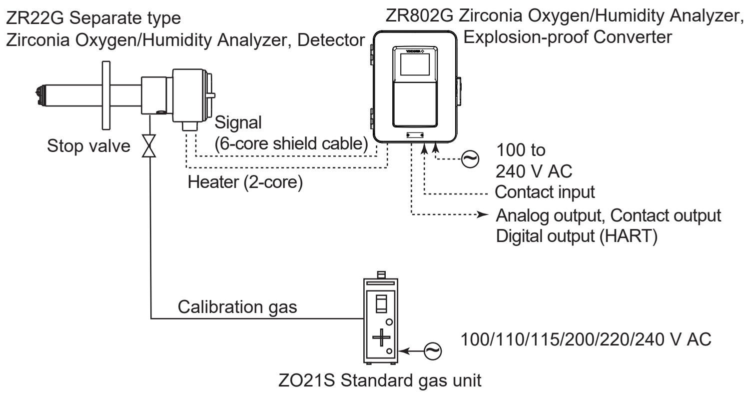


Figure 4.1 Piping in System 1

CAUTION

- The stop valve should be connected directly to the detector. If any piping is present between the detector and the stop valve, water may condense in the pipe, which may cause damage to the detector by rapid cooling when the calibration gas is introduced.
  The stop valve should be closed except while the calibration gas is being introduced.
- If a high temperature detector is used (the sample gas temperature is 700°C or higher), piping for the reference gas is required. In other cases, piping is required if the air around the detector is not clean.
- The reference gas should have an oxygen concentration identical to that of fresh air (21%).
- When a high temperature detector is used, the sample gas is vented into the surrounding air.
  Therefore, the oxygen concentration required may not be obtained unless an exhaust pipe is installed.

Piping in System 1 is as follows:

- Connect a stop valve to the nipple at the calibration gas inlet of the detector. 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 Connection to the Calibration Gas Inlet”). The tube is to be connected to this joint only during calibration.

- It is recommended to use ZH21B dust protector to protect the probe output from dust agitation (i.e., to prevent combustible materials from entering the probe cell) where humidity measurements are made under dusty or combustible, such as paper dust, environment.
- If a high temperature detector is used and no piping can be installed for the reference gas, place piping in the exhaust hole for the sample gas on the high temperature probe adapter so that the sample gas is carried away from the vicinity of the detector (see Section 4.1.4, “Figure 4.6 Exhaust pipe”).
- If a high temperature detector is used and the sample gas pressure is negative, connect an ejector assembly to the sample gas exhaust hole of the high temperature probe adapter (see Section 4.1.4, “Figure 4.3 Mounting the ejector assembly”).
- If a high temperature detector is used and the pressure of the sample gas is 0.49 kPa or higher, it is recommended that a needle valve (throttle) be used in the sample gas exhaust of the high temperature probe adapter (see Section 4.1.4, “Figure 4.4 Mounting the needle valve for restricting exhaust flow of the sample gas”).

CAUTION

This is for lowering the sample gas temperature below 700°C. If the gas temperature is high and the pressure is also significantly high, the sample gas temperature may not fall to below 700°C before it reaches the detector.
On the other hand, if the sample gas temperature is lowered too much, condensation may be produced in the High Temperature Probe Adapter. During wintertime, it is recommended that the High Temperature Probe Adapter be protected with an insulating material to avoid condensation forming (see Section 4.1.4, “Figure 4.5 Preventing to condensation”).
For the usage of the High Temperature Probe Adapter, refer to Section “3.2.1 Usage of the High Temperature Probe Adapter (ZO21P-H)”.

4.1.1 Parts Required for Piping in System 1

Check that the parts listed in Table 4.1 are ready.

Table 4.1

Detector	Piping location	Parts Name	Note	
General use detector	Calibration gas inlet	Stop valve	Recommended by YOKOGAWA (L9852CB or G7016XH)	
		Nipple *	Rc 1/4 or 1/4 NPT	General parts
		Joint for tube connection	Rc 1/4 (1/4 NPT) for a Ø6 x Ø4 mm soft tube	General parts
	Reference gas inlet	(sealed up)	(when piping is required, refer to section 4.1.3 Connection to the Reference Gas Inlet”)	
High temperature detector (0.15 m)	Calibration gas inlet	Stop valve	Recommended by YOKOGAWA (L9852CB or G7016XH)	
		Nipple *	Rc 1/4 or 1/4 NPT	General parts
		Joint for tube connection	Rc 1/4 (1/4 NPT) for a Ø6 x Ø4 mm soft tube	
	Reference gas inlet	(sealed up)	(when piping is required, refer to section “4.1.3 Connection to the Reference Gas Inlet”)	
	Sample gas outlet	Ejector assembly *	Recommended by YOKOGAWA (E7046EC or E7046EN)	
		T-shaped joint of the same diameter *	R1/4 or 1/4 NPT	General parts
		Needle valve *	Rc1/4 or 1/4 NPT	General parts
		Nipple of other diameter *	R 1/2 to R 1/4 or R 1/2 to 1/4 NPT	General parts

Note: Parts with marking * are used when required.
General parts can be found on the local market.

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 detector. First, mount a stop valve (of a quality specified by YOKOGAWA) on a nipple (found on the local market) as illustrated in Figure 4.2, and mount a joint (also found on the local market) at the stop valve tip. (The stop valve may be mounted on the detector prior to shipping the detector.)

Note: Mount the stop valve close to the detector.

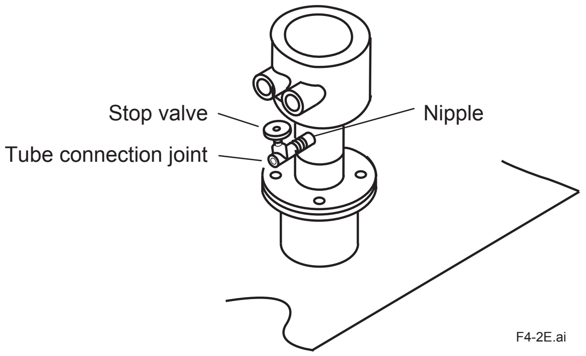


Figure 4.2 Connection to the calibration gas inlet

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 the reference gas (models ZR22G-☐-☐-☐-C). Leave the plug as it is . If the air around the detector is polluted and the necessary oxygen concentration (21 vol%O_2) cannot be obtained, prepare piping the same as which described 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 ZR22G-☐-☐-☐-E or P).

4.1.4 Piping to the High Temperature Probe Adapter

- The sample gas should be at a temperature below 700°C before reaching the detector sensor. If the gas is under negative pressure, it should be fed to the detector by suction.
- For usage of the probe adapter when using high temperature detector, refer to Section “3.2.1 Usage of the High Temperature Probe Adapter (ZO21P-H)”.
- If the sample gas is under negative pressure, connect the ejector assembly (E7046EC/ E7046EN) as illustrated in Figure 4.3. Mount the pressure gauge as close as possible to the ejector assembly. However, if the ambient temperature is too high, mount the gauge in a location with a temperature below 40°C.

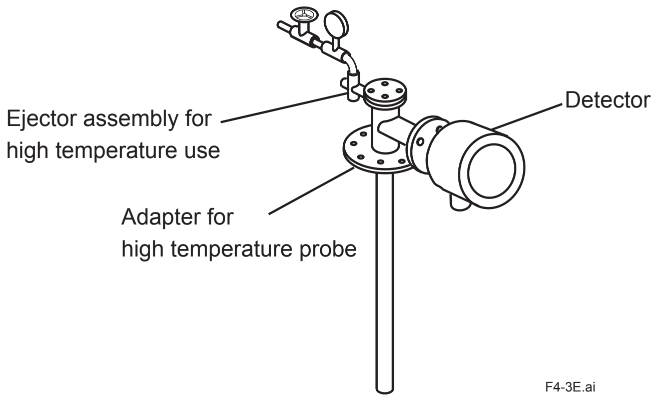


Figure 4.3 Mounting the ejector assembly

If the temperature of the sample gas exceeds the specified value and its pressure exceeds 0.49 kPa, the sample gas temperature may not be below 700°C at the detector.

In such a case, connect a needle valve (found on the local market) through a nipple (also found on the local market) to the probe adapter sample gas exhaust (Rc 1/2) so that the sample gas exhaust volume is restricted.

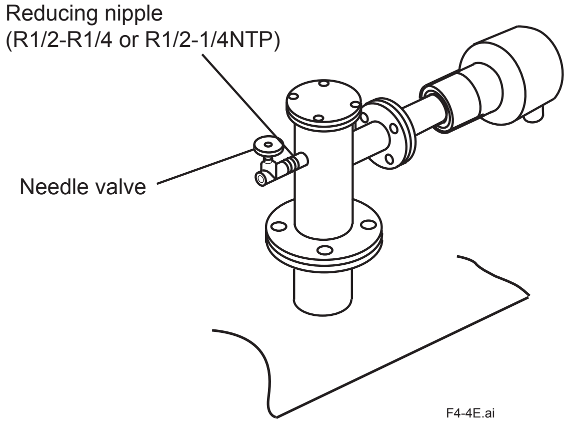


Figure 4.4 Mounting the needle valve for restricting exhaust flow of the sample gas

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

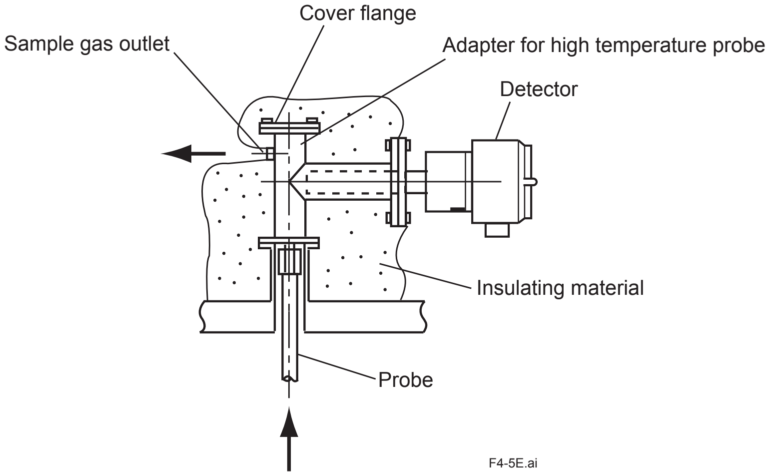


Figure 4.5 Preventing to condensation

If the sample gas is to be vented at a distance from the detector because no reference gas piping can be provided, an exhaust pipe should be installed as illustrated in Figure 4.6.
In addition, the exhaust pipe shall be kept warm to protect against condensation.

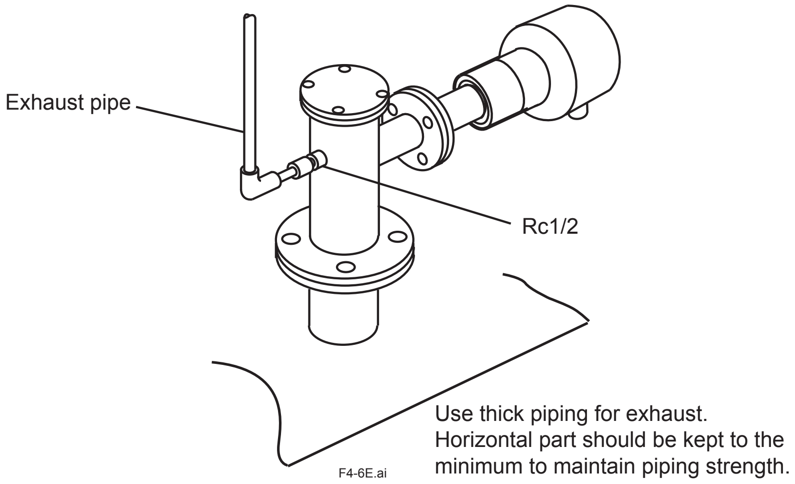


Figure 4.6 Exhaust pipe

4.2 Piping for System 2

Piping in System 2 is illustrated in Figure 4.7.

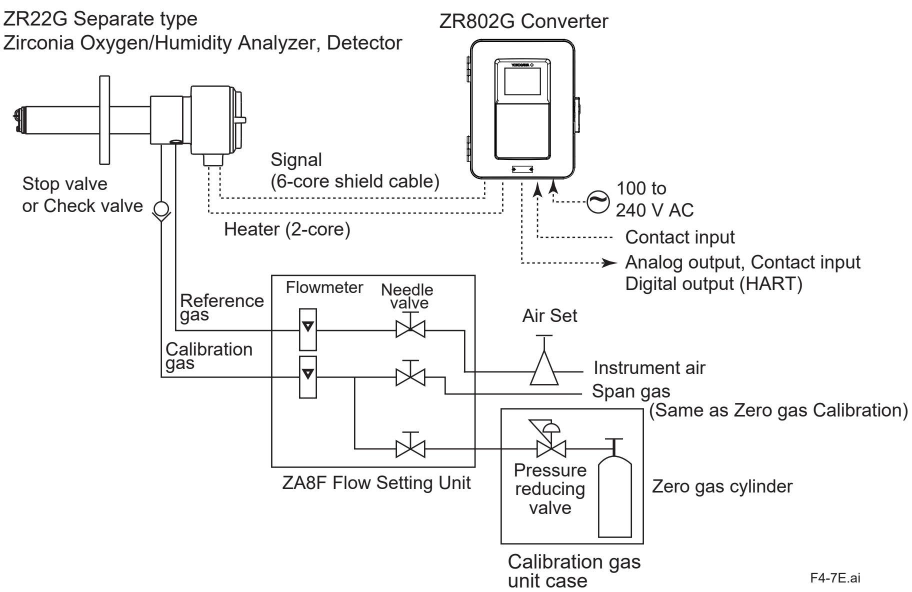


Figure 4.7 Piping for System 2

System 2 illustrated in Figure 4.7 requires piping as follows:

- Connect a stop valve or check valve the nipple at the calibration gas inlet of the detector.
- It is recommended to use ZH21B dust protector to protect the probe output from dust agitation (i.e., to prevent combustible materials from entering the probe cell) where humidity measurements are made under dusty or combustible environment.
- If a high temperature detector is used and the sample gas pressure is negative, connect an ejector assembly to the sample gas exhaust hole of the high temperature probe adapter (see Section 4.1.4, “Figure 4.3 Mounting the ejector assembly”).
- If a high temperature detector is used and the pressure of the sample gas is 0.49 kPa or higher, it is recommended that a needle valve (throttle) be used in the sample gas exhaust of the high temperature probe adapter (see Section 4.1.4, “Figure 4.4 Mounting the needle valve for restricting exhaust flow of the sample gas”).

CAUTION

This is for lowering the sample gas temperature below 700°C. If the gas temperature is high and the pressure is also significantly high, the sampled gas temperature may not reduced below 700°C when reaching the detector.
On the other hand, if the sample gas temperature is lowered too much, condensation may be produced in the high temperature probe adapter. During wintertime, it is recommended that the high temperature probe adapter be protected with an insulating material to prevent condensation (see Section 4.1.4, “Figure 4.5 Preventing to condensation”).
For the usage of the high temperature probe adapter, refer to Section “3.2.1 Usage of the High Temperature Probe Adapter (ZO21P-H)”.

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

CAUTION

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

4.2.1 Piping Parts for System 2

Check that the parts listed in Table 4.2 are ready.

Table 4.2 Piping Parts

Detector	Piping location	Parts Name	Note	
General use detector	Calibration gas inlet	Stop valve or check valve	Recommended by YOKOGAWA (L9852CB or G7016XH) Provided by YOKOGAWA (K9292DN or K9292DS)	
		Nipple *	Rc 1/4 or 1/4 NPT	General parts
		Zero gas cylinder	User´s scope	
		Pressure reducing valve	Recommended by YOKOGAWA (G7013XF or G7014XF)	
		Joint for tube connection	Rc 1/4 or 1/4 NPT	General parts
	Reference gas inlet	Air set	Recommended by YOKOGAWA (G7003XF/K9473XK or G7004XF/K9473XG)	
		Joint for tube connection	Rc 1/4 or 1/4 NPT	General parts
High temperature Detector (0.15 m)	Calibration gas inlet	Stop valve or check valve	Recommended by YOKOGAWA (L9852CB or G7016XH) Provided by YOKOGAWA (K9292DN or K9292DS)	
		Nipple *	Rc 1/4 or 1/4 NPT	General parts
		Zero gas cylinder	User´s scope	
		Pressure reducing valve	Recommended by YOKOGAWA (G7013XF or G7014XF)	
		Joint for tube connection	Rc 1/8 or 1/8 NPT	
	Reference gas inlet	Air set	Recommended by YOKOGAWA (G7003XF/K9473XK or G7004XF/K9473XG)	
		Joint for tube connection	Rc 1/4 or 1/4 NPT	General parts
	Sample gas outlet	Ejector assembly *	Recommended by YOKOGAWA (E7046EC or E7046EN)	
		T-shaped joint of the same diameter *	R 1/4 or 1/4 NPT	General parts
		Needle valve *	Rc 1/4 or 1/4 NPT	General parts
		Nipple of other diameter *	R 1/2 to R 1/4 or R 1/2 to 1/4 NPT	General parts

Note: Parts with marking * are used when required.
General parts can be found on the local market.

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 ZR22G detector.

The cylinder should be placed in a case assemble E7044KF or the like to avoid any direct sunlight or radiant heat so that the gas cylinder temperature does not exceed 40°C.
Mount a reducing valve (specified by YOKOGAWA) on the cylinder.

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

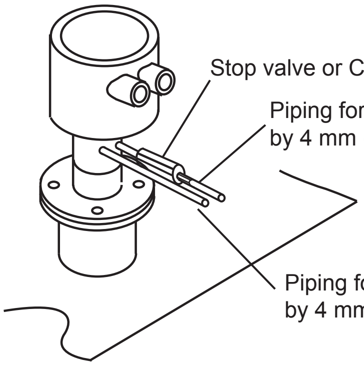


Figure 4.8 Piping for the Calibration Gas Inlet

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 detector.

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

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

4.2.4 Piping to the High Temperature Probe Adapter

Refer to Section “4.1.4 Piping to the High Temperature Probe Adapter”.

4.3 Piping for System 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 Piping for System 2”.

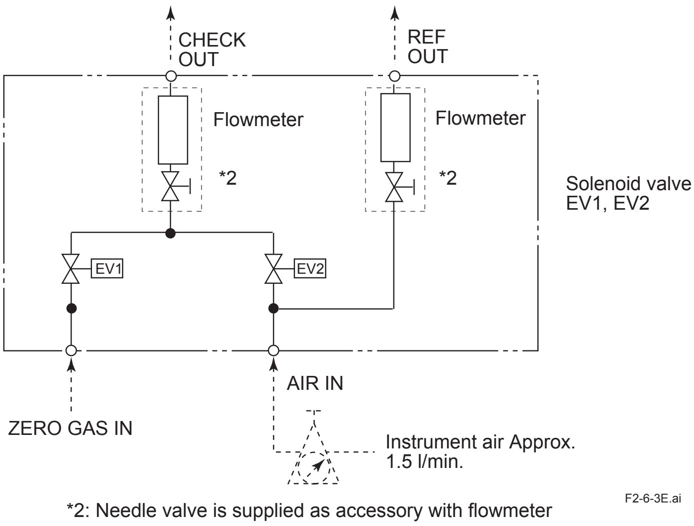
Adjust secondary pressure of both the air set and the zero gas reducing valve so that these two pressures are approximately the same. The flow rate of zero and span gases (normally instrument air) are set by a single needle valve.

After installation and wiring, check the calibration contact output (see Sec. “7.11.2 Checking Calibration Contact Output”), and adjust zero gas reducing valve 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.

When blow back function is used by contact input to the ZR802G converter, install blow back piping as illustrated in “■ Blow Back Piping”.

Note: Blow back function means the function to get rid of dust inside a probe in a high temperature probe adapter by using compressed air, when a high temperature detector is used.

It is recommended to use ZH21B dust protector to protect the probe output from dust agitation (i.e., to prevent combustible materials from entering the probe cell) where humidity measurements are made under dusty or combustible environment.



*2: Needle valve is supplied as accessory with flowmeter

*1 Shielded cable
Use a shielded cable for the signal cable, and connect the shield to the FG terminal of the transmitter.

*2 Select the detector from the detector configuration table.

*3 For zirconia type oxygen densitometers, 100 vol%N_2 gas cannot be used as zero gas. Normally, approximately 1 vol%O_2 (N_2 balanced) is used.

Figure 4.9 Piping inside in System 3

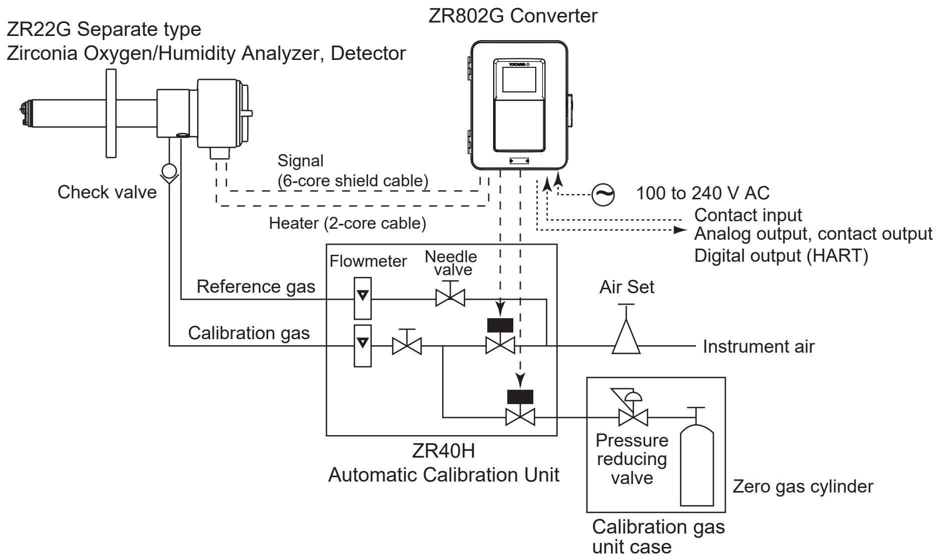


Figure 4.10 Piping for System 3

■ Blow Back Piping

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

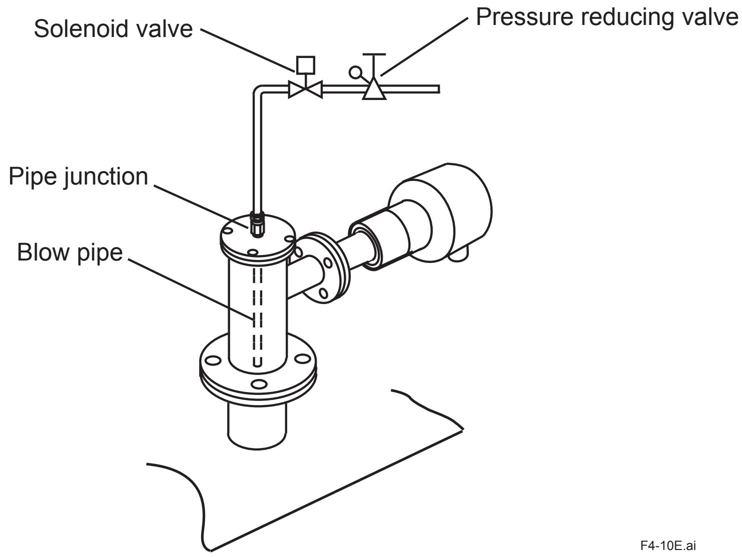


Figure 4.11 Blow back Piping

The following parts are required for blow back piping.

- Flange (to be prepared as illustrated in Figure 4.12.)
- Blow pipe (to be prepared as illustrated in Figure 4.12.)
- Two-way solenoid valve: “ Open “ when electric current is on. (Found on the local market) .
- Air set (recommended by YOKOGAWA, G7003XF / K9473XK or G7004XF / K9473XG)

<Blow pipe manufacturing>

Manufacture the blow pipe as illustrated in Figure 4.12, and mount it on the high temperature probe adapter.

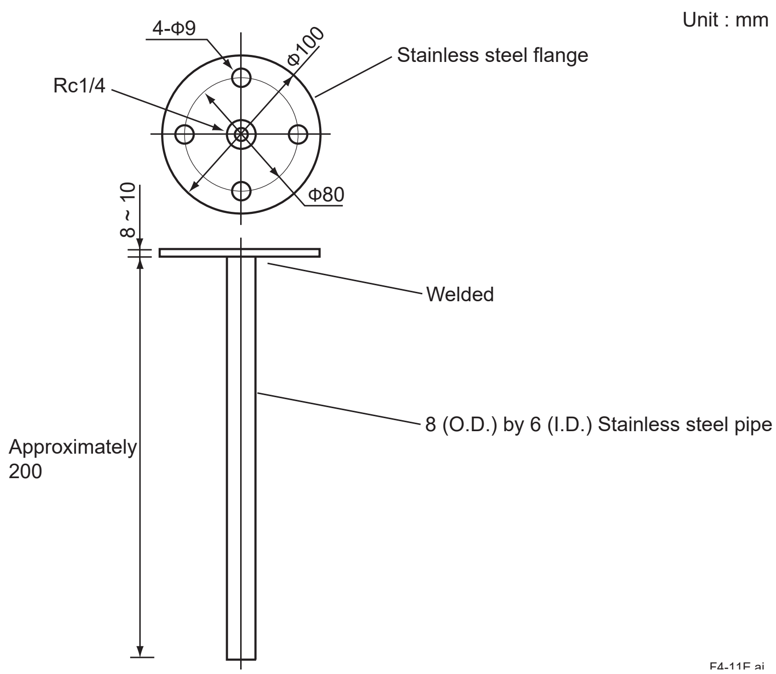


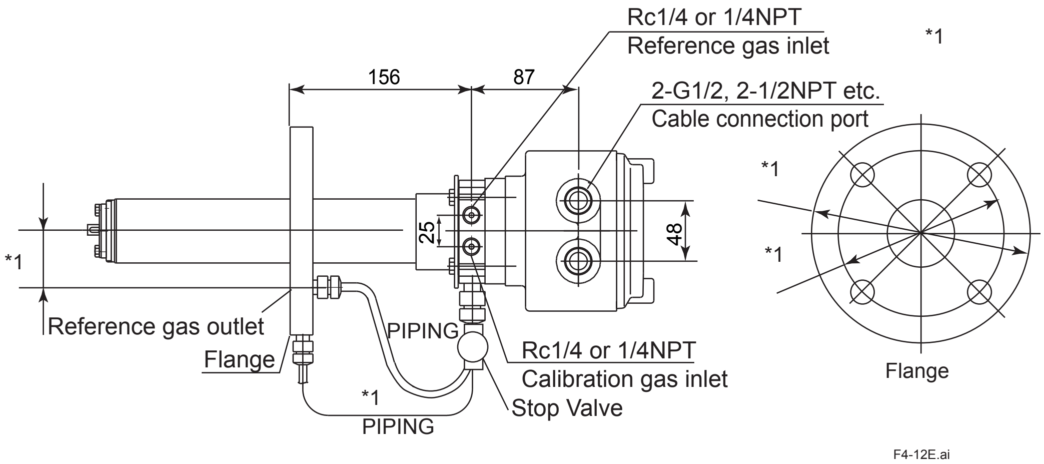
Figure 4.12 Manufacturing Blow pipe and Flange

4.4 Piping for the Detector with Pressure Compensation

The ZR22G-☐-☐-☐-P Detector with Pressure Compensation may be used in System 2 and System 3. However, it cannot use piping for high temperature probe adapter or blow back piping. Use this detector whenever the furnace pressure exceeds 5 kPa (see Note). Even if the furnace pressure is high, the detector can measure by adjusting pressure of the detector to the furnace pressure using instrument air. The inside pressure of the probe will be kept the same as the furnace pressure by feeding instrument air at higher pressure than that in the furnace.

NOTE

Sample gas pressure should not vary rapidly and widely.



*1 Dimensions may vary depending on the detector type. Refer to Section 2.2
Ensure that the flange gasket does not block the reference gas outlet.
Where necessary, make a notch on the flange

Figure 4.13 Detector with Pressure Compensation

Valve operation

(1) For safety, stop the furnace that the detector is to be installed in. If furnace internal pressure is high, this is especially dangerous.

(2) Before starting instrument air flow, completely shut the stop valve in front of the reference gas outlet.

(3) Check that the reference gas outlet is not blocked by a flange gasket or the like.

(4) Set the instrument air pressure higher than furnace internal pressure.

(5) Completely open the stop valve in front of the reference gas outlet and, after turning on instrument air flow, start furnace operation. As furnace internal pressure rises, confirm that instrument air continues to flow and adjust the valve or increase supply pressure if necessary.

(6) After furnace internal pressure stabilizes, adjust flow.

(7) If furnace operation is stopped, stop instrument air flow and completely shut the stop valve in front of the reference gas outlet. You may leave reference gas flowing if you wish.

CAUTION

- As far as possible do not stop the instrument air flow, to prevent the sample gas from entering the detector and damaging the zirconia cell.
- Connect the stop valve, which is at the calibration gas inlet, directly to the detector.
If there is piping between the detector and the valve, condensation may damage the detector by rapid cooling when calibration gas is introduced.

Figure 4.14 illustrates an example of System 2 using a detector with pressure compensation.

Supply air pressure (flow) may vary depending on the furnace pressure. It is recommended to use a flowmeter and an air set that is suitable for the furnace pressure.

NOTE

When using the ZA8F Flow Setting Unit and ZR40H Automatic Calibration Unit, please note that the supplying airflow (pressure) will vary depending on the furnace pressure.

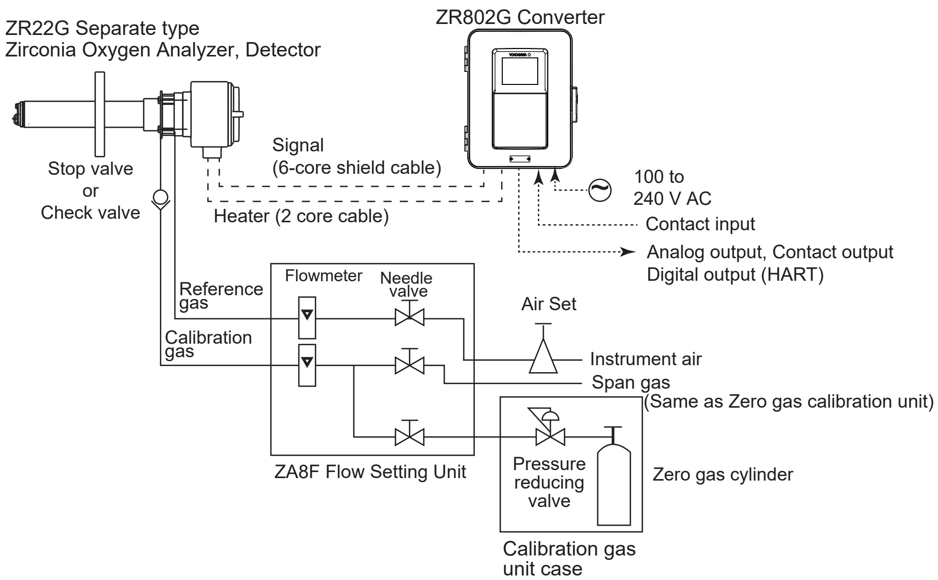


Figure 4.14 System 2 using a detector with pressure compensation

4.4.1 Piping Parts for a System using Detector with Pressure Compensation

Check that the parts listed in Table 4.3 are ready.

Table 4.3 Piping Parts

Detector	Piping location	Parts Name	Note	
Detector with pressure compensation	Calibration gas inlet	Stop valve or check valve	Recommended by YOKOGAWA (L9852CB or G7016XH) Provided by YOKOGAWA (K9292DN or K9292DS)	
		Nipple *	Rc 1/4 or 1/4 NPT	General parts
		Zero gas cylinder	User´s scope	
		Pressure reducing valve	Recommended by YOKOGAWA (G7013XF or G7014XF)	
		Joint for tube connection	Rc 1/4 or 1/4 NPT	General parts
	Reference gas inlet	Air set	Recommended by YOKOGAWA (G7003XF/K9473XK or G7004XF/K9473XG)	
		Joint for tube connection	Rc 1/4 or 1/4 NPT	General parts

Note: Parts with marking * are used when required.
General parts can be found on the local market.

4.4.2 Piping for the Calibration Gas

Calibration gas piping is basically identical to that of System 2. See Section “4.2.2 Piping for the Calibration Gas”.

4.4.3 Piping for the Reference Gas

Reference gas piping is basically identical to that of for System 2. See Section “4.2.3 Piping for the Reference Gas”.

5. Wiring

In this Chapter, the wiring necessary for connection to the Zirconia Oxygen/Humidity Analyzer is described.

5.1 General

WARNING

NEVER supply current to the converter or any other device constituting a power circuit in combination with the converter, until all wiring is completed.

CAUTION

This product complies with CE marking.
Where compliance with CE marking is necessary, the following wiring procedure is necessary.

- Install an external switch or circuit breaker to the power supply of the converter.
- Use an external switch or circuit breaker rated 5 A and conforming with IEC 947-1 or IEC 947-3.
- It is recommended that the external switch or circuit breaker be mounted in the same room as the equipment.
- 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 performed according to the following procedure:

(1) Be sure to connect the shield line to FG terminal of the converter.

(2) The outer sheath of the signal line should be stripped to a length of 50 mm or less.
The most outer sheath of the power cable should be stripped to a length of 20 mm or less.

(3) Signals may be affected by noise if signal lines, power cable and heater cable are located in the same conduit. When using conduit, signal lines should be installed in a separate conduit than power and heater cables.

(4) Install metal blind plug(s) in unused cable connection gland(s) of the converter.

(5) Metal conduit should be grounded.

(6) The following cables are used for wiring:

Table 5.1 Cable specifications

Terminal name of converter	Name	Need for shields	Number of cores
CELL+, CELL- HTR TC+, HTR TC- CJ+, CJ-	Detector signal	O	6
HEATER	Detector heater		2
L, N	Power supply		2 or 3 *
AO-1+, AO-1-, AO-2+, AO-2-	Analog output	O	2 or 4
DO-1, DO-2, DO-3, DO-4	Contact output		2 to 8
AC-Z, AC-S, AC-C	Automatic Calibration unit		3
DI-1, DI-2, DI-C	Contact input		3
AI+, AI-	Temperature input	O	2
Rs485	Rs485	O	3
Ether	Ether	O	(STP cable)

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

WARNING

Cables that withstand temperatures of at least 80°C should be used for wiring.

CAUTION

- Select suitable cable O.D. to match the cable gland size.
- Protective grounding should be connected in ways equivalent to JIS D style (Class 3) grounding (the grounding resistance is 100 Ω or less).
- For maximum use of options, nine cables are required for eight cable entries.
  In this case, create a cable using a mixture of two types: AO, DI, or AI. Shielded cables should be used for any mixed pattern. Never mix with other cables.

NOTE

Grounding of shielded cable

The shielded cables are very effective for noise-rejection, but the grounding of the shielded cables varies depending on the conditions of use.

One side grounding, which grounds only one end of the shield to ZR802G, requires longer cables and is effective for noise reduction when there is a potential difference of grounds between the FLXA402 and the connected device on the other side.

If there is no potential difference between the ZR802G and the device on the other side, it may be more effective to connect to the ground on both sides.

It may also be effective to connect a capacitor in series to one ground while both sids being grounded.

5.1.1 Terminals for the External Wiring in the Converter

Open the front door and remove the terminal covering plate to gain access to the converter external wiring terminals (see Figure 5.1).

⚠ CAUTION

After wiring necessary cable to the converter terminals, be sure to fix the terminal covering plate with two screws again.

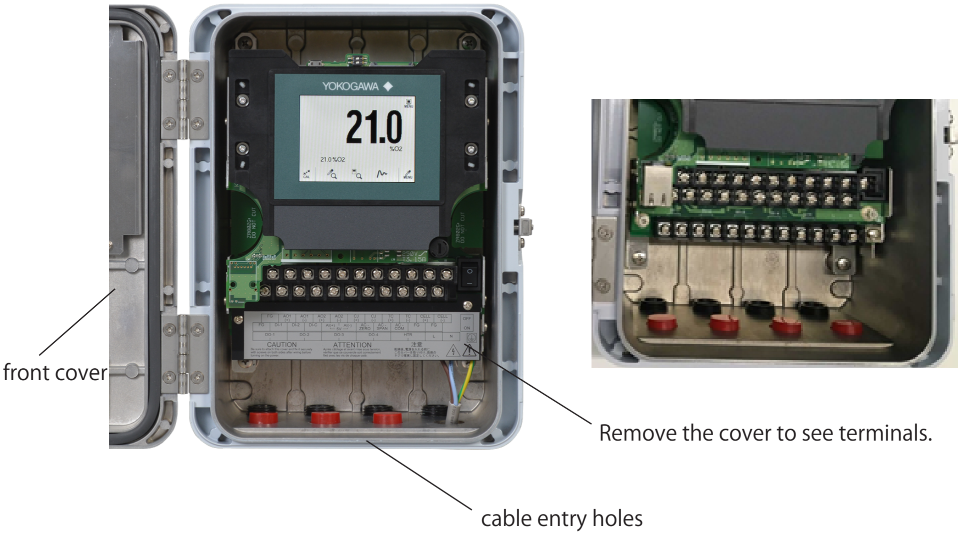


Figure 5.1 Terminals for external wiring in the converter

5.1.2 Wiring

Connect the following wiring to the converter. It requires a maximum of seven wiring connections as shown below.

(1) Detector output (connects the converter with the detector.)

(2) Detector heater power (connects the converter with the detector.)

(3) Analog output signal

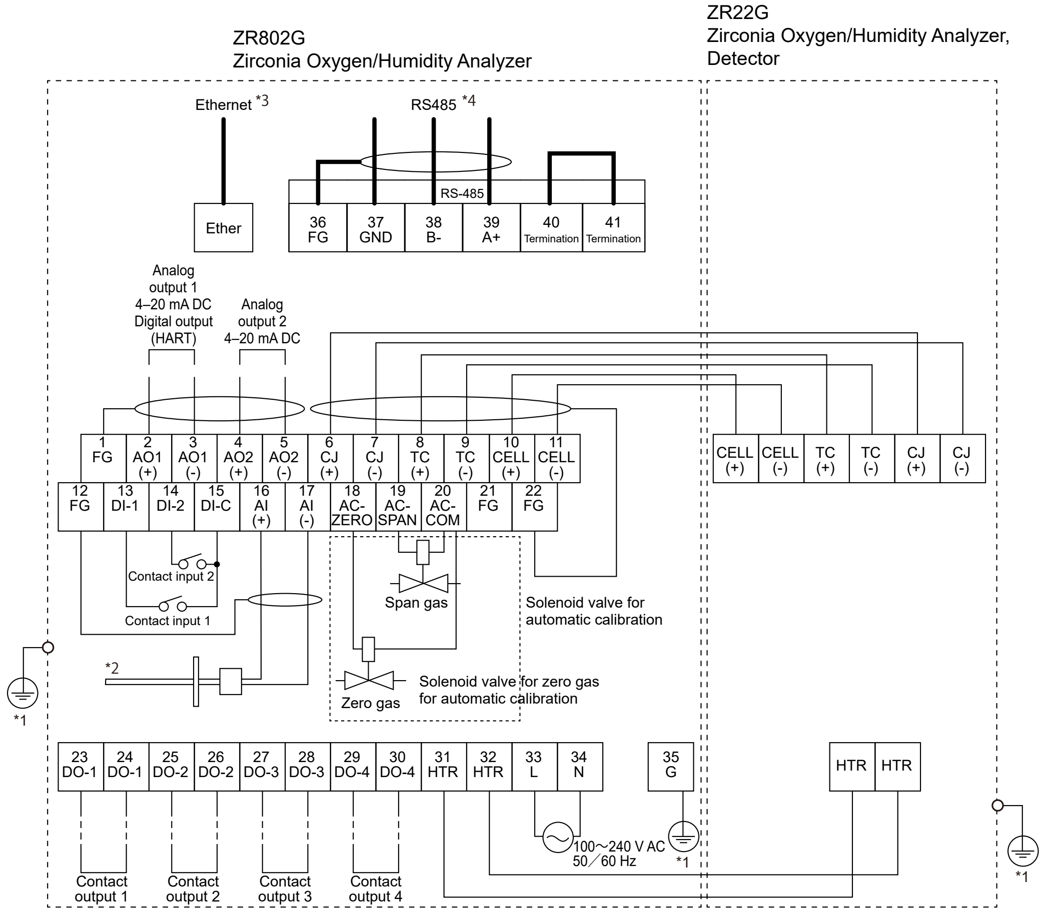
(4) Power and ground

(5) Contact output

(6) Operation of the solenoid valve of automatic calibration unit

(7) Contact input

(8) Temperature input



*1: The ground wiring of the converter should be connected to either the protective ground terminal in the equipment or the ground terminal of the converter case.
Ground to earth, ground resistance: 100 Ω or less.
*2: Option (Temperature or Pressure transmitter provide by user) for humidity measurement.
*3: Suffix Code "-E"
*4: Suffix Code "-M"

Figure 5.2 Wiring connection to the converter

5.1.3 Mounting of Cable Gland

For each cable connection opening of the converter, mount a conduit that matches the thread size, or a cable gland.

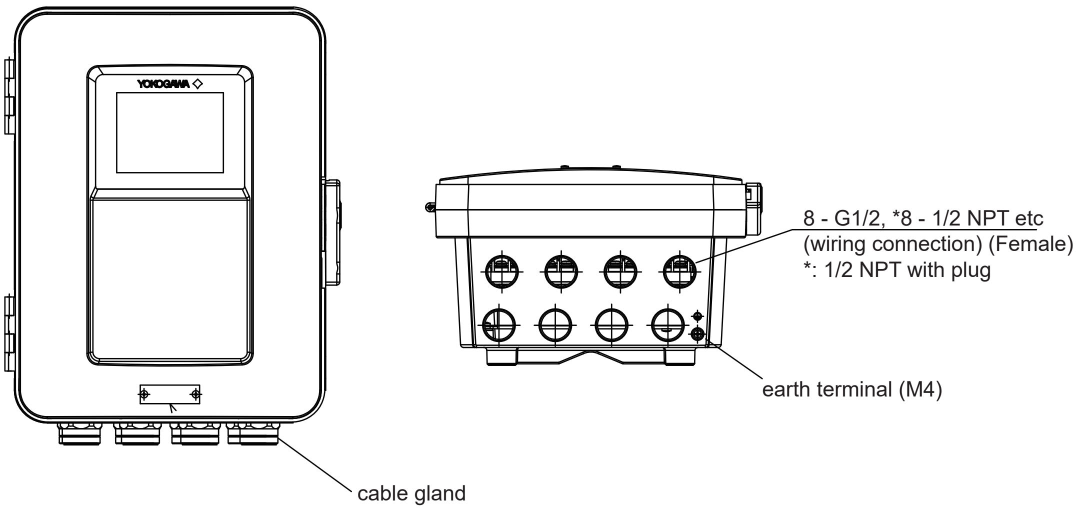


Figure 5.3 Cable gland mounting

5.2 Wiring

5.2.1 Connection to Converter

To connect the wiring to the converter, proceed as follows:

(1) M4 screws are used for the terminals of the converter. Each cable should be terminated in the corresponding size crimp-on terminals.

(2) When a rubber insulated glass braided wire is used for wiring to the detector, use a terminal box. For wiring between the terminal box and the converter, basically use a cable that withstand temperatures of at least 80°C.

NOTE

The above is to prevent moisture or corrosive gas from entering the converter.
Where the ambient environment of the detector and the converter is well-maintained, it is permissible to connect the wiring from the detector directly to the converter with protection by conduits.

WARNING

This wiring is to carry power for the heater. Be careful to wire the correct terminals, and be careful not to ground or short circuit terminals when wiring, as otherwise the instrument may be damaged.

5.2.2 Connection to Detector

When connecting the cable to the detector, proceed as follows:

(1) Mount cable glands or conduits of the specified thread size to the wiring connections of the detector.
The detector may need to be removed in future for maintenance, so be sure to allow sufficient cable length.

(2) If the ambient temperature at the location of wire installation is 75 to 150°C, be sure to use a flexible metallic conduit for the wire. If a non-shielded " 600 V silicon rubber insulated glass braided wire" is used, keep the wire away from noise sources to avoid noise interference.

(3) The size of the terminal screw threads is M3.5. Each cable should be terminated in the corresponding size crimp-on terminals contact (*1) respectively.

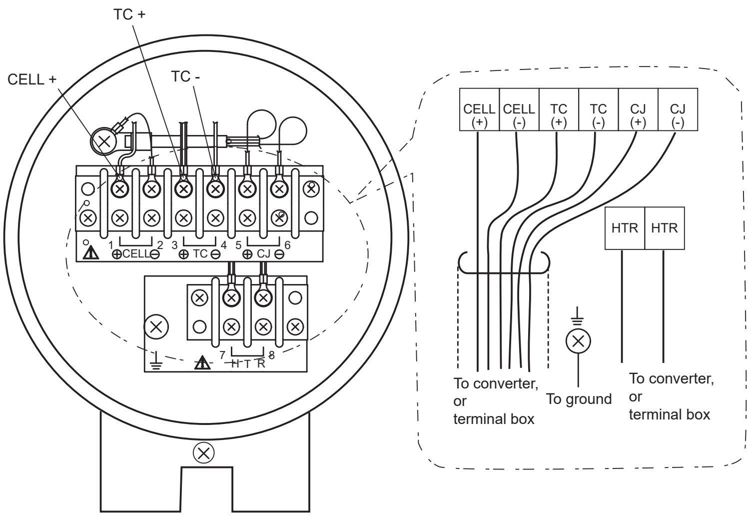


Figure 5.4 **Terminal assignment of detector**

● Notice when closing the cover of the detector

NOTE

- 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 in the detector body, secure it with the lock screw.

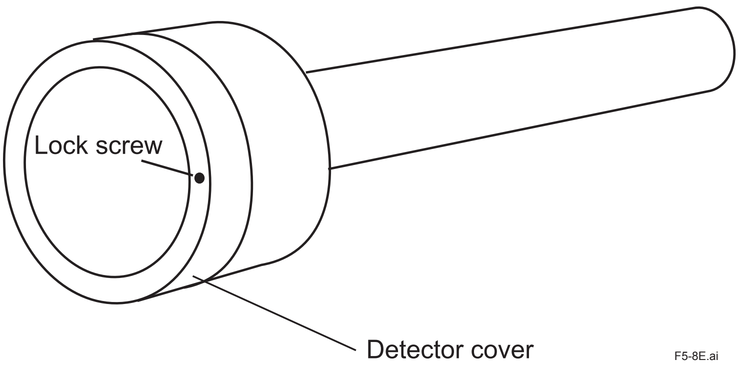


Figure 5.5

5.2.3 Power and Grounding Wiring

This wiring supplies power to the converter and grounds the converter/detector.

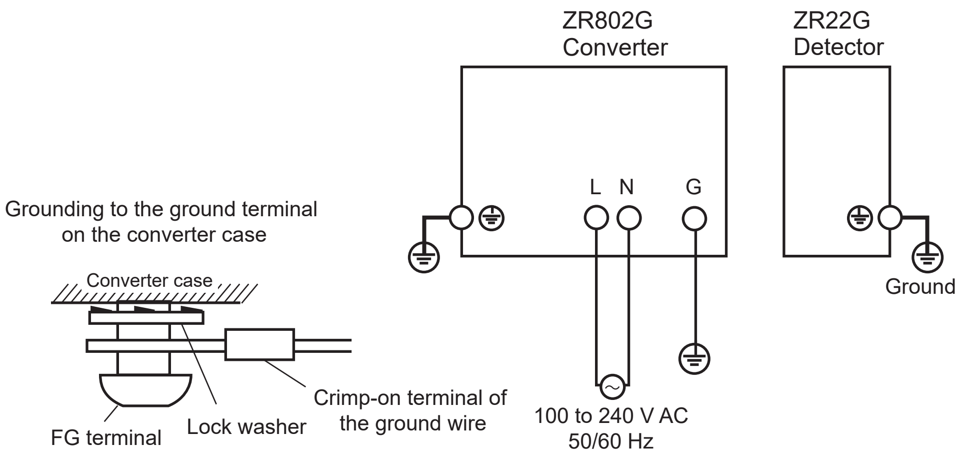


Figure 5.6 Power and Grounding wiring

Power Wiring

Connect the power wiring to the L and N terminals of the converter. Proceed as follows:

(1) Use a 2-core or a 3-core cable.

(2) The size of converter terminal screw threads is M4. Each cable should be terminated corresponding to crimp-on terminals.

Grounding Wiring

The ground wiring of the detector should be connected to the ground terminal of the detector case. The ground wiring of the converter should be connected to either the ground terminal of the converter case or the protective ground terminal in the equipment.
The grounding terminals of the detector and the converter are of size M4. Proceed as follows:

(1) Keep ground resistance to 100 Ω or less (equivalent JIS D style (Class 3)).

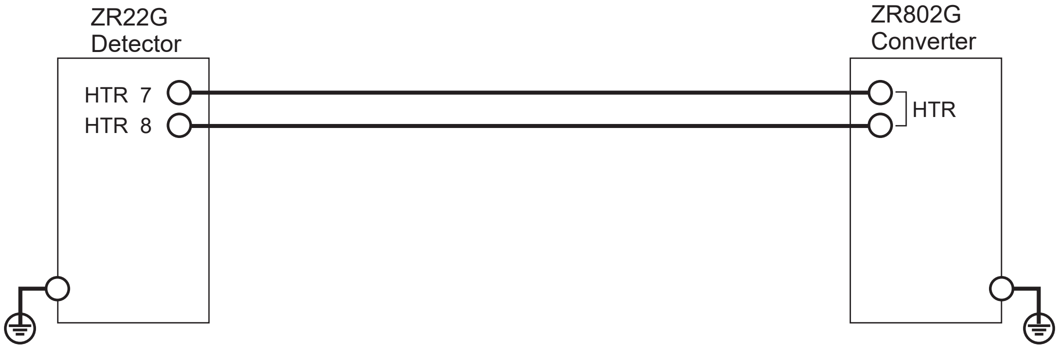
(2) When the ambient temperature of the wiring installation is 75 to 150°C for the wiring of the detector, use wiring material with sufficient heat resistance.

(3) When connecting the ground wiring to the ground terminal of the converter case, be sure that the lock washer is in contact with the case surface (see Figure 5.5.).

5.2.4 Wiring for Power to Detector Heater

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

(1) Ambient temperature of the detector: 75°C or less



(2) Ambient temperature of the detector: exceeding 75°C

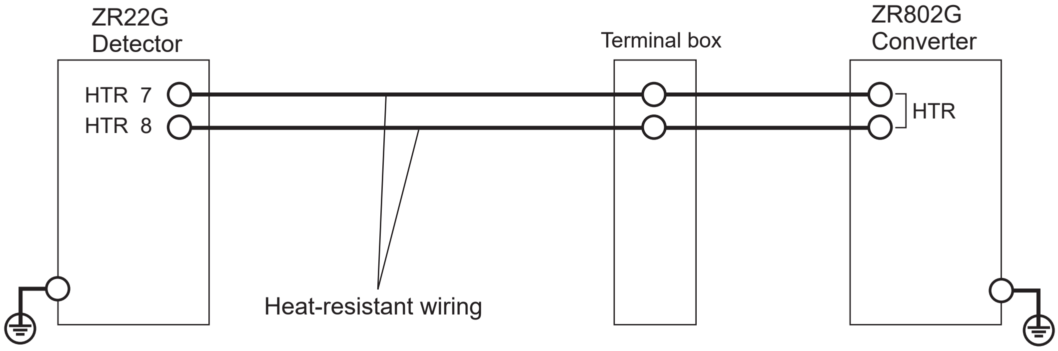


Figure 5.7 Wiring for power to detector heater

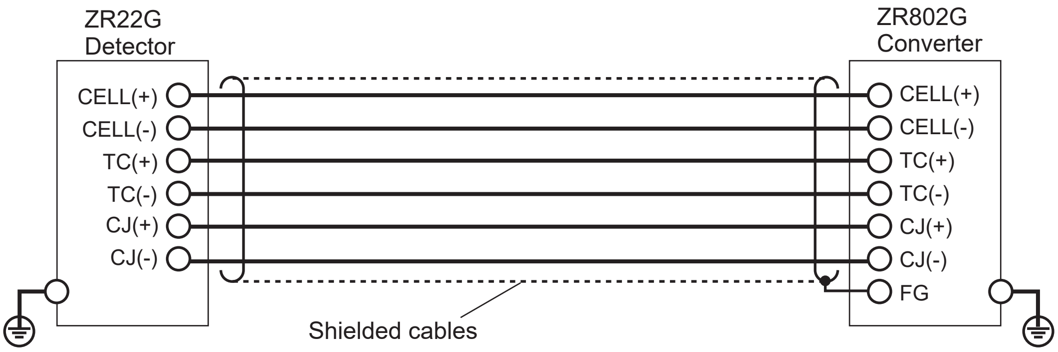
Cable Specifications

Basically, cables (2 cores) that withstand temperatures of at least 80°C are used for this wiring. When the ambient temperature of the detector exceeds 75°C, install a terminal box, and connect to the detector using six-piece 600 V silicon rubber insulated glass braided wires.

