User's
Manual

EXA IR

EXA IR
SG700 Stack Gas Analyzer

IM 11G04G06-01E

vigilantplant.™

YOKOGAWA
Yokogawa Electric Corporation

IM 11G04G06-01E
1st Edition

INTRODUCTION

Before using this manual, thoroughly read it for correct use instructions. Store the manual in the book rack (on the back of the front door of the SG700 Stack Gas Analyzing System).

In recent years, interest in protecting the environment has been rising not only domestically but also on a global scale. A major issue in this is air pollution due to sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), dioxins, and other contaminants, and there has been increasing cooperation in preventing pollution. An indispensable element in this is a source measurement of pollutant emissions.

Our EXA IR Series, SG700 Stack Gas Analyzing System provides continuous measurement of air pollution components, sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), and dioxides (O_2) in stack gases such as found in large boilers, industrial furnaces, and waste incinerators.

The SG700 consists of an SG700 stack gas analyzer main unit and an external sampling unit featuring a rich array of system configurations, enabling you to meet your process conditions.

Inspection on Delivery

Upon arrival of the SG700 Stack Gas Analyzing System, immediately verify that the specifications conform to those at the time of purchase. Note that the components for the external sampling system are packed and delivered separately. Verify that all items you ordered have arrived.

DO NOT store or install the stack gas analyzing system in the following locations:

- Areas subject to vibration. Vibration may loosen tubing connections.
- Areas with high temperatures and humidity. SG700 stack gas analyzer main units are designed for use in areas where the ambient temperature is -5 to 40°C (-15 to 40°C for cold-climate specifications) and the maximum ambient humidity is 90% RH. The allowable storage temperature ranges from -20 to 55°C.
- Areas where corrosive gases are present. Also avoid storage in dusty locations. While the system is in storage, keep the sample gas inlet closed to prevent dust from entering the connection.

1 st Edition: Feb. 2007 (YK)

Contents of this manual

This manual describes all aspects of the <SG700 Stack Gas Analyzing System> including the installation, operation, inspection and maintenance procedures. Therefore, note that this manual may involve devices and systems that are beyond your specifications. Keep this in mind when you read this manual.

The table below lists the titles of the individual chapters and provides a brief explanation. Chapters 1 through 5 describe the specifications and installation procedures of the product. For operation and calibration procedures, or the like, you can skip to chapter 6 or any other chapter or section. Consult the contents of this manual to find the title and page number you are referencing.

Manual Contents Summary and Guide to Sections by Task

Chapter	Content	When to read, by task		
		To Install	To Operate	To Maintain
1. Overview	Describes outline of Model SG700 Stack Gas Analyzing System.	○	△	○
2. Specifications	Gives standard specifications, model codes (or part number), and outline drawings for each device.	◎	○	○
3. Installation	Describes requirements and procedures for installation of SG700 analyzer main units and external sampling systems.	◎		△
4. Piping and tubing	Describes piping requirements and procedures, using an example of a typical external sampling system.	◎		△
5. Wiring	Describes wiring requirements and procedure for subsystems such as the power supply wiring, output signal wiring, etc.	◎		△
6. Component names and functions	Gives names and brief functional descriptions of SG700 main unit components.	△	○	○
7. General operation	Explains the basic procedure to be followed to bring an SG700 system to operational status. This section gives sufficient general knowledge to put a system into operation.		◎	△
8. Detailed key and display operations	Provides details concerning operating panel key operations and displays.		◎	△
9. Setting and Calibration	Discusses use of standard gas calibration, and describes manual automatic calibration procedures.		◎	△
10. Inspection and maintenance	Gives procedures for inspection and replacement of parts subject to deterioration, to maintain SG700 performance.		○	◎
11. Standard accessories spare parts	Standard accessories acompanying the instruments. One-Year-Use spare parts.etc.		△	◎
12. Troubleshooting	Gives procedures for dealing with error messages and for corrective action in the event of a failure.			
CMPL (Parts list)	Lists user-replaceable parts.		△	○

◎ :Read and understand completely before beginning work. ○ :Read once before beginning operation. Then refer to when necessary. △ :Recommend reading.

Introduction Table.eps

Document Map

● Specifications

Model SG700 Series of Stack Gas Analyzing Systems
GS 11G04G06-E

● Installation and Measurement Principle

Model SG8 Stack Gas Analyzing Systems (Application Volumes)
TI 11G04G01-01E

● Operation and Maintenance Manual

Model SG700 Stack Gas Analyzer
IM 11G04G06-01E

Includes a complete description of the Model SG700 Stack Gas Analyzing System with a sampling unit and a zirconia oxygen analyzer.

● Drawings

SD 11G04G06-01E	SG700	SG700 Stack Gas Analyzing System (Indoor type)
SD 11G04G06-02E	SG700	SG700 Stack Gas Analyzing System (Outdoor type)
SD 11G04G06-03E	SG700	SG700 Stack Gas Analyzing System (Indoor type with Enclosed Channel Base)
SD 11G04G06-04E	SG700	SG700 Stack Gas Analyzing System (Outdoor type with Enclosed Channel Base)
SD 11G04G05-10E	K9718VC	Type F Filtering Probe
SD 11G04G02-13E	K9219E□	Electric Heating Type Probe (Type M1E Filtering Probe)
SD 11G04G05-11E	K9718VE	Type M2E Filtering Probe
SD 11G04H01-13E	K9718PA, K9718PD	Type M1, M2 Probe
SD 11G04H01-14E	K9718QA	Type M3 Probe
SD 11G02G05-12E	SG8HSAP-L□□	Thermal Sampling Tube
SD 11G04H01-15E	K9718TA	Type M1E External Primary Filter
SD 11G04H01-16E	K9718UA	Type MS External Primary Filter
SD 11G04H01-25E	K9641EA	External Drain Separator
SD 11A00V01-04E	L9850BA, L9850BB	Pressure Reducing Valve for Gas Cylinder

● Please read the following document before reading this manual.