5.2.5 Wiring for Detector Output

This wiring enables the converter to receive cell output from the detector, output from a thermocouple and a reference junction compensation signal. Install wires that allow for 10 Ω of loop resistance or less. Keep detector wiring away from power wiring.

(1) Ambient temperature of the detector: 75°C or less



(2) Ambient temperature of the detector: exceeding 75°C

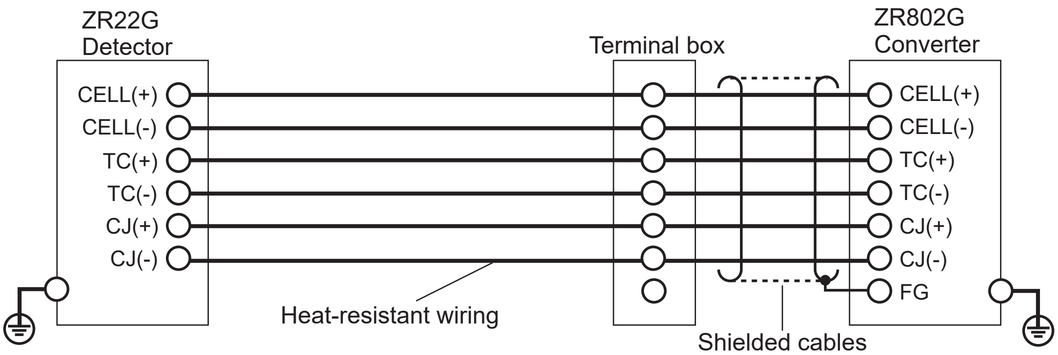


Figure 5.8 Wiring for detector output

CAUTION

If shielded cables cannot be used between the detector and the terminal box, for example, when heat-resistant wiring is used, locate the detector and the terminal box as close together as possible.

Cable Specifications

Basically, a cable (6-core) that withstand temperatures of at least 80°C is used for this wiring. When the ambient temperature of the detector exceeds 75°C, install a terminal box, and connect with the detector using six-piece 600 V silicon rubber insulated glass braided wires.

/CJ Option Specifications

When the /CJ option is specified, connecting the supplied cold junction compensation element to the CJ (+) and CJ (-) terminals of the converter, and connecting the tip to the FG terminal (see Fig. 5.9) is not required, and cabling of the CJ terminal is not required.

In addition, the cabling of the TCs is connected using compensating leads for TYPE K.

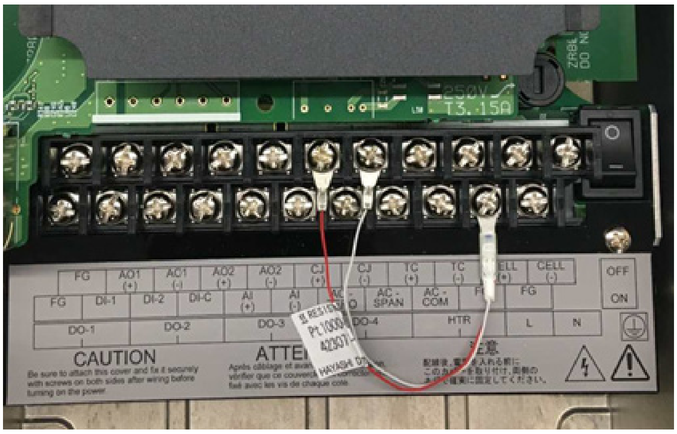


Figure 5.9 Connection of CJ compensation elements

5.2.6 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 at 550 Ω or less.

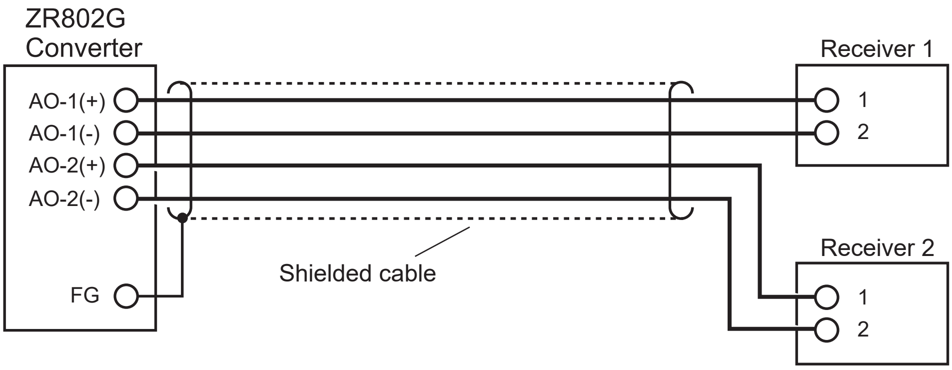


Figure 5.10 Wiring for analog output

Cable Specifications

For this wiring, use a 2-core or a 4-core shielded cable.

Wiring Procedure

(1) M4 screws are used for the terminals of the converter. Each wire in the cable should be terminated corresponding to crimp-on terminals. Ensure that the cable shield is connected to the FG terminal of the converter.

(2) Be sure to connect "+" and "-" polarities correctly.

5.2.7 Contact Output Wiring

Contact outputs 1 to 3 can be freely assigned to “low limit alarm”, “high limit alarm”, etc. user selectable, but the assignment of contact output 4 is fixed (“fault output”). And the action (contact closed on error output) also cannot be changed.

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

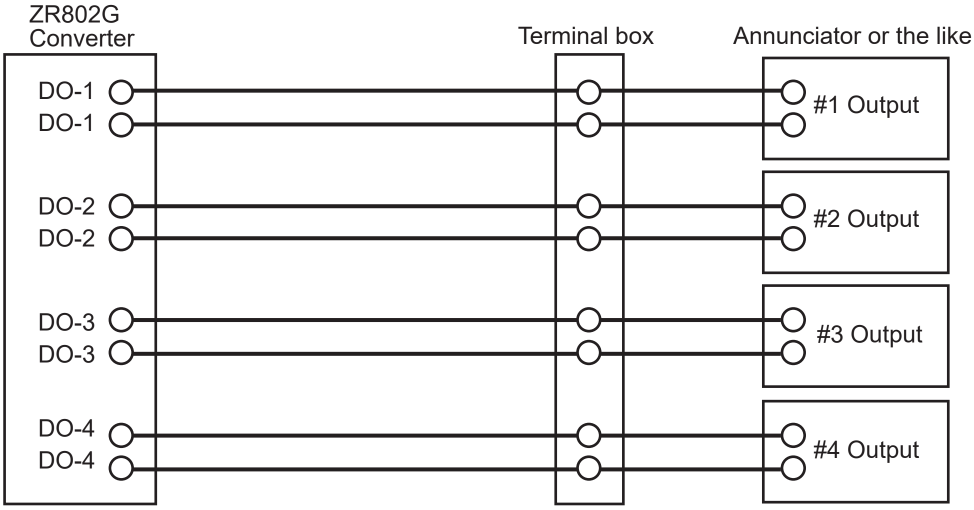


Figure 5.11 Contact output wiring

Cable Specifications

Number of wire in cable varies depending on the number of contact used.

Wiring Procedure

(1) M4 screws are used for the terminals of the converter. Each cable should be terminated corresponding to crimp-on terminals.

(2) The capacities of the contact output relay are 30 V DC 3 A, 250 V AC 3 A. Connect a load (e.g. pilot lamp and annunciator) within these limits. AC and DC voltage cannot be mixed.

5.2.8 Contact Input Wiring

The converter can execute specified function when receiving contact signals.
To use these contact signals, wire as follows:

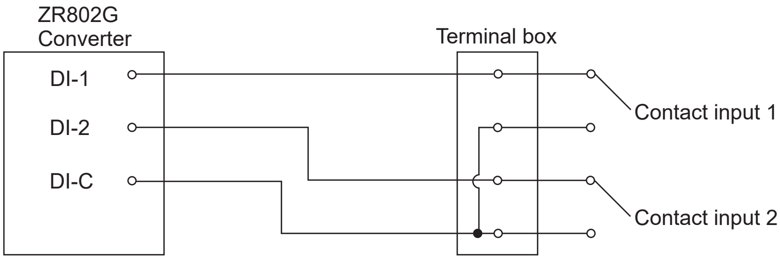


Figure 5.12 Contact Input Wiring

Cable Specifications

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

Wiring Procedure

(1) M4 screws are used for the terminals of the converter. Each cable should be terminated corresponding to crimp-on terminals.

(2) The ON/OFF level of this contact input is identified by the resistance or voltage. Connect a contact input that satisfies the specifications in Table 5.2.

Table 5.2 Identification of Contact Input ON/OFF

	Closed	Open
Resistance	200 Ω or less	100 kΩ or more
Voltage	-1 to 1 VDC	4.5 to 25 VDC

5.2.9 Wiring for ZR40H Automatic Calibration Unit

This wiring is for operating the solenoid valve for the zero gas and the span gas in the ZR40H Automatic Calibration Unit, in a system where the calibration gas flow rate is automatically controlled (e.g. System configuration 3). When installing this wiring, proceed as follows:

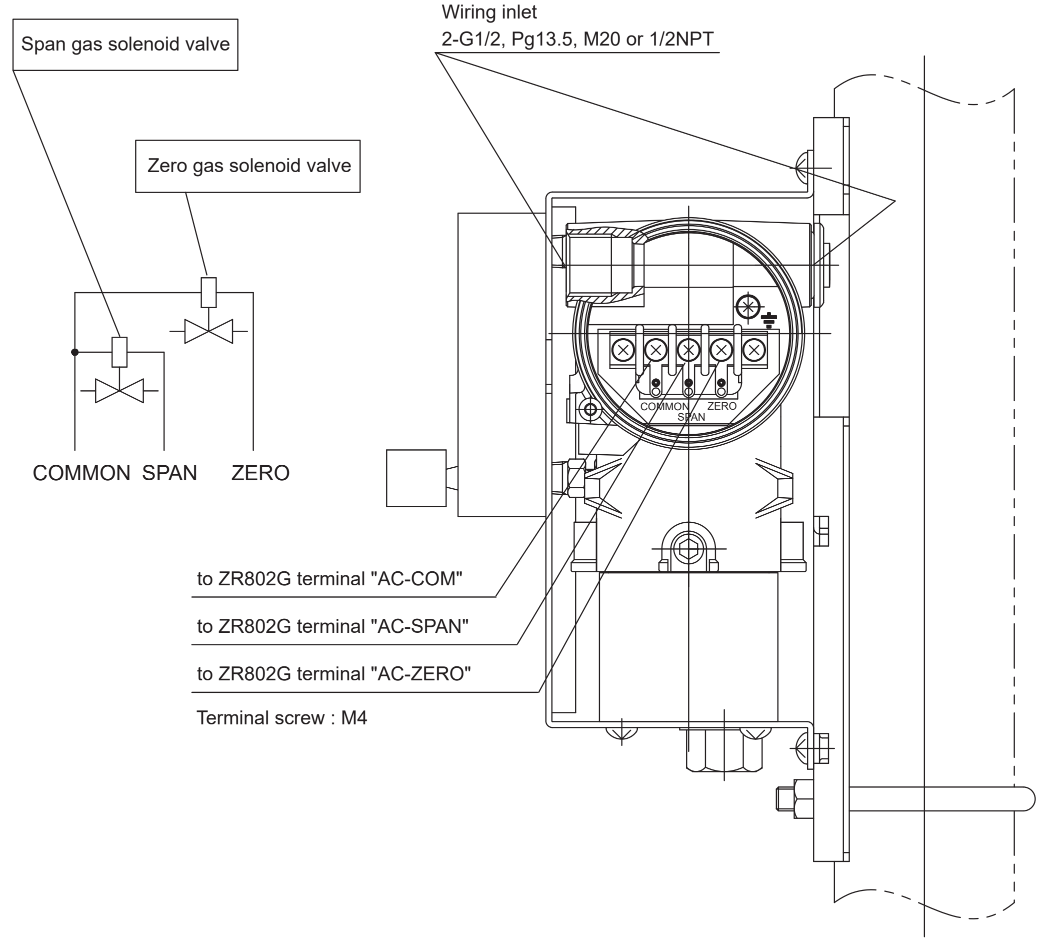


Figure 5.13 Automatic Calibration Unit

Cable Specifications

Use a 3-core cable for the above wiring.

Wiring Procedure

M4 screws are used for the terminals of the converter. Each cable should be terminated with crimp-on terminals suitable to M4 screws. M4 screws are used for the terminals of the solenoid valve as well.

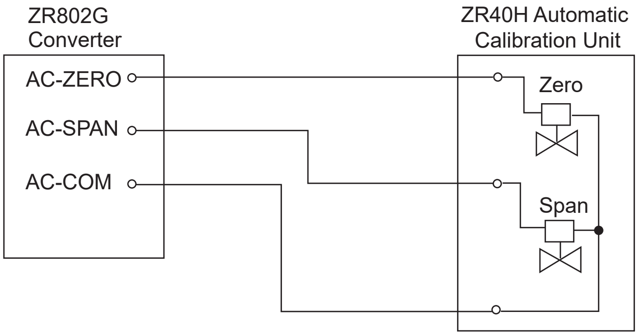


Figure 5.14 Wiring for Automatic Calibration Unit

5.2.10 Pressure or Temperature Input Wiring

(Only for Humidity Analyzer)

When inputting the measurement gas pressure or temperature from external of the equipment, connect a two-wire pressure or temperature transmitter (hereinafter referred to as transmitter). The relative humidity and dew point are acquired based on the temperature signal from the connected transmitter, in the case where the setting is "Pressure or Temperature input selected" and "external input". As for the wiring of the temperature transmitter and thermocouples, refer to appropriate temperature transmitter instruction manual.

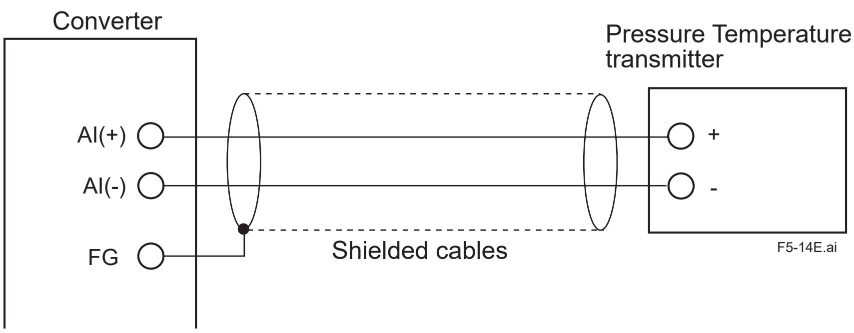


Figure 5.15 Pressure or temperature input wiring

● Applicable Temperature Transmitter

Apply a transmitter that is suit for the following interfaces:

Output signal: 4 to 20 mA DC, two-wire system (*1)

Maximum supply voltage from the analyzer: 25.2 V DC

Input resistance of the analyzer: Maximum 250 V (The load resistance of the transmitter is the total of wiring resistance and input resistance.)

(*1) When /AI is specified, the use of 4-wire transmitter eliminates the supply voltage of the transmitter. Prepare it separately.

Temperature Transmitter Burnout

When outputting a burnout signal of the temperature transmitter with a contact output of the analyzer, use "high/low-limit pressure (temperature) alarm". (Refer to Section 8.4, "Contact Output Setting.") In this case, set the burnout signal of the transmitter to exceed the high limit (20 mA or more).

Cable Specifications

Use a two-core shielded cable for wiring.

Wiring Procedure

(1) M4 screws are used for the converter terminals. Cables should be equipped with appropriate crimp contacts. Ensure that the cable shield be connected to the FG terminal of the converter.

(2) Be sure to connect "+" and "-" polarities correctly.

5.2.11 Communication wiring

ZR802G wired digital communication can be Ethernet(Modbus TCP) or RS-485 (Modbus RTU) depending on your requirements.

Be sure to use shielded cables to prevent malfunction due to external noise ad to avoid the effects of radiated noise from ZR802G on other equipment.

● RS-485 cable

Use RS-485 cable when the digital communication code-M (Modbus RTU) is selected. All RS-485 terminal screws are clamping terminals.

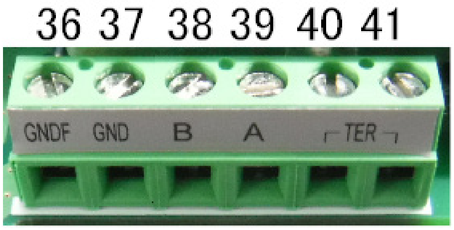


Figure 5.16 RS-485 terminal screw

Table 5.3 RS-485 Terminal Assignments

Terminal	Name	Application
36	GNDF	shield
37	GND	signal GND
38	B	data (negative electrode)
39	A	data (positive electrode)
40	TER	terminal resistor (110Ω)
41	TER	terminal resistor (110Ω)

Use a multi-core shielded cable with stranded core wires (twisted pair). The shield connects to terminal 36.

Termination resistor for signal (resistance value 110 Ω) is built-in. Perform termination according to the communication environment.

When terminating, connect terminals 40 and 41 using a jumper as shown in Figure 5.17.

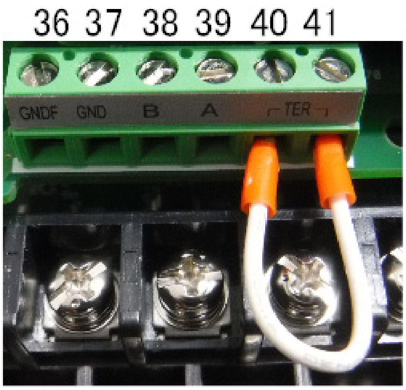


Figure 5.17 How to terminate RS-485

● Ethernet cable

Use Ethernet cable when the digital communication code -E (Modbus TCP) is selected. RJ45 connectors are provided in the positions shown in Fig. 5.18.

Insert a Category 5 or higher STP cable (shielded cable) into RJ45 connector. Both straight and cross connection is available for cable connection.

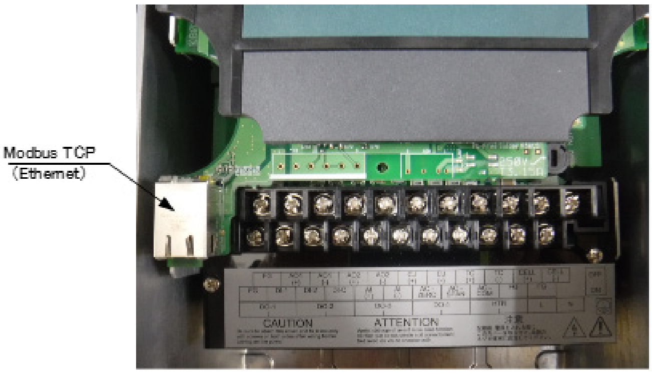


Figure 5.18 Ethernet connector position

6. Components

In this Chapter, the names and functions of components are described for the major equipment of the Zirconia Oxygen/Humidity Analyzer, Converter.

In the figure listed in this manual, the example of the oxygen analyzer is shown mainly.
In the case of the humidity analyzer, unit indication may be different. Please read it appropriately.

6.1 ZR22G Detector

6.1.1 General-purpose Detector (except for ZR22G-015)

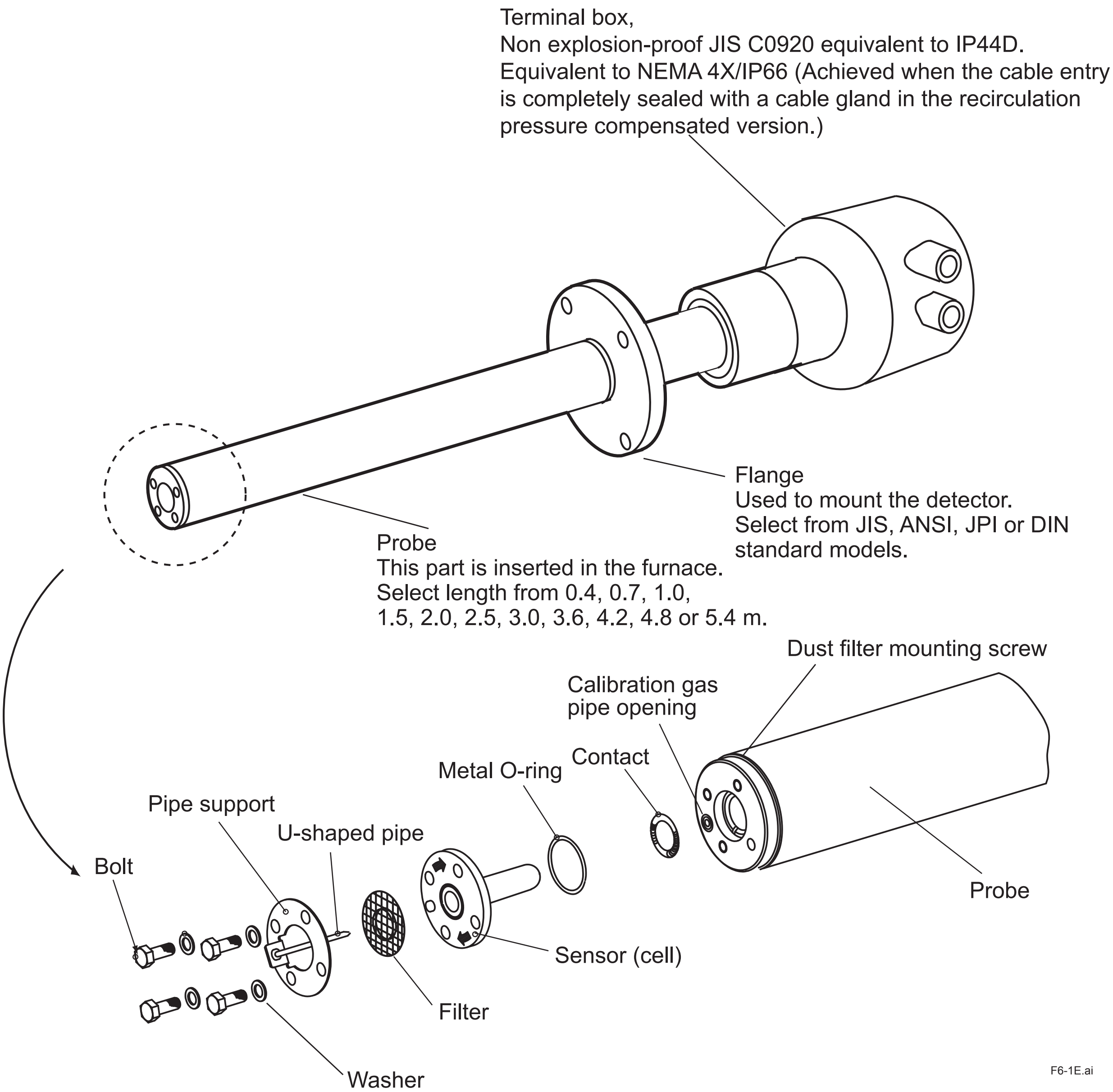


Figure 6.1 General-purpose Detector

6.1.2 High Temperature Detector (ZR22G-015)

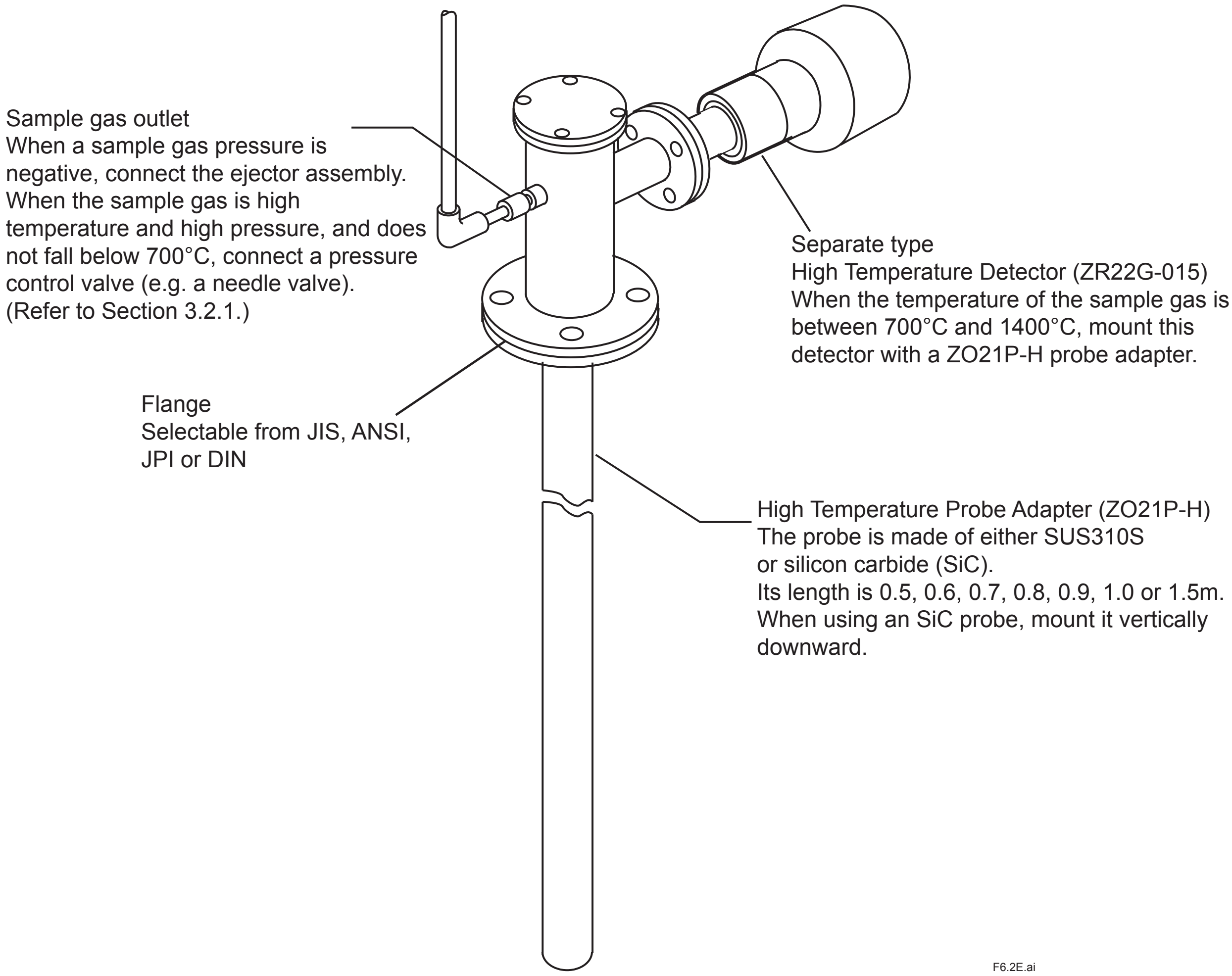


Figure 6.2 High Temperature Detector

6.2 ZR802G Converter

Operation panel

- LCD touch screen
- It is an easy-to-understand Japanese Display.
- You can operate while interacting with screen
- Various Display modes are available
- LCD with backlight for visible darkness
- Alarm code is displayed in addition to the alarm number.
- You can manage security with a password.

Touch panel display Display examples

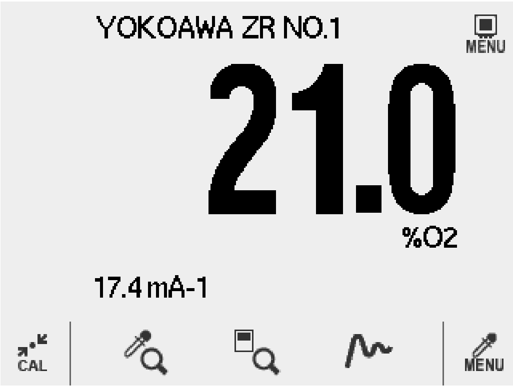


Figure 6.3 Home screen example

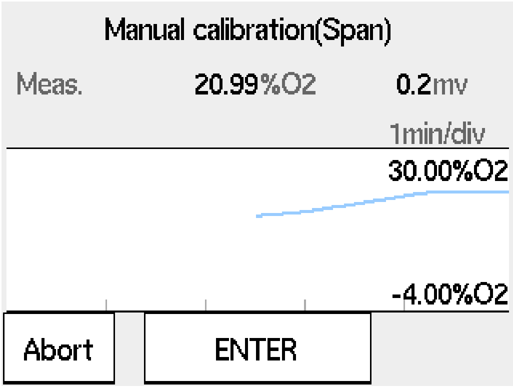


Figure 6.4 Trend screen

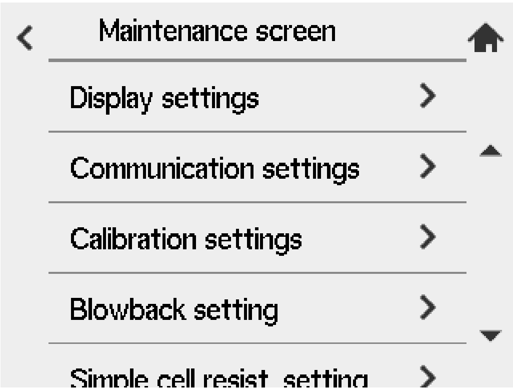


Figure 6.5 Data display setting example.

Self-diagnose leads to a remedy.
When a trouble occurs, an alarm is displayed on LCD.

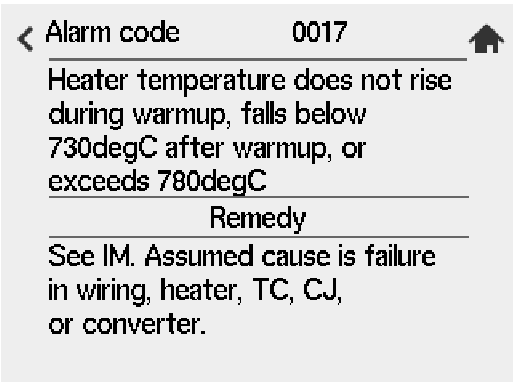


Figure 6.6 Alarm description example

6.3 Touchpanel Switch Operations

6.3.1 Home screen and icons

ZR802G adopts touch screen type which is operated by pressing the display. Fig. 6.3 shows the home screen. Icons displayed on the screen depend on setup and device status.

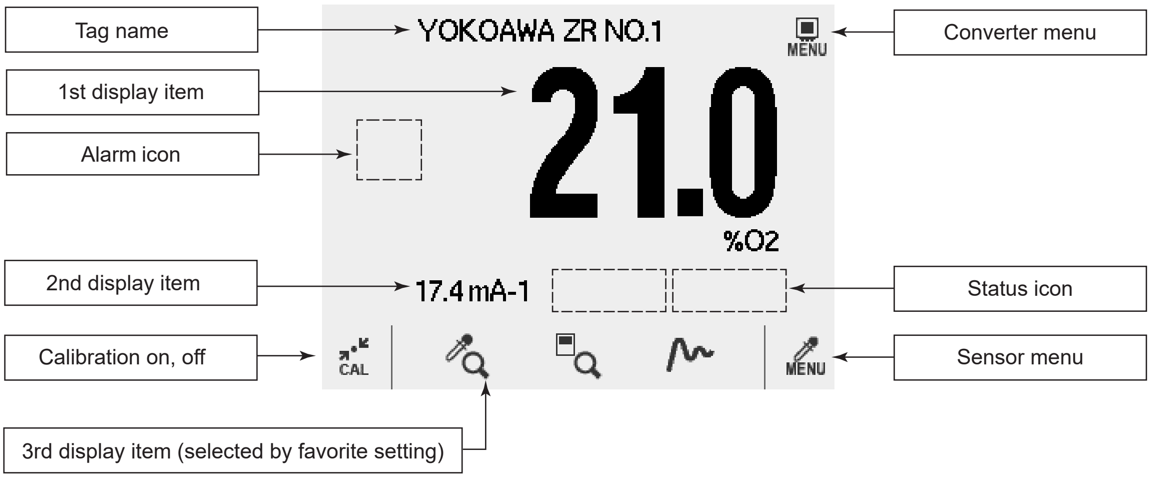


Figure 6.7 Home screen

Tag name: A setup tagname is displayed here. (See Section "10.4.4 Entering Tag Names")

1st to 3rd display item: Selected item is displayed. You can place a shortcut you select in the favorite setting. (See Section "7.9 Setting Display Item")

Shortcut icon

Sensor detail	Converter detail	Trend
Blowback	Set up	Save load
Maintenance	Restart	Simple cell resistance measurement

Alarm icon Display area:

Alarm icon is displayed here.

Press the area that the icon indicates to see the description of each alarm.

Fault icon	Alarm icon , , ,

See Section “10.4.2 NE107 mode”.

Status Display icon area: Icons are displayed depending on the device status. Some can be interrupted by pressing the corresponding icon.

Status	Left Display	Right Display	Priority	Interruption
Purging in progress (before warm-up	PURGE		High	×
Warm-up	WARM			×
Calibration in progress	CAL *1			O
During blowback	BLOW *1			O
Simple cell resistance measurement in progress	CELL *1			O *2
AO hold in progress		HOLD		×
AO switch range in progress		RANGE	Low	×

*1 While the icon is blinking, the status is being stabilized.
*2 The operation can be interrupted only while the icon is blinking.

6.3.2 Screen flow

Figure 6.8 shows the screen flow chart. You can move to each setting, execution or confirmation screen from “Converter menu”, “Sensor menu” on Home screen. [Home] returns to Home screen from any screen.

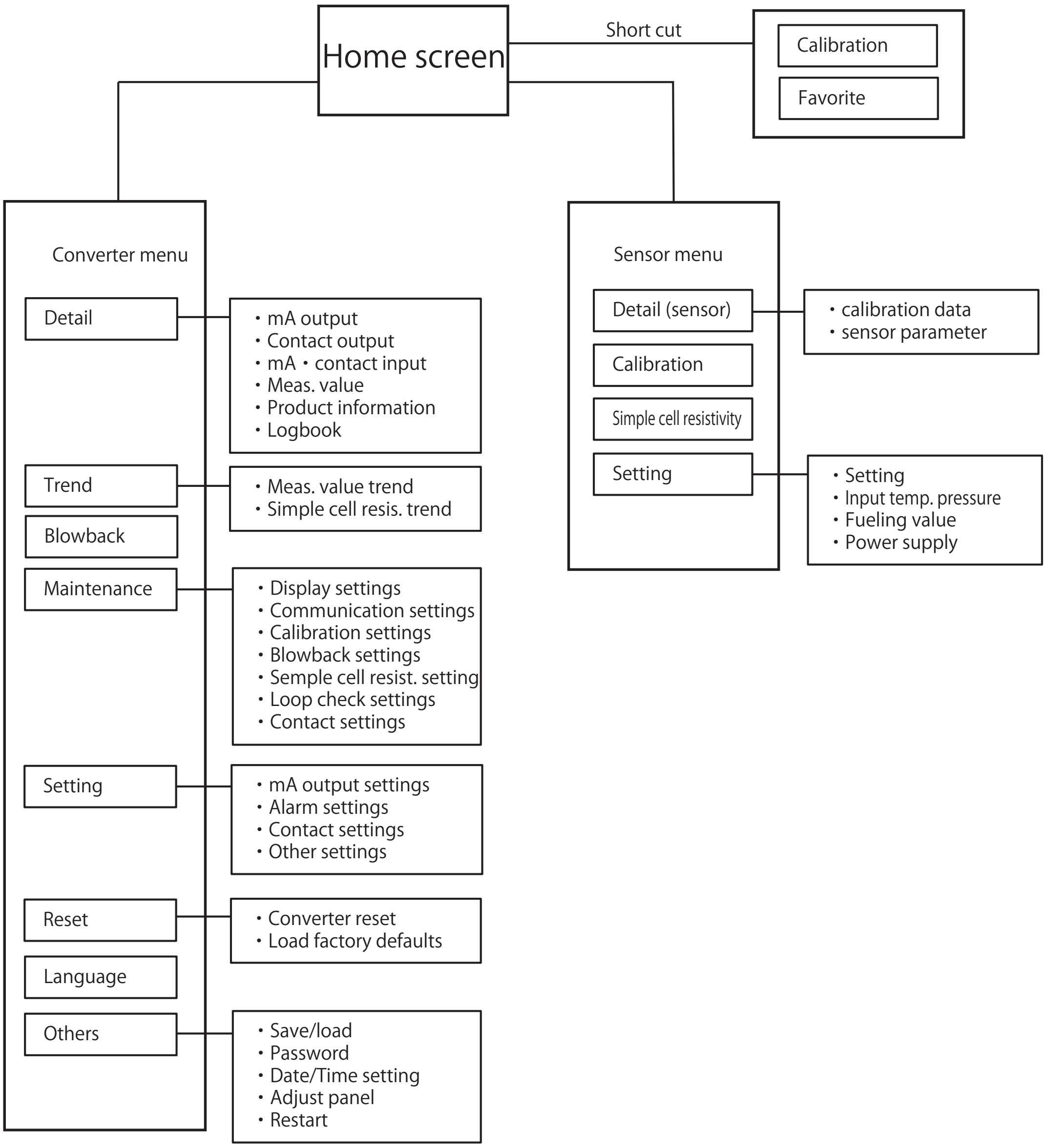


Figure 6.8 Screen flow chart

6.3.3 Functions on screens

(1) Home screen:
Displays three value of each selected item. See Section “7.9 Setting Display Item”. Icons are displayed to indicate alarm or status of the device.

(2) Converter menu:
Calibration, Maintenance, Setting and other items are displayed.

(3) Sensor menu:
This allows you to view such detailed data as the cell (sensor) electromotive force, cell (sensor) temperature etc..See Section “10.1 Detailed-data Display”

6.3.4 Entering Numeric and Text Data

When you enter a password, for instance, which uses text, numeric data or symbols, first an alphabetic entry screen appears.

Pressing the [123] key changes the numeric value entry screen and allows you to enter a numeric value. You can also press [#@&] to switch to symbolic screen and enter symbols. The only screen that can enter numeric values is the numeric entry screen.

Two to three alphabets and symbols are assigned to each key. Press the key several times to select character. When the desired character is turned at the cursor position, you can enter it by pressing the [→] key or another character key. After entering the numeric value and text, press [↵] to exit the entry screen. To return without inputting, key screen upper left [<] button

.

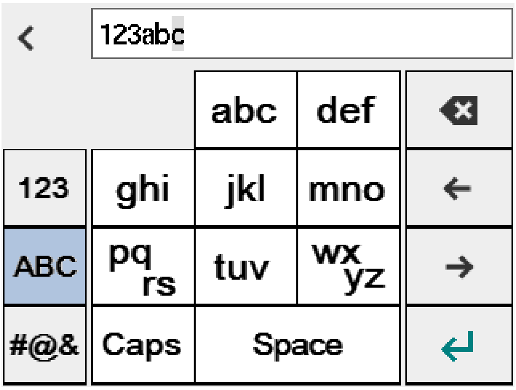


Figure 6.9 Text-data Entry

6.3.5 Navigation

Main navigation icons are as follows.


Returns to Home screen.

Displays Converter Menu screen

Displays Sensor Menu screen.


Returns to a previous screen.


Moves the cursor for selecting the menu item. Tap the icon to move the cursor up/down. Some pages may continue.


Switches screen


Saves data. Overwrites setting data. Fixes selected menu items or setup. After changing setup data, touch this button to save and fix the data.

6.4 ZA8F Flow Setting Unit, ZR40H Automatic Calibration Unit

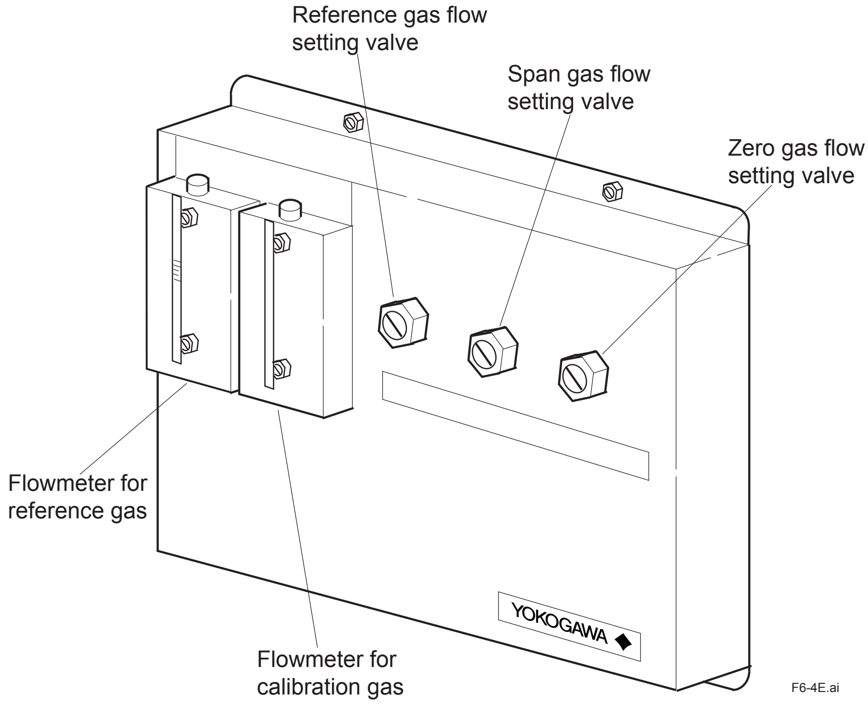


Figure 6.10 ZA8F Flow Setting Unit

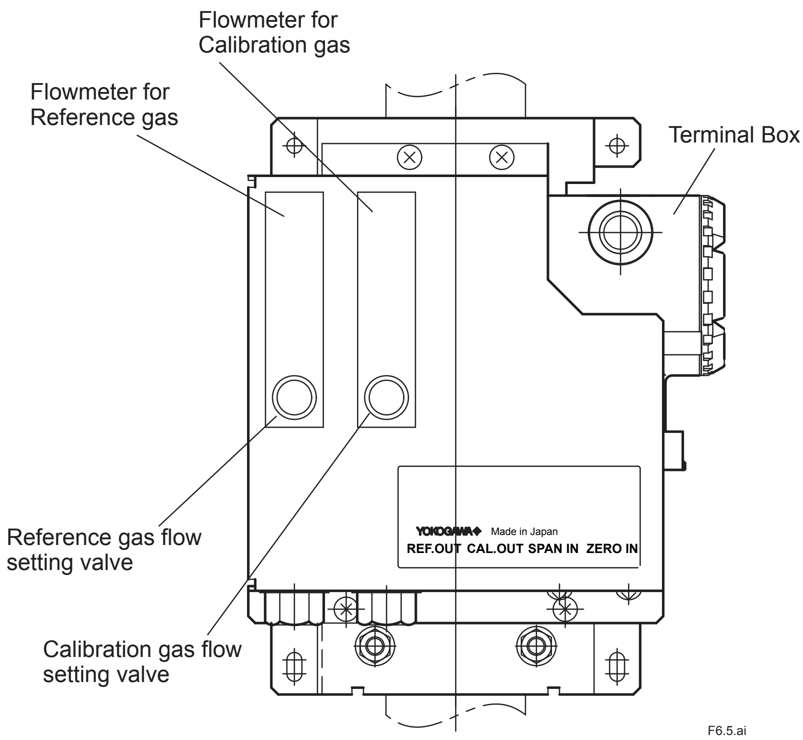


Figure 6.11 ZR40H Automatic Calibration Unit

7. Startup

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

System tuning by the HART communicator, refer to IM11M12A01-51E " HART Communication Protocol ".

In the figure listed in this manual, the example of the oxygen analyzer is shown mainly.
In the case of the humidity analyzer, unit indication may be different. Please read it appropriately.

7.1 Startup Procedure

The startup procedure is as follows:

CAUTION

If you connect Model ZO21DW detectors, then you need to change the detector parameters.

Before connecting power, refer to: Section 7.6 Confirmation of Detector Type Setting.

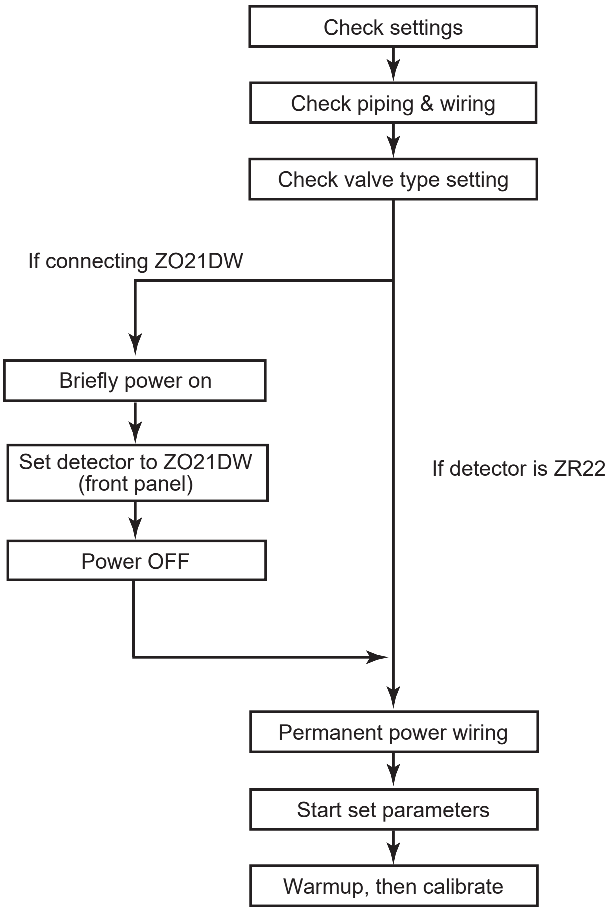


Figure 7.1 Startup Procedure

7.2 Checking Piping and Wiring Connections

Check that the piping and wiring connections have been properly completed in accordance with Chapter “4. Piping” and Chapter “5. Wiring”

7.3 Checking Valve Setup

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

(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 equals sample gas pressure plus approx. 50 kPa (or sample gas pressure plus approx. 150 kPa when a check valve is used, maximum pressure rating 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.

7.4 Supplying Power to the Converter

CAUTION

To avoid temperature changes around the detector, it is recommended that (rather than turning it on and off) power be continuously supplied to the Oxygen 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 7.2, 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 sample 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 7.3. This is called Home screen.

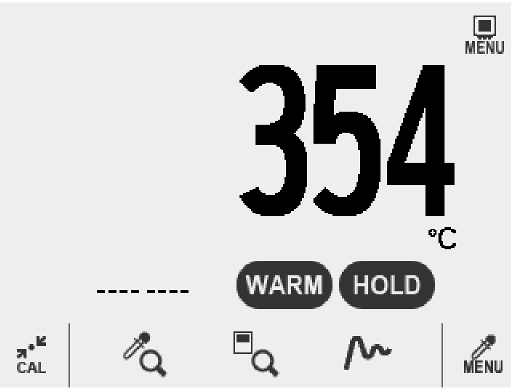


Figure 7.2 Display During Warm-up

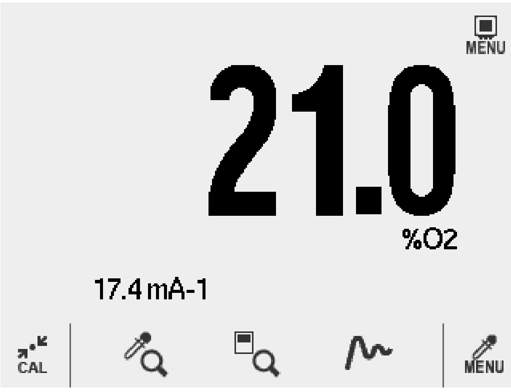


Figure 7.3 Measurement Mode Display

7.5 Confirmation of Converter Type Setting

This converter can be used for both the Oxygen Analyzer and the Humidity Analyzer.
Before setting the operating data, be sure to check that the desired converter model has been set.

CAUTION

If the converter type setting is changed, the operating data that have been set are initialized and the default settings remain.

(1) Press the [Converter menu] key.

(2) Select [Reset] > [Model setting].

(3) Confirm the displayed product model is one presently being used. When the specification for an High Temperature Humidity Analyzer is designated at order, High Temperature Humidity Analyzer is preset at the factory shipment.

(4) To change model, press [Oxygen model] or [Humidity model]. After changing the model, press [Execute].

(5) If a converter model is changed after setting the operating data, the entered data are initialized. Enter again the operating data to meet the model to use.

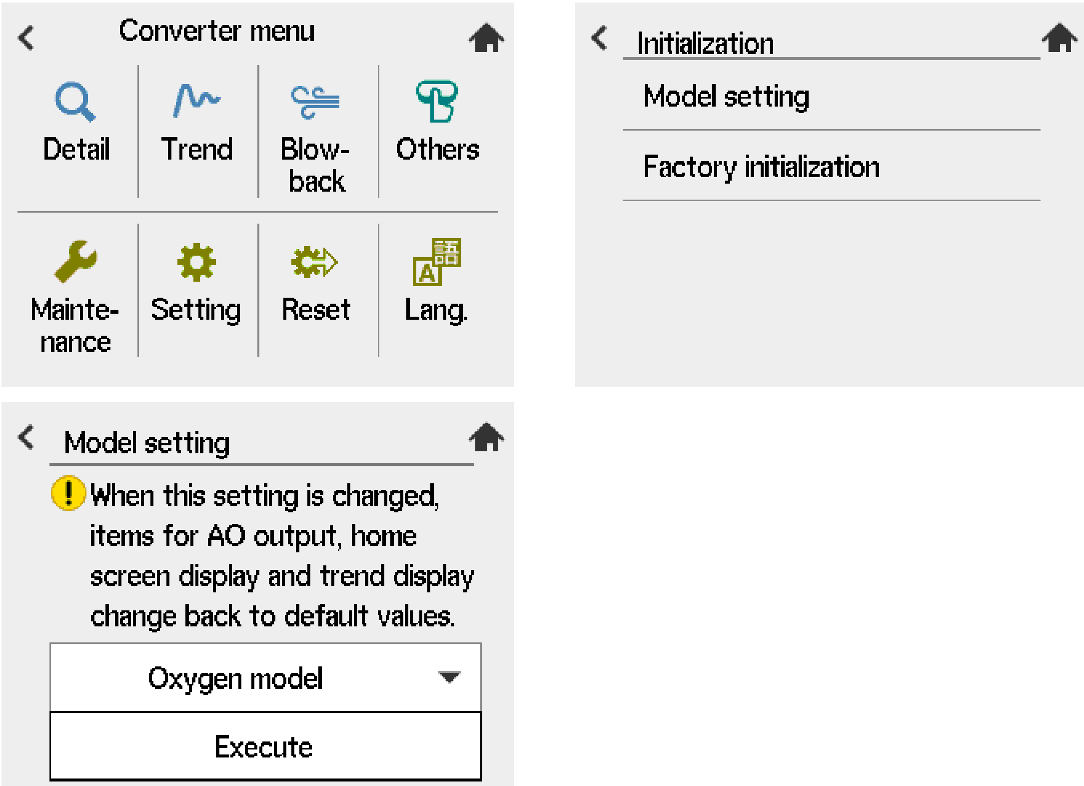


Figure 7.3 Equipment Setup

7.6 Confirmation of Detector Type Setting

(1) Press the [Sensor menu] key.

(2) Select [Setting] > [Setting].

(3) Confirm ZR22 (PT1000:Ohm) is selected as sensor. Factory default is ZR22.

(4) To change detector, press [Selection of detector]

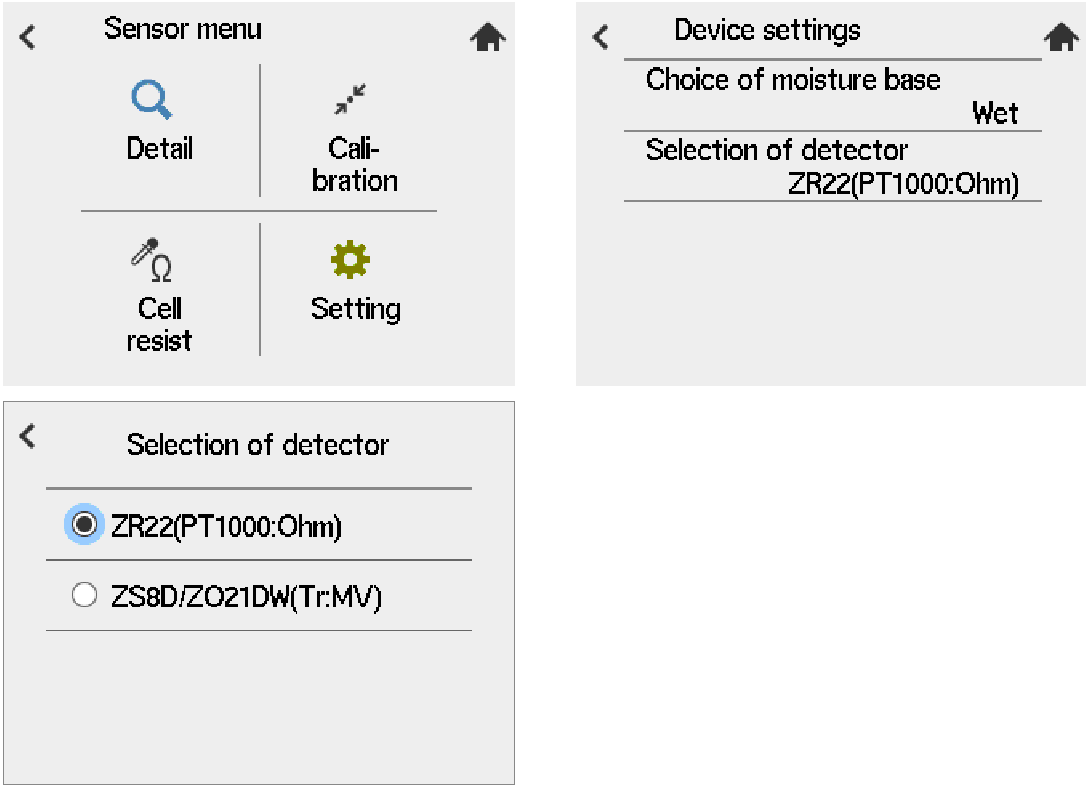


Figure 7.4 Selection of detector

CAUTION

If sensor/detector settings are to be changed, first disconnect the wiring connections between the sensor/detector and the converter. Then change detector settings appropriately.

7.7 Selecting moisture base

Only for Oxygen Analyzer.

Combustion gas contains water vapor generated by hydrogen combustion in the fuel. Therefore, if this water vapor is removed, the oxygen concentration at this time shows a higher value than when water vapor is contained. Here, you can specify whether to use the value in wet gas as the measured oxygen concentration value, or arithmetic and use it as the value in dry gas.

If you select "Choice of moisture base" in screen of the 7.6, the window "Wet", "Dry" to select. The factory default is "Wet".

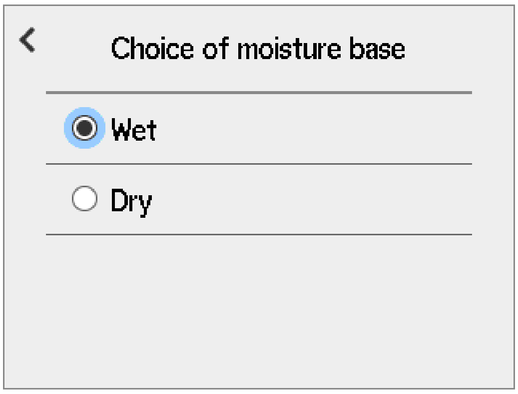


Figure 7.5 Choise of moisture base

7.8 Output Range Setting

This section sets forth analog output range settings. For details, consult Section "8.1 Current Output Setting", later in this manual.

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

To set the minimum and maximum current settings, follow these steps:

(1) Select the "Setting" from Converter menu.

(2) Select "mA-output settings".

(3) Select "mA-output1".

(4) On "Selection of AO1 Oxygen concentration" enter "4mA point" and "20 mA point"

(5) Set "mA-output2" in the same manner as steps above.

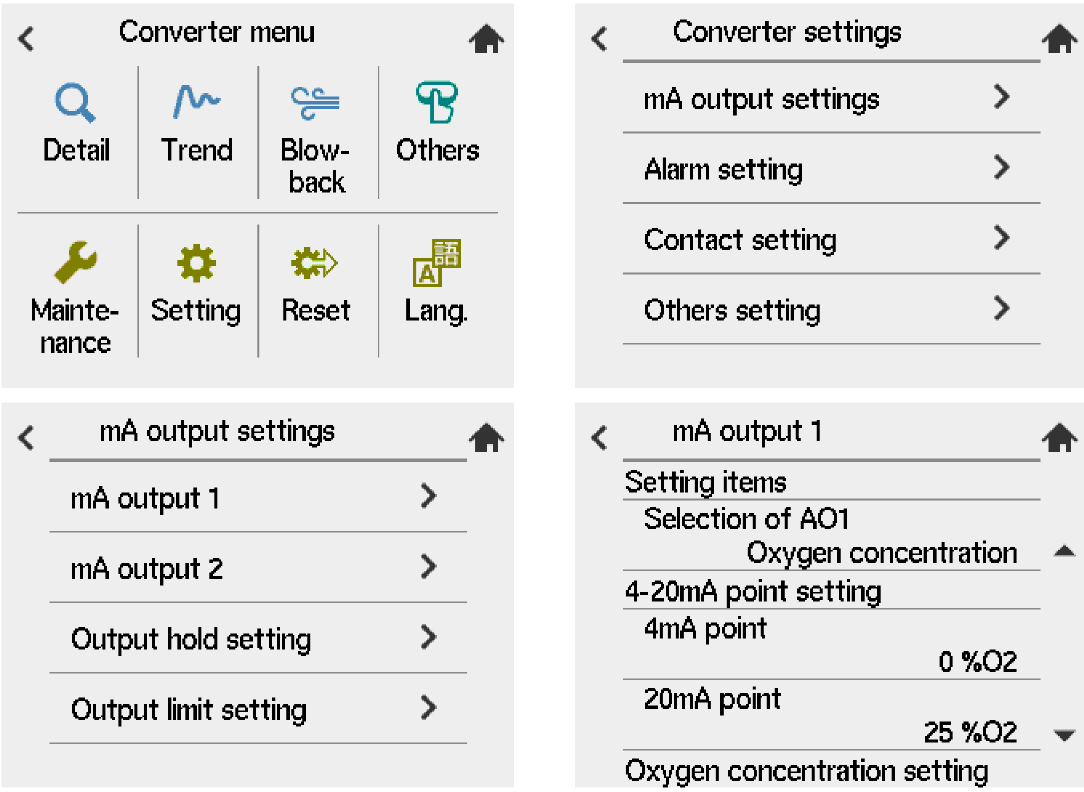


Figure 7.6 Setting "mA-output"

NOTE

Each setting is limited in value. See "8.1 Current Output Setting" for details.

7.9 Setting Display Item

7.9.1 Oxygen Analyzer - Setting Display Item

This section briefly describes the Home screen item shown in Figure 7.7

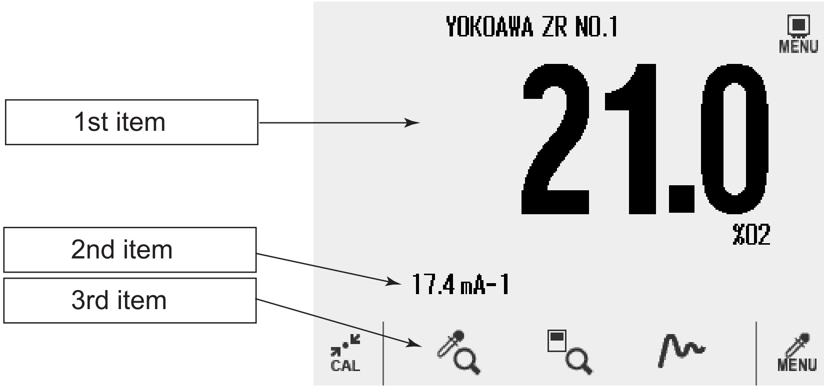


Figure 7.7 Home screen

(1) [Converter menu] > [Maintenance]

(2) Select the "Display settings".

(3) Select "Display item". Select "1st display item" selection. A window opens to select an item to display.

(4) Repeat the steps as shown above to setup 2nd or 3rd display item selection.

(5) Table 7.1 shows display Items that enable the selection of display items in individual display areas.

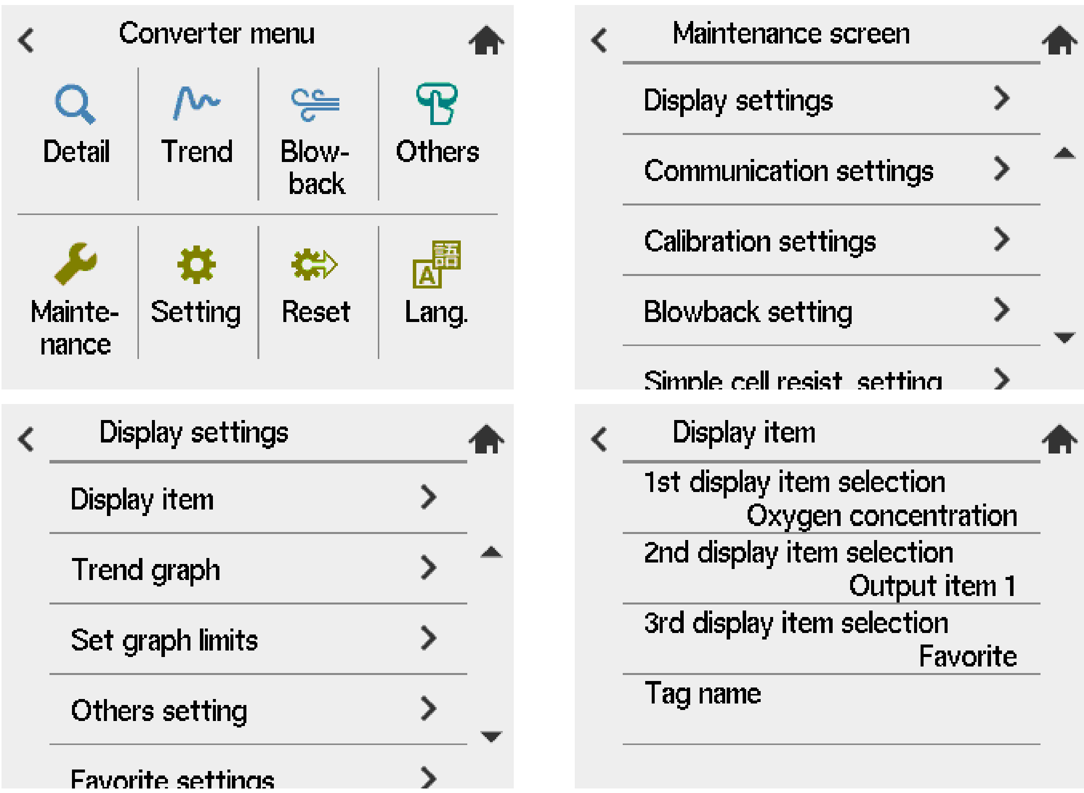


Figure 7.8 Setting Display Item

Table 7.1 Display Items

Item	1st display item	2nd, 3rd display item	Display
Oxygen concentration	○	○	Oxygen concentration during measurement
Air ratio		○	Current computed air ratio
Moisture content		○	Moisture content (%H_2O) in the exhaust gas
Output item 1	○	○	Oxygen concentration with the equipment set for oxygen analyzer (See *1 below.)
Output item 2	○	○	Oxygen concentration with the equipment set for oxygen analyzer (See *1 below.)
AO output 1		○	Current value output from analog output 1
AO output 2		○	Current value output from analog output 2
Favorite		○ 3rd display item only	

*1: If an analog output damping constant is set, the oxygen concentration display then includes these settings.

● Favorite settings

(1) "Display settings" > "Favorite settings"

(2) "Favorite settings" can have up to four items.

Figure 7.9 Favorite settings

● About the Air ratio:

“Air ratio” is defined as the ratio of (the amount of air theoretically required to completely burn all the fuel) to (the amount of air actually supplied).

For this equipment, the air ratio will be obtained in a simplified way by measuring the oxygen concentration in the exhaust gas. The air ratio may be expressed mathematically by:

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

If you use the air ratio data for estimating the combustion efficiency, etc., check that no air is leaking in beforehand and that the measured value has not been affected by any interference gas (CH_4, CO, H_2, etc.).

● About moisture content:

The moisture content in the exhaust gas is calculated based on the parameters of the fuel setting (refer to Section "8.7.3 Setting Fuels"). The moisture content may be expressed mathematically by:
Moisture content = {(water vapor content per fuel unit quantity) + (water content in air)}/ total amount of exhaust gas

$$= \{ Gw + (1.61 \times Z \times Ao \times m)\} / \{ X + (Ao \times m)\}$$

where,

Gw = water vapor content in exhaust gas, m^3/kg (m^3/m^3)
Z = Ambient absolute humidity, kg/kg
Ao = Ideal air amount, m^3/kg (m^3/m^3)
m = Air ratio
X = Fuel coefficient

For details on each parameter, refer to Section "8.7.3 Setting Fuels".

7.9.2 Humidity Analyzer - Setting Display Item

When the humidity analyzer was specified at the time of purchase, the 1st display item has been set at "Humidity" at the time of factory shipment. To change the setting of display item, read "7.9.1 Oxygen Analyzer - Setting Display Item".

Table 7.2 Display Items

Item	1st display item	2nd, 3rd display item	Display
Oxygen concentration	○	○	Oxygen concentration during measurement
Humidity	○	○	Humidity (%H_2O) in the exhaust gas
Mixing ratio	○	○	Mixing ratio during measurement
RH	○	○	Relative humidity calculated from the measured value
Dew point		○	Dew point calculated from the measured value
Output item 1	○	○	Item that is set in mA output1 (*)
Output item 2	○	○	Item that is set in mA output2 (*)
AO output 1		○	Current value output from analog output 1
AO output 2		○	Current value output from analog output 2
Favorite		○ 3rd display item only	Up to four of the following shortcuts can be displayed to the Home screen. Detail (sensor), Detail (converter), Trend, Blowback (execute), Setting (converter setting), Maintenance Face, Save load, Reset, Simple Cell Resistance Measure

*: If an analog output damping constant is set, the oxygen concentration display includes these settings.

NOTE

For the relative humidity and dew-point calculations, appropriate operation parameters should be entered. For details on the parameters, see Section "8.7.5 Setting Measurement Gas Temperature and Pressure".

7.10 Checking Current Loop

The set current can be output as an analog output.

(1) "Converter menu" > "Maintenance"

(2) Select "Loop check setting".

(3) Set AO1 test output, AO2 test output on "Loop check setting".

(4) Select "Test validity AO1/AO2". Check an item to enable. Press the save icon to store the data.

(5) Press the save icon on the Loop check setting. Preset current starts to output.

(6) When you exit the maintenance screen, Test validity AO1/AO2 turns off.

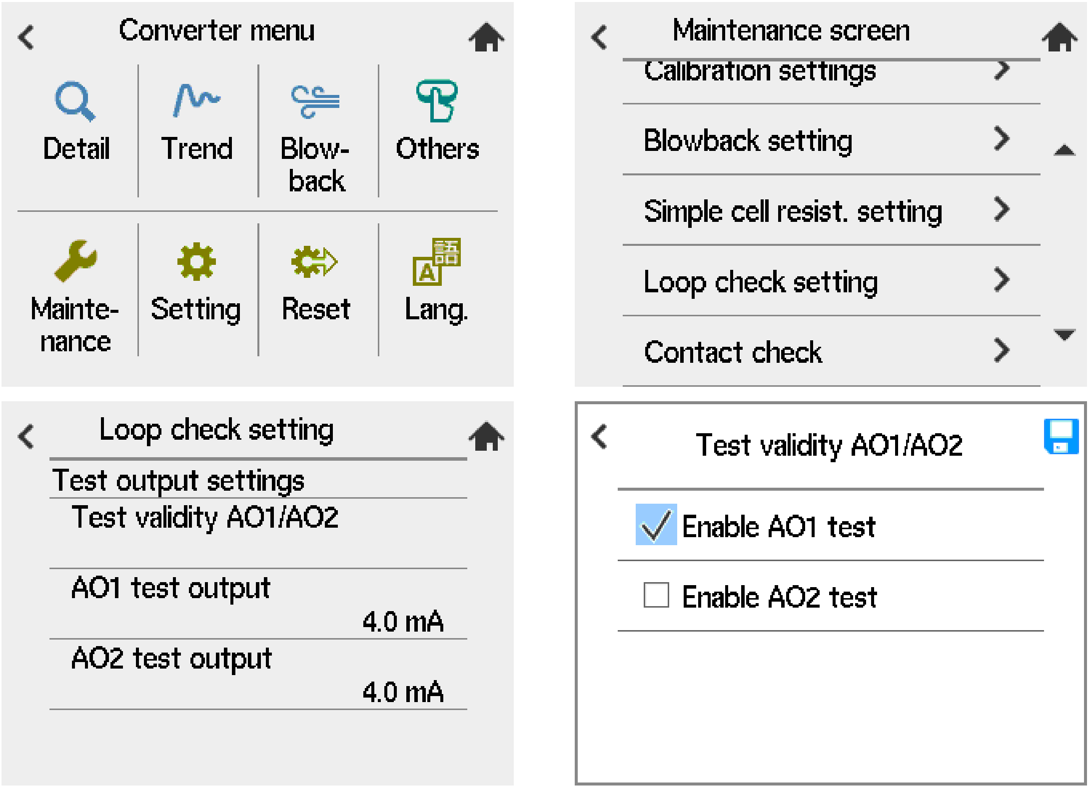


Figure 7.10 Current loop check

7.11 Checking Contact I/O

Conduct the contact input and output checking as well as operational checking of the solenoid valves for automatic calibration.

7.11.1 Checking Contact Output

To check the contact output, follow these steps:

(1) "Converter menu" > "Maintenance"

(2) Select "Contact check".

(3) Select "Contact output" on the "Contact check".

(4) On the "Contact output", select "Test output DO1 to DO4" and check on the test output. Press the save icon and fix the item.

(5) On the "Contact output", select "Test validity DO1 to DO4" and check on the test validity output .Press the save icon and fix the selection of test validity.

(6) Press the save icon on “Contact output” to output the setup data.

(7) When you exit the maintenance screen, test validity of DO1 to DO4 becomes OFF.

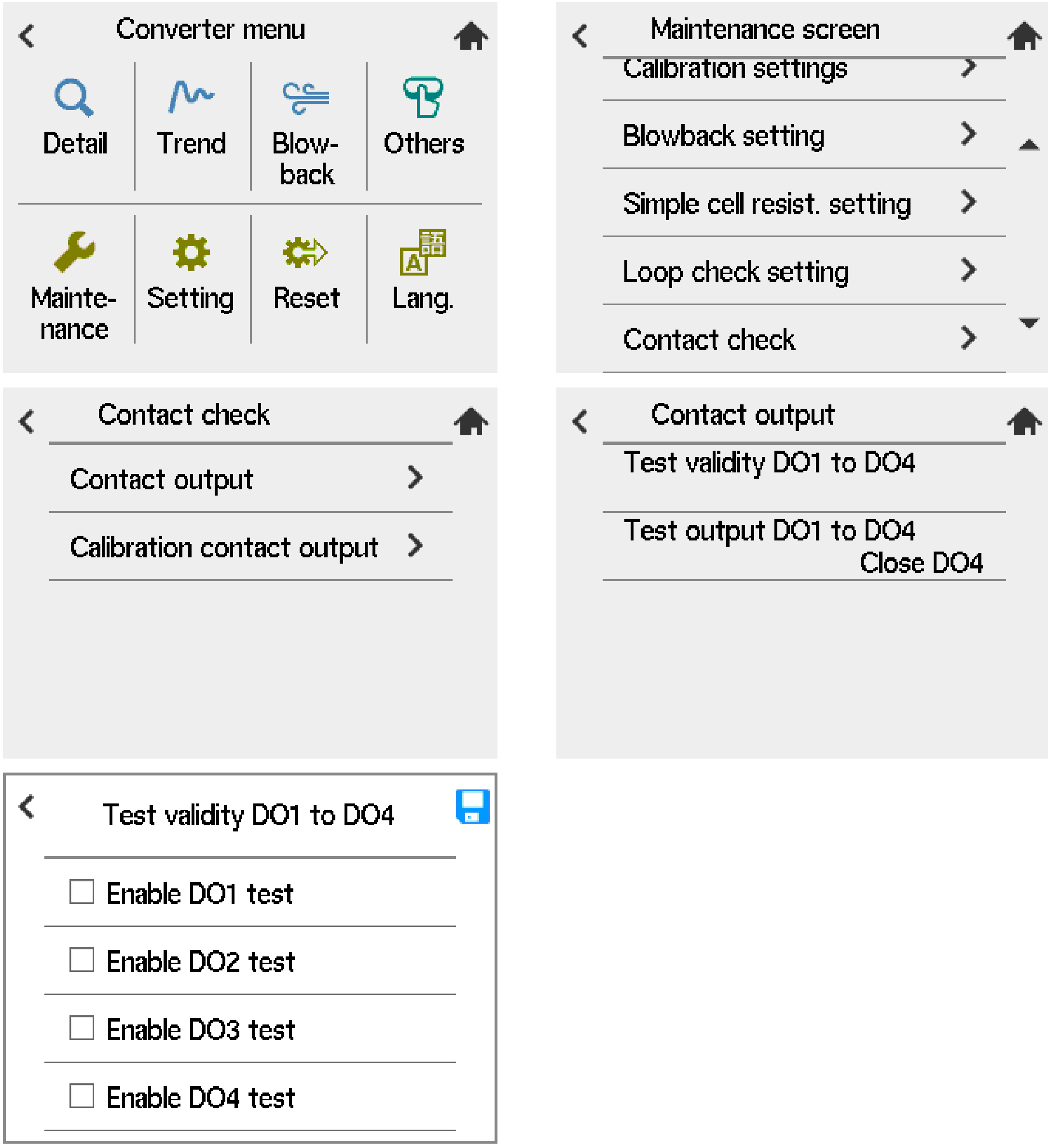


Figure 7.11 Contact output check

CAUTION

If you conduct an open-close check for contact output 4, Alarm 016 or Alarm 017 will occur. This is because the built-in heater power of the detector, which is connected to contact output 4, is turned off during the above check. So, if the above alarm occurs, reset the equipment or turn the power off and then back on to restart (refer to Section “10.10 Reboot”).

7.11.2 Checking Calibration Contact Output

The calibration contacts are used for solenoid valve drive signals for the ZR40H Automatic Calibration Unit. When using the ZR40H Automatic Calibration Unit, use the calibration contact output to check that the wiring connections have been properly completed and check equipment operation.

(1) "Converter menu" > "Maintenance menu"

(2) On Maintenance menu, select "Contact check".

(3) Select "Calibration contact output".

(4) On "Calibration contact output" select "Test output cal. contact". Check on test to output and press the save icon to fix the item.

(5) On "Calibration contact output", select "Test validity cal. contact". Check on test to make valid and press the save icon to fix the item.

(6) Press save icon to output the setup data.

(7) When you exit the maintenance screen, test validity of cal. contact becomes OFF.

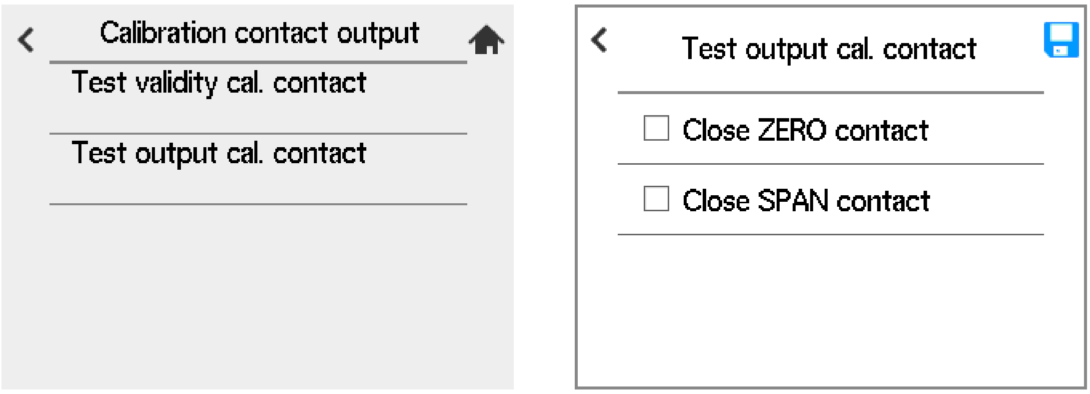


Figure 7.12 Output Contact Check Display

CAUTION

"Open" and "Closed" displayed on the Calibration contacts display indicate actions of drive contacts and are opposite to the valve open and close actions. If "Open" is displayed on the Calibration contacts display, no calibration gas flows. If "Closed" is displayed on that display, calibration gas flows.

7.11.3 Checking Input Contacts

(1) "Converter menu" > "Detail"

(2) Select "Input value". "ON" or "OFF" on the display refers to the present status of the contact input terminal. The ON/OFF switches according to the contact open/close status so that you can check whether the wiring or the operation is performed properly.

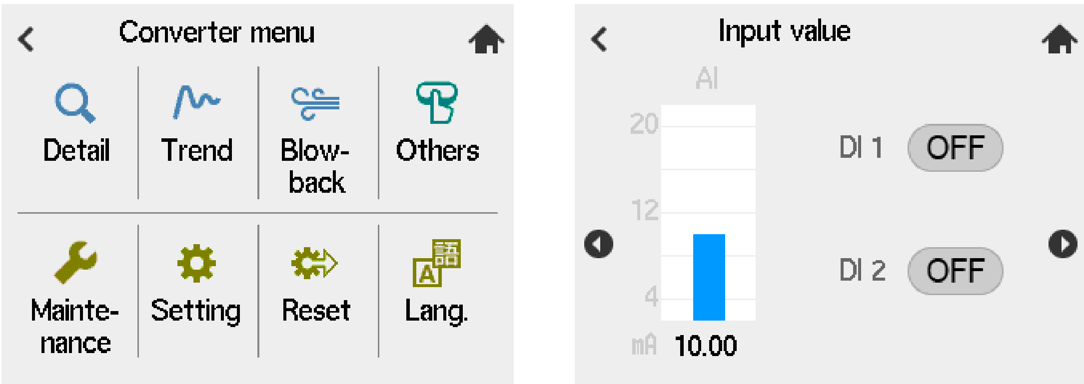


Figure 7.13 Input Contact Check Display

7.12 Calibration

To calibrate this instrument, the procedure is to measure zero gas and span gas and set the instrument to read the known concentrations. The procedure for both zero and span calibration, or for either zero or span calibration, can be performed manually from the touch display, or can be performed semi-automatically using contact signal inputs to start calibration, (allowing preset calibration and stabilization times), or it can be performed automatically 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 ZR40H 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.

7.12.1 Calibration Setup

“Converter menu” > “Maintenance” to go to Maintenance screen.

Select “Calibration settings”. Select “Calibration mode” then a window opens. Select “Manual”, “Semi-automatic”, “Automatic, semi-automatic.” Here select “Manual.”

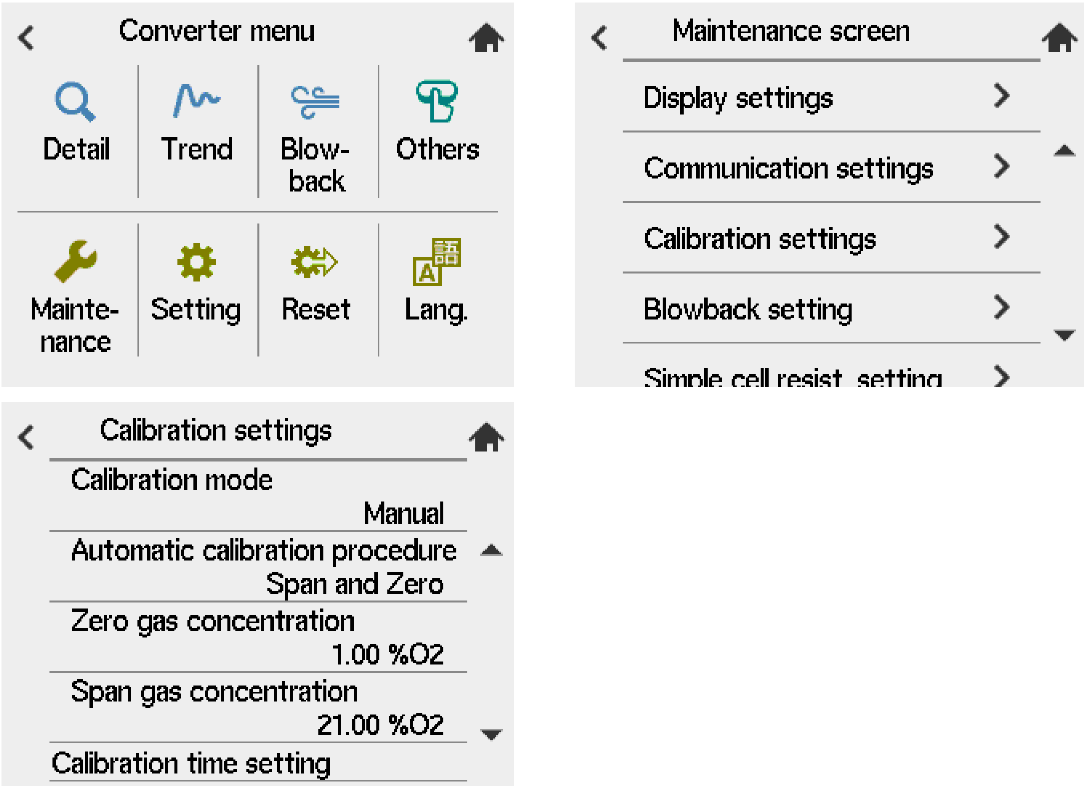


Figure 7.14 Calibration Setup Display

Calibration Gas Concentration Setting

(1) Zero gas concentration
“Calibration settings” > “Zero gas concentration” On the numeric-data entry page, enter an oxygen concentration value for the zero gas calibration.

(2) Span gas concentration

“Calibration settings” > “Span gas concentration”. On the numeric-data entry page, enter an oxygen concentration value for the span gas to use for the calibration.

If instrument air is used, enter 21 vol%O_2 value. When using the ZO21S Standard Gas Unit (for use of the atmospheric air as a span gas), use a portable oxygen analyzer to measure the actual oxygen concentration. Enter the gained value.

CAUTION

- If instrument air is used for the span gas, dehumidify to a dew point of -20°C or less to remove oil mist and dust before use.
- Insufficient dehumidification or use of dirty air may affect measurement accuracy.

7.12.2 Manual Calibration

Preparing for calibration Implementation

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

ZH40H Automatic calibration unit can perform manual calibration in the same way. ZR40H valves (solenoid valve) open and close in conjunction with screen.

Calibration operating instructions assume that the same instrumentation air as the reference gas is used as the span gas

(1) Home screen > “Calibration” > “Manual calibration” “Span”

■ Calibration Procedures

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:

(1) Press the [Setup] key in the Basic panel display to display the Execution/Setup display. Then select “Calibration” in the Execution/Setup display.

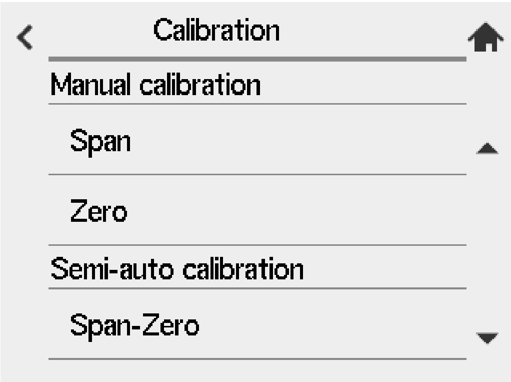


Figure 7.15 Manual calibration steps

(2) When "Span" is selected, screen of the span gas concentration is displayed. Check that the oxygen concentration value of the span gas on screen matches the oxygen concentration value of calibration gas to be actually used, and then select "Next"

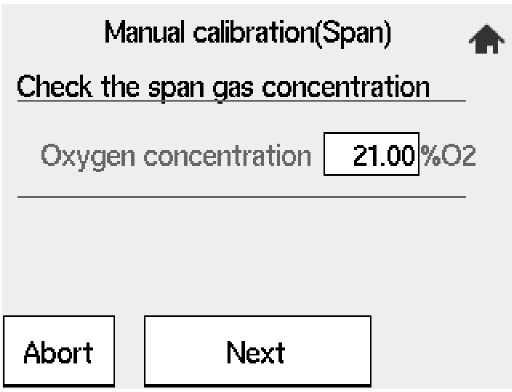


Figure 7.16 Span gas concentration check

(3) After the message of Figure 7.17 appears, feed the span gas to follow the message. Open the span gas flow setting valve and adjust the flow rate to The Manual calibration display shown in Figure 7.29 then appears. Check that the oxygen concentration for the span gas in this display coincides with the oxygen concentration in the calibration gas actually used. If the check results are assumed to be OK, select “Next” in the Manual calibration display.

(3) Follow the display message in Figure 7.30 to turn on span gas flow. Open the span gas valve for the flow setting unit and adjust flow rate to 600 ± 60 ml/min . For the valve, loosen the lock nut and slowly turn the valve shaft counterclockwise. Flow rate is checked with calibration gas flowmeter.

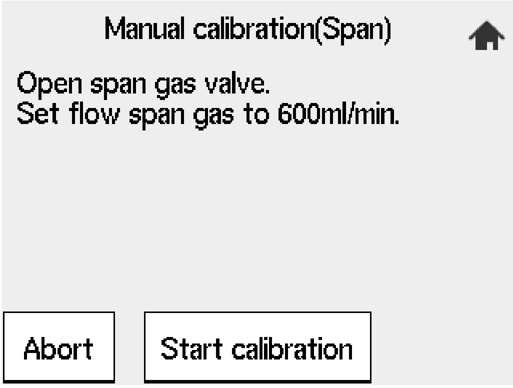


Figure 7.17 **Span gas Flow Display**

(4) Selecting “Start calibration” displays the trend graph of the oxygen concentration being measured (Fig. 7.18) on screen. Wait for the reading to stabilize around 21% by monitoring the graph and the sensor electromotive force. At this point, calibration is not yet executed. It is acceptable for the reading to deviate from 21%.

(The vertical and horizontal scales of the graph are static.)

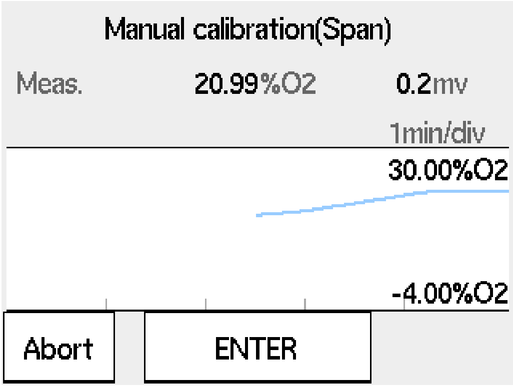


Figure 7.18 **Trend during Span gas calib.**

(5) After the measured value has stabilized, press the [Enter]. The screen of Figure 7.19 appears. At this point, the measured value is corrected to equal the span gas concentration setting. Close the span gas flow valve. The valve lock nut should be tightened completely so that the span gas does not leak.

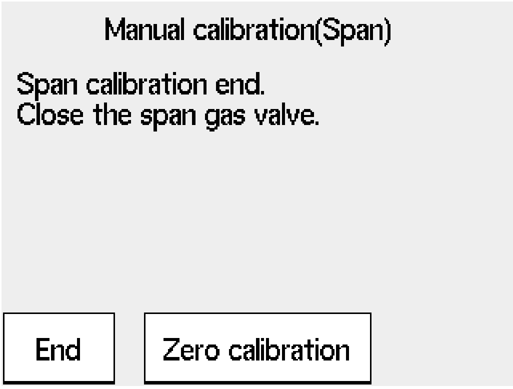


Figure 7.19 **Span Calibration Complete**

(6) Select “Zero calibration”. The screen of Figure 7.20 appears. Check that the oxygen concentration value on screen matches the oxygen concentration value of calibration gas that is actually used. Then select “Next”.

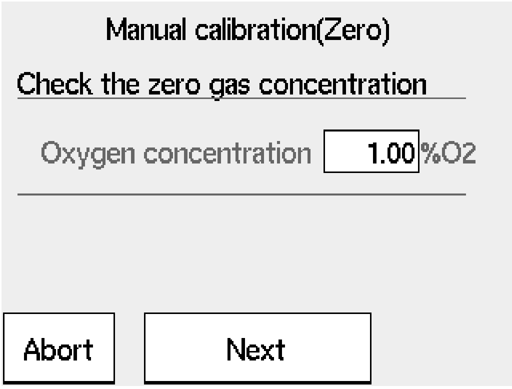


Figure 7.20 Zero gas concentration check

(7) Follow the instructions in the display as in Figure 7.21 to turn on the zero gas flow. Open the zero gas flow valve for the Flow Setting Unit and adjust that valve to obtain a flow of 600 ± 60 ml/min. The valve should be adjusted by loosening its lock nut and turning slowly the valve shaft counterclockwise. Use the calibration gas flowmeter to check the flow rate.

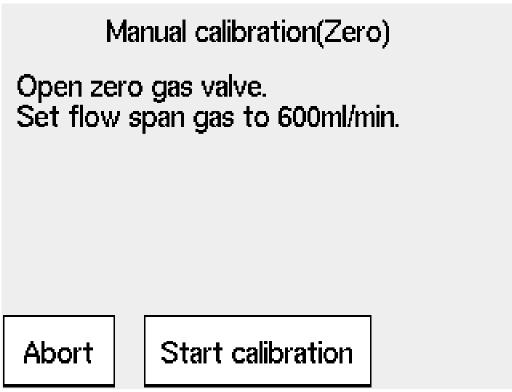


Figure 7.21 Zero gas flow rate check

(8) Similar to span calibration, selecting “Start calibration” displays the trend graph of the oxygen-concentration reading being measured (Figure. 7.22) on screen. Wait for the reading to stabilize near the zero gas concentration by monitoring the graph and the sensor electromotive force. At this point, calibration is not yet executed, so it is acceptable for the reading to deviate from the zero air concentration.

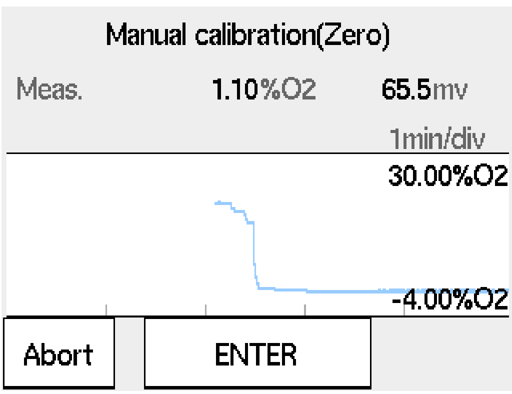


Figure 7.22 Trend in Zero gas calibration

(9) After the measured value has stabilized, press the [Enter] key to display the “Zero calibration complete” display shown in Figure 7.36. At this point, the measured value is corrected to equal the zero gas concentration setting. Close the zero gas flow valve. The valve lock nut should be tightened completely so that the zero gas does not leak.

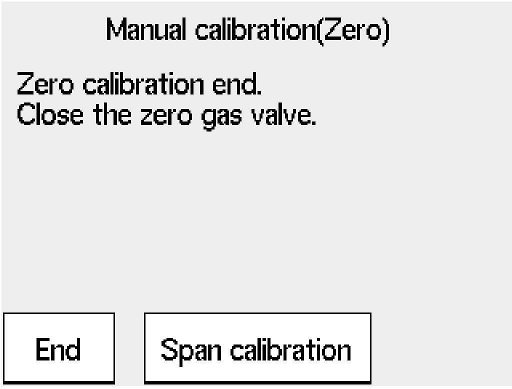


Figure 7.23 Zero Calibration complete

(10) Select “End”. An oxygen concentration trend graph (with the oxygen concentration being measured) appears and HOLD TIME flashes. This time is referred to as the output-stabilization time.

If the HOLD TIME has been set in “Output hold setting”, the analog output remains held. See Section “8.2 Output Hold Setting”

Manual calibration completes when the preset hold (output stabilization) time elapses. This hold (output stabilization) time is set to 10 minutes at the factory before shipment. If you press the [Enter] or [Abort] key within the hold (output stabilization) time, manual calibration completes.

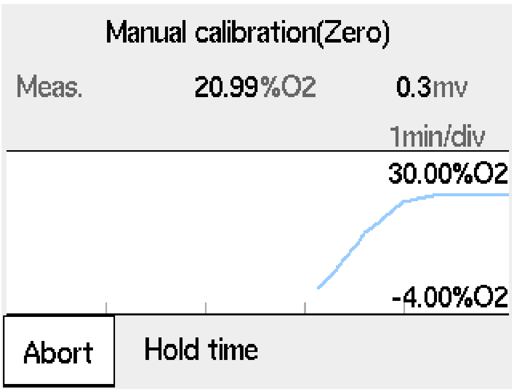


Figure 7.24 Hold Time

8. Detailed Data Setting

8.1 Current Output Setting

This section describes setting of the analog output range.

8.1.1 Setting Minimum Current (4 mA) and Maximum Current (20 mA)

(1) “Converter menu” > “Setting”

(2) Select the “mA output settings”.

(3) Select “mA output1”.

(4) Select “Selection of AO1” . Enter the value of “4mA point” and “20 mA point” for each.

(5) Set “mA output2” in the same way as the setting procedure for mA-output1 given above. See “7.8 Output Range Setting” for details.

NOTE

For the humidity measurement, 0% H_2O is a default setting for the minimum humidity and 25% H_2O is the default for the maximum humidity. If you first attempt to set 50% H_2O for the minimum humidity, you cannot set it because that value is outside the set range. In such a case, set the maximum humidity first.

8.1.2 Input Ranges

● **Oxygen Concentration setting range**

The range min. O_2 concentration value (corresponding to 4 mA output) can be set to either 0 vol%O_2 or in the range of 6 to 76 vol%O_2.

The range max. O_2 concentration value (corresponding to 20 mA output) can be set to any value in the range of 5 to 100 vol%O_2, however the range max. setting must be at least 1.3 times the range min. setting.

If you do not observe this restriction, the measurement will be invalid, and any previous valid value will be used. The gray area in Figure 8.1 represents the valid setting range.

Setting example 1

If the range minimum (corresponding to 4 mA output) is set to 10 vol%O_2 then range maximum (corresponding to 20 mA output) must be at least 13 vol%O_2.

Setting example 2

If the range minimum (corresponding to 4 mA output) is set to 75 vol%O_2 then range maximum (corresponding to 20 mA output) must be at least 75x1.3=98 vol%O_2 (rounding decimal part up).

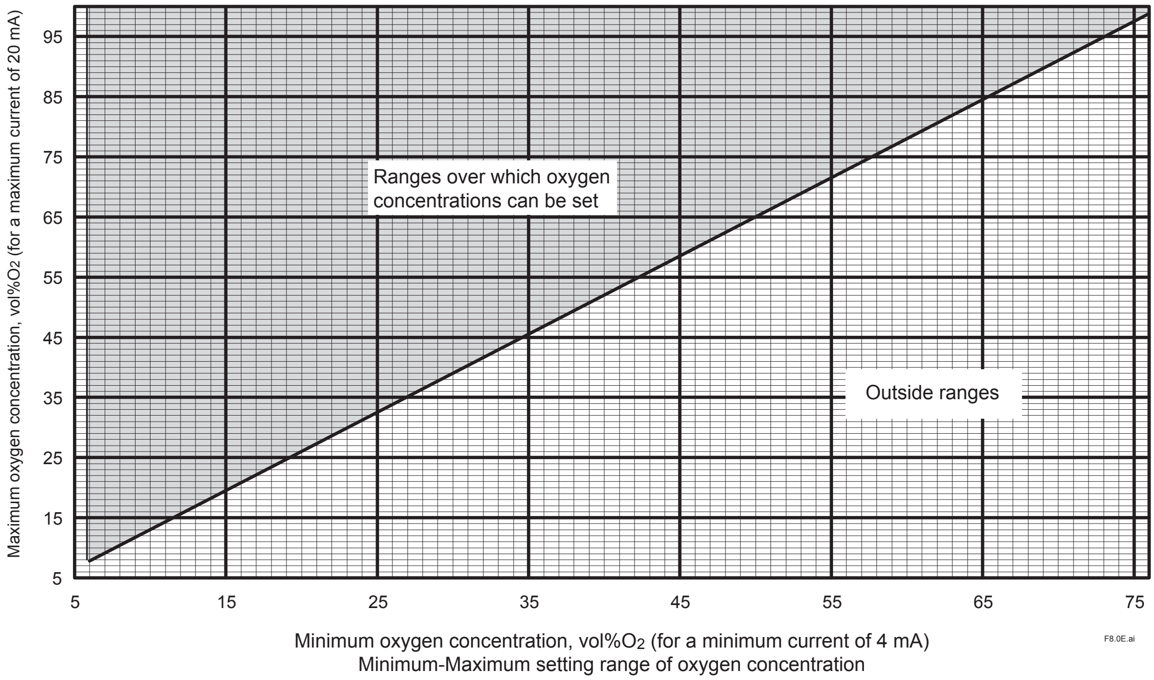


Figure 8.1

● Humidity (amount-of-moisture-content) and relative 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. See an example shown below or the graph Figure 8.2.

Numerical values are also equivalent for relative humidity Check the values by replacing vol % H_2O with % RH

Setting example 1

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

Setting example 2

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

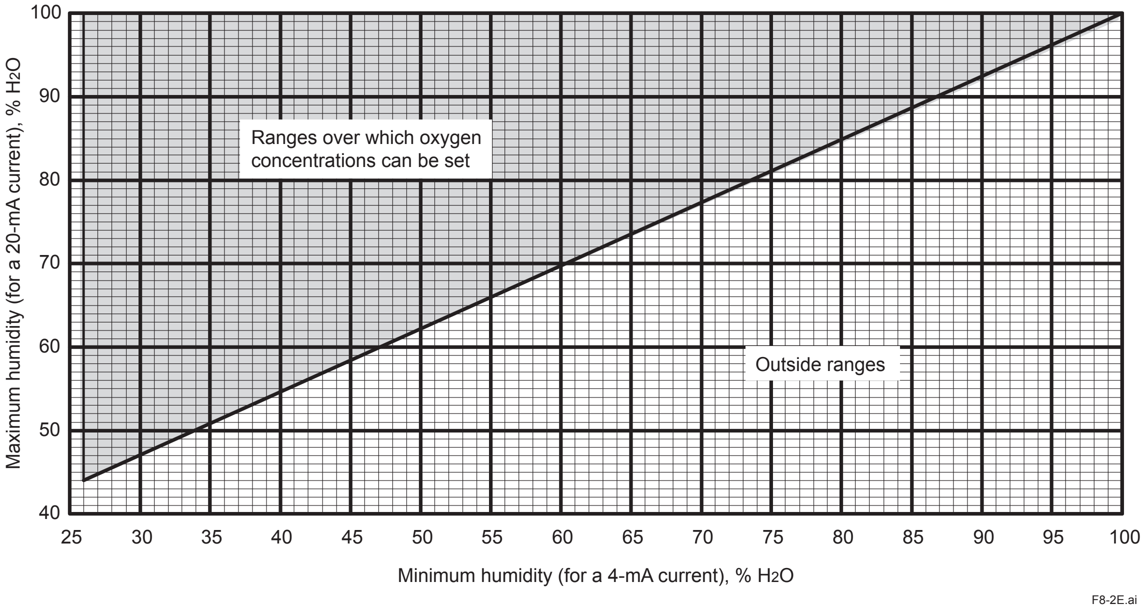


Figure 8.2 Max. and Min. Humidity Set Ranges

"Mixing ratio" setting range

The minimum mixing ratio is set to 0 kg/kg or ranges from 0.201 to 0.625 kg/kg. The maximum "mixing ratio" setting ranges from 0.2 to 1.0 kg/kg, and must be greater than 1.3 times plus 0.187 the mixing 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 3 1.3 + 0.187 kg/kg). (Numbers after the decimal point are rounded up.)

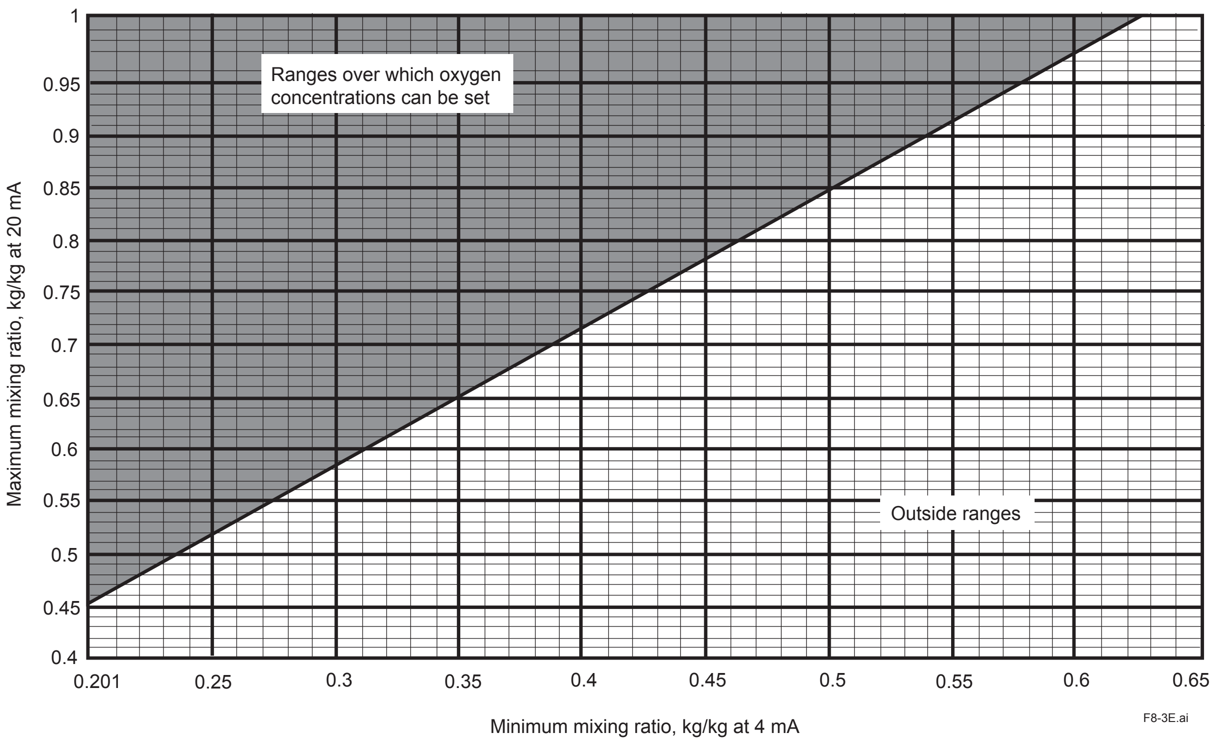


Figure 8.3 Max. and Min. Mixing Ratio Set Ranges

8.1.3 Setting Output Smoothing Factor

If the measured value changes suddenly, using this measured value as a control may cause harm such as frequent on-off operation.

In such a case, you can set a smoothing time constant of between 0 and 255 seconds to reduce the effect. Select “AO1 time constant”, “AO2 time constant” to enter an appropriate value.

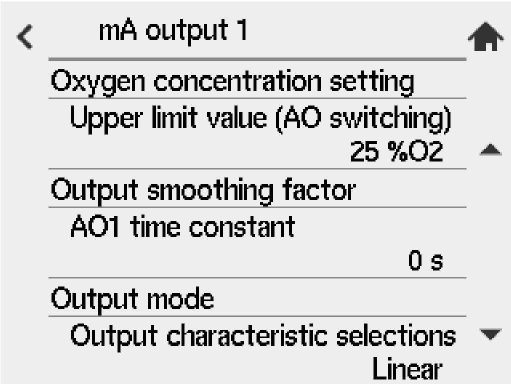


Figure 8.4 Output smoothing factor

8.1.4 Selection of Output Mode

You can select whether the relationship between the sample oxygen concentration and the analog output signal be linear or logarithmic. Press the [Output characteristic selections] in the output mode display. A linear/ logarithmic selection display then appears. Select the desired mode.

NOTE

If you select an output mode of “logarithmic” , regardless of range setting the minimum output value becomes fixed to 0.1 vol%O_2 , humidity; 0.1% H_2O, mixing ratio; 0.01 kg/kg, the relative humidity; 0.1%RH,regardless of setup value.

Display of the minimum oxygen concentration value, the minimum humidity, the minimum mixing ratio, and the minimum relative humidity remain unchanged.

8.1.5 Default Values

When the analyzer is delivered or reset to defaults, the output current default settings by as shown in Table 8.4.

Table 8.4 Output Current Default Values

Item	Default setting
4mA point oxygen concentration	0%O_2
20mA point oxygen concentration	25%O_2
4mA point humidity	0%H_2O
20mA point humidity	25%H_2O
4mA mixing ratio	-
20mA mixing ratio	-
4mA relative humidity	-
20mA relative humidity	-
Output smoothing factor	0 (seconds)
Output mode	Linear
Upper limit value (AO range switching)	25%O_2

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. Outputs 1 and 2 can not be set individually. Table 8.5 shows the analog outputs that can be retained and the individual states.

Table 8.5

Equipment status / Output hold values available	Warm-up mode	Maintenance mode	Calibration mode, Blow back mode, Simple cell resistance measurement mode	On fault occurrence
4 mA	○			
20 mA	○			
No hold		○	○	
Last value hold		○	○	○
Preset value (2.4 to 21.6 mA)	○	○	○	○

○: The output hold functions are available.

8.2.1 Definition of Equipment Status

(1) During warm-up

“During warm-up” is the time required after applying power until sensor temperature stabilizes at 750ºC and the instrument is in the measurement mode.

(2) Under Maintenance

Maintenance mode starts when you go to the next item from Converter menu or Sensor menu.

Table 8.6

Menu	Item	Maintenance (○: Enable)
Converter menu	Detail	
	Trend	
	Blowback	○
	Others	○
	Maintenance	○
	Setting	○
	Reset	○
	Lang.	○
Sensor menu	Detail	
	Calibration	○
	Cell resist	○
	Setting	○

(3) Under Calibration (see Chapter “9. Calibration”)

For manual Calibration:

Calibration period starts when you enter a calibration-start screen (“Figure 7.15 Manual calibration steps”). The calibration period lasts until you end the calibration after the calibration operations. The mode ends after End key is entered and the preset HOLD TIME elapses.

For semi-automatic Calibration:

Calibration mode starts when you select Calibration on the touch panel or the command is issued by contact input. The calibration period lasts until the HOLD Time elapses after the calibration operations.

For automatic calibration;

Calibration period lasts after a calibration is conducted at the time of calibration-start until HOLD Time (output stabilization) elapses.

(4) During Blow back (see Section “10.5 Blow Back”)

During semi-automatic blow back:

“During semi-automatic blow back” is the time required after pressing the [Blow back start] key, by using the touchpanel or entering a blow back start instruction by using a contact input, until the blow back time and Hold time (output stabilization) elapse.

During automatic blow back:

“During automatic blow back” is the time required after reaching the blow back start time until the blow back time and Hold time (output stabilization) elapse.

(5) During Simple Cell Resistance Measurement (see Section “10.6Simple cell resistance measurement”)

During semi-automatic simple cell resistance measurement

This starts when you press “Start” of the simple cell resistance measurement on the touch panel. The measurement period lasts until the simple cell resistance measurement time and HOLD time (output stabilization) elapse.

During automatic simple cell resistance measurement

This starts when you reach the simple cell resistance measurement start time. The period lasts until the simple cell resistance measurement time and HOLD time (output stabilization) elapse.

(6) Fault

“Fault “ means that Fault (Power Supply supply to sensor heater is stopped) is occurring. For more information on Fault or errors, See Chapter “12. Troubleshooting”.

8.2.2 Preference Order of Output Hold Value

The output hold value takes the following preference order:

High ↑ Fault is occurring.
Preference order: Under calibration/ during blow back.
/Simple cell resistance measuring
Under maintenance
During warm-up

For example, if the output current is set to 4 mA during maintenance, and no output-hold output for during calibration is preset, the output is held at 4 mA during the 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 hold (output stabilization) time elapses.

8.2.3 mA output settings

(1) “Converter menu” > “Setting”

(2) Select “mA output settings”.

(3) Select “Output hold setting”.

(4) You can configure output status or preset value for each of Warm-up, maintenance, calibration/blow back/simple cell resistance measurement, or Fault.

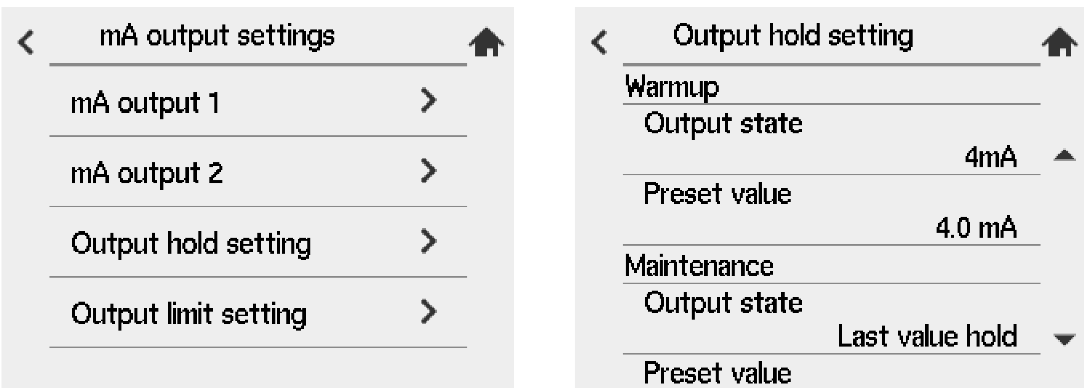


Figure 8.5 mA-outputs hold setting

8.2.4 Default Values

When the analyzer is delivered, or if data are initialized, output hold setting is the default as shown in Table 8.7.

Table 8.7 Output Hold Default Values

Status	Output hold setting	Preset value
Warm-up mode	4 mA	3.4 mA
Maintenance mode	Holds output at value just before maintenance started.	4 mA
Maintenance mode, Blow back mode, Simple cell resistance mode	Holds output at value just before starting calibration/blow back/simple cell resistance measurement	4 mA
On Fault occurrence	Holds output at a preset value.	3.4 mA

8.3 Output limit setting

Output limit is to set a limit in the range that set current value of the analog output signal beforehand.

You can set Upper limit value and Lower limit value.

You cannot set Output item 1 and Output item 2 individually.

8.3.1 Action of Output limit setting

Regardless of result of a measurement, it limits it current of the analog output signal is bigger than upper limit value or not to become smaller than lower limit value.

While current of the analog output signal is limited in upper limit value or lower limit value, Alarm 118 mA output 1 limit arrival, Alarm 119 mA output 2 limit arrival occurs.

8.3.2 Setting of Output limit

(1) “Converter menu” > “Setting”

(2) Select “mA output settings”.

(3) Select “Output limit setting”.

(4) Set upper limit value and lower limit value.

The set range of upper limit value and lower limit value is 2.4 mA to 21.6 mA both.

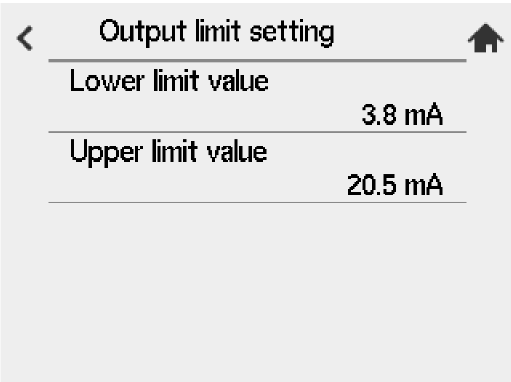


Figure 8.6 Setting of Output limit

8.3.3 Default Values

When the analyzer is delivered, or if data are initialized, output limit value is the default as shown in Table 8.8.

Table 8.8 Output Limit Default Values

Setting Item	Default value
Lower limit value	3.8 mA
Upper limit value	20.5 mA

8.4 Alarm Setting

The analyzer enables the setting of four alarms — high-high, high, low, and low-low alarms — depending upon the measurement conditions. In addition, You can set calibration coefficient alarm, temperature / pressure input alarm, simple cell resistance alarm, etc. The following section sets out the alarm operations and setting procedures.

8.4.1 Classification of Alarms

Based on NAMUR NE107, alarms can be classified into the following four types. When NE107 is set to ON in a display setup, alarms displayed on the converter are also labeled with 4 icons. Refer to “10.4.2 NE107 mode” for the setting.

- Failure: (equivalent to Fault, no power supply to heater)
- Function Check
- Out of Specification
- Maintenance Required

In the following sections, alarms are assumed to be enabled and categorized into the four types mentioned above.

8.4.2 Alarm values

(1) High-high and high alarm values

Outputs when “ON” is selected in setup items of the alarm “ON” and “OFF” and the measured value is larger than the setup limit

(2) Low and low-low alarm values

Outputs when “ON” is selected for setup items of the alarm “ON” and “OFF” and the measured value is smaller than the setup limit.

(3) Zero calibration coefficient alarm, Span calibration coefficient alarm

Outputs when calibration coefficient value (corrected value) is larger than the upper limit or smaller than the lower limit when calibration is performed.

(4) Temperature/pressure input alarm

Outputs when “ON” is selected in setup items of the alarm “ON” and “OFF” and the input value is larger than the setup limit.

(5) Simple cell resistance alarm

Outputs when the measured value of the simple cell resistance measurement is larger than the preset limit. For details on alarms, See Section “12.2.2 Remedies When Alarms are Generated”.

8.4.3 Alarm Output Actions

If the measured values of the oxygen concentration fluctuate between normal (steady state) values and the alarm setting, alarm outputs may be frequently issued and canceled.
To avoid this, set the alarm delay and hysteresis for alarm canceling under the alarm output conditions, as Figure 8.7 shows.
When a delay time is set, an alarm will not be issued so quickly even if 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 be issued. On the other hand, there will be a similar delay 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 greater 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 setpoint range and the delay time has elapsed.
For the alarm to be reset (canceled), the measured value must be beyond the preset hysteresis value and the preset delay time must have elapsed.
Refer to Figure 8.7 for any further alarm output actions. The delayed time and hysteresis settings are common to all alarm points.

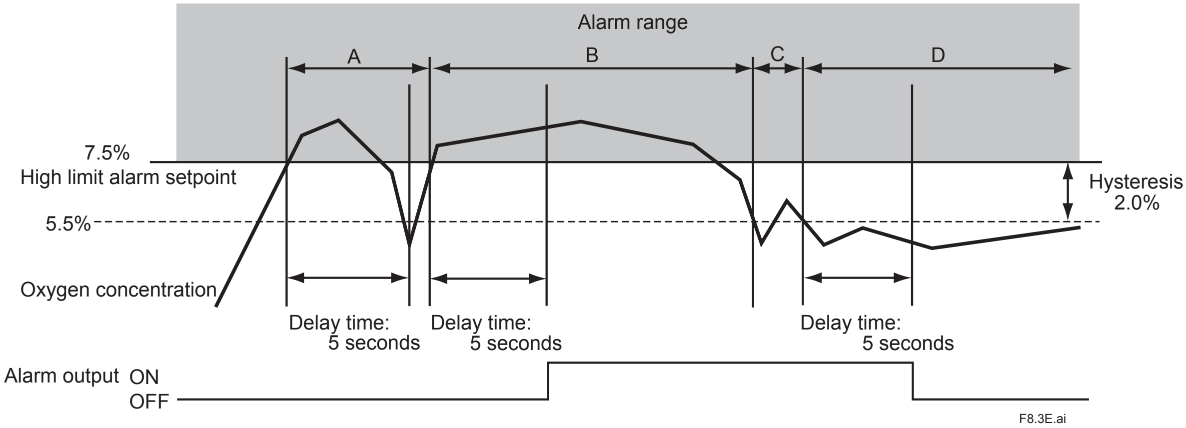


Figure 8.7 Alarm Output Action

In the example in Figure 8.7, the high limit alarm point is set to 7.5 vol%O_2, the delay time is set to five seconds, and hysteresis is set to 2 vol%O_2.

Alarm output actions in each section in this figure are as follows:

A. Although the oxygen concentration value exceeds the high limit alarm setpoint, it falls below the high limit alarm setpoint before the preset delay time of five seconds elapses. So, no alarm is issued.

B. The oxygen concentration value exceeds the high limit alarm setpoint and the delay time elapses during that measurement. So, an alarm is issued.

C. Although the oxygen concentration value falls below the hysteresis set value, the value rises again and exceeds the hysteresis set value before the preset delay time elapses. So, the alarm is not canceled.

D. The oxygen concentration value falls below the hysteresis set value and the preset delay time elapses, so the alarm is canceled.

8.4.4 Alarm Setting Procedure

(1) "Converter menu" > "Setting"

(2) Select "Alarm setting".

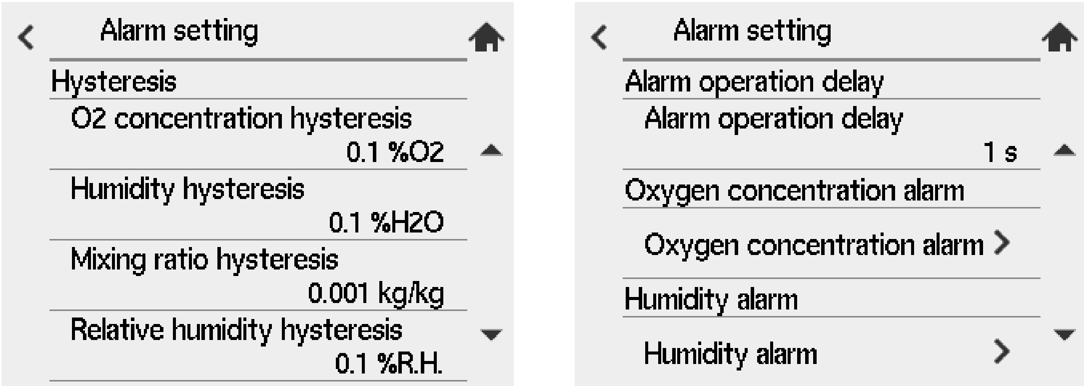


Figure 8.8 Alarm setting

• To set the hysteresis

(3) Select "Hysteresis" in the Alarm setting display. The numeric-data entry display then appears. Enter the desired hysteresis value.

• To set the delay time

(4) Select the "Alarm operation delay" in the Alarm setting display. The numeric-data entry display then appears. Enter the desired delay time, in seconds.

• To set the upper/lower alarm limit

(5) When you setup oxygen concentration alarm ON/OFF, or setup alarm value, select "Oxygen concentration alarm" to setup the alarm limit. To use High-high alarm, select "(HH) high-high alarm" and select one among "Failure", "Function check", "Out of specification", "Maintenance Required". Then High-high alarm becomes enabled.

(6) Set alarm value. To set the High-high alarm values select "(HH)high-high alarm value." The numeric-data entry display then appears. Enter the alarm set value (percent of oxygen concentration).

(7) Set the other alarm settings in the same manner as in the steps above.

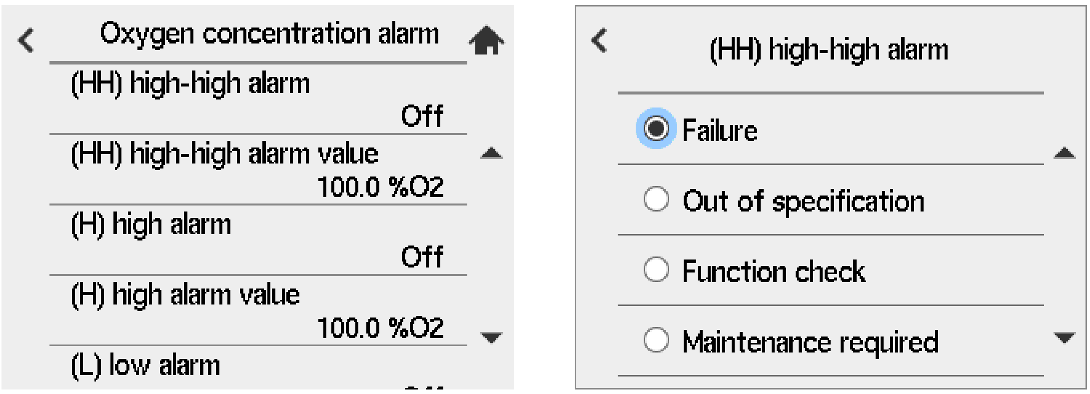


Figure 8.9 High/low alarm setting

NOTE

No alarm is issued when alarm is set to "OFF" (disabled) even after an alarm value is setup.

When using an alarm, setup one among Failure (stop power supply to the heater), Function check, Out of Specification, maintenance Required.

8.4.5 Default Values

When the analyzer is delivered, or if data are initialized, the default alarm set values are as shown in Table 8.9.

Table 8.9 Alarm Setting Default Values

Set item	Oxygen concentration		Humidity (amount of moisture content)		Mixing ratio		Relative humidity	
	Setting range	Default setting	Setting range	Default setting	Setting range	Default setting	Setup area	Default
Hysteresis	0 to 9.9 vol%O_2	0.1 vol%O_2	0 to 9.9 %H_2O	0.1 %H_2O	0 to 0.1 kg/kg	0.001 kg/kg	0 to 9.9%RH	0.1% RH
Delay time (Note 1)	0 to 255 seconds	3 seconds	0 to 255 seconds	3 seconds	0 to 255 seconds	3 seconds	0 to 255 seconds	3 seconds
High-high limit alarm	–	OFF	–	OFF	–	OFF	–	OFF
High-high limit alarm setpoint	0 to 100 vol%O_2	100 vol%O_2	0 to 100 %H_2O	100.0 %H_2O	0 to 1 kg/kg	1 kg/kg	0 to 100% RH	100.0%RH
High limit alarm	–	OFF	–	OFF	–	OFF	–	OFF
High limit alarm setpoints	0 to 100 vol%O_2	100 vol%O_2	0 to 100 %H_2O	100.0 %H_2O	0 to 1 kg/kg	1 kg/kg	0 to 100%RH	100.0% RH
Low limit alarm	–	OFF	–	OFF	–	OFF	–	OFF
Low limit alarm setpoint	0 to 100 vol%O_2	0 vol%O_2	0 to 100 %H_2O	0.0 %H_2O	0 to 1 kg/kg	0 kg/kg	0 to 100%RH	0.0% RH
Low-low limit alarm	–	OFF	–	OFF	–	OFF	–	OFF
Low-low limit alarm setpoint	0 to 100 vol%O_2	0 vol%O_2	0 to 100 %H_2O	0.0 %H_2O	0 to 1 kg/kg	0 kg/kg	0 to 100%RH	0.0% RH

Note 1 The setting of "Delay time" is common to all: Oxygen concentration, Humidity, Mixing ratio, Relative humidity.

Table 8.10 Alarm classification and default value

Alarm name	ON/OFF default setup (Note 1)	Alarm classification change (Note 2)
High/High-high limit, Low/Low-low limit alarm	OFF	Feasible
Simple cell resistance alarm	M	Feasible
AO1 saturation	S	Disable
AO2 saturation	S	Disable
Calibration stability alarm	C	Feasible
Zero correction ratio high alarm	C	Feasible
Zero correction ratio low alarm	C	Feasible
Span correction ratio high alarm	C	Feasible
Span correction ratio low alarm	C	Feasible
Cold junction temperature high alarm	S	Disable
Cold contact temperature low alarm	S	Disable
Thermocouple voltage high alarm	S	Disable
Thermocouple voltage low alarm	S	Disable
AI current high alarm	S	Disable
AI current low alarm	S	Disable
Input temperature high alarm	OFF	Feasible
Input temperature low alarm	OFF	Feasible
Input pressure high alarm	OFF	Feasible
Input pressure low alarm	OFF	Feasible
Battery low alarm	M	Feasible
Fast warm-up function alarm	M	Feasible

(Note 1) Alarms with C: Function Check, S: Out of Specification, and M: Maintenance Required
(Note 2) "disable" are classified as static.

8.5 Output Contact Setup

8.5.1 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. For output contacts 1 to 3 you can select open or closed contact when the contact is “operated.” For output contact 4, contact is closed only.
When power fails, contact outputs 1 to 3 are open, and 4 is closed.

Table 8.11

	State when contact “operated”	When no power is applied to this equipment
Contact output 1	Open (deenergized) or closed (energized) selectable.	Open
Contact output 2	Open (deenergized) or closed (energized) selectable.	Open
Contact output 3	Open (deenergized) or closed (energized) selectable.	Open
Contact output 4	Closed (deenergized) only	Closed

8.5.2 Setting Contact Outputs

To set the contact outputs, follow these steps.

(1) “Converter menu” > “Setting”

(2) Select “Contact setting”.

(3) Select item to setup. See Table 8.12. An example setting is displayed below. In this example, Contact output1 is expected to setup to output “Open” during maintenance and warmup.

(4) Select “Contact state during operation” and “Open”.

(5) Select “ Selection of contact output” and check “Maintenance” and “Warmup.” Multiple items can be set.

(6) Setup other contact outputs in a similar way.

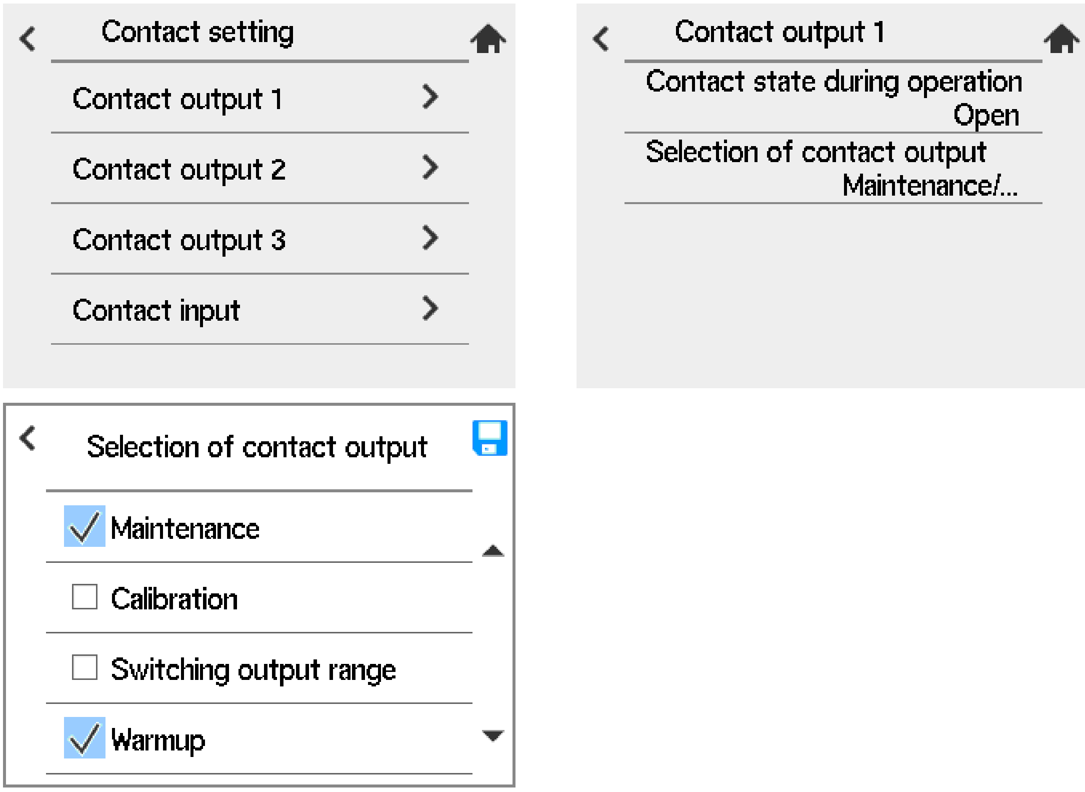


Figure 8.10 Contact output setting

CAUTION

The function of Contact output 4 is fixed as an fault only and fixed as “close during operation”. The setting cannot be changed.

Table 8.12 Output Contact Settings

	Item to be selected	Description
Alarm	(HH) high-high alarm	If “High-High alarm ON” is selected, contact output occurs when the high-high limit is issued. To do this, it is required, in Alarms setup, that the high-high alarm be set to be enabled beforehand (see Section “8.4 Alarm Setting”).
	(H) high alarm	If “High alarm ON” is selected, contact output occurs when the high limit alarm is provided. To do this, it is required, in Alarms setup, that the high limit alarm be set to be enabled beforehand (see Section “8.4 Alarm Setting”).
	(L) low alarm	If “Low alarm ON” is selected, contact output occurs when the low limit alarm is provided. To do this, it is required, in Alarms setup, that the low limit alarm be set to be enabled beforehand (see Section “8.4 Alarm Setting”).
	(LL) low-low alarm	If “Low-Low alarm ON” is selected, contact output occurs when the low-low limit alarm is issued. To do this, it is required, in Alarms setup, that the low-low alarm be set to be enabled beforehand (see Section “8.4 Alarm Setting”).
	Calibration correction alarm	If Calibration coefficient alarm is ON (enabled), then when a Zero correction ratio high/low alarm (Alarm 201, 202) or Span correction ratio high/low alarm (Alarm 203, 204) occurs, the calibration coefficient alarm contact output occurs. (see Sec. “12.2.1 Alarm Types”)
	Calibration stability alarm	If this alarm ON is selected, contact output occurs when the Calibration stability alarm (Alarm 120) occurs. (See Sec. “12.2.1 Alarm Types”)
	Upper and lower temp. alarm	This alarm is not used for an Oxygen Analyzer. When temperature measurement of a sample gas is performed with an external input, a contact output occurs if the temperature value exceeds the High limit which was setup in High limit alarm.
	Upper and lower press. alarm	This alarm is not used for High Temperature Humidity Analyzer. When temperature measurement of a sample gas is performed with an external input, contact output occurs if the temperature value exceeds the high limit which was setup in High limit alarm.
	Simple cell resistance alarm	If this alarm is selected, a contact output occurs when a simple cell resistance alarm is output. But in Alarm setting, Simple cell resistance alarm needs to be set to be enabled beforehand.(See Section “8.4 Alarm Setting”.)
	Fault	If “Fault” is selected, contact output occurs when Fault is issued. (See Chapter “12. Troubleshooting”).
Other settings	Warmup mode	If “Warm-up ON” is selected, contact output occurs during warm-up. For the definition of Warm-up (see Section “8.2.1 Definition of Equipment Status”).
	Switching output range	If “Range change ON” is selected, contact output occurs (“answer-back signal to a range change signal”) while a range change signal is applied to a contact input. To do this, it is required, in Input contacts setup, that the range change be selected beforehand. For more on this (see Section 8.6).
	Calibration mode	If “Calibration ON” is selected, contact output occurs during calibration. For the definition of Under calibration (see Section “8.2.1 Definition of Equipment Status”).
	Maintenance mode	If “Maintenance ON” is selected, contact output occurs during maintenance. For the definition of Under maintenance (see Section “8.2.1 Definition of Equipment Status”).
	Blow back mode	If “Blow back ON” is selected, contact output occurs during blow back. For the definition of During blow back (see Section “8.2.1 Definition of Equipment Status”).
	Cal. gas pressure drop	If “Cal. gas press. low ON” is selected, contact output occurs (“answer-back signal to a calibration gas low pressure signal”)when a calibration gas low pressure signal is applied to the contact input. To do this, it is required, in Input contacts setup, that “Cal. gas press. low” be selected beforehand. For more on this (see Section “8.6 Input Contact Settings”).
	Process upset	If “Process upset” is selected, contact output occurs (“answer-back signal to a process upset signal) when the process upset signal is applied to the contact input. To do this, it is required, in Input contacts setup, that “Process upset” be selected beforehand (see Section “8.6 Input Contact Settings”)
	With simple cell resist. meas.	If simple cell resistance mode is selected, contact output occurs during simple cell resistance measurement. See “8.2.1 Definition of Equipment Status” for the maintenance.

Note: To provide an alarm with an output contact, be sure to make an alarm setting.
When using contact output as an answer-back signal for an input contact, be sure to make an input contact setting.

8.5.3 Default Values

When the analyzer is delivered, or if data are initialized, alarm and other setting defaults are as shown in Table 8.13.

Table 8.13 Output Contact Default Settings

	Item to be selected	Contact output 1	Contact output 2	Contact output 3	Contact output 4
Alarm settings	(HH) high-high alarm				——
	(H) high alarm			ON	——
	(L) low alarm			ON	——
	(LL) low-low alarm				——
	Calibration correction alarm				——
	Calibration stability alarm				——
	Upper and lower temp. alarm				——
	Upper and lower press. alarm				——
	Simple cell resistance alarm				——
	Fault				ON
Other settings	Warmup	ON			——
	Switching output range				——
	Calibration		ON		——
	Maintenance	ON			——
	Blow back				——
	Cal. gas pressure drop				——
	Process upset				
	Cal. blowback simple cell resist.				——
	Contact state during operation	Open	Closed	Closed	Closed (fixed)

Note: Blank boxes in the above table indicate that the default is “disabled.”

8.6 Input Contact Settings

8.6.1 Input Contact Functions

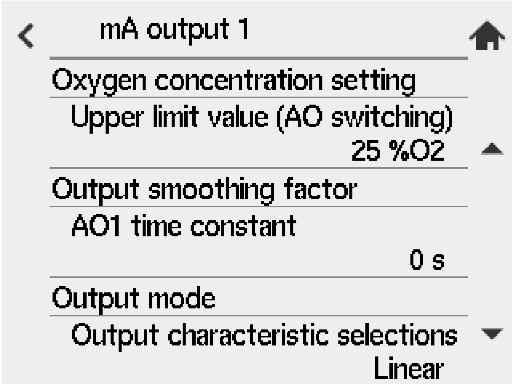
The converter input contacts execute set functions by accepting a remote dry-contact ("voltage-free contact") signal. Table 8.14 shows the functions executed by a remote contact signal.

Table 8.14 Input Contact Functions

Item	Function
Calibration gas pressure low	Contact input disables Semi-automatic or Automatic Calibration.
Measuring range change	While the contact signal is being input, mA output 1 switches as follows. When it is switching, "Range" is displayed on the screen (see "6.3.1 Home screen and icons"). When "Oxygen concentration" is selected for the setting item of mA output 1, the output range switches to 0–25%O_2 or 0–100%O_2. When "Humidity" selected for the setting item of mA output 1, the output range switches to 0–100%H_2O. When "Mixing ratio" is selected for the setting item of mA output 1, the output range switches to 0–1 kg/kg. When "RH(relative humidity)" is selected for the setting item of mA output1, the output range switches to 0–100%R.H.
Calibration start	Contact input starts Semi-Automatic Calibration. Calibration Mode setting must be [Semi-automatic] or [Automatic]. Contact signal must be applied for at least 1 sec. Even if input signal continues to be applied, calibration is not repeated unless contact input is released then reapplied.
Process upset (Combustible gas detection)	When the signal is sent to contact input, heater power will be switched off. Contact signal starts the operation with a single output signal of 1 second or longer. During the operation, span contact of calibration contact operates. When Auto calibration unit ZR40H is used and span gas (instrumentation air) is connected, you can lead span gas to sensor unit as a safety purge. When the combustible gas (unburned-gas) is detected, temperature of the sensor unit falls and Fault is generated. Recovery is possible only if you shut down and reboot or restart the system.
Blow back start	When the signal is sent to contact input, the Blow back starts. The contact signal starts operation with a single output signal of 1 to 11 seconds. While the signal continues to be input, the second blow back does not occur. To have the second blow back, release the contact signal once and input again. Refer to section "10.5 Blow Back".
Restart	Restarts the device when an contact signal is input. After restarting, restart from warm-up mode.

CAUTION

- Measurement range switching function by an external contact input is available for analog output1 only. The range during switching is 0–25%O_2 or 0–100%O_2. See below. For Humidity, mixing ratio, relative humidity, the range is 0–100%$H_2$0, 0–1kg/kg, 0–100 R.H.(static), respectively.



- When making a semi-automatic calibration, be sure to set the semi-automatic or automatic mode using the Calibration setup display. When carrying out “Blow back,” be sure to set “Blow back” in the output contact setup, and also set “Semi-automatic” or “Automatic, semi-automatic” to mode at Blow back setting.
- When the combustible gas detection signal is sent to contact input, the sensor heater will be switched off for safety. As a result, the heater’s temperature falls and Fault is generated.

8.6.2 Setting contact

(1) “Converter menu” > “Setting”

(2) Select “Contact setting”.

(3) Select “Contact input” and select the contact open or closed, and the function.

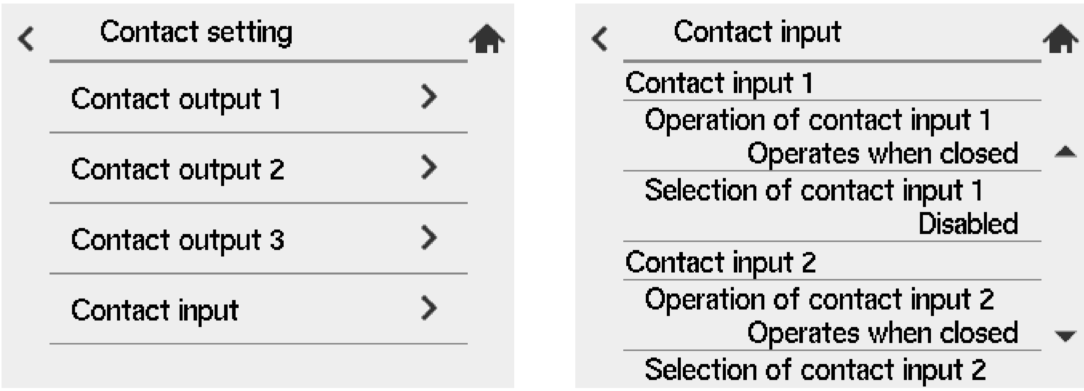


Figure 8.11 Contact input setting

8.6.3 Default Values

All contact inputs are set to “Disabled” and “Closed” prior factory shipment or after data initialization.

8.7 Other Settings

8.7.1 Setting the Date-and-Time

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

Proceed as follows:

(1) “Converter menu” > “Others”

(2) Select “Date/Time setting”.

(3) Input date and time. When you press “Adjust” the operation starts at the time you have set.

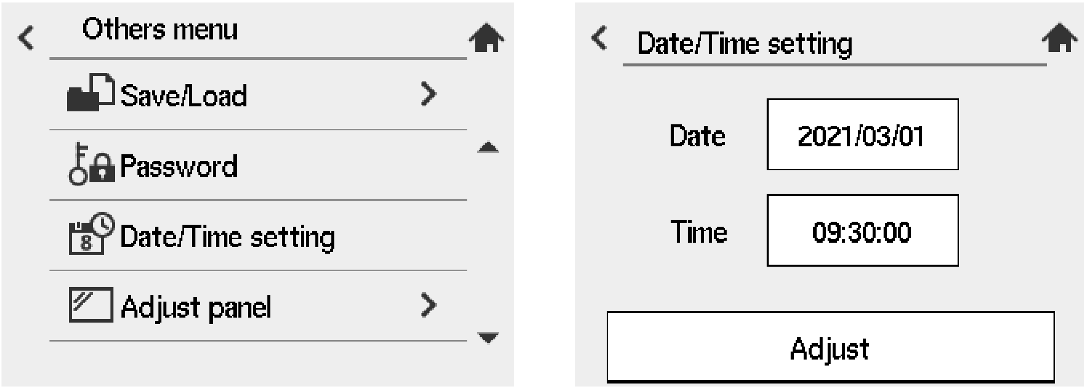


Figure 8.12 Date/Time setting

8.7.2 Setting the monitoring time for mean/max. min

The instrument can display the mean, minimum, maximum values of the oxygen concentration being measured. See 10.1.

This section explains how to setup the calculation time of the average value and the monitoring time of the maximum/minimum value.

(1) “Converter menu” > “Setting”.

(2) Select “Others setting”. Select “Average, maximum/minimum”.

(3) Select “Average value calculation time” and enter a value from the numeric entry screen. The input range is 1 to 255 hours.

(4) Select “Max and min monitoring time”. Enter a numeric value from the screen. The input range is 1 to 255 hours.

As factory default or when data is initialized, “Average Value Calculation Time” is 1 hour, “Max and min monitoring time” is 24 hour.

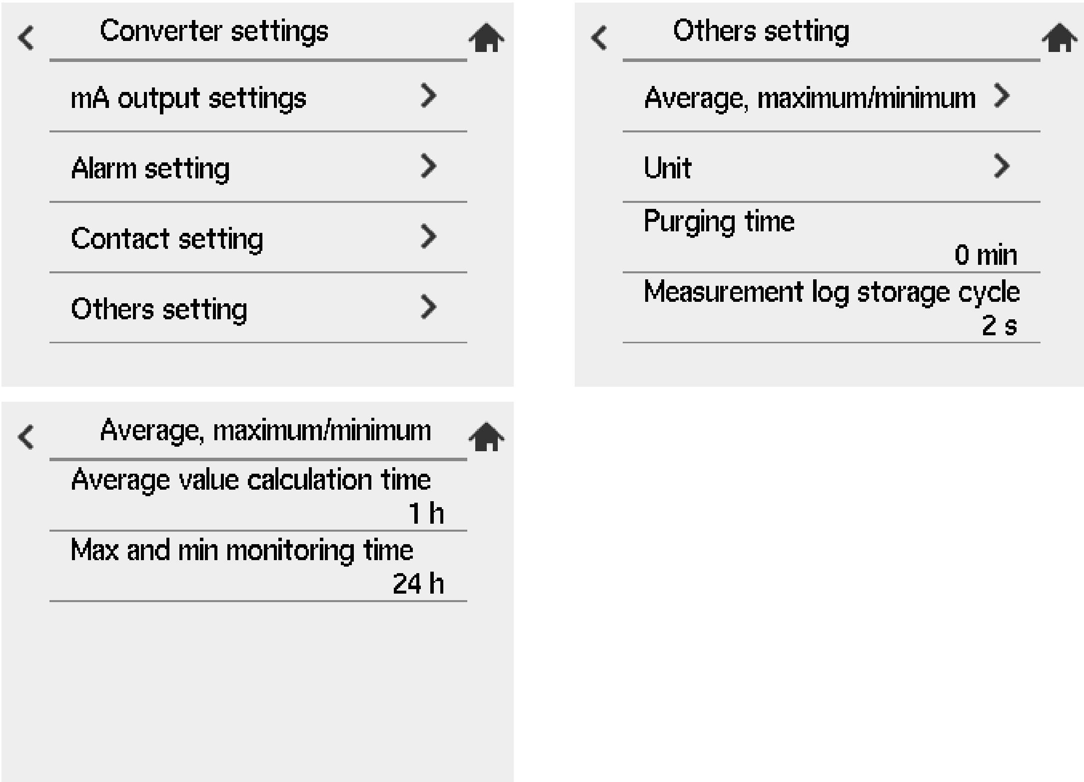


Figure 8.13 Setting the monitoring time of average/max.min. value

8.7.3 Setting Fuels

■ Input Parameters

The analyzer calculates the moisture content contained in exhaust gases. The following sets forth the fuel parameters necessary for calculation and their entries. The moisture content may be mathematically expressed by:

$$\text{Moisture content} = \frac{\overbrace{\text{(water vapor caused by combustion and water vapor contained in the exhaust gas)}} + \text{(water vapor contained in air for combustion)}}{\text{actual exhaust gas (including water vapor) per fuel}} \times 100 \quad \text{..... Equation 1}$$

$$= (Gw + Gw1)/G \times 100$$

$$= \frac{Gw + (1.61 \times Z \times m \times Ao)}{Go + Gw + [(m - 1) Ao + (1.61 \times Z \times m \times Ao)]} \times 100 \quad \text{........... Equation 2}$$

$$\fallingdotseq \frac{\boxed{Gw} + (1.61 \times \boxed{Z} \times m \times \boxed{Ao})}{\boxed{X} + \boxed{Ao} \times m} \times 100$$

where,

$\boxed{Ao}$: Theoretical amount of air per unit quantity of fuel, m^3/kg (or m^3/m^3) ... ② in Table 8.15

G: Actual amount of exhaust gas (including water vapor) per unit quantity of fuel, m^3/kg (or m^3/m^3)

$\boxed{Gw}$: Water vapor contained in exhaust gas per unit quantity of fuel (by hydrogen and moisture content in fuel), m^3 /kg (or m^3/m^3) .... ① in Table 8.15

Gw1: Water vapor contained in exhaust gas per unit quantity of fuel (moisture content in air), m^3 /kg (or m^3/m^3)

Go: Theoretical amount of dry exhaust gas per unit quantity of fuel, m^3/kg (or m^3/m^3)

m: Air ratio

$\boxed{X}$: Fuel coefficient determined depending on low calorific power of fuel, m^3/kg (or m^3/m^3) .... ③ in Table 8.15

$\boxed{Z}$: Absolute humidity of the atmosphere, kg/kg .... Figure 8.16

Fill in the boxes with fuel parameters in Equation 2 above to calculate the moisture content. Use Ao, Gw and X shown in Table 8.14. If there are no appropriate fuel data in Table 8.14, use the Figure 8.14 equations for calculation. Find the value of “Z” in Equations 1 and 2 using Japanese Standard JIS B 8222. If a precise measurement is not required, obtain the value of “Z” using a graph for the absolute humidity indicated by a dry and wet bulb hygrometer.

- For liquid fuel

Amount of water vapor in exhaust gas (Gw) = (1/100) {1.24 (9h + w)} (m^3/kg)

Theoretical amount of air (Ao) = 12.38 x (Hl/10000) – 1.36 (m^3/kg)

Low calorific power = Hl

X value = (3.37 / 10000) x Hx – 2.55 (m^3/kg)

where, Hl: low calorific power of fuel

h: Hydrogen in fuel (weight percentage)

w: Moisture content in fuel (weight percentage)

Hx: Same as numeric value of Hl

- For gas fuel

Amount of water vapor in exhaust gas (Gw) = (1/100) {(h2) + 1/2 ∑y (Cx Hy) + wv} (m^3/m^3)

Theoretical amount of air (Ao) = 11.2 x (Hl/10000) (m^3/m^3)

Low calorific power = Hl

X value = (1.05 / 10000) x Hx (m^3/m^3)

where, Hl: low calorific power of fuel

CxHy: Each hydrocarbon in fuel (volume percentage)

h2: Hydrogen in fuel (volume percentage)

wv: Moisture content in fuel (volume percentage)

Hx: Same as numeric value of Hl

- For solid fuel

Amount of water vapor in exhaust gas (Gw) = (1/100) {1.24 (9h + w)} (m^3/kg)

Theoretical amount of air (Ao) = 1.01 x (Hl / 1000) + 0.56 (m^3/kg)

Low calorific power = Hl = Hh – 25 (9h + w) (kJ/kg)

X value = 1.11 - (0.106 / 1000) x Hx (m^3/m^3)

where, w: Total moisture content in use (weight percentage)

h: Hydrogen content (weight percentage)

The average hydrogen content of coal mined in Japan, which is a dry ash-free type, is 5.7 percent. Accordingly, "h" may be expressed mathematically by:

h = 5.7 [{100 – (w + a)} / 100] x (100 – w) / (100 – w1)

where, a: Ash content (%)

w1: Moisture content (%), analyzed on a constant humidity basis

Hh: Higher calorific power of fuel (kJ/kg)

Hl: Low calorific power of fuel (kJ/kg)

Hx: Same numeric value of Hl

Figure 8.14 Calculation Formula

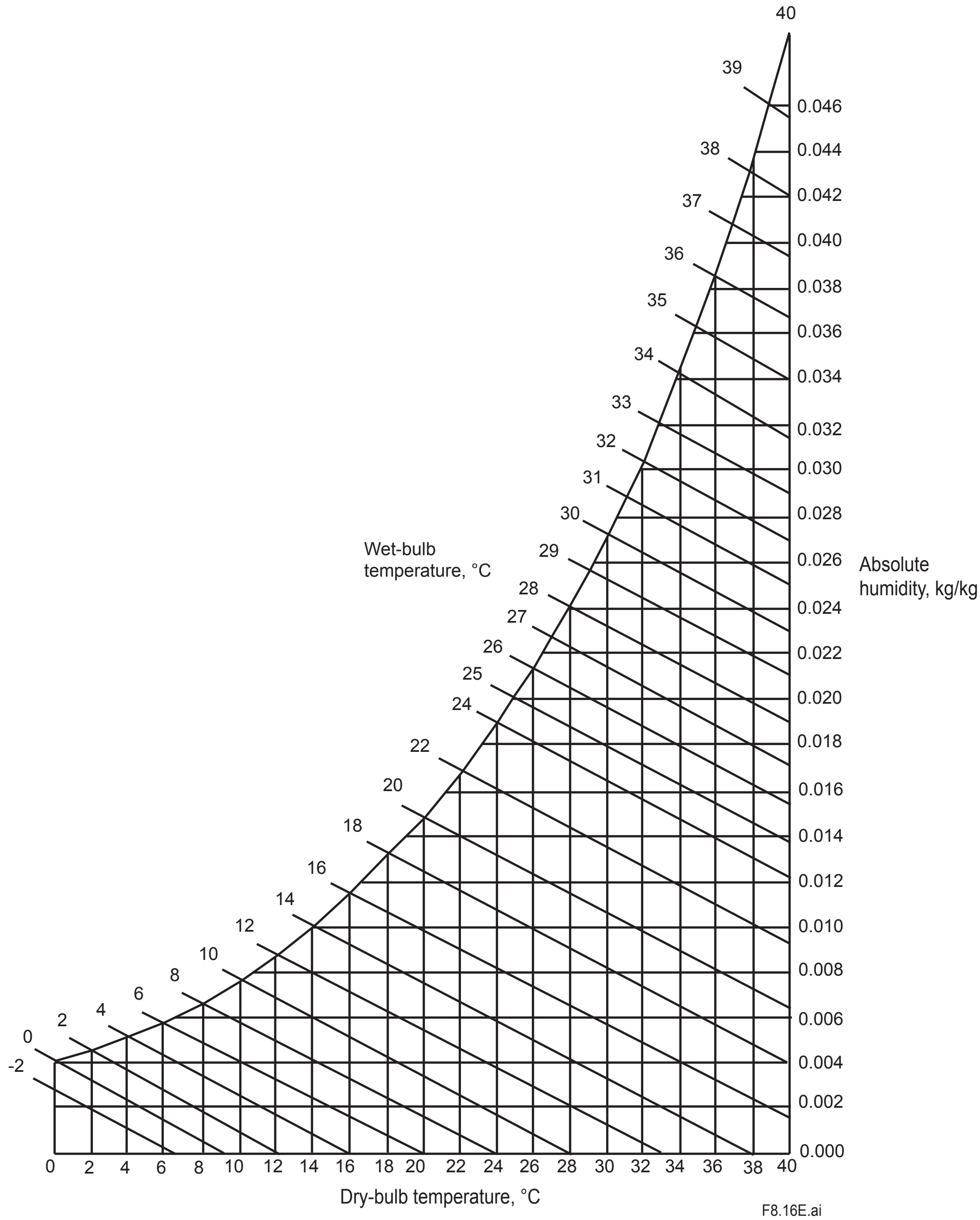


Figure 8.15 Absolute Humidity of Air

Table 8.15 Fuel Data

● **For liquid fuel**

Type \ Fuel properties	Specific weight kg/l	Chemical component (weight percentage) C	H	O	N	S	w	Ash content	Calorific power kJ/kg Higher order	Lower order	Theoretical amount of air for combustion Nm^3/kg	Amount of combustion gas Nm^3/kg CO_2	H_2O	SO_2	N_2	Total	X value
Kerosene	0.78~ 0.83	85.7	14.0	—	—	0.5	0.0	0.0	46465	43535	11.4	1.59	1.56	0.00	9.02	12.17	0.96
Light oil	0.81~ 0.84	85.6	13.2	—	—	1.2	0.0	0.0	45879	43032	11.2	1.59	1.47	0.00	8.87	11.93	0.91
A Heavy oil class 1 No.1	0.85~ 0.88	85.9	12.0	0.7	0.5	0.5	0.3	0.05	45544	42739	10.9	1.60	1.34	0.00	8.61	11.55	0.89
A Heavy oil class 1 No.2	0.83~ 0.89	84.6	11.8	0.7	0.5	2.0	0.4	0.05	45125	42320	10.8	1.58	1.32	0.01	8.53	11.44	0.86
B Heavy oil class 2	0.90~ 0.93	84.5	11.3	0.4	0.4	3.0	0.5	0.05	43827	41274	10.7	1.58	1.27	0.02	8.44	11.31	0.77
C Heavy oil class 3 No.1	0.93~ 0.95	86.1	10.9	0.5	0.4	1.5	0.5	0.1	43952	41441	10.7	1.61	1.22	0.01	8.43	11.27	0.79
C Heavy oil class 3 No.2	0.94~ 0.96	84.4	10.7	0.5	0.4	3.5	0.5	0.1	43116	40646	10.5	1.58	1.20	0.02	8.32	11.12	0.72
C Heavy oil class 3 No.3	0.92~ 1.00	86.1	10.9	0.5	0.4	1.5	0.6	0.1	43660	41190	10.7	1.61	1.22	0.01	8.43	11.27	0.77
											2		1				3

● **For gas fuel**

Theoretical amount of air

Type \ Fuel properties	Specific weight kg/Nm^3	Chemical component (weight percentage) CO	H_2	CO_2	CH_4	C_mH_n	O_2	N_2	Calorific power kJ/Nm^3 Higher order	Lower order	Theoretical amount of air for combustion Nm^3/m^3	Combustion product, Nm^3/m^3 CO_2	H_2O	N_2	Total	X value
Coke oven gas	0.544	9.0	50.5	2.6	25.9	3.9	0.1	8.0	20428	18209	4.455	0.45	1.10	3.60	5.15	0.46
Blast furnace gas	1.369	25.0	2.0	20.0	—	—	—	53.0	3391	3349	0.603	0.45	0.02	1.01	1.48	0.08
Natural gas	0.796	—	—	2.0	88.4	3.2	1.6	4.2	37883	34074	9.015	0.98	1.88	7.17	10.03	0.86
Propane	2.030	C_3H_8 90%, C_4H_{10} 10%							102055	93976	24.63	3.10	4.10	19.5	26.7	2.36
Butane	2.530	C_3H_8 10%, C_4H_{10} 90%							125496	115868	30.37	3.90	4.90	24.0	32.8	2.91
(Gases)		(Molecular Formula)														
Oxygen	1.43	O_2							—	—	—	—	—	—	—	—
Nitrogen	1.25	N_2							—	—	—	—	—	—	—	—
Hydrogen	0.09	H_2							12767	10758	2.390	—	1.0	1.89	2.89	0.27
Carbon monoxide	1.25	CO							12642	12642	2.390	1.0	—	1.89	2.89	0.32
Carbon dioxide	1.96	CO_2							—	—	—	—	—	—	—	—
Methane	0.72	CH_4							39750	35820	9.570	1.0	2.0	7.57	10.6	0.90
Ethane	1.34	C_2H_6							69638	63744	16.74	2.0	3.0	13.2	18.2	1.60
Ethylene	1.25	C_2H_4							62991	59060	14.35	2.0	2.0	11.4	15.4	1.48
Propane	1.97	C_3H_8							99070	91255	23.91	3.0	4.0	18.9	25.9	2.29
Butane	2.59	C_4H_{10}							128452	118623	31.09	4.0	5.0	24.6	33.6	2.98
											2		1			3

T8.8E.ai

■ Procedure

(1) "Sensor menu" > "Setting".

(2) Select "Fuel setup".

(3) Enter numerical value on "Exhaust water vapor content", "Theoretical air volume" "X value", "Absolute humidity of outside air".

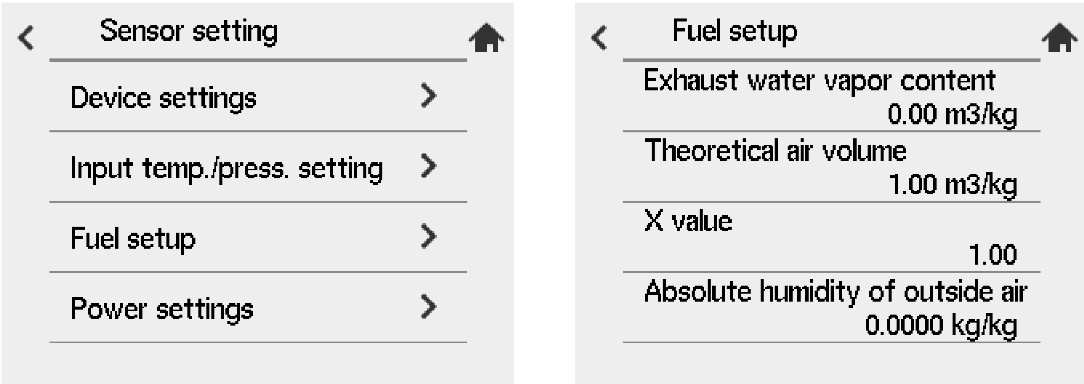


Figure 8.16 Fuel Setup

■ Default Values

When the analyzer is delivered, or if data are initialized, default, parameter settings are as shown in Table 8.16.

Table 8.16 Default Settings for Fuel Values

Item	Default setting
Exhaust water vapor content	0.00 m^3/kg (m^3)
Theoretical air volume	1.00 m^3/kg (m^3)
X value	1.00
Absolute humidity of outside air	0.0000 kg/kg

8.7.4 Setting Measurement Gas Pressure (Oxygen Analyzer)

This instrument can correct the oxygen concentration value by setting the pressure of the sample gas.

It is used when the influence of the pressure fluctuation of a sample gas, which occurs after calibration, cannot be ignored. (A pressure fluctuation of 1 kPa causes a deviation of about 1% in the reading value.)

If the sample gas pressure exceeds 3 kPa, do not use this function and use a detector with pressure compensation. If you use a detector with pressure compensation, you do not need to set this function.

● Setting method of the measurement gas pressure

There are two methods for inputting the sample gas pressure. One is measuring the actual gas pressure with a pressure transmitter. The other one is manually inputting a preset value in advance.

(1) "Sensor menu" > "Setting".

(2) On "Sensor setting", select "Input temp./press. setting".

(3) On "Input temp./press.setting", select "Oxygen model setting".

(4) When you select “Pressure input selection”, a dialog box appears to select “Preset value”, “External input”. Select according to your system.

When Preset value is selected

(5) When “Preset value” is selected on “Pressure input selection”, enter a sample gas pressure on “Input pressure set value”.

When External input is selected

(6) When “External input” is selected on “Pressure input selection”, Enter the values of pressure of 4 mA point and 20 mA point respectively of a pressure transmitter you use.

(7) When alarm from sample gas pressure is used, select “Pressure upper limit alarm value”, “Pressure lower limit alarm value.” Enter the alarm pressure value with numeric input.

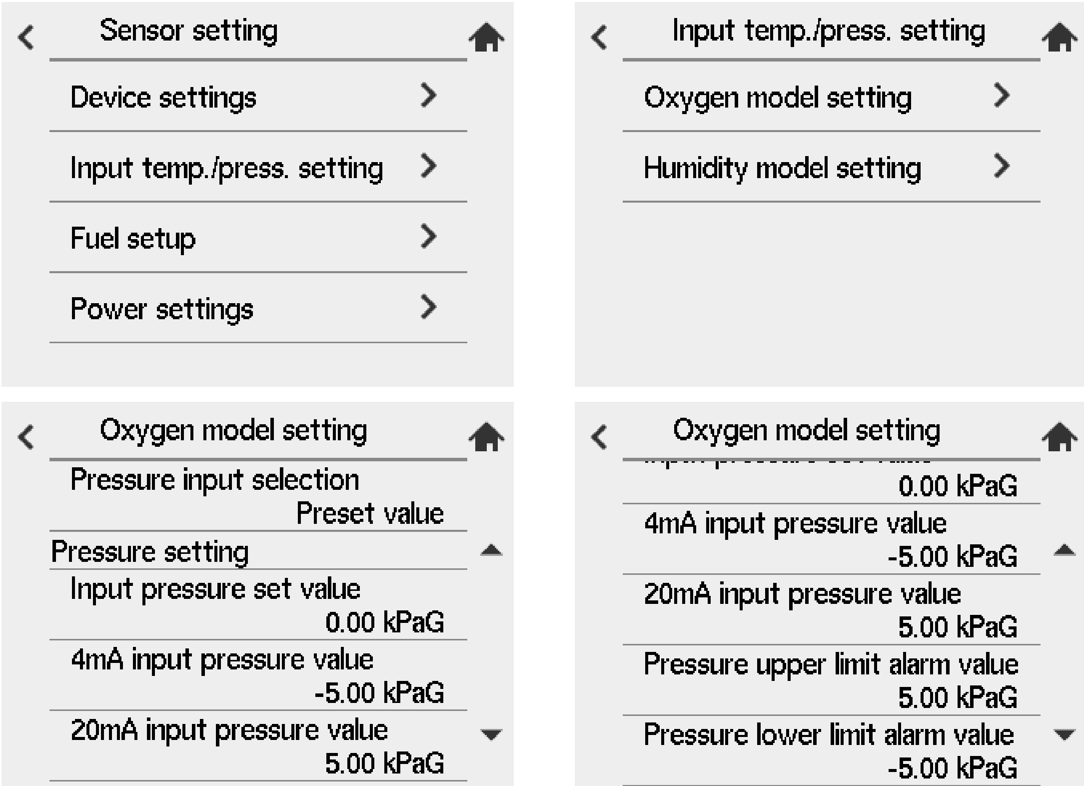


Figure 8.17 Setting Measurement Gas Pressure (Oxygen Analyzer)

● Default Values

When the analyzer is delivered, or if data are initialized, measurement gas temperature and pressure set ranges and their default settings are as shown in Table 8.17.

Table 8.17 Measurement Gas Pressure Set Ranges and Default Settings

Set Item	Set range	Default setting
Pressure input selection	-	Preset value
Input pressure set value	-500 to 500 kPaG	0.00 kPaG
4 mA input pressure value	-500 to 500 kPaG	-5.00 kPaG
20 mA input pressure value	-500 to 500 kPaG	5.00 kPaG
Pressure upper limit alarm value	-500 to 500 kPaG	5.00 kPaG
Pressure lower limit alarm value	-500 to 500 kPaG	-5.00 kPaG

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

To obtain the relative humidity:

The relative humidity U that is obtained from JIS Z 8806 is:

U = e/***es*** x 100

where, e = water vapor pressure of moist air
es = Saturated water vapor

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

U = P x H/ ***es*** x 100

where, P = Gas pressure
H = moisture content (volume ratio)

The saturated water vapor pressure es is determined by a gas temperature, so the relative humidity can be obtained by entering the above parameters.

To obtain the 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 ad volume ratio (= pressure ratio), as given below.

e = P x H

where, e = water vapor pressure in moist air
P = gas pressure
H = Humidity (moisture content) (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.

● Setting Measurement Gas Temperature, Pressure

There are two ways of entering measurement gas temperatures: one is to measure actual gas temperature using a temperature transmitter and the other is to enter a preset value manually.

Set the measurement gas temperature as follows:

(1) “Sensor menu” > “Setting”

(2) Select “Input temp./press. setting”.

(3) “Select Humidity model setting”.

(4) When you select “Temperature ipunt selection”, a dialog box appears to select “Preset value”, “External input”. Select according to your system.

When “preset value” is selected

(5) Enter the measurement gas temperature on “input temperature setting”.

When “external input” is selected

(6) Enter the values of temperature of 4 mA point and 20mA point respectively of a temperature transmitter you use.

(7) Select “Temp. upper limit alarm value” or “Temp. lower limit alarm value” when using an alarm caused by temperature of measured gases. Enter the alarm temperature from the numeric entry screen

How to setup the measured gas pressure

(8) Enter the pressure (absolute pressure) of the measured gas in “Exhaust gas pressure.”

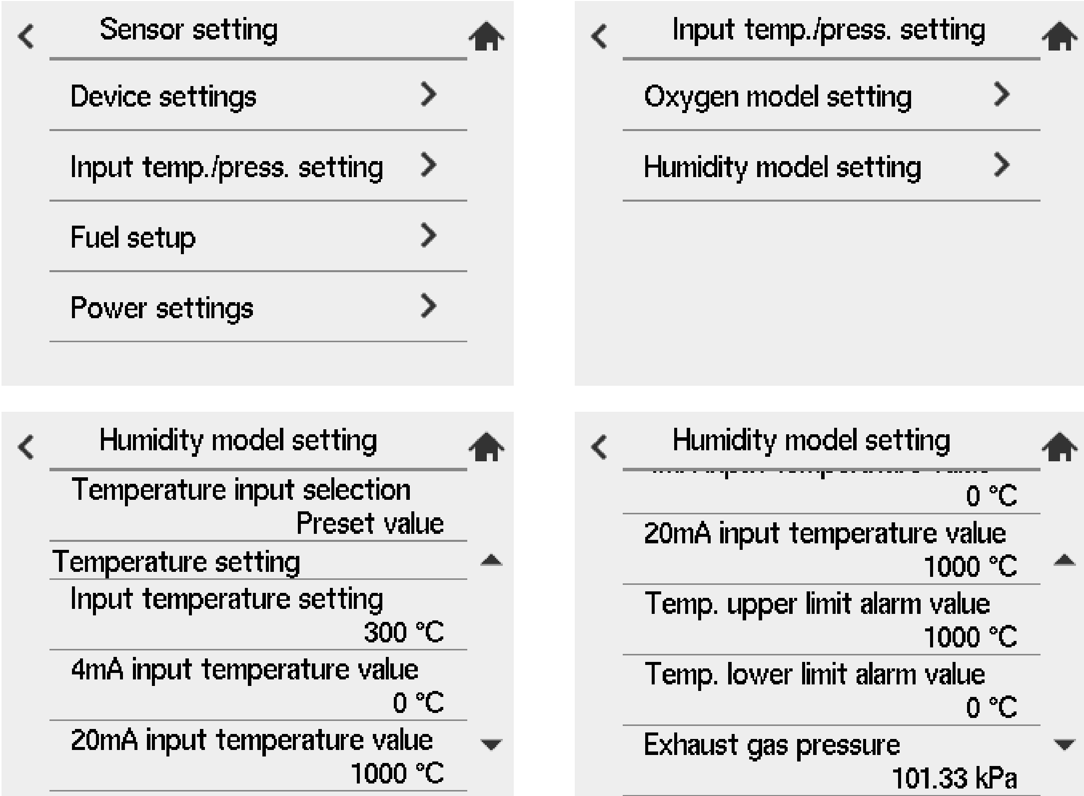


Figure 8.18 Setting Measurement Gas Temperature and Pressure (Humidity Analyzer)

NOTE

- 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.
- If an invalid value is set, no correct calculation will be obtained. Be sure to check allowable temperature ranges of the temperature transmitter you use, and then enter the value correctly.

● Default Values

When the analyzer is delivered, or if data are initialized, measurement gas temperature and pressure set ranges and their default settings are as shown in Table 8.18.

Table 8.18 Measurement Gas Temperature and Pressure Set Ranges and Default Settings

Set Item	Set range	Default setting
Temperature input selection	-	Preset value
Input temperature setting	0 to 3000°C	300°C
4 mA input temperature value	0 to 3000°C	0°C
20 mA input temperature value	0 to 3000°C	1000°C
Temp. upper limit alarm value	0 to 3000°C	1000°C
Temp. lower limit alarm value	0 to 3000°C	0°C
Exhaust gas pressure	0 to 689.47 kPa abs	101.33 kPa abs

8.7.6 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.

How to setup purging

(1) "Converter menu" > "Setting"

(2) Select "Others setting". Enter "Purging time" value.

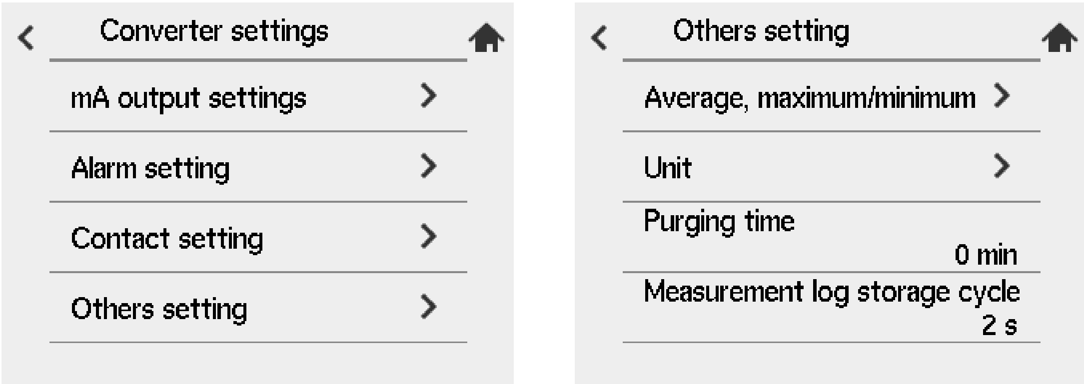


Figure 8.19 Purging time setting

8.7.7 Setting password

The instrument can protect various setup and executes by means of a password. You can setup the password of "Commissioning" and "Execute" respectively for each item as below. "Commissioning" password is for setting each revised setup data. "Execute" password is to execute maintenance or calibration.

Table 8.19 Pasword Setting Items

Menu	Item	Password (Commissioning / Execute)
Converter menu	Detail	-
	Trend	-
	Blowback	Execute
	Others	Commissioning
	Maintenance	Execute
	Setting	Commissioning
	Reset	Commissioning
	Lang.	Execute
Sensor menu	Detail	-
	Calibration	Execute
	Cell resist	Execute
	Setting	Commissioning

NOTE

You can establish password for the calibration or a shortcut of Favorite on Home screen as well.

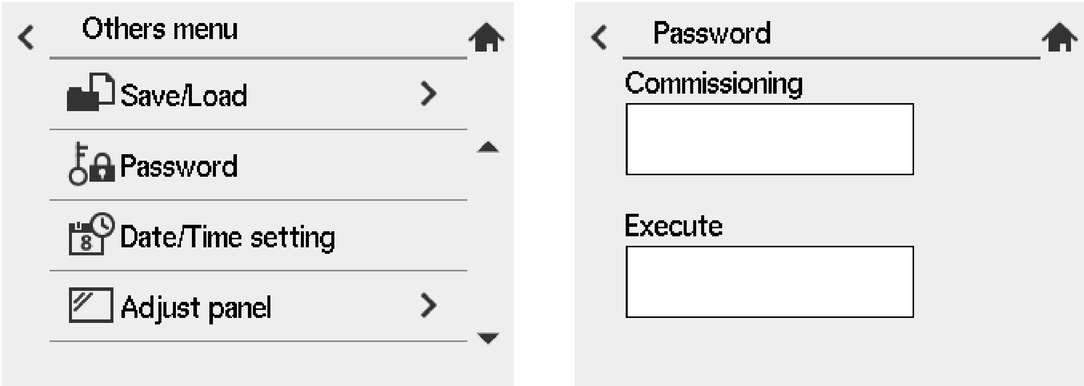


Figure 8.20 Passwords Display

<Default setting>
The passwords are not set as shipped from factory. If you reset data, the password settings are deleted.

CAUTION

If you setup a password, write down the password so you won't forget it.

You are asked for the password when entering a protected operation, such as "Setting" or calibration.

If your password is not verified, the message "Wrong password" (or similar message) appears.

When you enter a correct password, you can move to operator ID entry screen.

The operator ID is recorded in the log information to identify the person who operated on it. You can proceed without entering anything. Operator IDs can be up to 4 characters

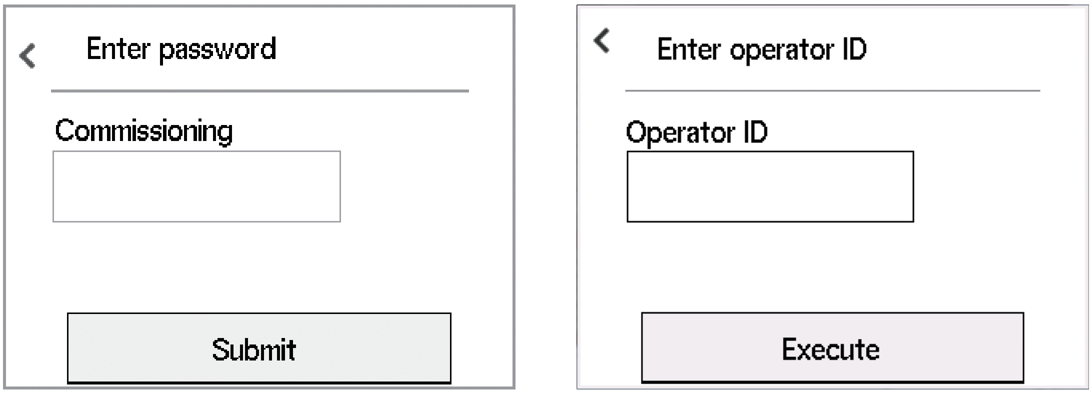


Figure 8.21 Password, Operator ID verification

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9. Calibration

9.1 Calibration Briefs

9.1.1 Principle of Measurement with a zirconia oxygen analyzer

This section sets forth the principles of measurement with a zirconia oxygen analyzer before detailing calibration.

A solid electrolyte such as zirconia allows the conductivity 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 oxygen partial pressures on each side, the element shows the action of the concentration cell. In other words, the electrode in contact with a gas with a higher oxygen partial pressure acts as a negative electrode. As the gas comes in contact with the zirconia element in this negative electrode, oxygen molecules in the gas acquire electrons and become ions. Moving in the zirconia element, they eventually arrive at the positive electrode on the opposite side.
There, the electrons are released and the ions return to the oxygen molecules. This reaction is indicated as follows:

Negative electrode: $O_2 + 4e \rightarrow 2\,O^{2-}$
Positive electrode: $2\,O^{2-} \rightarrow O_2 + 4\,e$

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

$$E = -RT/nF \ln Px/Pa \cdots\cdots \text{Equation (1)}$$

where,
- R: Gas constant
- T: Absolute temperature
- n: 4
- F: Faraday's constant
- Px: Oxygen concentration in a gas in contact with the positive zirconia electrode (%)
- Pa: Oxygen concentration in a gas in contact with the negative zirconia electrode (%)

Assuming the zirconia element is heated up to 750 °C, then we obtain equation (2) below.

$$E = -50.74 \log \frac{Px}{Pa} \ \cdots\cdots \ \text{Equation (2)}$$

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

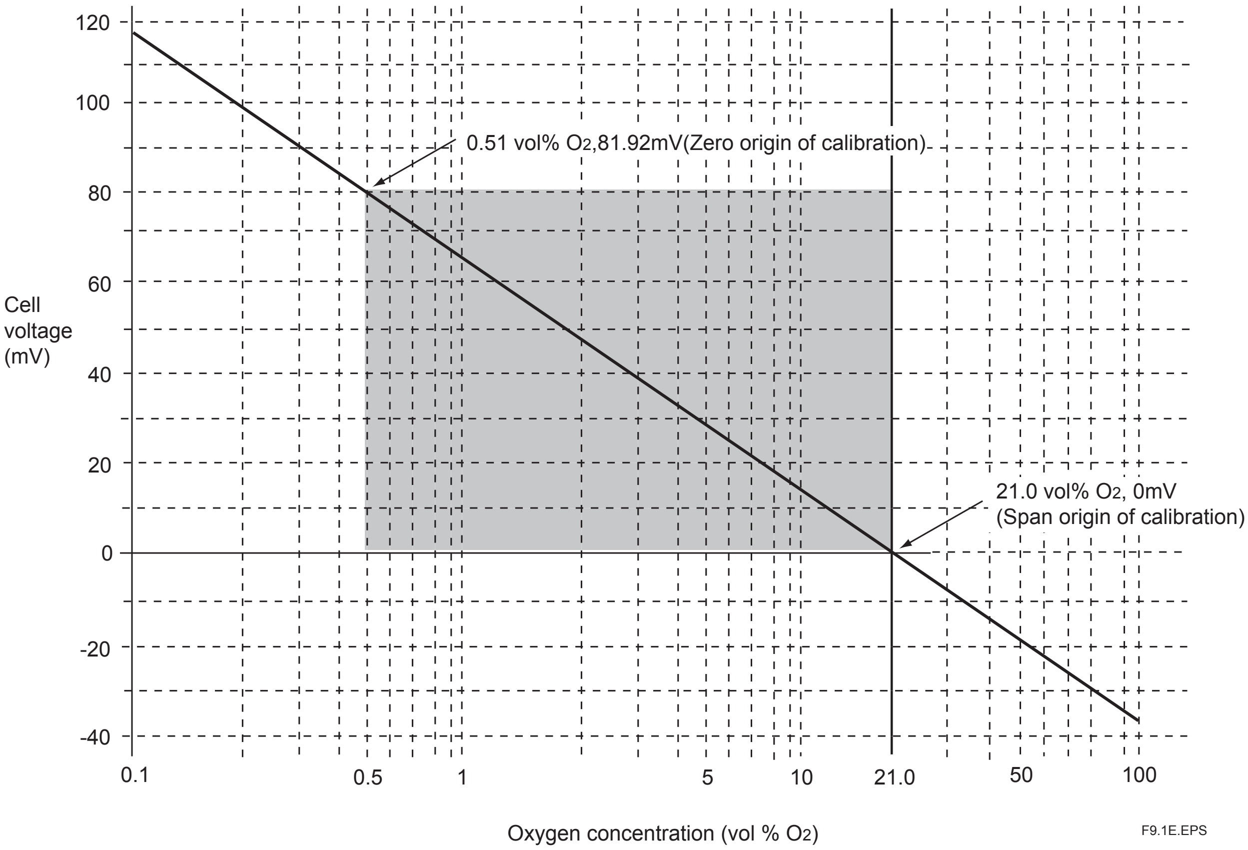


Figure 9.1 Oxygen concentration in a Sample Gas vs Cell Voltage (21 vol%O_2 Equivalent)

The measurement principles of a zirconia oxygen analyzer have been described above. However, the relationship between oxygen concentration and the electromotive force of a cell is only theoretical. Usually, in practice, a sensor shows a slight deviation from the theoretical value. This is the reason why calibration is necessary. To meet this requirement, an analyzer calibration is conducted so that a calibration curve is obtained, which corrects the deviation from the theoretical cell electromotive force.

9.1.2 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 % O2) 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 = O2 vol % on the zirconia element measurement electrode
a = O2 vol % to 21.0 vol % O2 on the zirconia element reference electrode

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

(A) For the vol % H2O measurement

x:Assuming that H2O vol % in a mixed gas is measured:

y = (100 – x) 3 0.21 .... Equation (2)

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

E = -K log y/a = -Klog [(100 – x) 30.21] /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.

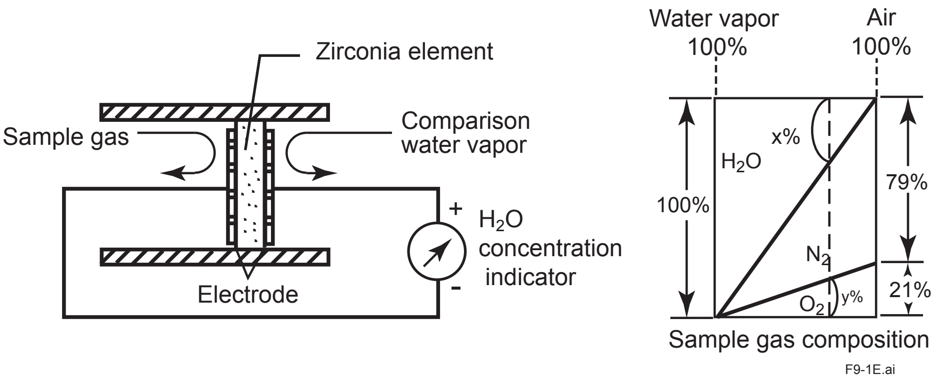


Figure 9.2 Schematic Diagram of Measurement Principle

(B) For the “mixing ratio” measurement

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

r = 0.622 3 x/(100 – x) .... Equation (4)

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

E = -K log y/a = -K log 50.622 3 21/(0.622 + r)/216
= -K log 0.622/(0.622 + r) ... . Equation (5)

where, K = Constant

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

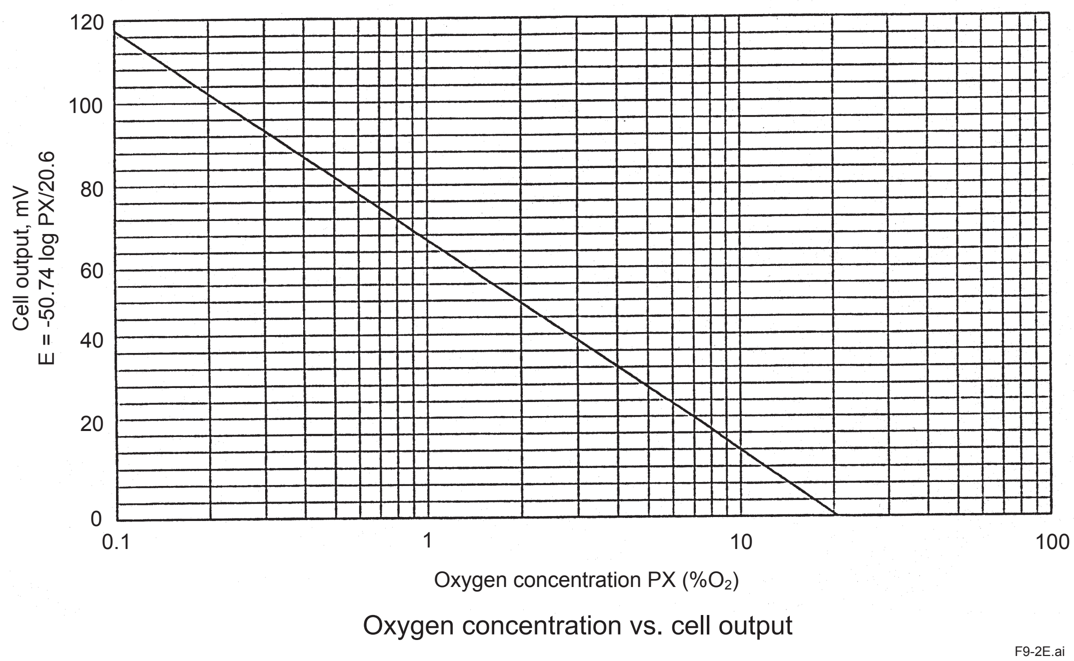
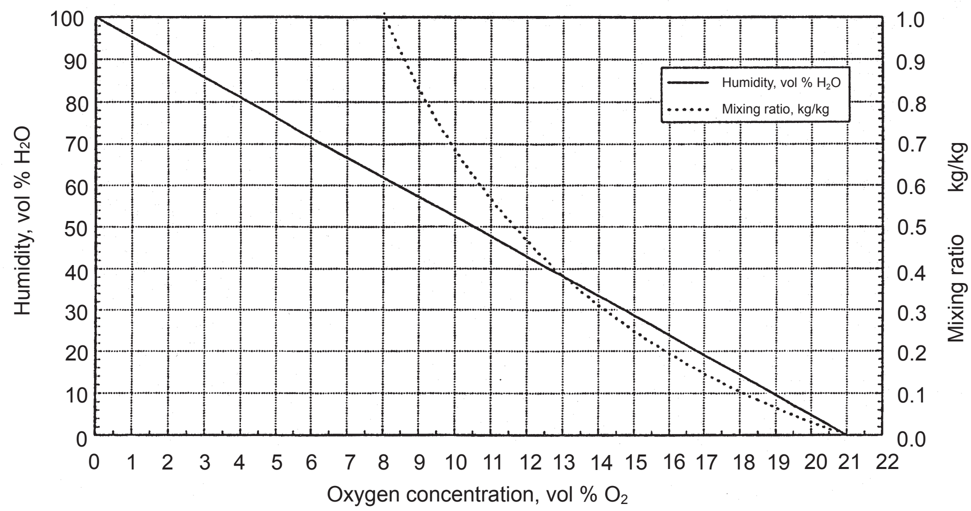


Figure 9.3



Oxygen concentration vs. Humidity, Mixing ratio

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Figure 9.4

9.1.3 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.

9.1.4 Compensation

The deviation of a measured value from the theoretical cell electromotive force is checked by the method in Figure 9.5 or Figure 9.6.

Figure 9.5 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 sample 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 x 100 (%) on the basis of A, B and C shown in Figure 9.5 and a span correction ratio of C/A x 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.

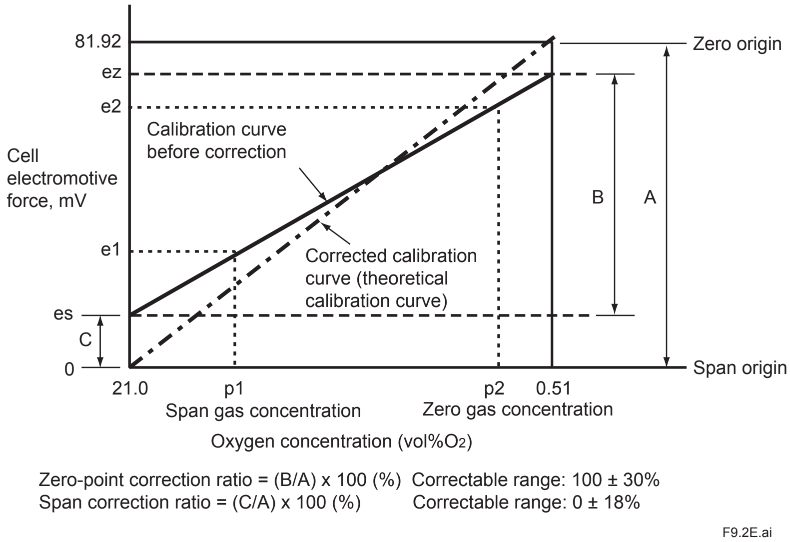


Figure 9.5 Calculation of a Two-point Calibration Curve and Correction Ratios using Zero and Span Gases

Figure 9.6 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.

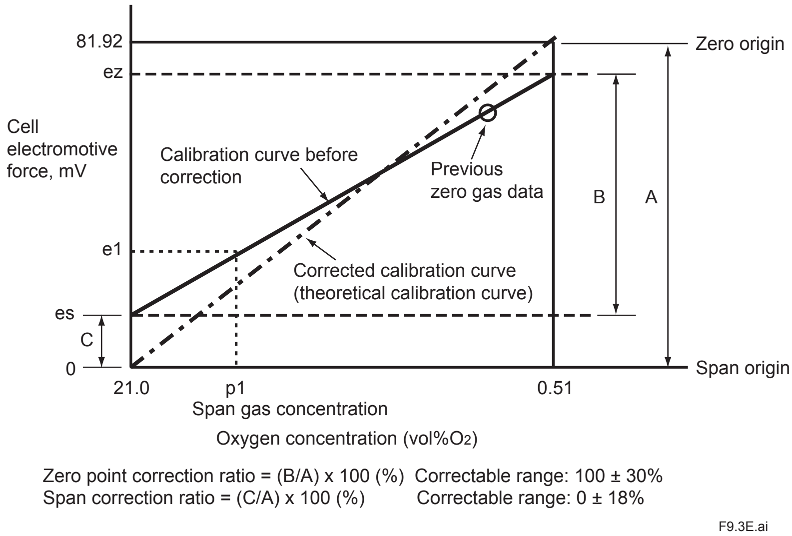


Figure 9.6 Calculation of a One-point Calibration Curve and Correction Ratios using a Span Gas

9.1.5 Characteristic Data from a Sensor Measured During Calibration

In addition to calibration data, the following data is collected during calibration to determine the status of the sensors. However, if calibration is not performed correctly (e.g. semi-automatic calibration, an error occurs when it is automatic calibration), these data in this calibration will not be collected. These data can be viewed in the log information in converter menu and in the detailed display in sensor menu. For instructions and instructions on how to operate the data, refer to Section “10.1 Detailed-data Display” and “10.2 Converter Detail”.

(1) History of Span Point Correction Rate
The value up to the last 20 times is memorized.

(2) History of zero point correction rate

The value up to the last 20 times is memorized

(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

NOTE

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

The following sets forth the required calibration settings:

9.2.1 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 interval and stabilization time.

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

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.

To execute this calibration, follow these steps:

(1) "Converter menu" > "Maintenance"

(2) Select "Calibration settings" "Calibration mode" > "Manual", "Semi-automatic, Auto", "Semi-automatic."

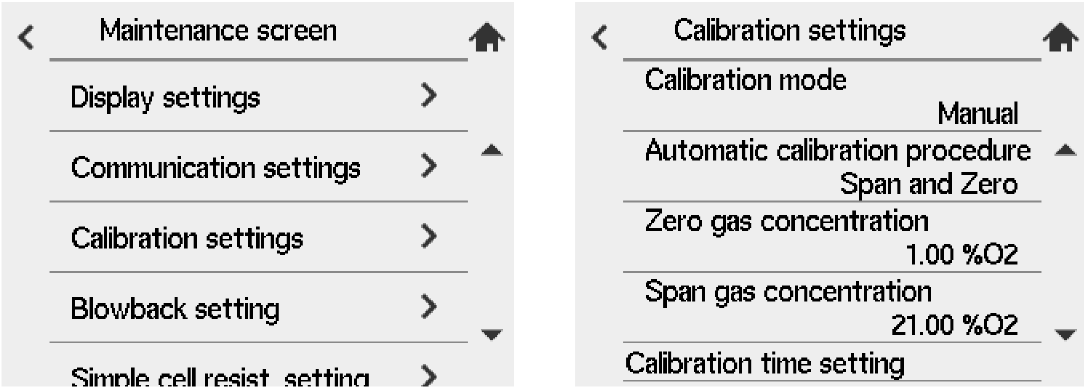


Figure 9.7 Calibration mode

9.2.2 Calibration procedure

Select one among Calibration of both span and zero, Calibration of only span, Calibration of only zero. Normally select “span-zero.”

9.2.3 Zero gas Concentration

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

Select “Zero gas concentration” on the “Calibration settings”. The numeric-data entry display then appears. Enter the desired oxygen concentration for the zero-point calibration. The setting range is 0.3 to 100 vol%O_2.

9.2.4 Span gas Concentration

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

Select “Span gas concentration” on the “Calibration settings”. Enter the desired span gas oxygen concentration from the numeric-data entry display.

(The span gas set ranges from 4.5 to 100 vol%O_2.)

Enter 02100 for an oxygen concentration of 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.

NOTE

- When the instrument air supply is to be used as span gas, cool it to -20°C below dew point to remove moisture, oil mist and dust from the air.
- If you do not do this to purify the air, then the accuracy of the calibration may be affected.

9.2.5 Setting Calibration Time

• When the calibration mode is in manual:

First set the “Hold time” (output stabilization time).

“Hold time” refers to the time from when calibration is finished to when the test is resumed. This time setup the time after calibration until the sensor replaces calibration gas with the measured gas and the output returns to a steady state. After a series of calibration operations, the analogue outputs are turned setup at “output hold” until the stabilization time has elapsed (if hold is turned setup). The “Stabilization Time” can be setup from 00 minutes 00 seconds to 60 minutes 59 seconds (see Section “8.2 Output Hold Setting”).

When the mode is turned setup to “Semi-automatic”:

In addition to the “Hold time” “stabilization time” described above, “calibration time” is turned setup. Calibration time is the time from when calibration begins to flow until calibration is executed. Setup times work commonly for both zero calibration and span calibration. The settling time and calibration time can be setup from 00 minutes 00 seconds to 60 minutes 59 seconds. Fig. 9.8 shows the relationship between calibration time and the stabilization time

.

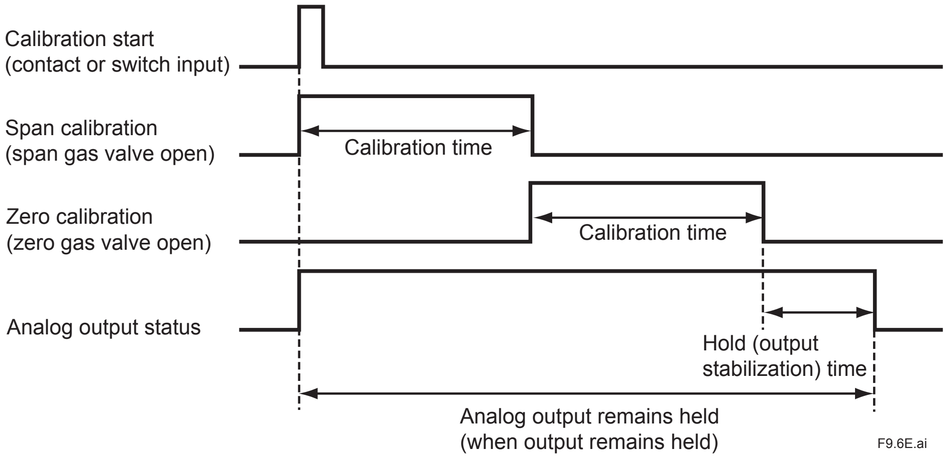


Figure9.8 Calibration and Hold Time Settings

• When the calibration mode is in automatic:

In addition to the above Hold (output stabilization) time and Calibration time, set the Interval, First Start date, and First 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 First start-calibration time to the “Start date” and “Start time” respectively.

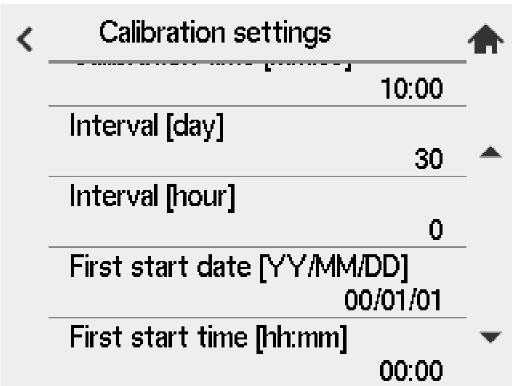


Figure 9.9 Calibration settings

NOTE

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

(1) If the calibration interval is shorter than the sum of Hold (output 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 blow back operations, calibration will start after completing the maintenance service or blow back 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.

9.2.6 Default Values

When the analyzer is delivered, or if data are initialized, the calibration settings are by default, as shown in Table 9.1.

Table 9.1 Default Settings for Calibration

Item	Default Setting
Calibration mode	Manual
Automatic calibration procedure	Span and Zero
Zero gas concentration	1.00%O_2
Span gas concentration	21.00%O_2
Hold time [mm:ss]	10:00
Calibration time [mm:ss]	10:00
Interval [day]	30
Interval [hour]	0
First start date [YY/MM/DD]	00/01/01
First start time [hh:mm]	00:00

9.3 Calibration

9.3.1 Manual Calibration

For manual calibration, consult Section “7.12 Calibration”, earlier in this manual.

9.3.2 Semi-automatic Calibration

By the touch panel

(1) Press[set up] on Home screen to enter a calibration screen. Select “Span” of “Semi-auto calibration”. Only the procedure setting established at “9.2.2 Calibration procedure” is enabled.

(2) Press “Start calibration” . A trend screen appears and the calibration starts.

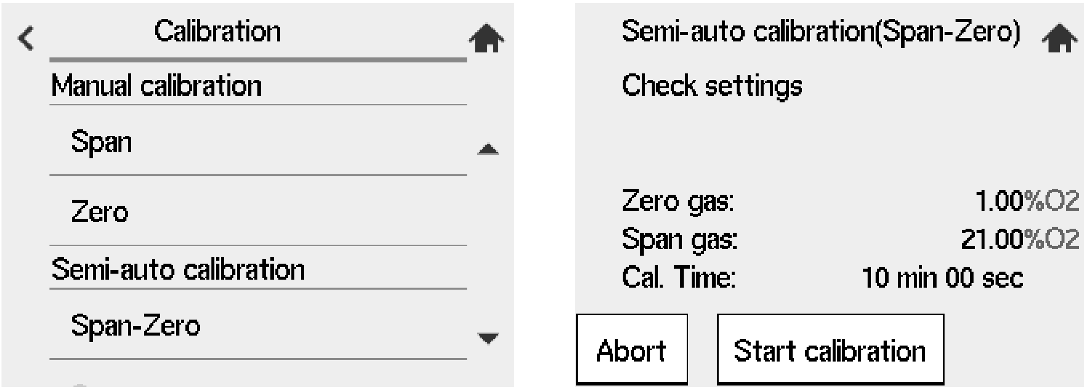


Figure 9.10 Semi-auto Calibration

By contact input

(1) Make sure that Calibration start has been selected in the Input contacts display (see Section “8.6 Input Contact Settings”, earlier in this manual).

(2) When the signal is sent to contact input, the calibration starts.

To stop calibration midway, follow these steps:

(1) Press the [Abort] key. If this key is pressed midway during calibration, the calibration will stop and the hold (output stabilization) time will be set up.

(2) Press the [Abort] key once again to return to the screen as shown in Figure 9.10.

9.3.3 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.

NOTE

Before starting Semi-automatic calibration or Automatic calibration, operate the calibration gas solenoid valves and adjust calibration gas flow to 600 ± 60 ml/min.

10. Other Functions

10.1 Detailed-data Display

"Sensor menu" > "Detail"

This section describes each data of sensors.

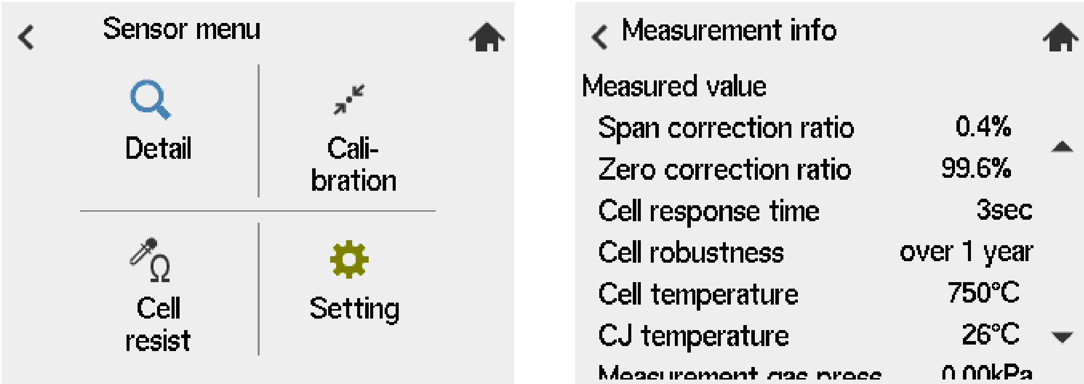
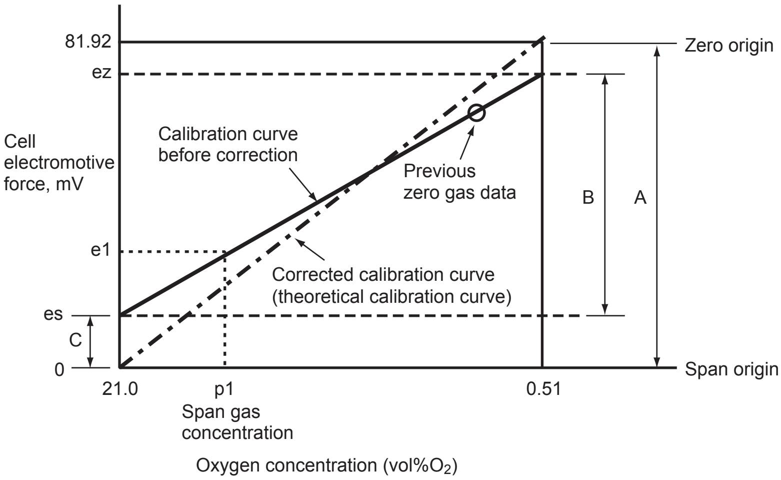


Figure 10.1 Detailed-data Display

10.1.1 Span correction ratio, Zero correction ratio

These are used to check for 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.



Zero gas correction ratio = (B/A) x 100 (%) Correctable range: 100 ± 30%
Span gas correction ratio = (C/A) x 100 (%) Correctable range: 0 ± 18%

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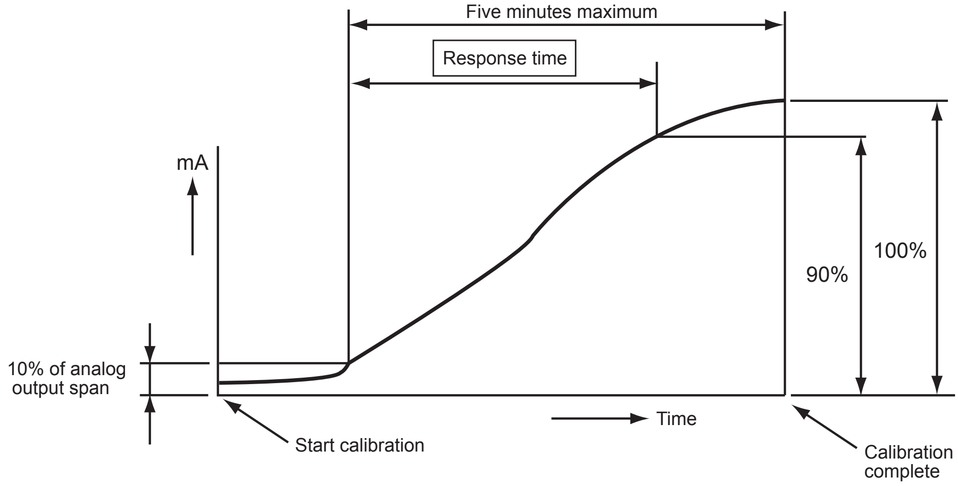
Figure 10.2

10.1.2 Cell response time

The cell's response time is obtained in the procedure shown in Figure 10.3. 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.

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Figure 10.3 Typical Response Time characteristic

10.1.3 Cell robustness

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 response time is not used as a factor in evaluating the cell’s robustness.

10.1.4 Cell Temperature

This displays the cell (sensor) temperature, which is determined from the thermocouple emf and cold junction temperature. Normally it is 750°C.

10.1.5 C. J. Temperature

This indicates the detector terminal box temperature (except for ZR802G-/CJ selected), which compensates for the cold junction temperature for a thermocouple measuring the cell temperature. When the ZR22 Detector is used, the maximum C. J. temperature will be 150°C. If the terminal box temperature exceeds this, take measures to shield the terminal box from heat radiation.

The maximum C. J. temperature varies depending on the type of detector.

When ZR80G /CJ is selected, this shows a temperature near terminal box inside a converter case.

10.1.6 Measurement gas press. (oximeter), Measurement gas temperature (hygrometer)

Displays the preset value or the value entered by the transmitter. Turn Display the measured gas pressure for the oximeter and the measured gas temperature for the hygrometer.

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

Table 10.1 shows oxygen concentration versus cell voltage.

Table 10.1 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

T10.1E.ai

10.1.8 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.

10.1.9 Cold Junction Resistance (CJ resistance)

The ZR22 Detector measures the cold junction temperature using an RTD (Pt 1000).
If detector is “ZR22” is selected in the “Setting”, the RTD resistance values will be displayed.

10.1.10 Cell resistance

A new cell (sensor) indicates its internal resistance of 200 Ω maximum. As the cell degrades, so will the cell’s internal resistance increase.Those changes in the cell’s internal resistance are just a guide to the extent the cell is degrading. The updated values obtained during the calibration are displayed.

10.1.11 IF software revision

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

10.1.12 Cell heater duty

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

10.1.13 Pwr. supply voltage mode

For the best control of the detector's heater, the control parameters are automatically configured by power supply voltage and frequency. When the power voltage supplied to this instrument is lower than 165 V, "100V", is indicated. When it is over 165V, "200V" is indicated.

10.1.14 Power frequency mode

When the power frequency supplied to the instrument is lower than 55 Hz, "50 Hz" is indicated. When it is over 55 Hz, "60Hz" is indicated.

10.1.15 Simple cell resistance

Displays the numeric value gained from the cell resistance value by using a simple cell without using calibration gas. This value is effective to evaluate the sensor wellness between calibrations times. This shows a value gained from a latest calibration.

10.1.16 Simple cell robustness

Simple cell resistance measurement evaluates the cell's life expectancy with 4 levels: longer than 1 year, 6 months, 3 months or less than 1 month. (All values are estimated for the purpose of safety and prevention, and not calculated for the quality guarantee.)

10.2 Converter Detail

"Converter menu" > "Detail" to see the converter output or log data. Switch the screen with ◀ ▶.

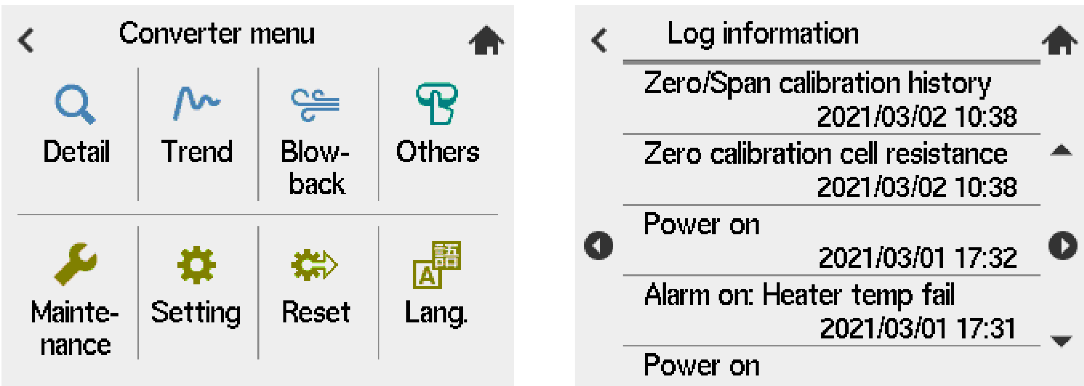


Figure 10.4 Converter Detail

10.2.1 Analog output

Displays Analog output1, Analog output2 on graphs with the unit (mA).

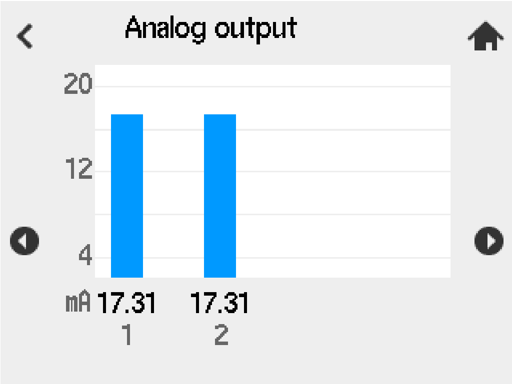


Figure 10.5 Analog output

10.2.2 Contact output

Displays the status of contact output from DO1 to DO4. When the contact is active, ON, not active, OFF is lit on. See 8.4 for details on contact ON/OFF.

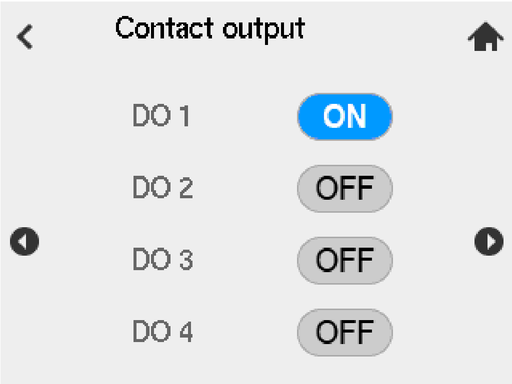


Figure 10.6 Contact output

10.2.3 Input value

Displays analog input mA and contact input status of contact DI 1 and DI 2. Analog input is displayed on a graph with the unit (mA). When there is no analog input setting, the value is displayed "---" (bar). When the contact is active, the contact input is ON, when not the contact input is OFF.

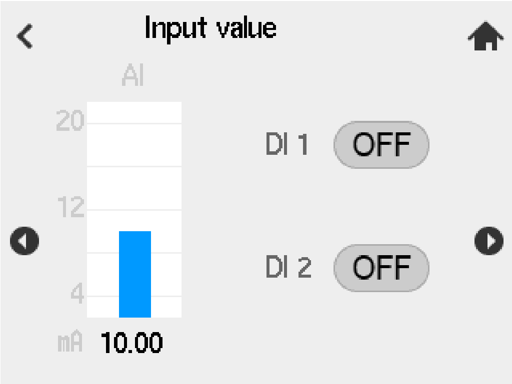


Figure 10.7 Input value

10.2.4 Measurement info

Displays average, maximum, minimum value of measurement. Maximum and minimum value show the date when the measurement is conducted. Setup the monitoring hour value of average/ max. min according to the setting described in 8.6.2.

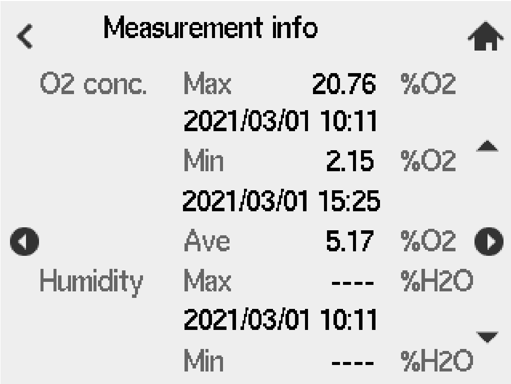


Figure 10.8 measurement info

10.2.5 Product information

Displays the set time (see "8.7.1 Setting the Date-and-Time"), version number of Main software, HART address, HART device revision number.

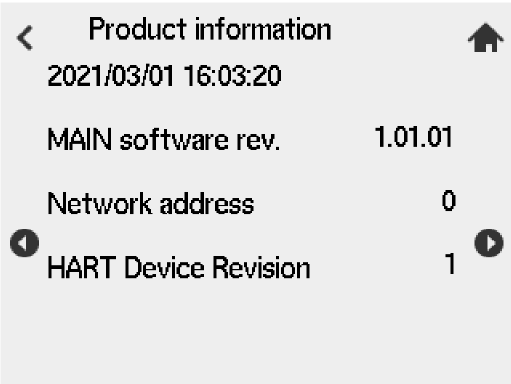


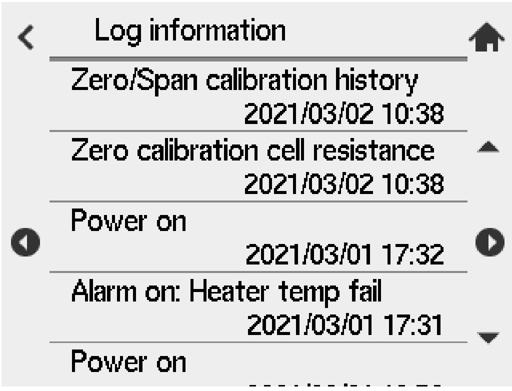
Figure 10.9 Product information

10.2.6 Log information

Displays Alarm occurrence, Alarm cancel, Calibration history, Cell resistance during calibration, date of power-on.Up to 20 logs are displayed. When you tap some specific log, you can see the detail data.

table 10.2 Log information

Log item	Details (except Time)
Alarm: cell voltage error	Cell electromotive force (mV)
Alarm: Heater temperature error	Thermocouple electromotive force (mV)
Alarm occurrence: (Other)	-
ALARM RESET	-
Zero/span calibration history	Span Correction Ratio (%), Zero Compensation Ratio (%)
Cell internal storage resistor at zero calibration	Cell resistance (Ω)
Power Supply ON	-
Farm update	-
Operator ID	Operator ID input value



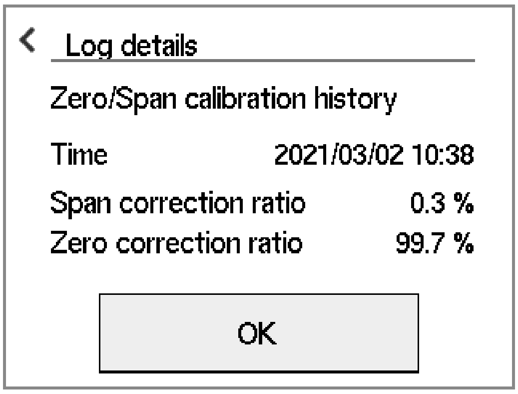


Figure 10.10   Log information

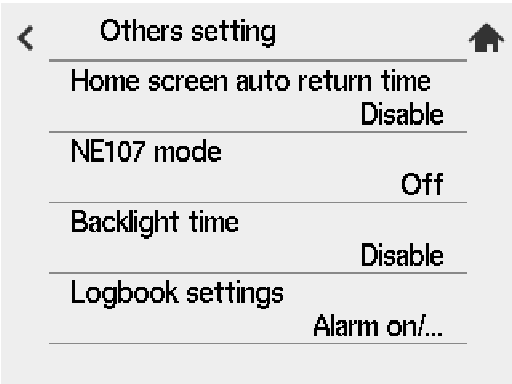
● Changing HMI setting of Logbook configuration

You can change what to display on the Log information.

(1) "Converter menu" > "Maintenance" > "Display setting" > "other settings"

(2) Select "Logbook settings". Check items to change.

You can see Cell resistance of zero calibration in "Calibration history", power ON/Firm update/Operator ID in "Other".



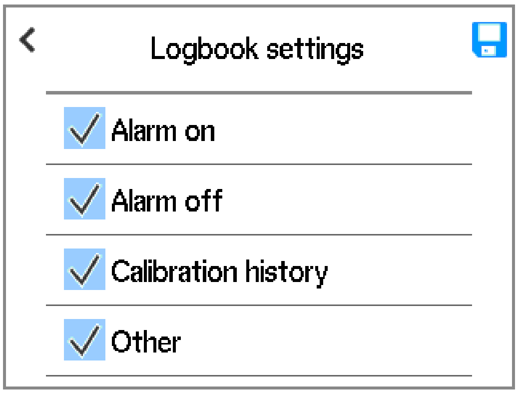


Figure 10.11   Changing log information setting

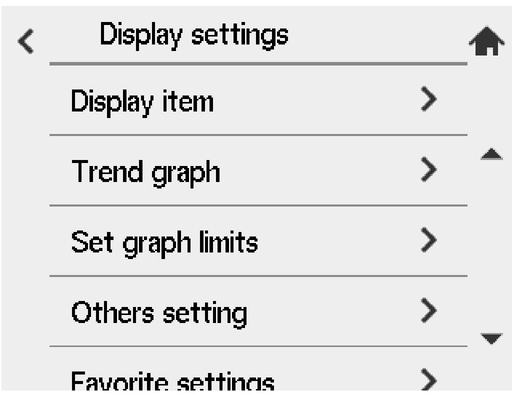
10.3 Trend Graph

"Converter menu" > "Trend". You can check the measurement trend and simple cell resistance trend. .You can check the transition of the measured value and sensor resistance value.

10.3.1 Measurement Trend setting

(1) "Converter menu" > "Maintenance" > "Display settings" > "Trend graph"

(2) Select "Graph selection items" from the Maintenance. A window opens to select an item to display. Selectable items are as shown in the table 10.3.



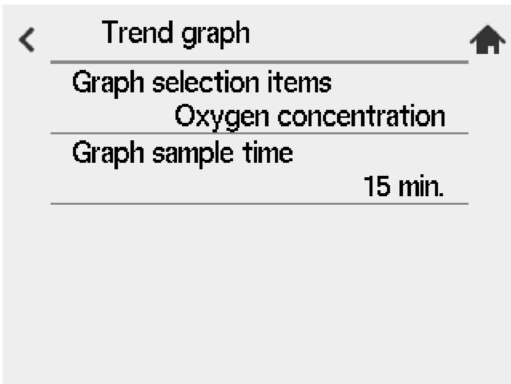


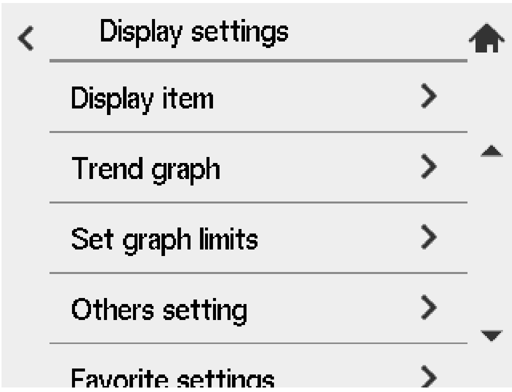
Figure 10.12   Trend graph setting

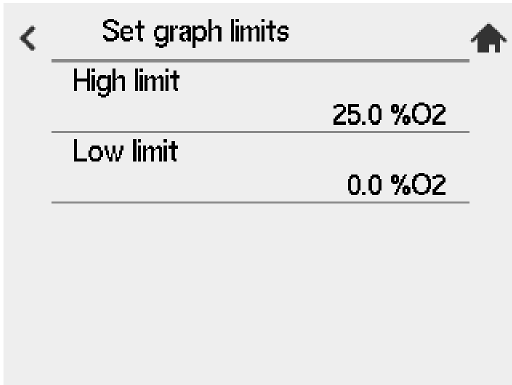
Table 10.3 Trend graph setting

selectable item	Description
Oxygen concentration	The graph shows the oxygen concentration during measurement.
Humidity	The graph shows the moisture content during measurement.
Mixing ratio	The graph shows the mixing ratio during measurement.
Relative Humidity	The graph shows the relative humidity during measurement.
Output item 1	The graph shows the item select as Output item 1. If this equipment is for the oxygen analyzer, the trend graph will be an oxygen concentration graph.
Output item 2	The graph shows the item select as Output item 2. If this equipment is for the oxygen analyzer, the trend graph will be an oxygen concentration graph.

(3) Select “Graph Sample Time” to Display the selectable sample time. Select the desired Display item from this menu.
Selectable sample time: 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, 24 hours, 7 days, 14 days.

(4) “Converter Menu” > “Maintenance” > “Display settings” > “Set graph limits”.
Setup the Hi and Low limits respectively. Tapping the graph area displays the scale of the vertical axis.





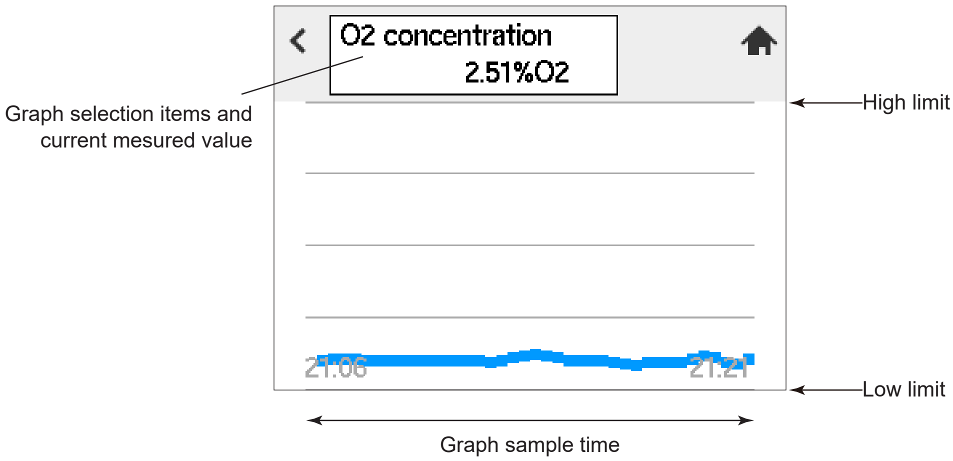


Figure 10.13 Trend graph

NOTE

If a rapid change in the measured value occurs during sampling, no sampled data are plotted on the graph. Use the graph indication tentatively. Check the output current for accurate data

10.3.2 Simple cell resistance trend

Displays the result of the simple cell resistance measurement (see “10.6 Simple cell resistance measurement”). On the measurement date the result is displayed in dots. (An example shown below shows a measurement taken once a day).

Trend displays only one data per day and the value measured at the earliest time of the day. The horizontal axis is static in six months. You can check the trend for another half year by pressing display switch. The vertical axis is determined by the value of the simple cell resistor alarm that is turned setup.

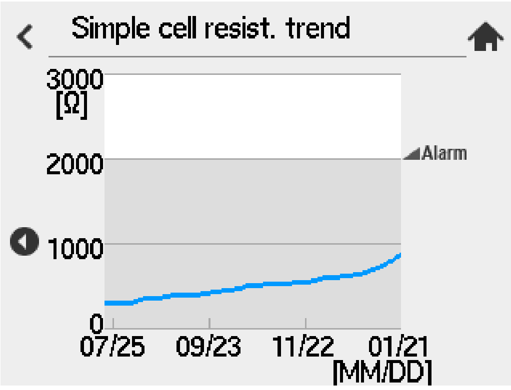


Figure 10.14 Simple cell resistance trend

10.4 Other functions of displays

10.4.1 Homescreen auto return time

What is Auto return:

When there is no key pad entry for a certain period of time while the screen other than Home (screen) is displayed, the screen returns Home (screen). This shift is called Auto return. After the key touch operation stops, the Auto return time starts and lasts until the screen returns Home automatically. You can setup the Auto return time. However, Auto return is disabled during the following period.

- During manual calibration
- During semi auto calibration
- During semi auto blow back
- During semi auto simple cell resistance measurement
- During key pad calibration (While you are on the touch panel adjustment screen, touch panel confirmation screen)
- Trend screen (including Simple cell resistance trend) on display
- Details on display (Converter menu, sensor menu)
- Alarms on display
- When the change is not saved after changing the setting

(1) “Converter menu” > “Maintenance” > “Display setting”> “Other setting”.

(2) Select “Home screen auto return time”. Select “Disable”, “10 min.”, “60 min.”.

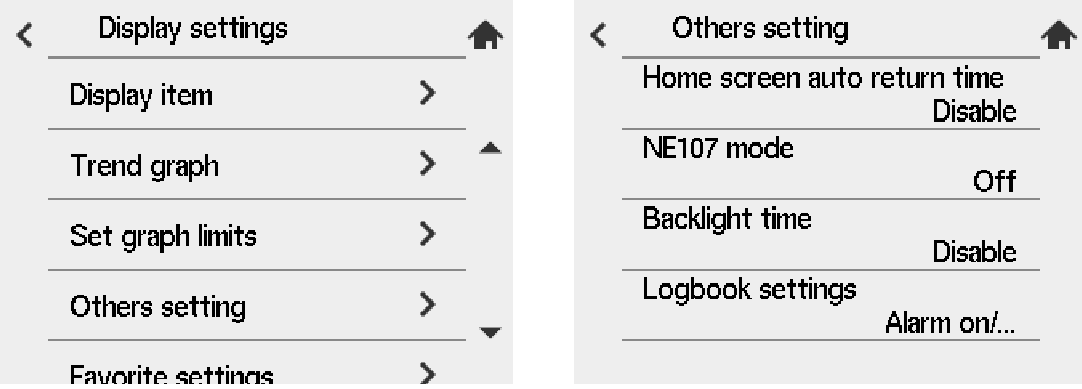


Figure 10.15 Other settings Display

10.4.2 NE107 mode

You can change the alarm display according to the NAMUR NE 107.

(1) "Converter" > "Maintenance" > "Display setting" > "Others setting"

(2) Select NE107 Mode. Select ON/Off.

Table 10.4 NE107 - Off

Icon	Alarm setting
	Failure (no power supply to heater)
	Function Check, Out of Specification, Maintenance Required

Table 10.5 NE107 - ON

Icon	Alarm setting
	Failure (no power supply to heater)
	Function Check
	Out of Specification
	Maintenance Required

10.4.3 Backlight time

You can set the back light to turn off automatically to keep LED life long. The backlight will turn off if no screen action is taken during a setup time.

(1) Select “Maintenance” → “Display setup” → “Other setup” from “converter Menu” screen.

(2) Select “Backlight time”. You can setup “disable”, “10 minutes”, “30 minutes” or “60 minutes”

10.4.4 Entering Tag Names

You can assign any tag name to the instrument;

If there is an instruction in the specification at the time of order, it is entered at the time of shipment.

(1) Select "Maintenance" → "Display settings" → "Display Items" from "converter Menu" screen.

(2) Select "Tag Name" to enter screen and use alphabets, numbers, and symbols. You can enter up to 32 character of characters.

Figure 10.16 Entering Tag Names

10.4.5 Language Selection

You can select a display language from among Japanese, English, Chinese, French, German, Portuguese.

The display language is set to the one specified in the purchase order when the analyzer is shipped from the factory.

(1) “Converter menu” > “ Language”. Set the language to display.

Figure 10.17 Language selection

Note

When the language is changed, the trend data of the trend screen is cleared.

10.4.6 Unit

You cannot change the unit displayed on the screen. If you need to change the temperature to °F, the pressure to psi, please contact Yokogawa.

10.5 Blow Back

This section explains the parameter settings for performing blow back.

10.5.1 Mode

There are three modes of blow back operation: no function, semi-automatic, and automatic. Blow back is not performed when the mode is set to “No function”. In “Semi_Auto” mode, blow back can be started by key operation on the display or by a contact input signal, and then sequentially performed at a preset blow back time and hold time. In “Auto” mode, blow back is automatically performed at preset intervals. For “Semi_Auto” or “Auto” modes, blow back is performed. The following restrictions apply:

- **When “None” is selected:**

Blow back is not performed

- **When “Semi-automatic” is selected:**

Semi-auto blow back can be performed. (Blow back does not start at Auto blow back start time.)

- **When “Automatic, semi-automatic” is selected:**

Blow back can be performed in either “Auto” or “Semi_Auto” mode.

(1) “Converter menu” > “maintenance” > Blowbak setting”

(2) Select “mode” then you can select “None”, “Semi-automatic”, “Automatic, semi-automatic”.

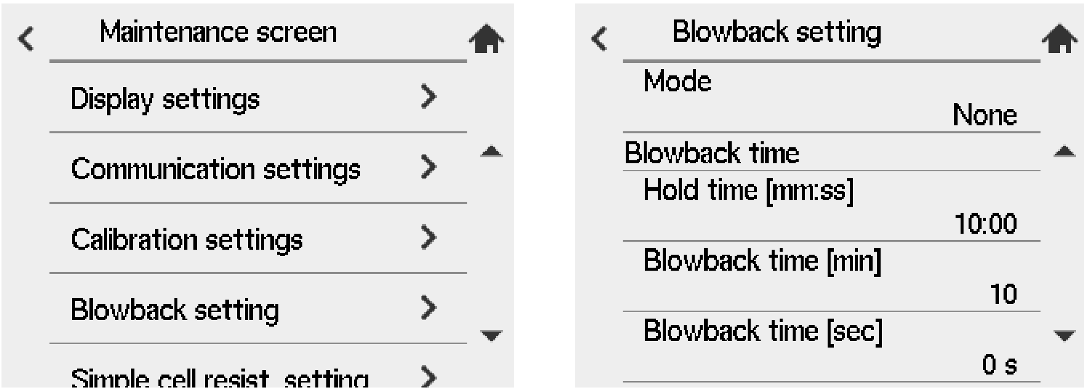


Figure 10.18 Blowback setting

10.5.2 Operation of Blow back

The timing chart of blowback operation is shown next. To perform blowback on contact input signal, input a contact signal for at least 1 second and not more than 11 seconds. When blowback is initiated, contact output repeats opening and closing approximately every 10 seconds during setup blowback time. After the blowback period has elapsed, the analogue output is held in a state configured at the “setup of the output hold” until the Hold time has elapsed (see Section “8.2 Output Hold Setting”). For the Hold time, set a time period from when the blow back ends until the sample gases are replaced in the detector and the output returns to the steady state.

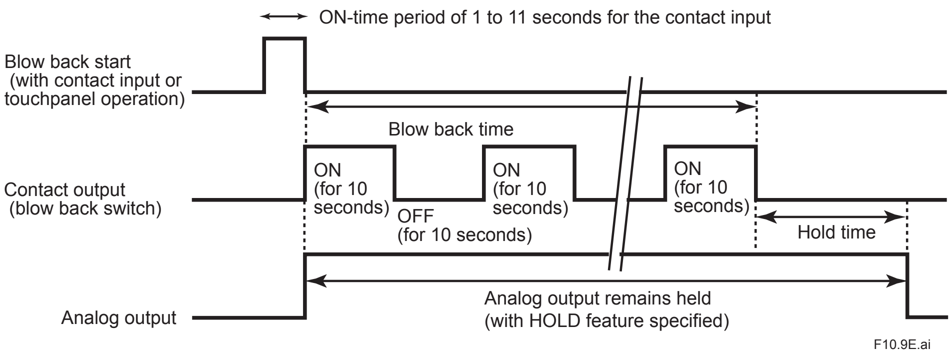


Figure 10.9 Operation of Blow back

10.5.3 Setting Output Hold Time and Blow back Time

If the blow back mode is in “No function”, the output “Hold time” and “Blow back time” are not displayed. If you select “Hold time”, the numeric-data entry display appears. Enter the desired “Hold time” (output stabilization time) from 00 minutes, 00 seconds to 60 minutes, 59 seconds.

When you select “Blow back time”, the numeric-data entry display appears. Enter the desired “Blow back time” from 00 minutes, 00 seconds to 60 minutes, 59 seconds.

10.5.4 Setting Interval, Start Date, and Start Time

The “Interval” is the time to execute blow back automatically. Display the numeric-data entry panel display to set the desired interval from 000 days, 00 hours to 255 days, 23 hours.

For the “Start date” and “Start time”, set the date when the blow back is first executed and the time when to start the blow back, respectively. If you want to execute the first blow back, for example, at 4:00 p.m. on March 25, 2001, enter 25/ 03/ 01 for the Start date and 16:00 for the Start time.

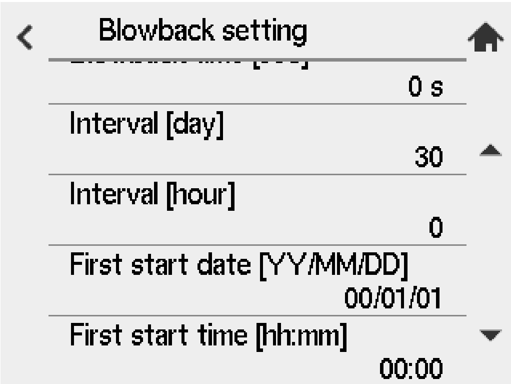


Figure 10.19 Setting Interval, Start Date, and Start Time

In the Blow back setup display shown in Figure 10.10, if you choose “Mode: No function” or “Semi_Auto”, the Interval, Start date, and Start time for these are not displayed.

NOTE

- If the blow back is executed with an input contact, it must be preset in the Input contact settings (for more details, see Section “8.6 Input Contact Settings”).
- Set the Output contact used as the blowback switch (for more details, see Section “8.5 Output Contact Setup”).
- Do not set any other function for the contact used as the blow back switch. Otherwise, blow back may be activated when the contact is closed by any other function.
- No blow back is executed during calibration. If the start time of the automatic blow back comes, the calibration ends and the blow back will be executed after the instrument returns to the measurement status.
- If the start time of the automatic blow back comes during a maintenance mode or semi-auto blow back, the auto blow back of this time will not be executed.
- If you set the blow back interval at 000 days, 00 hours, only the first blow back is then executed. No subsequent blow backs will be executed.
- If a past date is set for the Start time, no automatic blow back will be executed.

10.5.5 Default Setting

When the analyzer is delivered, or if data are initialized, the blow back settings are by default, as shown in Table 10.6.

Table 10.6 Blow back Default Setting

Item	Default setting
Mode	None
Hold time [mm:ss]	10:00
Blowback time [min]	10
Blowback time [sec]	0s
Interval [day]	30
Interval [hour]	0
First start date [YY/MM/DD]	00/01/01
First start time [hh:mm]	00:00

10.6 Simple cell resistance measurement

When the cell of the zirconia oximeter deteriorates, the cell resistance increases. This function simply measures the cell resistance without using calibration gases.

10.6.1 MODE

There are three operation modes of simple cell resistance measurement of this instrument: “None” without simple cell resistance measurement, “Semi-automatic simple cell resistance measurement” in which simple cell resistance measurement is started by manipulation from the tach panel, and “Simple cell resistance measurement” in which simple cell resistance measurement is automatically performed at setup cycle. Here you can select these modes. The following restrictions apply to each mode:

- **When “None” is selected**

Simple cell resistance measurement is not performed.

- **When “Semi-automatic” simple cell resistance measurement is selected**

Semi-automatic simple cell resistance measurement is enabled (measurement is not executed when the start time of automatic simple cell resistance measurement is reached).

- **When “Automatic, semi-automatic” simple cell resistance measurement is selected**

Both automatic and semi-automatic simple cell resistance measurement mode are enabled.

(1) “Converter menu” > “Maintenance” >”Simple cell resist. setting”

(2) When “Measurement mode” is selected in the “Simple cell resist. setting”, you can select “None”, “Semi-automatic”, “Auto, Semi-automatic.”

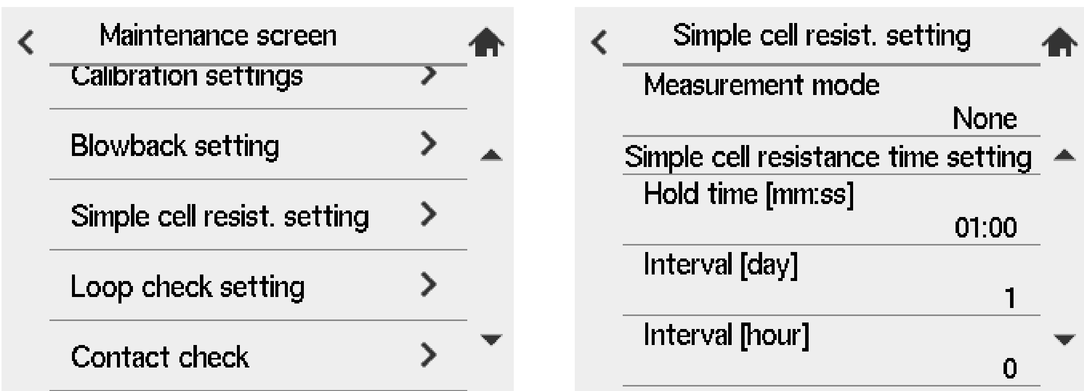


Figure 10.21 Simple cell resistance setting

10.6.2 Setup of Hold time, interval, start date, and start time

The stabilization time is turned setup because the measured value changes temporarily immediately after the simple cell resistance measurement. When “Hold time” is selected, the numeric entry screen is turned Display, so enter the hold time. Setup can range from 00 minutes 00 seconds to 60 minutes 59 seconds. Default has been setup in one minute. If no significant cell degradation occurs, the meter returns to the normal measurement in 1 minute.

When using Auto Simple Cell Resistance Measure, “Interval”, “First Start Date” and “First Start time” must be turned setup. The term “Interval” refers to the period at which automatic simple cell resistance measurement is performed. Select “Interval” and enter it from the numeric entry screen. Setup is possible for 000 days 00 hours to 255 days 23 hours. For Start Date and Start Time, setup the date on which you want to perform the first simple cell resistance measurement and the start time.

Note

- The degradation tendency of the cell can be checked with the simple cell resistance trend by performing automatic simple cell resistance measurement. Setup of the automatic simple cell resistance measurement is recommended when the measurement downtime by executing the simple cell resistance measurement is not an issue.
- A measurement time of approximately 15 seconds is usually required for simple cell resistance measurement. If the hold time is included, the measurement stops for more than 1 minute.
- Simple cell resistance measurement is not executed during calibration. When the start time of auto-simple resistance measurement comes during calibration, the calibration ends and the simple resistance measurement will be executed after the instrument returns to the measurement status.
- When the start time of auto-simple cell resistance measurement comes during maintenance, semi-auto simple cell resistance measurement, the auto simple cell resistance measurement of this time will not be executed.
- When “000 days 00 hours” is set to setup for the interval, simple cell resistance measurement is executed only for the first time and is not performed after the second time.
- If the previous date is turned setup on the starting date, the auto simple cell resistance measurement is not executed.

10.6.3 Default

When the analyzer is delivered, or if data are initialized, the default set values are as shown in Table 10.7.

Figure 10.7 Default value of the simple cell resistance setting

Item	Default
Mode	Semi-automatic
Hold time [mm:ss]	01:00
Interval [day]	1
Interval [hour]	0
First start date [YY/MM/DD]	00/01/01
First start time [hh:mm]	00:00
Simple cell resistance alarm value	2000 Ω

10.6.4 Procedure for Simple Cell Resistance Measurement

Semi-automatic simple cell resistance measurement

(1) Select “Cell resist” from the “sensor Menu” screen.

(2) The message screen is displayed prior to starting the measurement. When “Start” is selected, measurement starts.

(3) The message “Simple cell resistance measurement in progress...” blinks. When the measurement is finished, the unit shifts to screen of the hold time.

(4) The resistor reading is Display at the top right of screen. The hold time can be ended by pressing the [Abort] key

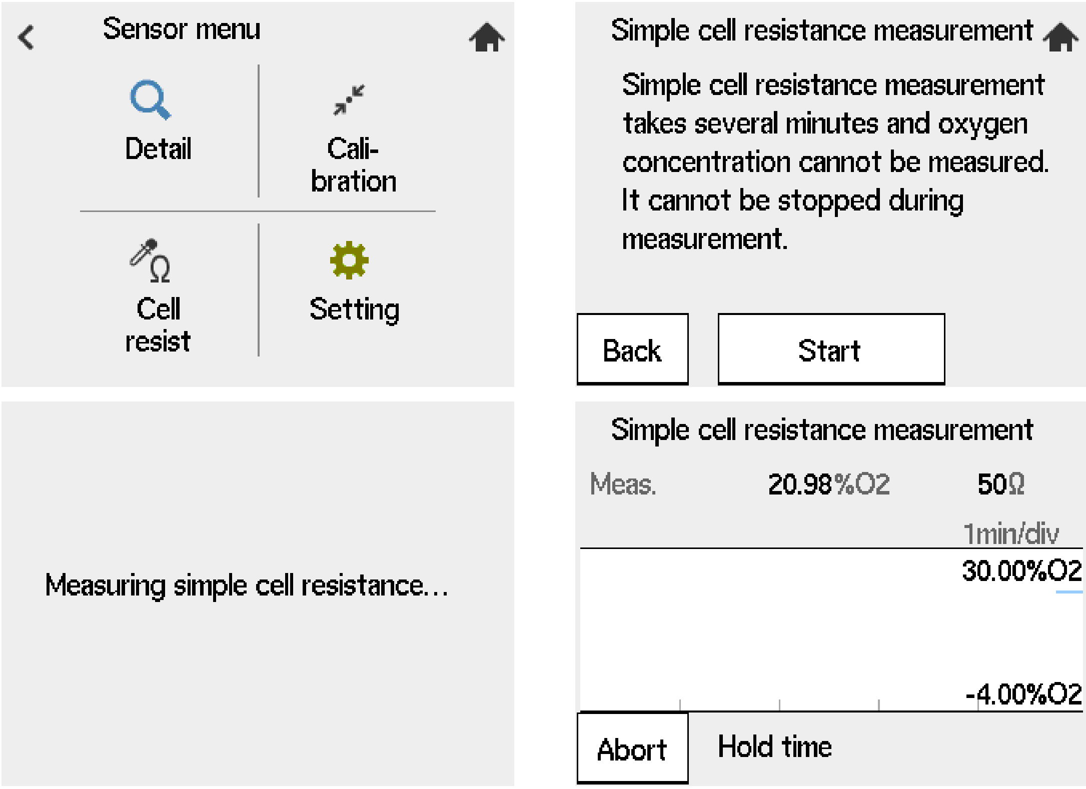


Figure 10.22 Procedure for Simple Cell Resistance Measurement

Auto simple cell resistance measurement

No operation is required to perform automatic simple cell resistance measurement. Measurement starts at the starting time of setup starting date. The cell resistor measurement is performed at the setup interval.

NOTE

- The measurement results vary depending on the concentration of sample gases and the process conditions.
- If you want to measure an accurate value, perform zero calibration and check the cell resistance.
- If the measured value exceeds the 2000 ohm, a default of a simple cell resistance alarm, consider replacing the sensor. If it exceeds 3000 Ω, it is likely that normal measurement cannot be performed, and sensor replacement is recommended.

10.7 Communication Function

■ MODBUS Communication setup

ZR802G has a MODBUS function. RS485 communication and Ethernet (MODBUS TCP/IP) are available by specification of the model of ZR802G.

Here, setup it according to your hardware configuration. For MODBUS communication, refer to TI 11M12G01-62EN.

● RS485 Setup (RS)

MODBUS communication using RS485 is available.

Preset “MODBUS address”, “Baud Rate” and “Parity” from HMI according to the connected MODBUS master.

Setup according to your MODBUS communication requirements

Converter addressing	1 to 247(default 1)
Transmission speed	9600 [bps], 38400 [bps]115200 [bps] (default 9600 [bps])
Parity	Even, odd, none (default even)

The stop bit is 1 bit when the parity is “even”/“odd”, and 2 bit when the parity is “none”. It is recommended to setup the parity to “even” or “odd”.

(1) “Converter menu” > “Maintenance” > “Communication settings.”

(2) Select “MODBUS setting” to setup

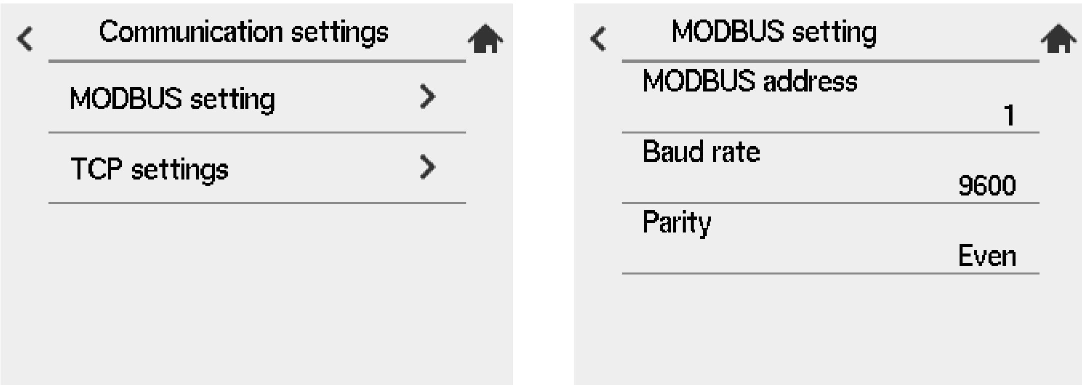


Figure 10.23 MODBUS Communication setup

● Ethernet setup (E)

Modbus TCP/IP communication is possible by connecting master devices with an Ethernet cable.

Communication standards	Ethernet
Session times (Up to.)	2
Protocol	Modbus/TCP
Port number	502

The communication rate corresponds to Ethernet 10/100 and Protocol corresponds to Ipv4.

To assign an IP address automatically by DHCP, set “DHCP” to “On”. To use a fixed IP address, set “DHCP” to “Off” (default).

If you are using static IP addresses, setup IP addresses, subnet masks, and default gateways appropriately for your Ethernet environments. Ethernet setup parameter has the following default:

Parameter name	Default
DHCP enable	Off
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Default gateway	192.168.1.1

(1) “Converter menu” > “Maintenance” > “Communication settings.”

(2) Select “TCP settings” to setup.

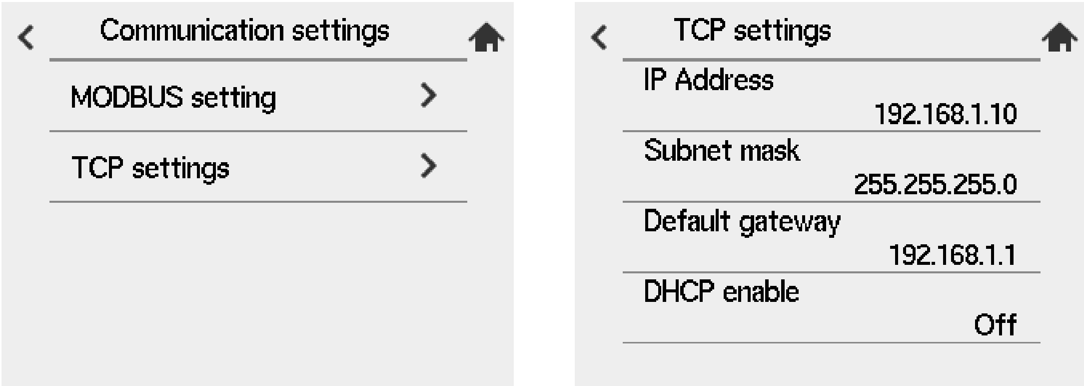


Figure 10.24 TCP settings

Note

Setup of Ethernet is reflected after ZR802G is restarted.

10.8 Save load

Converter has functions for outputting log files, setup load, and updating software using SD-Card.

● Precautions When Using SD Card

- Be sure to format the SD card with SD Association software. If you use an SD card without being formatted by the tool, operation is not guaranteed.

  To download the formatter, select [Download] from the link below and proceed to SD Memory Card Formatter.

  https://www.sdcard.org
- Do not disconnect Power Supply or remove the SD card while accessing (reading/writing, software updating) the SD card.

10.8.1 Log file output

You can output the following files as log files:

- Maintenance report

  Outputs the last three calibration and various set values.
- Measured value log

  The following log data is output. Log cycle and measurement days can be selected from "1 second cycle × 8 days", "2 second cycle × 16 days", and "5 second cycle × 40 day
  - Date and time
  - Oxygen concentration
  - Cell voltage
  - CJ temperature
  - Thermocouple temperature
  - Simple cell resistance value
  - NE107 Status
  - Equipment status

Selecting Measurement log storage cycle

(1) “Converter menu” > “Setting” > “Other setting”

(2) Select “Measurement log storage cycle” to setup. Default is 2 seconds (16 days).

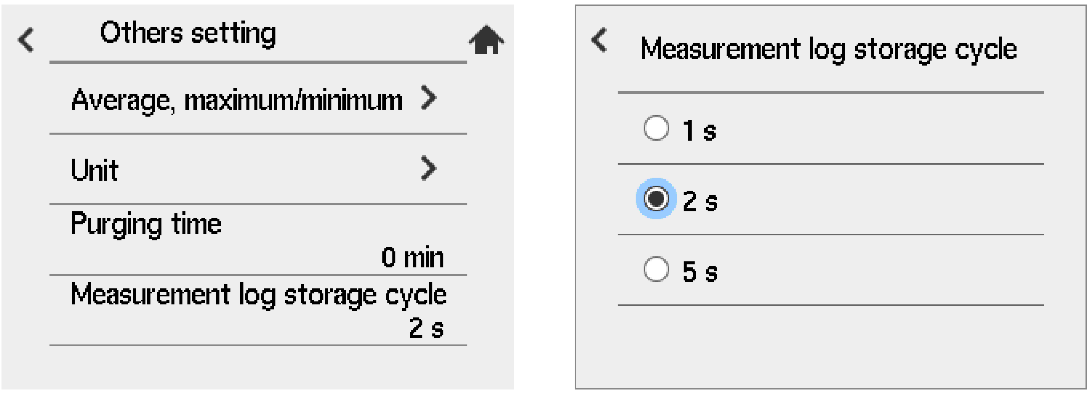


Figure 10.25 Measurement log storage cycle

- Setup File

  You can save a variety of set value. Tag names, passwords, language setup, and communication addresses are not saved. You can export the data files or copy to other converter to backup the configuration.
- Event Log

  Outputs the data that can be checked in the log data of converter detailed information. This data is used for checking by our service when a device malfunctions

Table 10.8 File name and output format of log file output

Output file	Folder name	File name	Output format
Maintenance report	Report/	ZC_report_YYYYMMDDhhmm.csv	.csv format
Measured value log	MeasLog/	ZC_measure_YYYYMMDDhhmm.csv	.csv format
Setup file (setup save)	SaveLoad/	ZC_setting.*	Binary file format
Event Log	EventLog/	ZC_event_YYYYMMDDhhmm.L00	Binary file format

Procedure for outputting log files

(1) “Converter menu” > “Other menu” > “Save/Load.”

(2) Select the file that you want to output.

(3) Check that the file name and press “Execute” to export the data into SD card. The SD card can be connected or disconnected except for when writing or reading files.

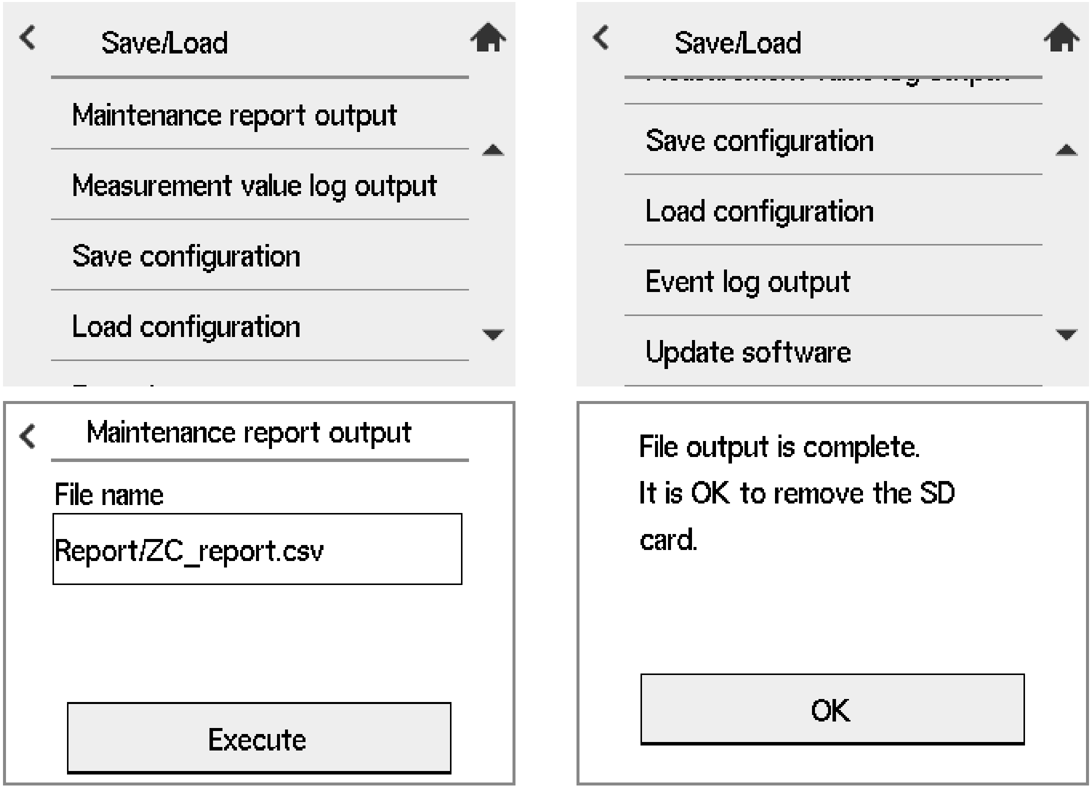


Figure 10.26 Outputting log files

10.8.2 Load configuration

(1) "Converter menu" > "Other" > " Save/Load"

(2) Select "Load configuration"

(3) Save the file output by "Save configuration" into a SD card. Press "Execute" to load the data.

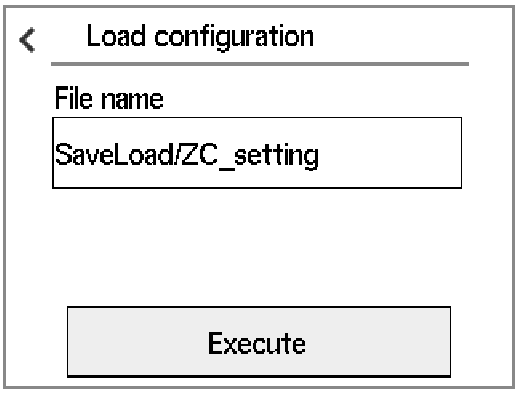


Figure 10.27 Load configuration

10.8.3 Update software

(1) "Converter menu" > "Other" > "Save/Load"

(2) Select "Update software"

(3) Save a designated file into a SD card to update the software. Normally you don't need to update the software. If you need the update file, contact Yokogawa.

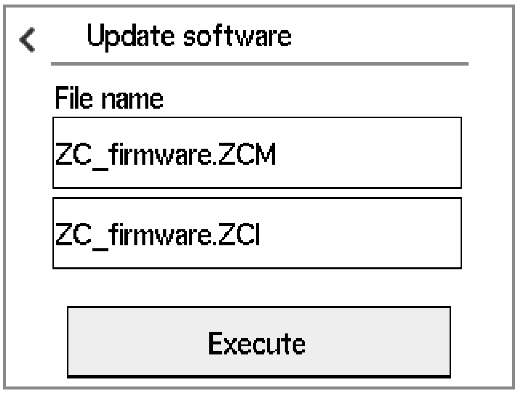


Figure 10.28 Update software

10.9 Data Initialization

Parameter settings can be initialized to the factory default settings. Initialization can be done for all parameters or for individual parameters. The parameters that can be initialized and their defaults are listed in Table 10.5.

(1) "Converter menu" > "Initialization"

(2) Select "Factory initialization"

(3) Press "Execute" to initialize to factory default.

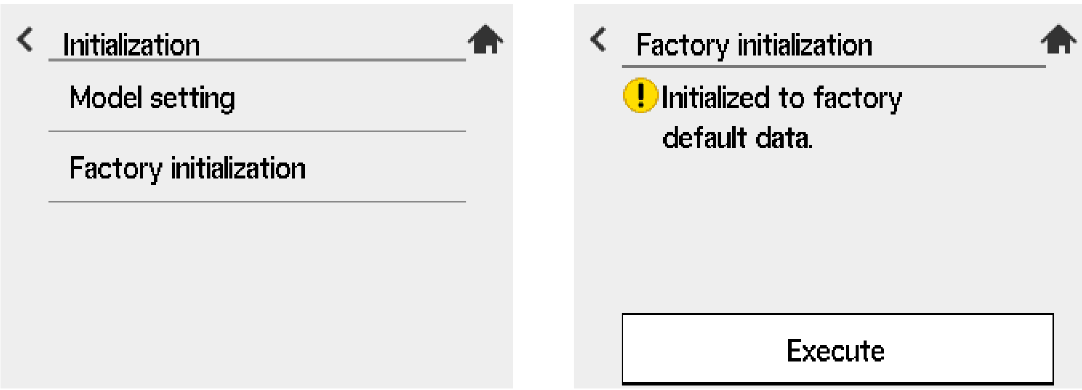


Figure 10.29 Initialization

WARNING

Do not turn off the power during initialization. Otherwise, initialization will not be performed properly.

Table 10.9 Initialization Items and Default Values (Oxygen Analyzer)

Item	Initialization Parameter		Default setting
Model Setting	-		Oxygen Analyzer
Language	-		Not initialized
Display settings	Display item	1st display item selection	Oxygen concentration
		2nd display item selection	Output item 1
		3rd display item selection	Favorite
		Tag name	Specified at order: Specified string NOT specified at order: Deleted
	Trend graph	Graph selection items	Oxygen concentration
		Graph sample time	15min.
	Set graph limits	High limit	25.0%O2
		Low limit	0.0%O2
	Others setting	Home screen auto return time	Disable
		NE107 mode	Off
		Backlight time	Disable
		Logbook settings	All ON
	Favorite settings	Favorite display item 1	Sensor details screen
		Favorite display item 2	Converter details screen
		Favorite display item 3	Trend screen
		Favorite display item 4	No setting
Communication settings	MODBUS setting	MODBUS address	Not initialized
		Baud rate	Not initialized
		Parity	Not initialized
	TCP settings	IP Address	Not initialized
		Subnet mask	Not initialized
		Default gateway	Not initialized
		DHCP enable	Not initialized
Calibration settings	Calibration mode		Manual
	Automatic calibration procedure		Span and Zero
	Zero gas concentration		1.00%O2
	Span gas concentration		21.00%O2
	Calibration time setting	Hold time [mm:ss]	10:00
		Calibration time [mm:ss]	10:00
		Interval [day]	30
		Interval [hour]	0
		First start date [YY/MM/DD]	00/01/01
		First start time [hh:mm]	00:00

Item	Initialization Parameter			Default setting
Blowback setting	Mode	Mode		None
	Blowback time	Hold time [mm:ss]		10:00
		Blowback time [min]		10
		Blowback time [sec]		0s
		Interval [day]		30
		Interval [hour]		0
		First start date [YY/MM/DD]		00/01/01
		First start time [hh:mm]		00:00
Simple cell resist. setting	Measurement mode			Semi-automatic
	Simple cell resistance time setting	Hold time [mm:ss]		01:00
		Interval [day]		1
		Interval [hour]		0
		First start date [YY/MM/DD]		00/01/01
		First start time [hh:mm]		00:00
mA output settings	mA output 1	Setting items	Selection of AO1	Oxygen concentration
		4-20mA point setting	4mA point	0%O2
			20mA point	25%O2
		Oxygen concentration setting	Upper limit value (AO switching)	25%O2
		Output smoothing factor	AO1 time constant	0s
		Output mode	Output characteristic selections	Linear
	mA output 2	Setting items	Selection of AO2	Oxygen concentration
		4-20mA point setting	4mA point	0%O2
			20mA point	25%O2
		Output smoothing factor	AO2 time constant	0s
		Output mode	Output characteristic selections	Linear
	Output hold setting	Warmup	Output state	4mA
			Preset value	3.4mA
		Maintenance	Output state	Last value hold
			Preset value	4 mA
		Cal. blowback simple cell resist.	Output state	Last value hold
			Preset value	4 mA
		Fault	Output state	Preset Value
			Preset value	3.4 mA
	Output limit setting	Lower limit value		3.8mA
		Upper limit value		20.5mA

Item	Initialization Parameter			Default setting
Alarm setting	Hysteresis	O2 concentration hysteresis		0.1%O2
	Alarm operation delay	Alarm operation delay		3s
	Oxygen concentration alarm	Oxygen concentration alarm	(HH) high-high alarm	Off
			(HH) high-high alarm value	100.0%O2
			(H) high alarm	Off
			(H) high alarm value	100.0%O2
			(L) low alarm	Off
			(L) low alarm value	0.0%O2
			(LL) low-low alarm	Off
			(LL) low-low alarm value	0.0%O2
	Zero correction ratio alarm	(H) high alarm		Function check
		(L) low alarm		Function check
	Span correction ratio alarm	(H) high alarm		Function check
		(L) low alarm		Function check
	Input temperature alarm	(H) high alarm		Off
		(L) low alarm		Off
	Input pressure alarm	(H) high alarm		Off
		(L) low alarm		Off
	Simple cell resistance alarm	Alarm setting		Maintenance required
		Alarm value		2000 Ω
	Other alarm settings	Calibration stability alarm setting		Function check
		Battery low alarm setting		Maintenance required
		Fast warmup alarm setting		Maintenance required

Item	Initialization Parameter			Default setting
Contact setting (continued on next page)	Contact output 1	Contact state during operation		Open
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	OFF
			(L) low alarm event	OFF
			(LL) low-low alarm event	OFF
			Maintenance	ON
			Calibration	OFF
			Switching output range	OFF
			Warmup	ON
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF
	Contact output 2	Contact state during operation		Closed
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	OFF
			(L) low alarm event	OFF
			(LL) low-low alarm event	OFF
			Maintenance	OFF
			Calibration	ON
			Switching output range	OFF
			Warmup	OFF
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF

Item	Initialization Parameter			Default setting
Contact setting (continuation of the previous page)	Contact output 3	Contact state during operation		Closed
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	ON
			(L) low alarm event	ON
			(LL) low-low alarm event	OFF
			Maintenance	OFF
			Calibration	OFF
			Switching output range	OFF
			Warmup	OFF
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF
	Contact output 4	Contact state during operation		Closed (fixed)
		Selection of contact output	Fault	ON (fixed)
			Other settings	All OFF
	Contact input	Contact input 1	Operation of contact input 1	Operates when closed
			Selection of contact input 1	Disabled
		Contact input 2	Operation of contact input 2	Operates when closed
			Selection of contact input 2	Disabled
Others setting	Average, maximum/ minimum	Average value calculation time		1h
		Max and min monitoring time		24h
	Unit	Temperature setting	Temperature unit selection	°C
		Pressure setting	Selection of pressure unit	kPa
	Purging time			0min
	Measurement log storage cycle			2s
	Password	Commissioning		Deleted
		Execute		Deleted
	Adjust panel	Touch panel		Not initialized
		Brightness		50%

<table>
<tr><th>Item</th><th colspan="3">Initialization Parameter</th><th>Default setting</th></tr>
<tr><td rowspan="10">Sensor setting</td><td rowspan="2">Device settings</td><td colspan="2">Choice of moisture base</td><td>Wet</td></tr>
<tr><td colspan="2">Selection of detector</td><td>ZR22(PT1000:Ohm)</td></tr>
<tr><td rowspan="6">Input temp./press. setting</td><td rowspan="6">Oxygen model setting</td><td>Pressure input selection</td><td>Preset value</td></tr>
<tr><td>Input pressure set value</td><td>0.00kPaG</td></tr>
<tr><td>4mA input pressure value</td><td>-5.00kPaG</td></tr>
<tr><td>20mA input pressure value</td><td>5.00kPaG</td></tr>
<tr><td>Pressure upper limit alarm value</td><td>5.00kPaG</td></tr>
<tr><td>Pressure lower limit alarm value</td><td>-5.00kPaG</td></tr>
<tr><td rowspan="2">Power settings</td><td colspan="2">Power supply voltage</td><td>Auto</td></tr>
<tr><td colspan="2">Power frequency</td><td>Auto</td></tr>
</table>

Table 10.10 Initialization Items and Default Values (Humidity Analyzer)

Item	Initialization Parameter		Default setting
Model Setting	-		Humidity Analyzer
Language	-		Not initialized
Display settings	Display item	1st display item selection	Humidity
		2nd display item selection	Output item 1
		3rd display item selection	Favorite
		Tag name	Specified at order: Specified string NOT specified at order: Deleted
	Trend graph	Graph selection items	Humidity
		Graph sample time	15min.
	Set graph limits	High limit	25.0%H_2O
		Low limit	0.0%H_2O
	Others setting	Home screen auto return time	Disable
		NE107 mode	Off
		Backlight time	Disable
		Logbook settings	All ON
	Favorite settings	Favorite display item 1	Sensor details screen
		Favorite display item 2	Converter details screen
		Favorite display item 3	Trend screen
		Favorite display item 4	No setting
Communication settings	MODBUS setting	MODBUS address	Not initialized
		Baud rate	Not initialized
		Parity	Not initialized
	TCP settings	IP Address	Not initialized
		Subnet mask	Not initialized
		Default gateway	Not initialized
		DHCP enable	Not initialized
Calibration settings	Calibration mode		Manual
	Automatic calibration procedure		Span and Zero
	Zero gas concentration		1.00%O_2
	Span gas concentration		21.00%O_2
	Calibration time setting	Hold time [mm:ss]	10:00
		Calibration time [mm:ss]	10:00
		Interval [day]	30
		Interval [hour]	0
		First start date [YY/MM/DD]	00/01/01
		First start time [hh:mm]	00:00

Item	Initialization Parameter			Default setting
Blowback setting	Mode	Mode		None
	Blowback time	Hold time [mm:ss]		10:00
		Blowback time [min]		10
		Blowback time [sec]		0s
		Interval [day]		30
		Interval [hour]		0
		First start date [YY/MM/DD]		00/01/01
		First start time [hh:mm]		00:00
Simple cell resist. setting	Measurement mode			Semi-automatic
	Simple cell resistance time setting	Hold time [mm:ss]		01:00
		Interval [day]		1
		Interval [hour]		0
		First start date [YY/MM/DD]		00/01/01
		First start time [hh:mm]		00:00
mA output settings	mA output 1	Setting items	Selection of AO1	Humidity
		4-20mA point setting	4mA point	0%H_2O
			20mA point	25%H_2O
		Oxygen concentration setting	Upper limit value (AO switching)	25%O_2
		Output smoothing factor	AO1 time constant	0s
		Output mode	Output characteristic selections	Linear
	mA output 2	Setting items	Selection of AO2	Humidity
		4-20mA point setting	4mA point	0%H_2O
			20mA point	25%H_2O
		Output smoothing factor	AO2 time constant	0s
		Output mode	Output characteristic selections	Linear
	Output hold setting	Warmup	Output state	4 mA
			Preset value	3.4 mA
		Maintenance	Output state	Last value hold
			Preset value	4 mA
		Cal. blowback simple cell resist.	Output state	Last value hold
			Preset value	4 mA
		Fault	Output state	Preset Value
			Preset value	3.4 mA
	Output limit setting	Lower limit value		3.8 mA
		Upper limit value		20.5 mA

Item	Initialization Parameter			Default setting
Alarm setting (continued on next page)	Hysteresis	O2 concentration hysteresis		0.1%O_2
		Humidity hysteresis		0.1%H_2O
		Mixing ratio hysteresis		0.001kg/kg
		Relative humidity hysteresis		0.1%R.H.
	Alarm operation delay	Alarm operation delay		3s
	Oxygen concentration alarm	Oxygen concentration alarm	(HH) high-high alarm	Off
			(HH) high-high alarm value	100.0%O_2
			(H) high alarm	Off
			(H) high alarm value	100.0%O_2
			(L) low alarm	Off
			(L) low alarm value	0.0%O_2
			(LL) low-low alarm	Off
			(LL) low-low alarm value	0.0%O_2
	Humidity alarm	Humidity alarm	(HH) high-high alarm	Off
			(HH) high-high alarm value	100.0%H_2O
			(H) high alarm	Off
			(H) high alarm value	100.0%H_2O
			(L) low alarm	Off
			(L) low alarm value	0.0%H_2O
			(LL) low-low alarm	Off
			(LL) low-low alarm value	0.0%H_2O

<table>
<tr><th>Item</th><th colspan="3">Initialization Parameter</th><th>Default setting</th></tr>
<tr><td rowspan="30">Alarm setting (continuation of the previous page)</td><td rowspan="8">Mixing ratio alarm</td><td rowspan="8">Mixing ratio alarm</td><td>(HH) high-high alarm</td><td>Off</td></tr>
<tr><td>(HH) high-high alarm value</td><td>1.000 kg/kg</td></tr>
<tr><td>(H) high alarm</td><td>Off</td></tr>
<tr><td>(H) high alarm value</td><td>1.000 kg/kg</td></tr>
<tr><td>(L) low alarm</td><td>Off</td></tr>
<tr><td>(L) low alarm value</td><td>0.000 kg/kg</td></tr>
<tr><td>(LL) low-low alarm</td><td>Off</td></tr>
<tr><td>(LL) low-low alarm value</td><td>0.000 kg/kg</td></tr>
<tr><td rowspan="8">Relative humidity alarm</td><td rowspan="8">Relative humidity alarm</td><td>(HH) high-high alarm</td><td>Off</td></tr>
<tr><td>(HH) high-high alarm value</td><td>100.0%R.H.</td></tr>
<tr><td>(H) high alarm</td><td>Off</td></tr>
<tr><td>(H) high alarm value</td><td>100.0%R.H.</td></tr>
<tr><td>(L) low alarm</td><td>Off</td></tr>
<tr><td>(L) low alarm value</td><td>0.0%R.H.</td></tr>
<tr><td>(LL) low-low alarm</td><td>Off</td></tr>
<tr><td>(LL) low-low alarm value</td><td>0.0%R.H.</td></tr>
<tr><td rowspan="2">Zero correction ratio alarm</td><td colspan="2">(H) high alarm</td><td>Function check</td></tr>
<tr><td colspan="2">(L) low alarm</td><td>Function check</td></tr>
<tr><td rowspan="2">Span correction ratio alarm</td><td colspan="2">(H) high alarm</td><td>Function check</td></tr>
<tr><td colspan="2">(L) low alarm</td><td>Function check</td></tr>
<tr><td rowspan="2">Input temperature alarm</td><td colspan="2">(H) high alarm</td><td>Off</td></tr>
<tr><td colspan="2">(L) low alarm</td><td>Off</td></tr>
<tr><td rowspan="2">Input pressure alarm</td><td colspan="2">(H) high alarm</td><td>Off</td></tr>
<tr><td colspan="2">(L) low alarm</td><td>Off</td></tr>
<tr><td rowspan="2">Simple cell resistance alarm</td><td colspan="2">Alarm setting</td><td>Maintenance required</td></tr>
<tr><td colspan="2">Alarm value</td><td>2000 Ω</td></tr>
<tr><td rowspan="3">Other alarm settings</td><td colspan="2">Calibration stability alarm setting</td><td>Function check</td></tr>
<tr><td colspan="2">Battery low alarm setting</td><td>Maintenance required</td></tr>
<tr><td colspan="2">Fast warmup alarm setting</td><td>Maintenance required</td></tr>
</table>

Item	Initialization Parameter			Default setting
Contact setting (to be continue)	Contact output 1	Contact state during operation		Open
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	OFF
			(L) low alarm event	OFF
			(LL) low-low alarm event	OFF
			Maintenance	ON
			Calibration	OFF
			Switching output range	OFF
			Warmup	ON
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF
	Contact output 2	Contact state during operation		Closed
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	OFF
			(L) low alarm event	OFF
			(LL) low-low alarm event	OFF
			Maintenance	OFF
			Calibration	ON
			Switching output range	OFF
			Warmup	OFF
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF

Item	Initialization Parameter			Default setting
Contact setting (continuation of the previous page)	Contact output 3	Contact state during operation		Closed
		Selection of contact output	Fault	OFF
			(HH) high-high alarm event	OFF
			(H) high alarm event	ON
			(L) low alarm event	ON
			(LL) low-low alarm event	OFF
			Maintenance	OFF
			Calibration	OFF
			Switching output range	OFF
			Warmup	OFF
			Cal. gas pressure drop	OFF
			Upper and lower temp. alarm	OFF
			Upper and lower press. alarm	OFF
			Blowback	OFF
			Process upset	OFF
			Calibration correction alarm	OFF
			Calibration stability alarm	OFF
			With simple cell resist. meas.	OFF
			Simple cell resistance alarm	OFF
	Contact output 4	Contact state during operation		Closed (fixed)
		Selection of contact output	Fault	ON (fixed)
			Other settings	All OFF
	Contact input	Contact input 1	Operation of contact input 1	Operates when closed
			Selection of contact input 1	Disabled
		Contact input 2	Operation of contact input 2	Operates when closed
			Selection of contact input 2	Disabled
Others setting	Average, maximum/ minimum	Average value calculation time		1 h
		Max and min monitoring time		24 h
	Unit	Temperature setting	Temperature unit selection	°C
		Pressure setting	Selection of pressure unit	kPa
	Purging time			0min
	Measurement log storage cycle			2 s
	Password	Commissioning		Deleted
		Execute		Deleted
	Adjust panel	Touch panel		Not initialized
		Brightness		50%

Item	Initialization Parameter			Default setting
Sensor setting	Device settings	Choice of moisture base		Wet
		Selection of detector		ZR22 (PT1000: Ohm)
	Input temp./press. setting	Humidity model setting	Temperature input selection	Preset value
			Input temperature setting	300°C
			4mA input temperature value	0°C
			20mA input temperature value	1000°C
			Temp. upper limit alarm value	1000°C
			Temp. lower limit alarm value	0°C
			Exhaust gas pressure	101.33 kPa
	Fuel setup	Exhaust water vapor content		0.00 m^3/kg
		Theoretical air volume		1.00 m^3/kg
		X value		1.00
		Absolute humidity of outside air		0.0000 kg/kg
	Power settings	Power supply voltage		Auto
		Power frequency		Auto

10.10 Reboot

Reboot enables the equipment to restart. If the equipment is rebooted, the power is turned off and then back on. In practical use, the power remains on, and the equipment is restarted under program control.

When Fault happens, for safety, the power supply to the sensor heater is turned off. To cancel the error (Fault), reboot by following the procedure below or turn off the power once to restart the system.

CAUTION

Make sure that before a reboot or restarting the power that there is no problem with the detector or converter.

After the instrument reboots, if Fault occurs again, turn off the power. Find the problem by trouble shooting.

How to reboot the system

(1) “Converter menu” > “Others”

(2) “Reboot” A confirmation screen appears. Tap “Execute”.

(3) A confirmation screen appears again .Tap “Yes” to reboot.

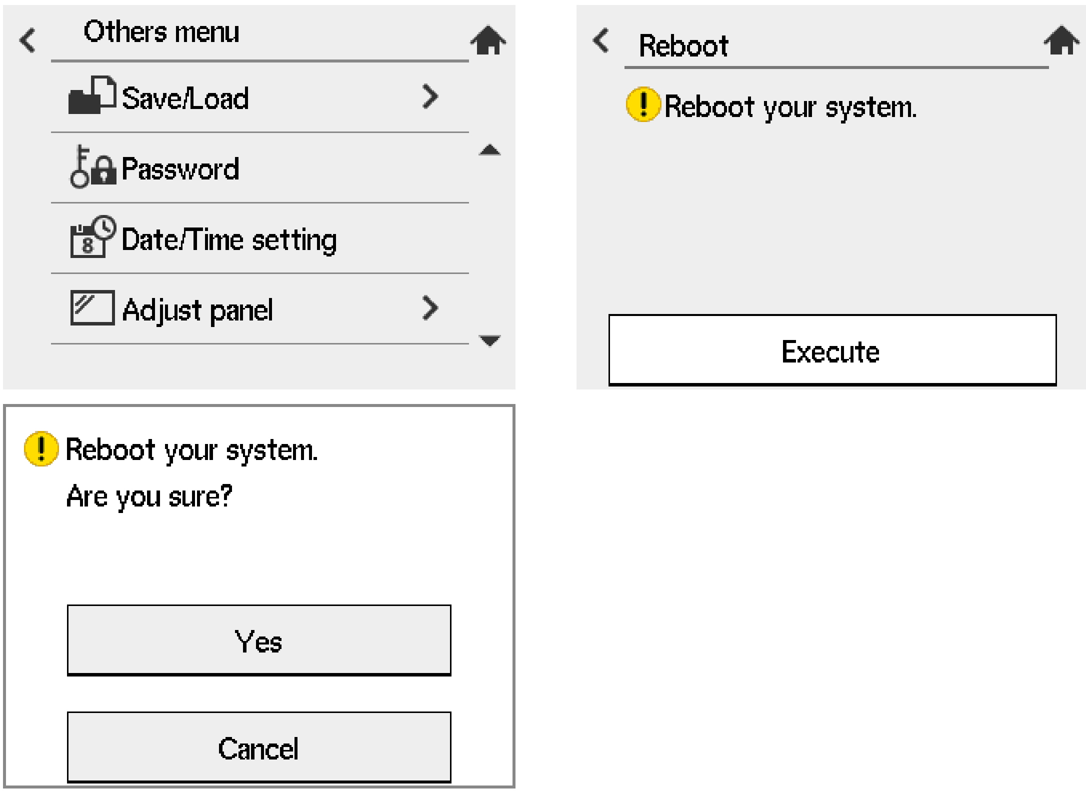


Figure 10.30 Reboot the system

10.11 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.

10.11.1 Standard Gas Unit Component Identification

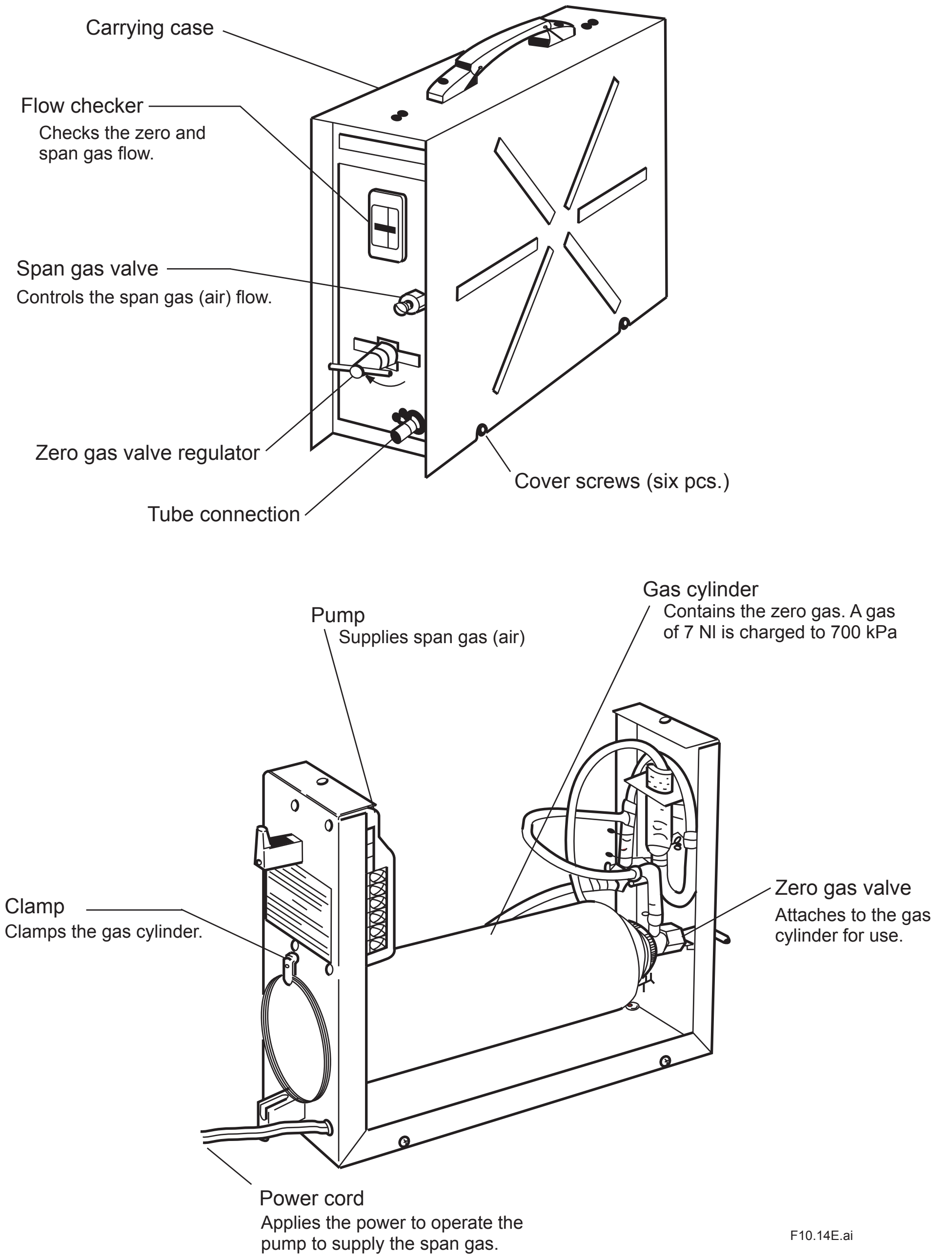


Figure 10.31 Standard Gas Unit Component Identification

10.11.2 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%O2 (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, following instructions on the converter display. 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 10.7.3).

10.11.3 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.

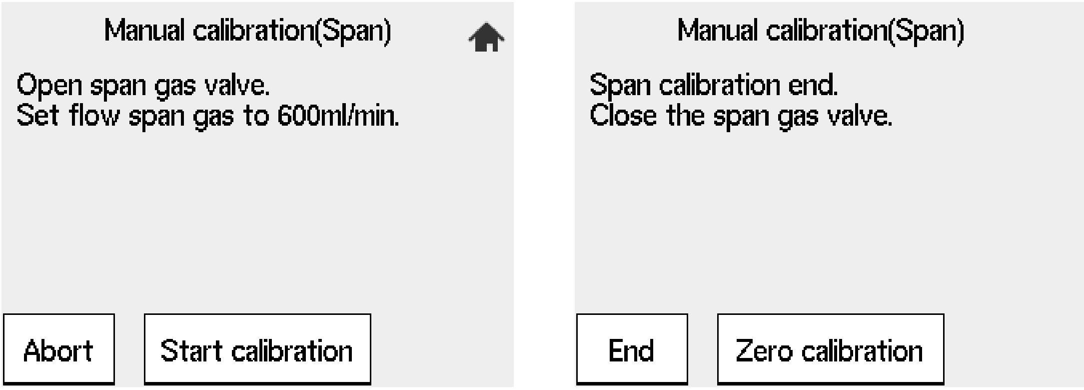
(3) Fully open the stop valve mounted on the calibration gas inlet of the detector.

(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%O2 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 feeding span gas (air) is included in the manual calibration flowchart described in Section “7.12.2 Manual Calibration”. For operation of the converter, see Section “7.12 Calibration”.

(1) When the message “Open span gas valve” is displayed on the converter display during calibration, plug the power cord into the power supply socket to start the pump of the standard gas unit.



(1) (2)

Figure 10.32 Flow of span gas (air)

(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) Select "Valve opened" (to start calibration) from the Manual calibration display shown in Figure 10.15. Check the Trend graph display to see that the measured value is stabilized. Then press the [Enter] key. The Manual calibration display shown in Figure 10.16 appears. Disconnect the power cord to stop the pump.

<Flow of zero gas>

Feeds zero gas by following the instruction on the converter.

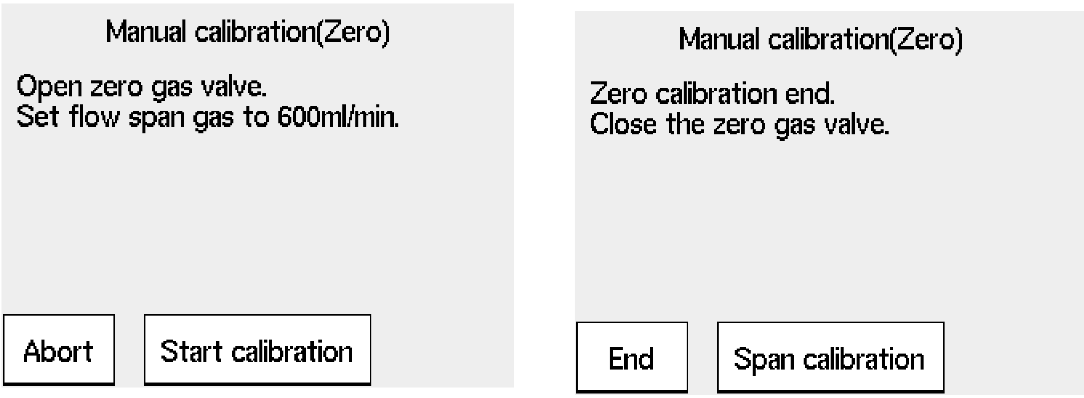


Figure 10.33 Flow of zero gas

(1) Use the needle of the zero gas valve " CHECK GAS " to puncture a hole in the gas cylinder installed as described in Section "10.11.2 Installing Gas Cylinders". 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 valves back slowly counterclockwise. At that time, the flow rate also decreases as the inner pressure of the gas cylinder decreases. Therefore, monitor the flow check and, when the ball's position changes greatly, readjust the valve.

(3) Select "Valve opened" (to start calibration) from the Manual calibration display. Check the Trend graph display to see that the measured value is stabilized. Then press the [Enter] key. The Manual calibration display shown in Figure 10.18 appears. Then stop the zero gas flow immediately. 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.

NOTE

Be sure not to terminate a calibration in progress because of a shortage of gas in the cylinder. Each gas cylinder is operable for 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.

<Treatment after completion of calibration>

(1) Fully close the stop 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.

10.12 Methods of Operating Valves in the ZA8F Flow Setting Unit

The ZA8F Flow Setting Unit is used as a calibration device for a system conforming to System 2. Calibration in such a system is to be 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 ZR40H Automatic Calibration Unit. For operation of the converter, see Section “7.12 Calibration”, earlier in this manual.

10.12.1 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 sample gas pressure plus approx. 50 kPa (or sample gas pressure plus approx. 150 kPa when a check 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 in the converter.

10.12.2 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.

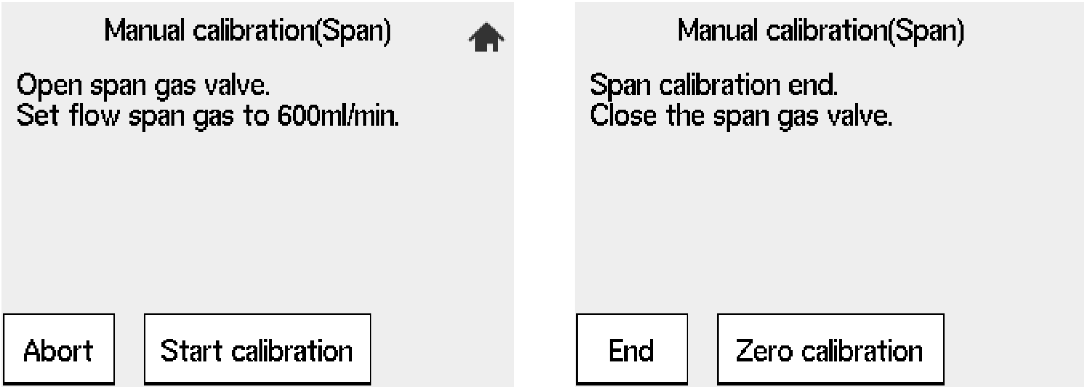
(1) When the display shown in Figure 10.15 appears during calibration, open the span gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ± 60 ml/min. Turn the valve slowly counterclockwise after loosening the lock nut if the valve has a lock nut. To check the flow rate, use the calibration flowmeter. If the sample gas pressure is extremely high, adjust the sample gas pressure to obtain pressures (listed in Table 10.7) ± 10%.

Table 10.11

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

(2) Adjust the flow rate and select “Valve opened” from the Manual calibration display. Check the Trend graph display to see that the measured value is stabilized. Then press the [Enter] key. The Manual calibration display shown in Figure 10.16 appears.

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



(1) (2)

Figure 10.34 Span Gas Manual calibration

10.12.3 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 display shown in Figure 10.19 appears 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, if the valve has a lock nut loosen the lock nut and slowly turn it counterclockwise. To check the flow rate, monitor the calibration gas flowmeter.
If the sample gas pressure is extremely high, adjust the sample gas pressure to obtain pressures (listed in Table 10.7) ± 10%.

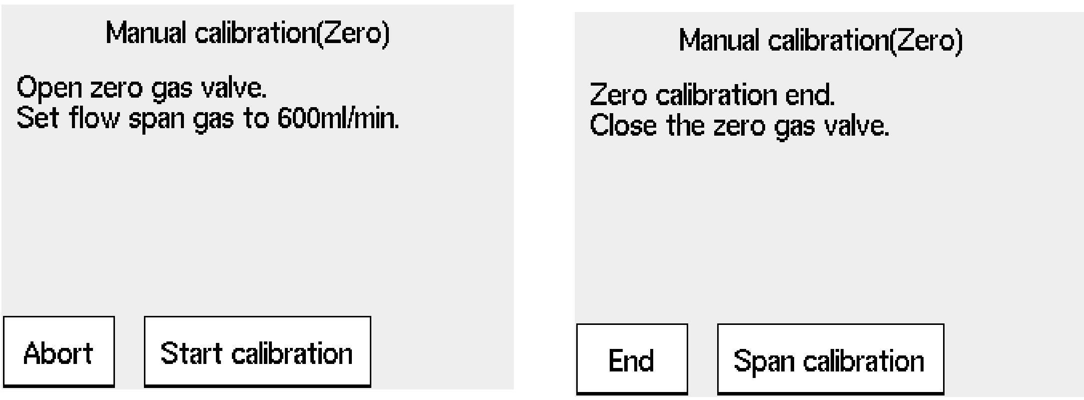


Figure 10.35 Zero Gas Manual calibration

(2) Adjust the flow rate and select “Valve opened” from the Manual calibration display. Check the Trend graph display to see that the measured value is stabilized. Then press the [Enter] key. The Manual calibration display shown in Figure 10.20 appears.

Close the zero gas flow setting valve to stop the zero gas flow. If the valve has a lock nut, be sure to tighten the lock nut to prevent the any leakage of the zero gas into the detector because the valve may become loose during measurement.

10.12.4 Operation After Calibration

No special operation of the instrument is needed after calibration. However, it is recommended that the pressure reducing valve 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 Zirconia Oxygen Analyzer to maintain its measuring performance and normal operating conditions.

WARNING

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.)

CAUTION

When checking the detector, carefully observe the following:

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

If the filter at the probe tip of the detector is clogged with dust, etc., it will interfere with measurement. If dust has adhered to the filter to the extent that it inhibits the gas flow, remove the dust by brushing.

11.1.2 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 sample gas. If you become aware of clogging, such as when a higher pressure is required to achieve a specified flow rate (600 ± 60 ml/min), clean the calibration gas tube.

To clean the tube, follow these steps:

(1) Remove the detector from the installation assembly.

(2) Following Section 11.1.3, later in this manual, remove the four bolts (and associated washers) that tighten the sensor assembly, and the pipe support as well as the U-shaped pipe.

(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 for a general-purpose detector, or 15 cm for high temperature detector.

(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 11.1.3 to restore all components in their original positions. Be sure to replace the O-ring(s) with new ones.

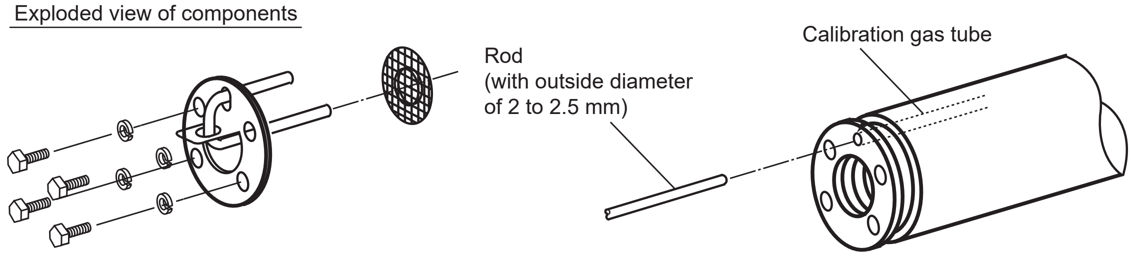


Figure 11.1 Cleaning the Calibration Gas Tube

11.1.3 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)

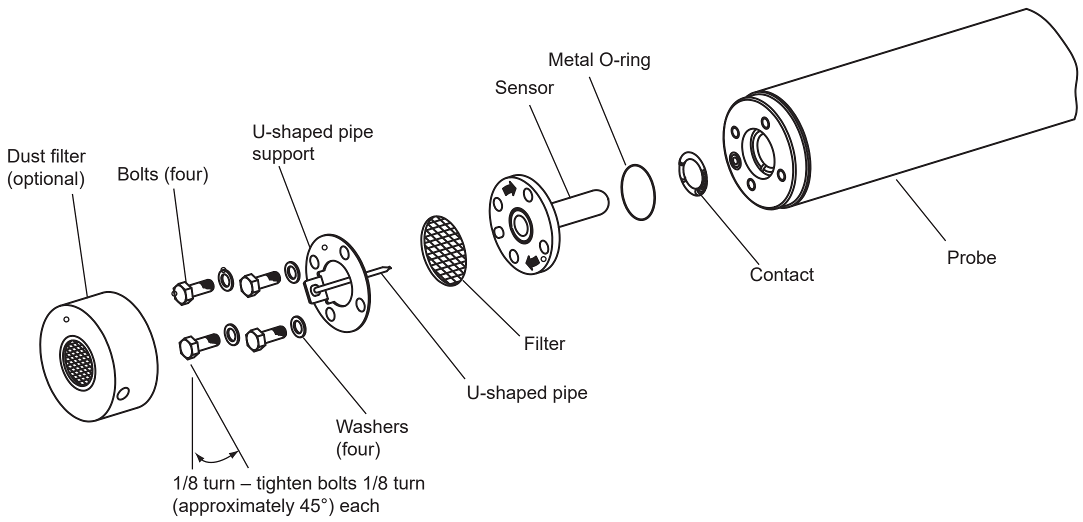


Figure 11.2 Exploded View of Sensor Assembly

⚠ CAUTION

Inconel bolts have large elongation, so if excessive torque is applied when tightening the bolts, abnormal elongation or breakage will occur. Be careful not to apply excessive torque.

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 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. Remove filter also.
(When replacing the assembly, be careful not to scratch or dent 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 sample gas will not be sealed.)

(4) Use tweezers to pull the contact out of the groove in the tip of the probe.

(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 used, it can not be reused. 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.

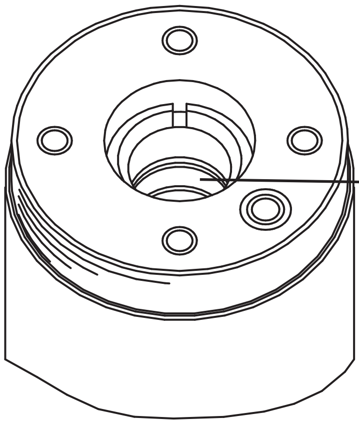


Figure 11.3 Installing the Contact

(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 and its support into the probe.

(4) Coat the threads of the four bolts with anti-seize 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.

NOTE

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.

11.1.4 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 details, 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.

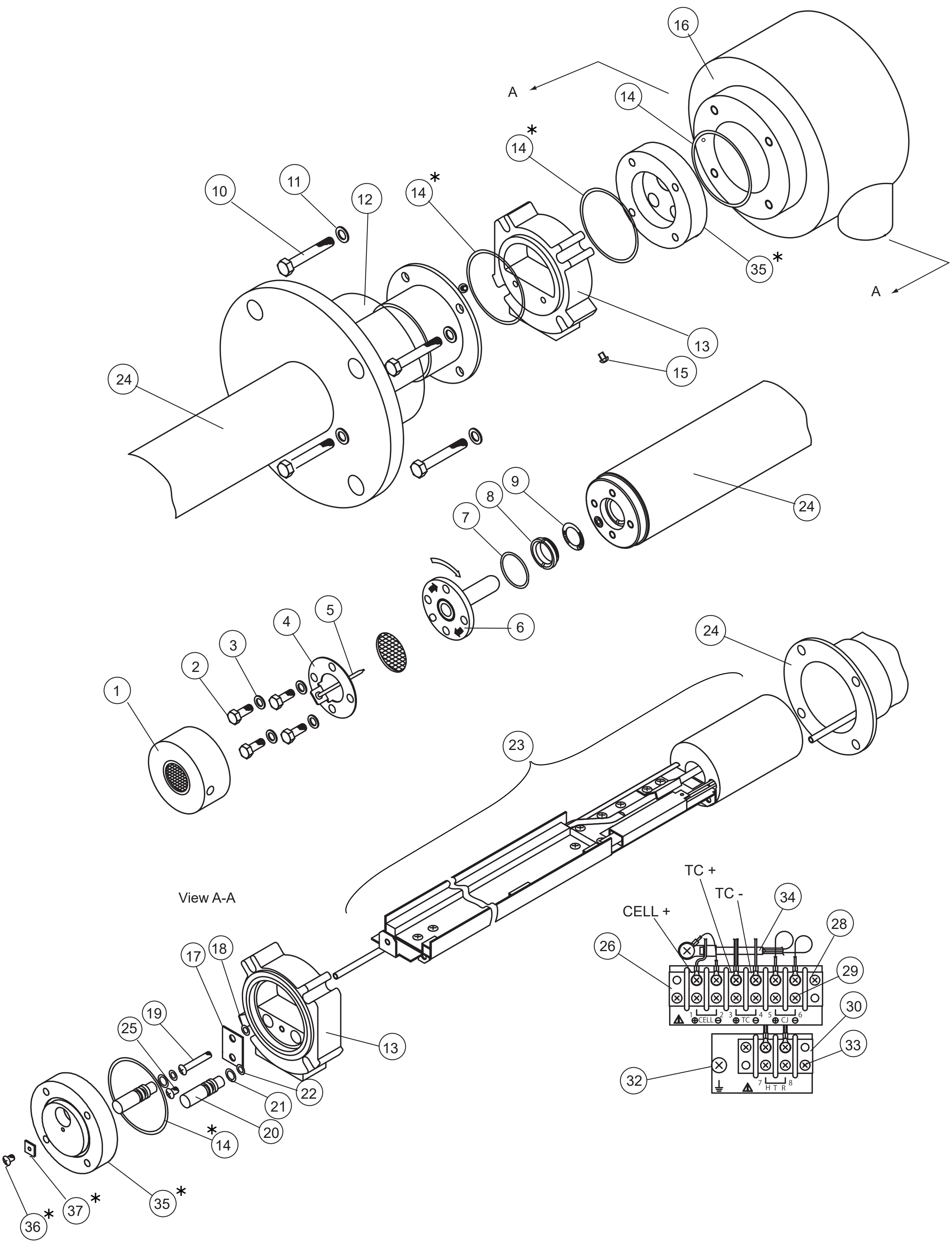


Figure 11.4 Oxygen Analyzer
Exploded View of Detector (When pressure compensation specified)

Note: The parts marked by ∗ is not equipped with the types except the pressure compensation type.

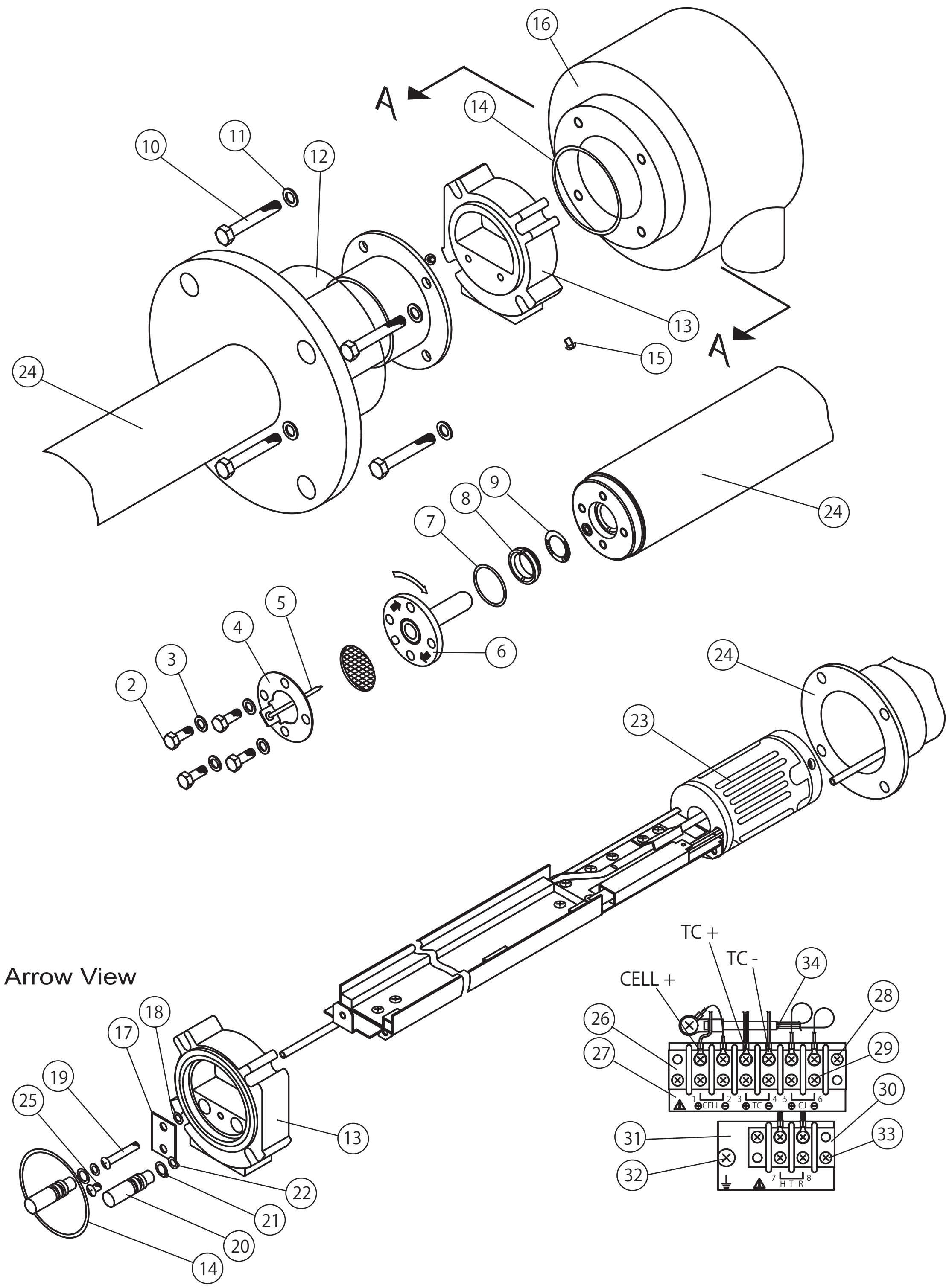


Figure 11.5 **High Temperature Humidity Analyzer**
Exploded View of Detector (When pressure compensation specified)

■ Replacement of heater strut assembly (ZR22G : Style S2 and after)

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. Open the terminal box (16) and remove the three terminal connections – CELL +, TC + and TC -.Before disconnect the HTR terminals, remove the terminal block screw (28). Keeping the other terminal remaining to be connected. Disconnect the two HTR connections. (These terminals have no polarity.)

Remove the two screws (15) that fasten the cover (12) and slide it to the flange side.
Remove the four bolts (10) and terminal box (16) with care so that the already disconnected wire will not get caught in the terminal box.

In case of the pressure compensation type detector, remove the screw (36) and the plate (37) on the adapter (35). Remove the adapter (35), drawing out the wires of the heater strut assembly (23) from it.

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 for the heater assembly fixation (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 for the heater assembly fixation (8) with grease (NEVER SEEZ: G7067ZA) and tighten the screw for the heater assembly fixation (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-rings (22) remains in the hole, pull them out from the back. Pass the heater and thermocouple lead wire 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 the screw (19) in heater strut assembly (23) until connector (13) can’t move.

Reassemble in reverse order to the above disassembly procedure.

The two wires with ceramic insulators from the heater strut assembly are heater wires, and the single-core shielded wire is the cell signal + terminal; for the two-core shielded cable, the semi-translucent rubber-sheathed wire is the thermocouple + terminal, and the other wire is the − terminal. (If the wires are marked, match the markings with those on the terminal board).

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

11.1.5 Replacement of Dust Filter

Set the dust filter (1) in place using a special pin spanner (with a pin 4.5 mm in diameter: part no. K9471UX or equivalent). If a dust filter that has already been replaced once is used again, apply grease (NEVER SEEZ: G7067ZA) to the threads of the dust filter.

11.1.6 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 and calibration gas sealing and require periodic replacement.

	Part No.	Description
(7) *	K9470BJ	Metal O-ring
(14)	K9470ZS	O-ring with grease
(21), (22)	K9470ZP	Two pairs of O-rings with grease

*: O-ring used for sensor assembly

11.1.7 Cleaning the High Temperature Probe Adapter

CAUTION

Do not subject the probe of the High Temperature Probe Adapter (ZO21P-H-A) to shock. This probe uses silicon carbide (SiC) which may become damaged if it is subjected to a strong shock or thermal shock.

The high temperature detector is structured so that the gas to be measured is directed toward the detector with the high temperature probe adapter. Therefore, if the probe or the sample gas outlet clogs, a precise measurement is no longer possible because of no gas flow. If you use the high temperature detector, you have to inspect it periodically and, if any part of it is significantly clogged with dust, clean it.

Dust found sticking to the probe should be blown off. If any dust still remains after the blowing, clean it with a metal rod, etc., inserted. In addition, if dust is found on the auxiliary ejector or needle valve (choke) at the sample gas outlet, remove these parts from the high temperature probe adapter and then clean them. To remove dust, blow air on them or rinse them with water.

11.1.8 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 fixes the dusts on itself. Consequently, the dusts can make the sensor performance much lower. If a large amount of water is condensed, the sensor can be broken and will never be used.

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 gas to the sensor. If this is impossible to do the above, remove the detector.

(2) If unavoidably impossible to supply the power and removing the detector, keep on the following air at 600 ml/min into the calibration gas pipe.

<Restarting Operation>

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

A dirty touchpanel should be wiped off with a soft dry cloth.

11.2.1 Replacing Fuses

The converter incorporates a fuse, as indicated in Figure 11.5. If the fuse blows out, replace it in the following procedure.

CAUTION

- If a replaced fuse blows out immediately, there may be a problem in the circuit. Go over the circuit completely to find out why the fuse has blown.
- This fuse is for protecting the main power supply circuit and does not provide overcurrent protection for the heater temperature control circuit. For overcurrent protection circuitry, refer to Section 12.1.2.2, Heater Temperature Failure.

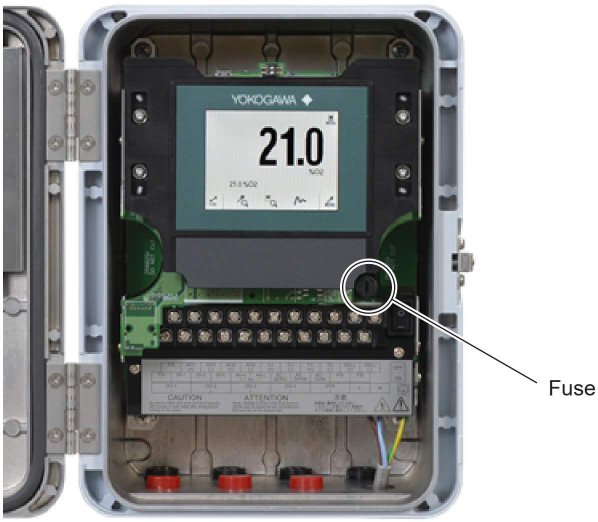


Figure 11.6 Location of Fuse in the Converter

To replace the fuse, follow these steps:

(1) Turn off the power to the converter for safe replacement.

(2) Remove the fuse from its holder. With the appropriate flat-blade screwdriver that just fits the holder cap slot (Figure 11.6), turn the fuse holder cap 90° counterclockwise.
By doing so, you can remove the fuse together with the cap.

(3) 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- or VDE-approved

Part number: A1113EF

Place a new, properly rated fuse in the holder together with the cap, and push and turn the cap clockwise 90° with the screwdriver to complete installation of the fuse.

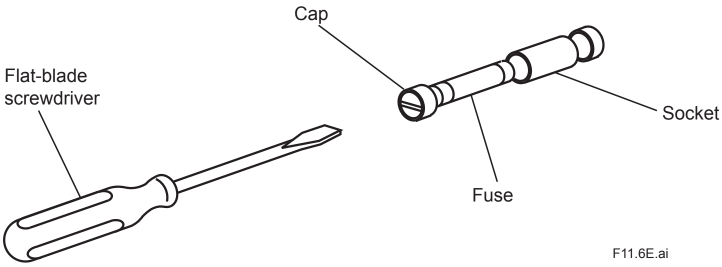


Figure 11.7 Removing the Fuse

11.2.2 Cleaning

Use a soft dry cloth to clean any part of the converter during inspection and maintenance.

11.2.3 Adjust LCD panel

Adjust he position of touch button or brightness of LCD panel.

"Sensor menu" > "Other menu" > "Adjust panel"

Figure 11.8 Adjust panel

■ Touch panel

● How to adjust the touch panel

(1) Touch "+" and you will see "Please touch the point".

(2) Touch "+" and hold until you see "Please release from the point".

(3) Once you release the point, "+" moves to 2nd place.

Touch and hold "+" until you see "Please release from the point." Release the point.

Repeat touching on/off as (1),(2), until "+" moves to 4th place.

(4) After completing the touch and hold the 4th place, you will see "Please check the calibration result."

If you touch the screen, the point you touched shows "Displayed point" by coordinate points.

(5) Touch "+" again, which shows "Touched point" by coordinate points. Check if the difference in coordinates of both points are acceptable.

To leave the screen, touch and hold it for three seconds.

(6) You will return to the first page of Adjust panel.

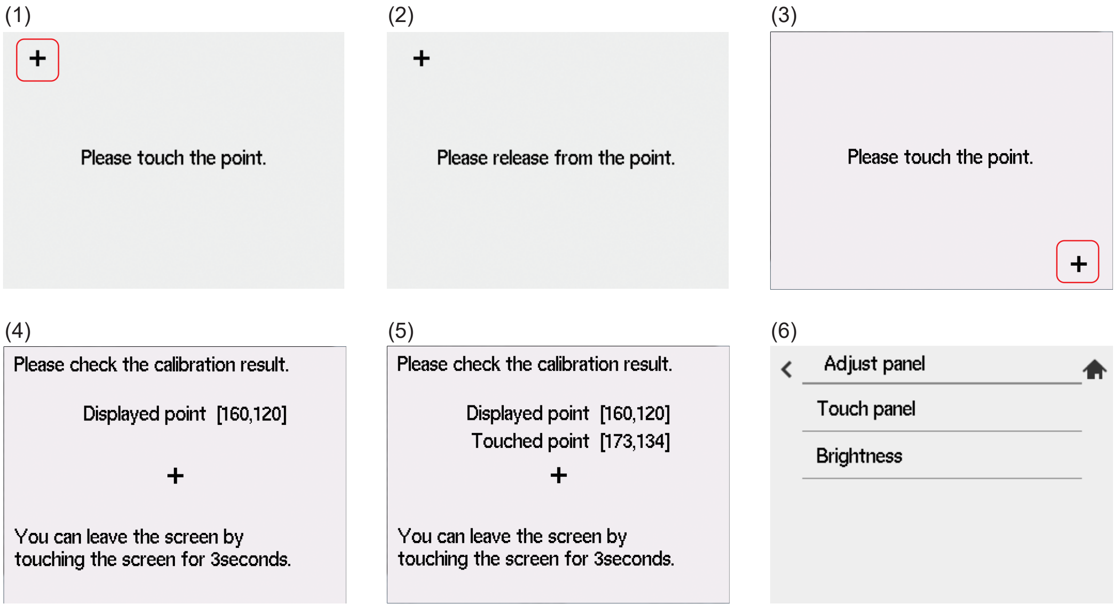


Figure 11.9 Touch panel position adjustment

■ Brightness

Adjust "Brightness" of back light. Select the level from below. The default is 50%. The larger % the brightness indicates, the brighter the light glows.

Brightness: 0%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%

11.3 Replacing Flowmeter in ZR40H Automatic Calibration Unit

(1) Remove piping and wiring, and remove the ZR40H from the 2B pipe or wall mounting.

(2) Remove four M6 bolts between brackets.

(3) Remove piping extension

(4) 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.

(5) 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.

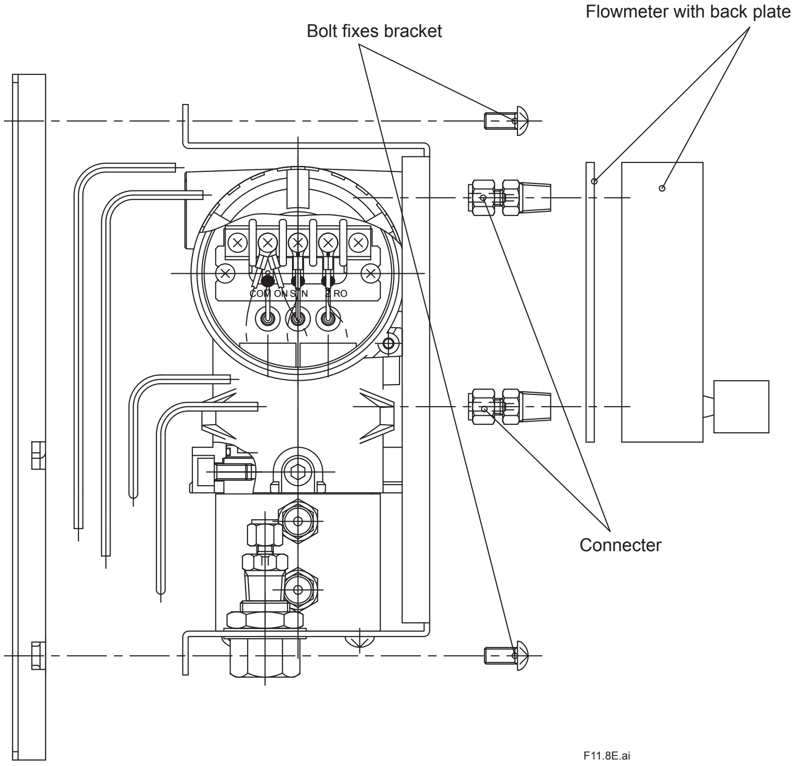


Figure 11.10 Flowmeter replacement

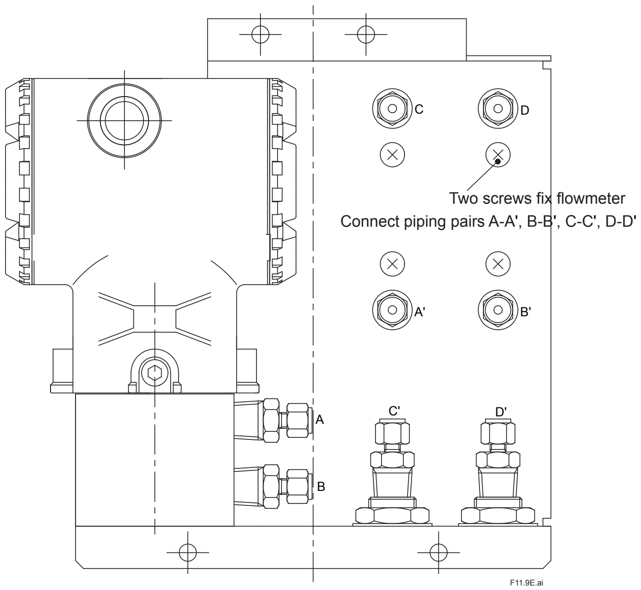


Figure 11.11 Fixing Flowmeter

12. Troubleshooting

This chapter describes Fault (errors) and alarms detected by the self-diagnostic function of the converter. It also explains inspections and remedies when other problems occur.

12.1 Displays and Remedies When Fault Occur

12.1.1 Fault

A Fault occurs when an abnormality is detected in the detector or the converter, e.g., in the cell (sensor), detector heater, or internal circuits of the the converter.
If a Fault occurs, the converter performs the following:

(1) Stops the supply of power to the heater in the detector to insure system safety.

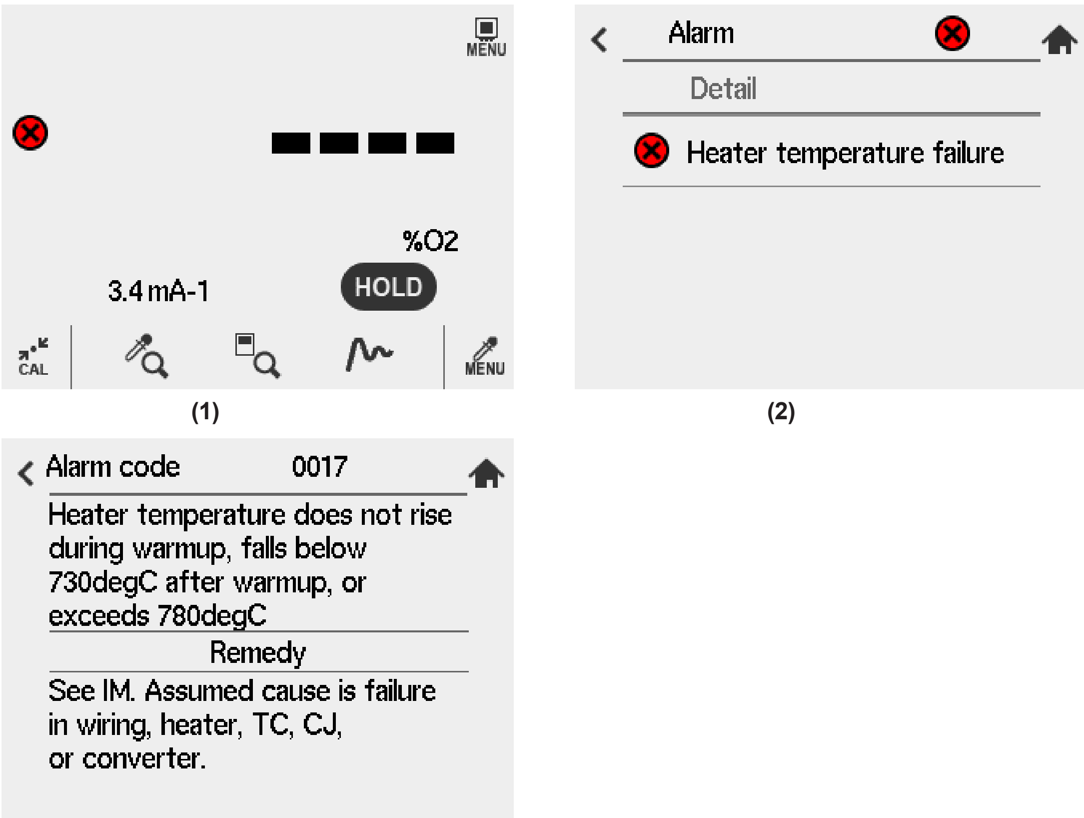
(2) Fault indication is displayed by blinking the icon to notify of a Fault generation (Figure 12.1).

(3) When Fault is set to output in “Selection of contact output”, Fault is output to contact. (refer to Section “8.5 Output Contact Setup”.)

(4) The analog output becomes the status which is set in “Output hold setting”.

(refer to Section “8.2 Output Hold Setting”.)

When the display shown in Figure 12.1 (1) appears, pressing the Fault indication brings up a description of the Fault (Figure 12.1 (2))



(3)

Figure 12.1 Fault description

Table 12.1 Types of Fault , Reasons for Occurrence

Alarm Number	Type	Occurrence Conditions
001	Hardware failure	Occurs when internal storage hardware fails.
002	Internal com. failure	This error occurs when there is an error in internal storage communication.
003	MAC address read failure	This error occurs when there is an error in MAC address being read.
004	Converter user param. failure	This error occurs when there is an error in reading converter setup data.
016	Cell voltage failure	Occurs when the cell (sensor) electromotive force input to converter becomes less than -50 mV.
017	Heater temperature failure	Occurs when temperature of the heater does not rise during warm-up, or when the temperature drops below 730°C or rises above 780°C after the warm-up. Also, when the polarity of the thermocouple output (TC+, TC-) from sensor is reversed.
018	A/D converter failure	Occurs when an error occurs in A/D converters in the electric circuitry of converter internal storage.
019	Sensor EEPROM failure	This error occurs when writing to memories is not performed normally in the electric circuitry of converter internal storage.
020	Sensor user param. failure	This error occurs when reading sensor setup data is abnormal.

12.1.2 Remedies When Fault Occurs

(1) Alarm 016: Cell electromotive force error

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

(1) Poor contact in terminal connections between the converter and detector

(2) Breakage in wiring cable between the converter and the detector

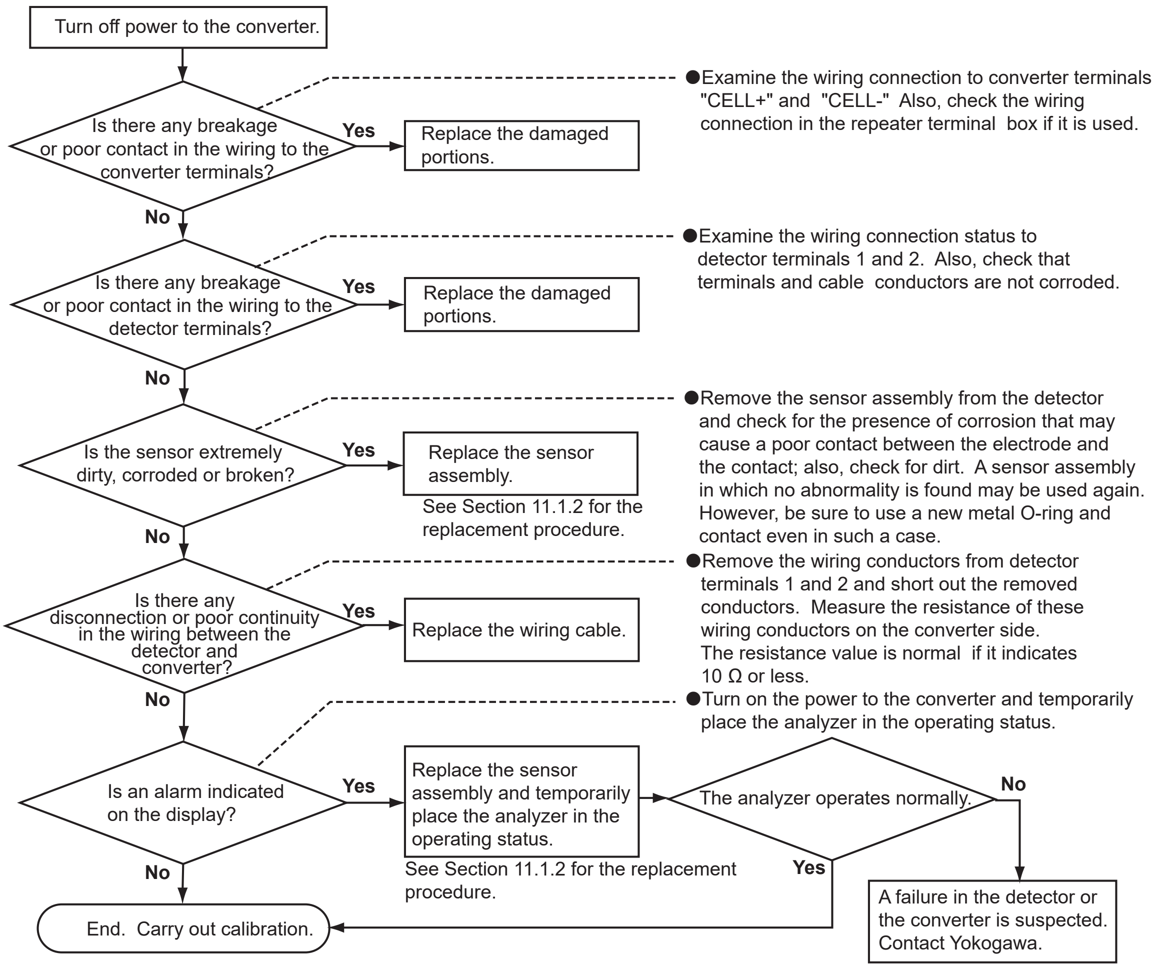
(3) Damage or deterioration of the sensor assembly

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

(5) Wiring failure inside the detector

(6) Abnormality in electrical circuits in the converter

<Locating the failure and countermeasures>



(2) Alarm 017: Heater Temperature Failure

This alarm occurs if the temperature of the detector heater does not rise during warm-up, or it drops below 730°C or exceeds 780°C after the warm-up ends.

When alarm 017 occurs, alarm 205 (Cold junction temperature high alarm) and alarm 206 (Cold junction temperature low alarm) may have been issued at the same time. Be sure to press the alarm icon on the screen to identify each alarm and check if these alarms are occurring at the same time. If alarm 205 and alarm 206 are occurring at the same time, the problem might have been caused by the abnormality in the cold junction system at the detector terminal. In this case, perform a trouble shooting according to **(7) Alarms 205 and 206: Cold junction temperature alarm** in “12.2.2 Remedies When Alarms are Generated”.

When alarm 207 and alarm 208 occur at the same time, the problem might have been caused by the abnormality in the heater unit of the detector. In this case, perform the trouble shooting according to **(8) Alarms 207 and 208: Thermocouple voltage alarm** in “12.2.2 Remedies When Alarms are Generated”.

Or if the same problem happens immediately after the power supply starts, the polarity of the thermocouple output (TC +, TC-) from the detector may be reversed. Check the connection to detectors.

Causes considered for cases where Alarm 017 occurs independently are shown below.

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

(2) Faulty thermocouple in the detector

(3) Faulty cold junction sensor located at the detector terminal block.

(4) Failure in electrical circuits inside the converter

(5) Heater temperature control overcurrent limiting triggered.

(6) TC+ ,TC- thermocouple terminals wired to detector with reverse (wrong) polarity.

Overcurrent protection is triggered if there are problems in the heater wiring. When the protective circuit is triggered, the internal fuse blows and the heater is disconnected, resulting in Alarm 017 (temperature failure).

<Locating cause of failure, and countermeasures>

(1) Turn off power to the converter.

(2) Remove the cable from terminals 7 and 8 of the detector and measure the resistance value between these terminals. The heater unit is normal if the resistance is lower than about 90 Ω. If the resistance value is higher, failure of the heater unit is suspected. In this case, replace the heater unit (refer to Section “11.1.4 Replacement of the Heater Unit”). In addition, check that the wiring resistance between the converter and detector is 10 Ω or less.

(3) Ensure that TC+ terminal (terminal 3 in detector) is connected to converter TC+ terminal, and TC- terminal (terminal 4) is connected to converter TC- terminal.

(4) Remove the wiring from terminals 3 and 4 of the detector and measure the resistance value between these terminals. The thermocouple is considered normal if the resistance value is 5 Ω or less. If the value is higher than 5 Ω, it may indicate that the thermocouple wire has broken or is about to break. In this case, replace the heater unit (refer to Section “11.1.4 Replacement of the Heater Unit”). Also, check that the wiring resistance between the converter and detector is 10 Ω or less.

(5) Even if items (2) to (4) are normal, the heater overcurrent protection fuse may have blown. Check for wiring problems such as the following:

(a) Heater terminals shorted.

(b) Heater terminal(s) shorted to ground.

(c) Heater terminals shorted to power supply.

If the internal fuse blows, this cannot be replaced by the user. Contact your Yokogawa service representative.

NOTE

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

(3) Alarm 018: A/D Converter Failure/Alarm 019: Sensor EEPROM Failure

- A/D Converter Failure

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

- Sensor EEPROM Failure

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

<Locating 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 alarm 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 electrical circuits 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 alarm occurs again after restarting, a failure in the electrical circuits is suspected. Consult the service personnel at Yokogawa.

(4) Miscellaneous Failure (Alarm 001 to 004, 020)

An internal failure has occurred. Contact your Yokogawa service representative.

12.2 Displays and Remedies When Alarms are Generated

12.2.1 Alarm Types

When an alarm is generated, the alarm indication blinks in the display to notify of the alarm.
Pressing the alarm indication displays a description of the alarm.
Alarms include those shown in Table 12.2.

Table 12.2 Types of Alarms and Reasons for Occurrence

Alarm number	Alarm Type	Reasons for Occurrence
101	Oxygen concentration high high alarm	Oxygen density exceeds setup limit.
102	Oxygen concentration high alarm	Oxygen density exceeds setup limit.
103	Oxygen concentration low alarm	Oxygen level is lower than setup.
104	Oxygen concentration low low alarm	Oxygen level is lower than setup.
105	Humidity high high alarm	The water content is above setup limit.
106	Humidity high alarm	The water content is above setup limit.
107	Humidity low alarm	The water content is below setup.
108	Humidity low low alarm	The water content is below setup.
109	Mixing ratio high high alarm	Mixing ratio exceeds setup
110	Mixing ratio high alarm	Mixing ratio exceeds setup
111	Mixing ratio low alarm	Mixing ratio is lower than setup
112	Mixing ratio low low alarm	Mixing ratio is lower than setup
113	Relative humidity high high alarm	The relative humidity exceeds setup value.
114	Relative humidity high alarm	The relative humidity exceeds setup value.
115	Relative humidity low alarm	The relative humidity is less than setup relative humidity.
116	Relative humidity low low alarm	The relative humidity is less than setup relative humidity.
117	Simple cell resistance alarm	The simple cell resistor has exceeded setup limit.
118	AO1 saturation	mA output has reached the upper or lower limit
119	AO2 saturation	mA output has reached the upper or lower limit
120	Calibration stability alarm	Electromotive force of the cell does not stabilize after calibration period has elapsed.
201	Zero correction ratio high alarm	Zero point correction ratio exceeds 130%
202	Zero correction ratio low alarm	Zero point correction rate is lower than 70%.
203	Span correction ratio high alarm	Span point correction ratio exceeds 18%
204	Span correction ratio low alarm	Span point correction rate is lower than-18%.
205	Cold junction temperature high alarm	Temperature of the cold contact has exceeded 155°C.
206	Cold junction temperature low alarm	Temperature of the cold contact is below-25°C.
207	Thermocouple voltage high alarm	Thermocouple electromotive force is over 42.1 mV (approx. 1020°C)
208	Thermocouple voltage low alarm	Thermocouple electromotive force is below-5 mV (approx.-170°C)
209	AI current high alarm	AI-input mA is above 20.5 mA
210	AI current low alarm	AI-input mA is below 3.8 mA
211	Input temperature high alarm	The incoming temperature has exceeded setup threshold.
212	Input temperature low alarm	The incoming temperature is lower than setup.
213	Input pressure high alarm	The input pressure exceeds setup value.
214	Input pressure low alarm	The input pressure is lower than setup value.

301	Battery low alarm	The internal battery is low. Turning OFF Power Supply when the battery is exhausted will reset the clock.
319	Fast warm-up function alarm	The function to shorten the warm-up time when an instantaneous power failure occurs does not work.

If an alarm is generated, actions such as turning off the heater power are not carried out. The alarm is cancelled when the cause of the alarm is removed. However, Alarm 205 to 208 may be generated concurrently with Alarm 017 (Fault: heater temperature error). In this case, the remedy when the error occurs has priority.

If the power to the converter is turned off after an alarm is generated and the converter is restarted before the cause of the alarm has been removed, the alarm will be generated again. However, Alarms 120, 201 to 204 (alarms related to calibration) are not generated unless calibration is executed.

12.2.2 Remedies When Alarms are Generated

(1) Alarm 101 to Alarm 116: Oxygen concentration alarm, Humidity alarm, Mixing ratio alarm, Relative humidity alarm

This alarm is generated when the set alarm value is exceeded or falls below. For details on these alarms, see Section “8.4 Alarm Setting”, in the chapter on operation.

(2) Alarm 117: Simple cell resistance alarm

The result of the simple cell resistance measurement has exceeded setup alarm value. For a resistance value of 2000 Ω or more, consider replacing the sensor. For a resistance value of 3000 Ω or more, sensor replacement is recommended. If the alarm must be cleared, change setup alarm setting.

(3) Alarms 118 and 119: AO1 saturation, AO2 saturation

The analog output has reached the upper or lower limit. Check set value, and process-measurements.

(4) Alarms 120: Calibration stability alarm

This alarm occurs when electromotive force of the sensor (cell) does not stabilize after calibration period has elapsed because the sensor section of sensor is not filled with calibration gas (zero gas, span gas).

<Cause of occurrence>

- Low flow rate of calibration gases (specified flow rate :600 ± 60 ml/min).
- The length or thickness of the calibration gas tubing has been changed (lengthened or thickened).
- The measured gases flow toward the probe-tip of sensor.
- The response of the sensor (cell) deteriorated.

<Searching for the cause of the error and remedy>

(1) Calibration should be performed with calibration gases flowing at the specified flow rate (600 ± 60 ml/min) after confirming that there are no leaks in the pipes.

(2) When calibration is performed normally, perform steady operation as it is.

If the alarm recurs, check the following before replacing the sensor assembly.

- The tip of sensor probe is markedly contaminated with dust, etc. If it is, clean it (see section “11.1.2 Cleaning the Calibration Gas Tube”). If an alarm also occurs in calibration after the sensor assembly is replaced, it may be caused by the flow of the measured gases. Make sure that the measured gases do not flow towards the probe tip of sensor, for example by repositioning sensor.

(5) Alarms 201 and 202: Zero correction ratio high and low alarm

Occurs when the zero-point compensation ratio exceeds 100 ± 30% in the auto calibration or semi-auto calibration (see section: "9.1.4 Compensation"). Possible causes of this are as follows.

- Zero gas oxygen concentration does not match the zero gas concentration value setup in "setup of calibration", or the span gas was used as the zero gas.
- The zero-air flow rate is outside the specified flow rate (600 ± 60 ml/min).
- The sensor assembly is damaged and the cell electromotive force is faulty.

<Searching for the cause of the error and remedy>

(1) Check the following and perform calibration again. If the status is not correct, correct it.

1. When "Zero gas concentration" is turned Display in setup of calibration, is set value matched with the actually used zero gas concentration?
2. Are calibration gas pipes installed to prevent zero air leakage?

(2) If calibration is performed again and there is no alarm, it is probable that calibration condition was incorrect as the reason for the alarm in the results calibration. In this case, no special remediation is required.

(3) If the alarm is triggered again after calibration, the sensor assembly may be degraded or damaged. It must be replaced with a new cell (sensor), but do the following before replacing.

Check the cell electromotive force when zero and span gases are flowed.

1. Running calibration turns Display the cell electromotive force in Trend screen.
2. Check that Display cell electromotive force is not significantly different from the theoretical oxygen-concentration. The theoretical value of cell electromotive force can be found in Table 12.3. The difference from the theoretical value is not generally acceptable, but consider it to be approximately ± 10 mV .

Table 12.3 Oxygen Concentration and Cell Electromotive Force

Oxygen concentration	Cell electromotive force
1% O_2	67.1 mV
21% O_2	0 mV

(4) Check the following steps to see if any degradation or damage to the sensor assembly caused by the alarm occurred suddenly during this calibration.

1. Select the detailed screen from the "Converter Menu" to display the log information.
2. By selecting "Zero/Span Calibration History", you can check the values of the span point correction rate and zero point correction rate, so you can see the change in degradation of the cell (sensor).

(5) If the sensor assembly deteriorates abruptly, the check valve that prevents moisture from entering the calibration gas piping from inside the furnace may be defective. When gas from the furnace enters the calibration gas line, it cools and becomes condensed water and accumulates in the piping. This may have been blown into the sensor assembly by the calibration gas during calibration and the sensor assembly has been damaged by the rapid cooling of the cell.

(6) If the sensor assembly is gradually deteriorated, check the status of the sensor assembly by following the procedure below.

1. Select the detailed screen from the "Sensor Menu" and check "Cell Resistance". New cell (Sensor) indicates a value of 200 Ω or less. On the other hand, cells (sensors) approaching the end of their life, Values range from 3 to 10 kΩ.
2. Check the "Cell health level". Good cells (sensors) indicate "lifetime > 1 year"

(6) Alarms 203 and 204: Span correction ratio high and low alarm

This error occurs when the span point correction rate exceeds the range of 0 ± 18% in automatic calibration or semi-automatic calibration (see Section: “9.1.4 Compensation”). This may be caused by the following:

- The span gas oxygen concentration does not match the span gas concentration value set in “Setting calibration”.
- The span gas flow rate is outside the specified flow rate (600 ± 60 ml/min).
- The sensor assembly is damaged and the cell electromotive force is abnormal.

<Searching for the cause of the error and remedy>

(3) Check the following and perform calibration again. If the condition is not correct, correct it.

1. When “Span Gas Concentration” is displayed in “Calibration Settings”, is the set value and the span gas concentration actually used matched?
2. Are calibration gas pipes constructed so that span gas does not leak?

(4) If no alarm was detected as a result of recalibration, it is probable that the calibration condition was inappropriate as the cause of the alarm in the previous calibration. In this case, no special remediation is required.

(5) If an alarm occurs again as a result of recalibration, the sensor assembly may be degraded or damaged as the cause of the alarm. It must be replaced with a new cell (sensor), but do the following before replacing.

It must be replaced with a new cell (sensor), but before replacement, follow the procedure of **(5) Alarm 201, 202: Zero correction ratio high and low alarm <Search for the cause of the error and remedy>** (3) to (6).

(7) Alarms 205 and 206: Cold junction temperature alarm

This error occurs when the cold junction temperature at the detector’s terminal (terminal block in the converter when /CJ option was chosen) drops below-25°C or exceeds 155°C. If “C.J. Temperature” is indicated as 200°C or-50°C, the following may be considered.

- Breakage of the cold junction signal wire between the converter and the detector. Or, the cable is not securely connected to the connection terminal.
- The cold junction signal is in the middle of wiring, or the + and-poles are short-circuited at the connection terminal.
- Defective detector terminal cold junction temperature sensor
- Converter internal electrical circuit error

If the “C.J. Temperature” is higher than 150°C or lower than -20°C, the following may be considered:

- The temperature of the detector terminal block is out of the operating temperature range (-20°C to 150°C).
- Defective detector terminal cold junction temperature sensor
- Converter internal electrical circuit error

<Searching for the cause of the error and remedy>

Before proceeding with the operation below, investigate whether the terminal part of the detector exceeds the operating temperature range. The operating temperature range depends on the detector model. If it is exceeded, take measures to reduce the temperature, such as taking measures to avoid receiving radiant heat.

(1) Disconnect the power supply to the converter.

(2) Remove the wires from terminals 5 and 6 of the detector and measure the resistance between the terminals. If the resistance value deviates from the range of 1 to 1.6 kΩ, the cold junction temperature sensor may be defective.

Replace the cold junction temperature sensor.

(3) If the resistance value is within the range, the cold junction temperature sensor is considered normal. Check that the wiring cable is not broken or short-circuited and that it is securely connected to the terminal. Also check that the wiring resistance between the transmitter and sensor is 10 Ω or less.

(4) If the wiring is correct, the electrical circuit inside the transmitter may be faulty.

Contact our service.

(8) Alarms 207 and 208: Thermocouple voltage alarm

Generated when the electromotive force of the thermocouple drops below-5 mV (approx.-170°C) or exceeds 42.1 mV (approx. 1020°C). When alarm 207, 208 occurs, alarm 017 (heater temperature error) is always generated.

- The heater TC signal wire between the converter and the detector is broken, or the cable is not securely connected to the connection terminal.
- The positive and negative poles of the heater thermocouple signal wiring are shorted out in the wiring extension or at the connection terminals.
- Defective thermocouple of sensor heater
- Converter internal electrical circuit error

<Searching for the cause of the error and remedy>

(1) Disconnect the power supply to the converter.

(2) Remove the wires from terminals 3 and 4 of the detector and measure the resistance between terminals 3 and 4. If the resistance is 5 Ω or less, the thermocouple is considered normal. If the resistance is greater than 5 Ω, the wire may be broken or disconnected. Replace the heater assembly in this case (see section: “11.1.4 Replacement of the Heater Unit”).

CAUTION

Measure the resistance of the thermocouple after the difference between the tip of the detector and the ambient temperature is 50°C or less. If the electromotive force of the thermocouple is large, it cannot be measured accurately.

(9) Alarms 209 and 210:AI current high and low alarm

If “External input” is selected in “Setting the measured gas pressure” or “Setting the measured gas temperature”, this occurs when the input current from the pressure or temperature transmitter (hereinafter referred to as transmitter) deviates from the range of 3.8 to 20.5 mA. If this alarm comes out at the same time as alarms 211 to 214 (pressure/temperature input alarm), Take action for alarms 211 to 214. If alarms 209 and 210 are occurring independently, the cable between the converter and the transmitter may be broken.

<Searching for the cause of the error and remedy>

(1) Check the cable status, including the connection terminals.

(2) If there is no problem with the cable connection, display the measured gas pressure/temperature in the “Detailed Data Display”.

Check that this pressure/temperature matches the signal from the transmitter. If the pressure/temperature is incorrect, check that the output range of the transmitter matches the “input temperature setting” of the tester.

(3) If there is no problem with the range setting, it is probable that the device’s electrical circuit is faulty. Please consult our service.

(10) Alarm 211 to 214: Input temperature high and low alarm

If “External input” is selected in “Set measured gas pressure” or “Set measured gas temperature”, this alarm occurs when the input current exceeds the set alarm value. Possible causes are as follows

- The output range of the transmitter does not correspond to the “Input pressure setting” or “Input temperature setting” of the tester (in case of occurrence at start-up).
- Burnout is caused by an error in the thermocouple connected to the temperature transmitter.
- Abnormal transmitter.
- The pressure/temperature of the measured gas actually exceeds the alarm value.

<Searching for the cause of the error and remedy>

- Check that the temperature at 4 mA point and 20 mA point of the temperature transmitter matches the “Input temperature setting” of the tester.
- Check that there is no error in the actual measurement gas.
- Select the detailed screen of the sensor menu and check the values for “Measured gas pressure” or “Measured gas temperature”. If this value is the burnout value of the temperature transmitter, it is probable that the temperature transmitter or the thermocouple connected to the temperature transmitter is abnormal. In this case, refer to the instruction manual of the temperature transmitter to investigate the cause.

(11) Alarm 301: Battery low alarm

The internal circuit of the tester has a built-in battery, which is used to back up the internal clock, etc. When this alarm occurs, the internal clock may stop while the power is not supplied to the unit (this does not affect the set values of other operating parameters). The internal clock is used for automatic calibration and automatic blowback schedule management. Therefore, when using these functions, if the power supply to the tester stops, such as when a power failure occurs after the low battery alarm occurs, be sure to check the date and time set in the tester the next time the power is turned on. If it is different from the current time, set it again.

<Action>

The internal battery cannot be replaced by the customer. Contact our service.

Note

Approximate Battery Life (The battery life varies greatly depending on the operating environment. The following is only a guideline and is not a guarantee.)

- The internal battery is not consumed when power is supplied to the instrument. Consider it as a guideline for 10 years. However, after shipment, it will be consumed from the battery until start-up.
- When power is not supplied to the unit, the life of the internal battery changes greatly depending on the storage temperature. Storing the unit at room temperature (20 to 25°C) results in five years or more, but in the case of-30 to 70°C, the life of the internal battery is shortened to one year.

(12) Alarm 319: Fast warm-up function alarm

The internal circuit of the tester is equipped with a function to shorten the warm-up time when an instantaneous power failure occurs, but this alarm occurs when the tester does not operate. Contact our service to restore the warm-up reduction function.

12.3 Measures to be taken when measured values indicate abnormalities

The cause that the measured value indicates an abnormal value is not necessarily a failure of the equipment. Rather, there are many cases in which the measured gas itself is in an abnormal state or due to external factors that disturb the operation of the equipment. This section explains the causes and remedies for when the measured value indicates the following phenomena.

(1) The measured value shows a higher value than the actual value.

(2) Measured value shows lower value than actual value

(3) Measured values occasionally show abnormal values

12.3.1 The measured value is higher than the actual value (lower in the case of a hygrometer).

<Cause and remedy>

(1) The pressure of the measured gas increases.

Oxygen concentration measurement value X when the pressure of the measured gas becomes higher by Δ p (kPa) than at the time of calibration (vol%O_2) is as follows.

X=Y[1+(Δ p/101.30)]

Y: Measured oxygen concentration at the same pressure as at calibration (vol%O_2)

If the change in the measured value due to pressure fluctuation cannot be ignored, measures must be taken. Consider the following points and make possible improvements in each process.

- Consider the following points and make possible improvements in each process.
- Is it possible to perform calibration under the average measured gas pressure (furnace pressure)?

(2) The amount of moisture contained in the comparison gas changes greatly (increases)

If the air at the detector installation site is used as a comparator gas, a large change in the amount of water contained 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 with a constant moisture content, such as instrumented air that is almost dry, as the comparison gas. Changes in the amount of water in the combustion exhaust gas can also be considered as an error factor. Normally, this amount of error is negligible.

(3) Calibration gas (span gas) is leaking into the detector.

If span gas leaks into the detector due to a defective valve installed in the calibration gas piping system, the measured value will show a higher value. Check valves in the calibration gas piping system (needle valves, check valves, solenoid valves for automatic calibration, etc.) for leaks. In the case of a manual valve, check that the valve is fully closed before checking for leaks. Also, check that there is no leakage at the joint part of the piping.

(4) The comparison gas enters the measurement gas side, or the measurement gas enters the comparison gas side.

The difference in oxygen partial pressure between the anode and cathode sides of the sensor is reduced, so the measured value indicates a higher value. Check that there is no problem with the installation of the sensor referring to section “11.1.3 Replacing the Sensor Assembly”.

An error that does not appear as alarm 016 may have occurred in the sensor. In addition, if the metal O-ring is not tightened sufficiently or if the seal surface is damaged or dirty, the measured gas or comparison gas may be leaking. Visually inspect the sensor. If any cracks are found, replace the sensor assembly with a new one.

(NOTE) The data such as cell health displayed on the detailed display screen should also be used as a reference for judging the quality of the sensor.

12.3.2 The measured value is lower than the actual value (higher in the case of a hygrometer).

<Cause and remedy>

(1) The pressure of the measured gas decreases.

If the change in the measured value due to pressure fluctuation cannot be ignored, take measures according to (1) in section 12.3.1.

(2) The amount of water contained in the comparison gas changes greatly (decreases).

If the air at the detector installation site is used as a comparator gas, a large change in the amount of water contained in the air may result in errors in the measured oxygen concentration (vol%O_2) and humidity (vol%H_2O or kg/kg).

If this error cannot be ignored, use a gas with a constant moisture content, such as instrumented air that is almost dry, as the comparison gas. Changes in the amount of water in the combustion exhaust gas can also be considered as an error factor. Normally, this amount of error is negligible.

(3) Calibration gas (zero gas) is leaking into the detector

If zero air leaks into the detector, e.g. due to a defective valve installed in the calibration gas piping system, the measured value will be lower.

Check the valves in the calibration gas piping system for leaks. For manual valves, check that the valve is fully closed before checking for leaks.

(4) Combustible components exist in the measured gas.

If there is a combustible component in the measurement gas, it will burn in the sensor and the O2 concentration will decrease. Check for flammable components.

(5) The detector cell temperature is 750°C or higher.

If the measured gas leaks into the comparison gas side for some reason, the thermocouple may be corroded and the temperature of the sensor may become 750°C or higher. If the measured gas leaks into the comparison gas side for some reason, the thermocouple may be corroded and the temperature of the sensor may become 750°C or higher.

12.3.3 Measured values occasionally show abnormal values

<Cause and remedy>

(1) Noise comes in from the detector output wiring.

Ensure that the transmitter and sensor are properly grounded.

Check that the signal lines are not routed along other power lines.

(2) Affected by power supply noise.

Check that the power is not supplied from the same location as the other power equipment.

(3) Poor contact of wiring.

Poor contact in the wiring may cause the electromotive force of the sensor or thermocouple to change due to vibration, etc. Check that the wiring connections are not loose and that the crimped part of the crimp terminal is not loose.

(4) Combustible components in the measured gas enter the sensor.

If the combustible component is dust-like, attach the dust filter K9471UA to improve the flammability.

(5) There is a crack in the sensor or a leak in the sensor mounting part.

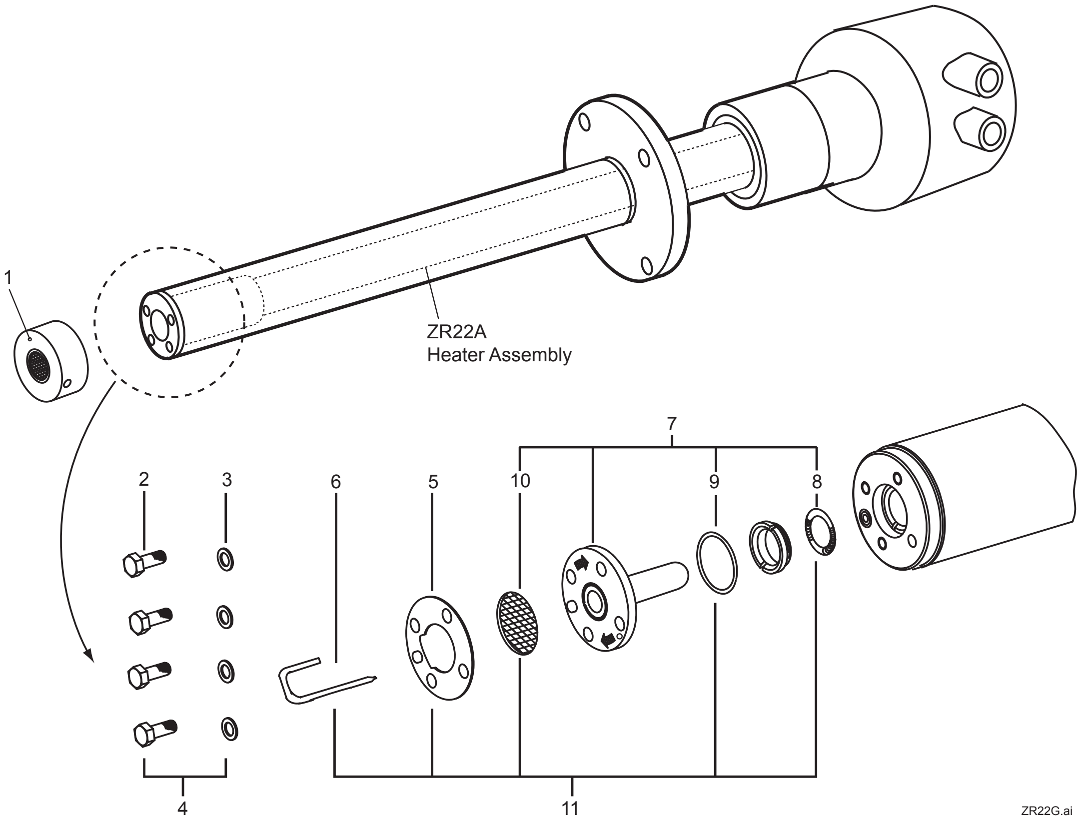
If the indication changes in synchronization with the fluctuation of the furnace pressure, check that there is no crack in the sensor, that the metal O-ring is firmly crushed, and that the flange of the sensor is in close contact with the contact surface of the probe.

(6) There is a leak in the calibration gas piping

In the case of negative pressure in the furnace, if the indication fluctuates with fluctuation in the furnace internal pressure, check the calibration gas piping for leaks.

Customer Maintenance Parts List

Model ZR22G
Zirconia Oxygen/Humidity Analyzer, Detector (Separate type)



Item	Part No.	Qty	Description
1	K9471UA	1	Dust Filter (Option)
2	---	4	Bolt
	G7109YC		(M5x12, SUS316 stainless steel)
	K9470BK		(M5x12, inconel) for Option code "/C"
3	E7042DW	4	Washer (SUS316 stainless steel)
4	---	1	Bolts and Washers
	K9470ZF		G7109YC x 4 + E7042DW x 4
	K9470ZG		K9470BK x 4 + E7042DW x 4 for Option code "/C"
5	E7042BR	1	Plate
6	K9470BM	1	Pipe
	K9473AN	1	Pipe for Option code "/C"
7	---	1	Cell Assembly
	E7042UD		only for Japan
	ZR01A01		for other than Japan
8	E7042BS	1	Contact
9	K9470BJ	1	Metal O-ring
10	E7042AY	1	Filter
11	---	1	Calibration Tube Assembly
	K9470ZK		Cal. Gas Tube Assembly
	K9470ZL		Cal. Gas Tube Assembly for Option code "/C"

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CMPL 11M12A01-02E
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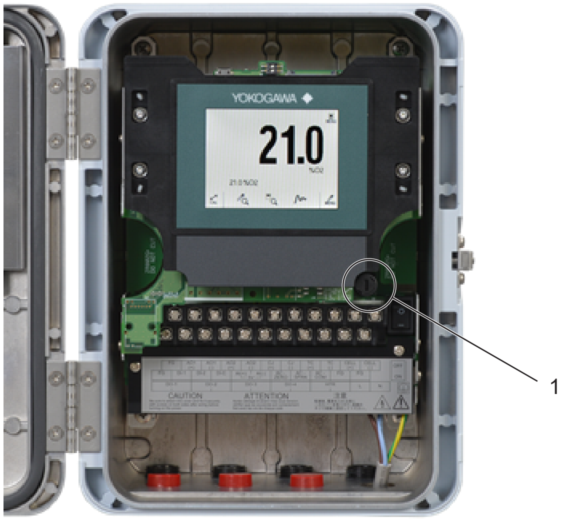
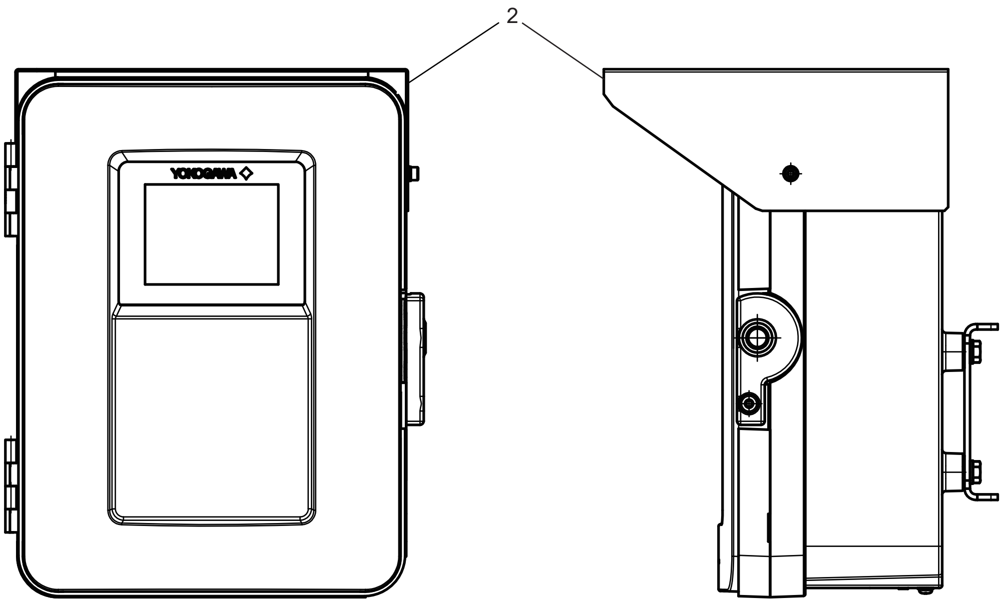
Customer Maintenance Parts List

ZR802G
Zirconia Oxygen/Humidity Analyzer, Converter



Hood for ZR802G



Item	Part No.	Qty	Description
1	A1113EF	1	Fuse (3.15A)
2	K8000PA	1	Hood Assy (include Bolt and washer)

CMPL 11M12G01-01EN
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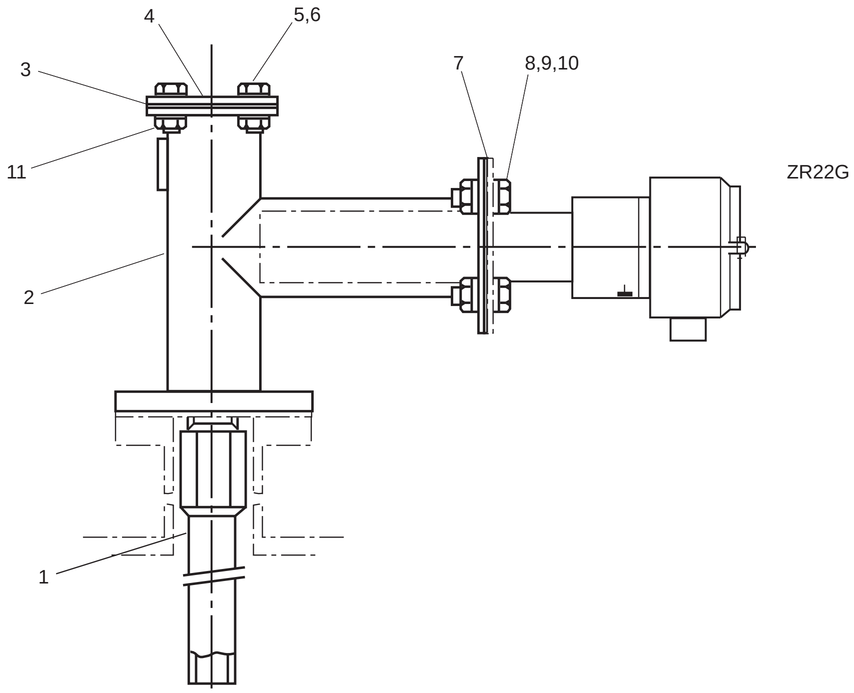
Customer Maintenance Parts List

Model ZO21P-H
Zirconia Oxygen Analyzer
High Temperature Probe Adaptor



Item	Part No.	Qty	Description
1	K9292TP	1	Probe (SiC, L=0.5m)
	E7046CF	1	Probe (SiC, L=0.6m)
	K9292TQ	1	Probe (SiC, L=0.7m)
	E7046CG	1	Probe (SiC, L=0.8m)
	E7046CH	1	Probe (SiC, L=0.9m)
	E7046AL	1	Probe (SiC, L=1.0m)
	E7046BB	1	Probe (SiC, L=1.5m)
	K9292TV	1	Probe (SUS, L=0.5m)
	E7046CR	1	Probe (SUS, L=0.6m)
	K9292TW	1	Probe (SUS, L=0.7m)
	E7046CS	1	Probe (SUS, L=0.8m
	E7046CT	1	Probe (SUS, L=0.9m
	E7046AP	1	Probe (SUS, L=1.0m
	E7046AQ	1	Probe (SUS, L=1.5m
2	E7046FA	1	Probe Adaptor (for JIS 5K-50-FF)
	E7046FE	1	Probe Adaptor (for ANSI CLASS150-4-RF)
	E7046FK	1	Probe Adaptor (for DIN PN10-DN50-A)
	E7046FD	1	Probe Adaptor (for JIS 10K-100-FF)
	E7046FC	1	Probe Adaptor (for JIS 10K-80-FF)
	E7046FB	1	Probe Adaptor (for JIS 10K-65-FF)
	E7046FG	1	Probe Adaptor (for ANSI CLASS150-3-RF)
	E7046FF	1	Probe Adaptor (for ANSI CLASS150-2 1/2-RF)
	E7046FJ	1	Probe Adaptor (for JPI CLASS150-4-RF)
	E7046FH	1	Probe Adaptor (for JPI CLASS150-3-RF)
3	E7046FQ	1	Gasket
4	E7046FN	1	Plate
5	Y9825NU	4	Bolt
6	Y9800WU	8	Washer
7	G7073XL	1	Gasket
8	Y9630RU	4	Bolt
9	Y9121BU	4	Nut
10	Y9120WU	4	Washer
11	Y9801BU	4	Nut

CMPL 11M03B01-10E
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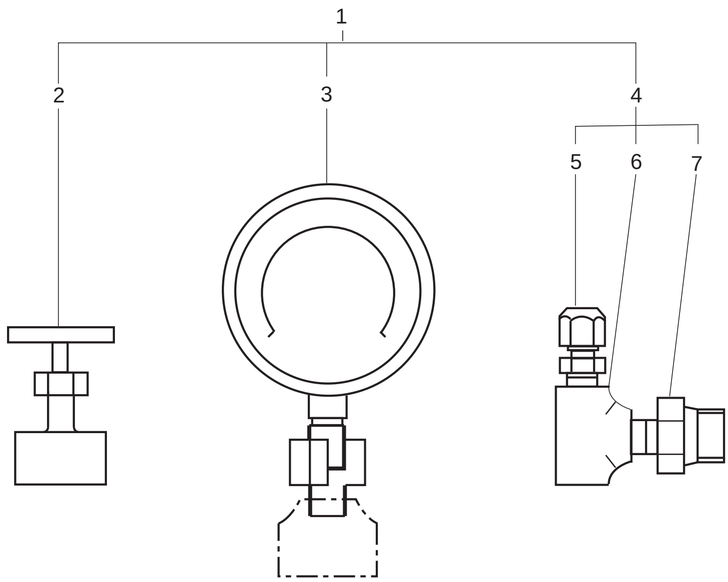
Customer Maintenance Parts List

E7046EC/E7046EN
Zirconia Oxygen Analyzer
Auxiliary Ejector Assembly (for Model ZO21P-H)



Item	Part No.	Qty	Description
1	E7046EC	1	Auxiliary Ejector Assembly, Connection Rc1/4
	E7046EN	1	Auxiliary Ejector Assembly, Connection 1/4 NPT
2	L9852CB	1	Needle Valve, Connection Rc1/4
	G7016XH	1	Needle Valve, Connection 1/4NPT
3	E7046EK	1	Pressure Gauge, Connection Rc1/4
	E7046EV	1	Pressure Gauge, Connection 1/4NPT
4	E7046ED	1	Ejector, Connection Rc1/4
	E7046EP	1	Ejector, Connection 1/4NPT
5	E7046EF	1	Nozzle Assembly, Tube Connection Ø6xØ4 tube
	E7046ER	1	Nozzle Assembly, Tube Connection 1/4 inch tube
6	G7031XA	1	Tee, Connection Rc1/4
7	E7046EJ	1	Reducing nipple, Connection R1/4

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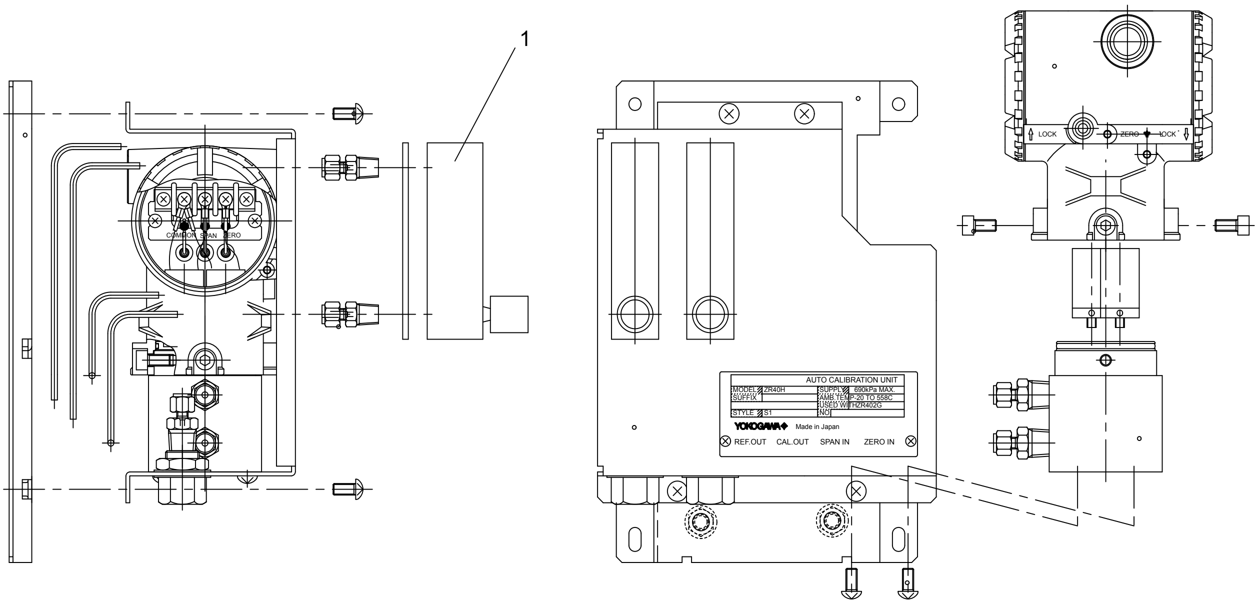
8th Edition : Mar. 2013 (YK)

Customer Maintenance Parts List

Model ZR40H
Automatic Calibration Unit
for Separate type Zirconia Oxygen/Humidity
Analyzer (ZR22G + ZR402G)

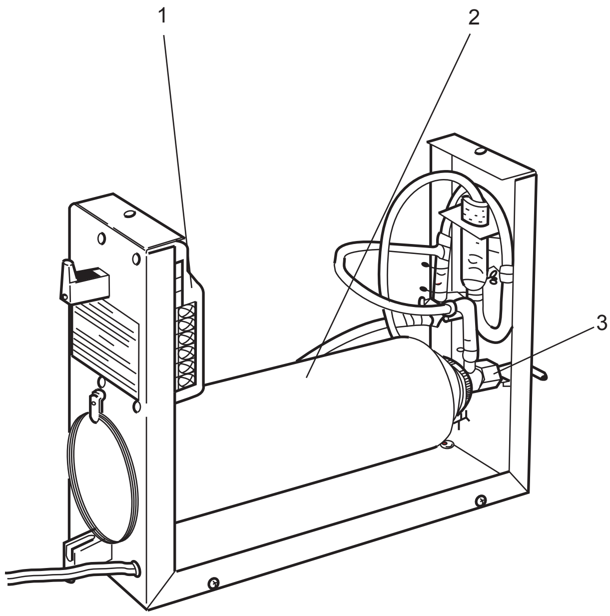


Item	Part No.	Qty	Description
1	K9473XC	1	Flowmeter

CMPL 11M12A01-11E
1st Edition : Dec. 2000 (YK)
4th Edition : Mar. 2013(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 100 V 110 115	E7050AU
AC 200 V 220 240	E7050AV

CMPL 11M3D1-01E
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- Manual No. : IM 11M12G01-02EN

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Reviced the table in Section "● STANDARD ACCESSORIES," deleted the Section "● Mounting bracket by specifications." (Page 2-21)
Corrections (Page 2-15, 2-18, 7-4, 10-22, 10-28)

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