GS 11G04G06-E EXA IR Model SG700 Series of Stack Gas Analyzing System

DOC_MAP.eps

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 instruction manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- 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 symbols are used in the product and instruction manual to indicate that there are precautions for safety:

Indicates a caution regarding operation. This symbol is placed on the product where the user is recommended to refer to the instruction manual in order to protect the operator and the equipment. In the instruction manuals you will find precautions to avoid electrical shocks and physical injury to, or possible death of the operator.

Identifies a protective grounding terminal. Before using the product, ground the terminal.

Identifies a functional grounding terminal. Before using the product, ground the terminal.

Indicates an AC supply.

■ Notes on Handling Manuals

- Please hand over the instruction manuals to your end users so that they can keep the manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these 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 manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the manuals and product at any time, without notice or obligation.
- For any questions, mistakes or omissions detected in the manuals, contact our sales representative or your local distributor.

■ 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 the any defect of the product that YOKOGAWA can not predict in advance.

■ Symbol Marks

Throughout this manual, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

WARNING

Identifies instructions that must be observed in order to avoid physical injury and electric shock or death to the operator.

CAUTION

Identifies instructions that must be observed in order to prevent the software or hardware from being damaged or the system from becoming faulty.

Note

Identifies additional information required to understand the operations or functions.

Tip

Identifies additional information.

SEE ALSO

Identifies a source to be referred to.

■ Drawing Conventions

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

Some screens depicted in the manual may have different display positions or character types (e.g., the upper / lower case).

■ Caution on installation and transport of analyzer


DANGER

This unit is not an explosion-proof type. Do not use it in a place with explosive gases to prevent explosion, fire or other serious accidents.


CAUTION

- For installation, observe the rule on it given in the instruction manual and select a place where the weight of gas analyzer can be endured. Installation at an unsuited place may cause turnover or fall and there is a risk of injury.
- When lifting the gas analyzer, be sure to wear protective gloves. Bare hands may invite an injury.
- Before transport, fix the casing so that it will not open. Otherwise, the casing may be separated and fall to cause an injury.
- The gas analyzer is heavy. It should be transported carefully. Otherwise, body may be damaged or injured.
- During installation work, care should be taken to keep the unit free from entry of cable chips or other foreign objects. Otherwise, it may cause fire, trouble or malfunction of the unit.

■ Caution on piping


DANGER

In piping, the following precautions should be observed. Wrong piping may cause gas leakage. If the leaking gas contains a toxic component, there is a risk of serious accident being induced. Also, if combustible gas is contained, there is a danger of explosion, fire or the like occurring.

- Connect pipes correctly referring to the instruction manual.
- Exhaust should be led outdoors so that it will not remain in the locker and installation room.
- Exhaust from the analyzer should be relieved in the atmospheric air in order that an unnecessary pressure will not be applied to the analyzer. Otherwise, any pipe in the analyzer may be disconnected to cause gas leakage.
- For piping, use a pipe and a pressure reducing valve to which oil and grease are not adhering. If such a material is adhering, a fire or the like accident may be caused.

■ Caution on wiring

CAUTION

- Wiring is allowed only when all power supplies are turned off. This is required for preventing a shock hazard.
- Enforce construction of specified grounding wire by all means. If the specified grounding construction is neglected, a shock hazard or fault may be caused.
- Wires should be the proper one meeting the ratings of this instrument. If using a wire which cannot endure the ratings, a fire may occur.
- Use power source that matches the rating of the unit. Use of power source out of rating may cause fire.

■ Caution on use

DANGER

- When handling the standard gas such as calibration gas, read the instruction manual of the standard gas carefully and use the gas correctly.

CAUTION

- Avoid continuous operation with the casing drawn out.
- During operation, avoid opening the casing and touching the internal parts. Otherwise, you may suffer a bum or shock hazard.

■ Caution on maintenance and check

- When doors are open during maintenance or inspection for adjusting the optical system, etc., be sure to purge sufficiently the inside of the gas analyzer as well as the measuring gas line with nitrogen or air, in order to prevent poisoning, fire or explosion due to gas leaks.
- The system uses high-voltage circuits inside the component cases. DO NOT attempt to remove those cases; otherwise, you may receive an electrical shock. Only our mainte nance service personnel should remove them.

CAUTION

- Before working, take off a wrist watch, finger ring or the like metallic accessories. And never touch the instrument with a wet hand, Otherwise, you will have a shock hazard.
- If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before. Otherwise, shock hazard or fault may be caused.

■ Others

CAUTION

- If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or YOKOGAWA service office in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury.
- Do not use a replacement part other than specified by the instrument maker. Otherwise, adequate performance will not be provided. Besides, an accident or fault may be caused.
- Replacement parts such as a maintenance part should be disposed of as incombustible.

■ CAUTIONS ON USE

● **Select a suitable installation place.**
Install the unit in a place with normal temperature and humidity, free from excessive change in temperature and from heat radiation and direct sunlight.

● **Do not install the unit in a place with vibrations.**

● **Cleaning of instrument**
Do not use solvents such as benzine, thinner, etc., as it damages the case.

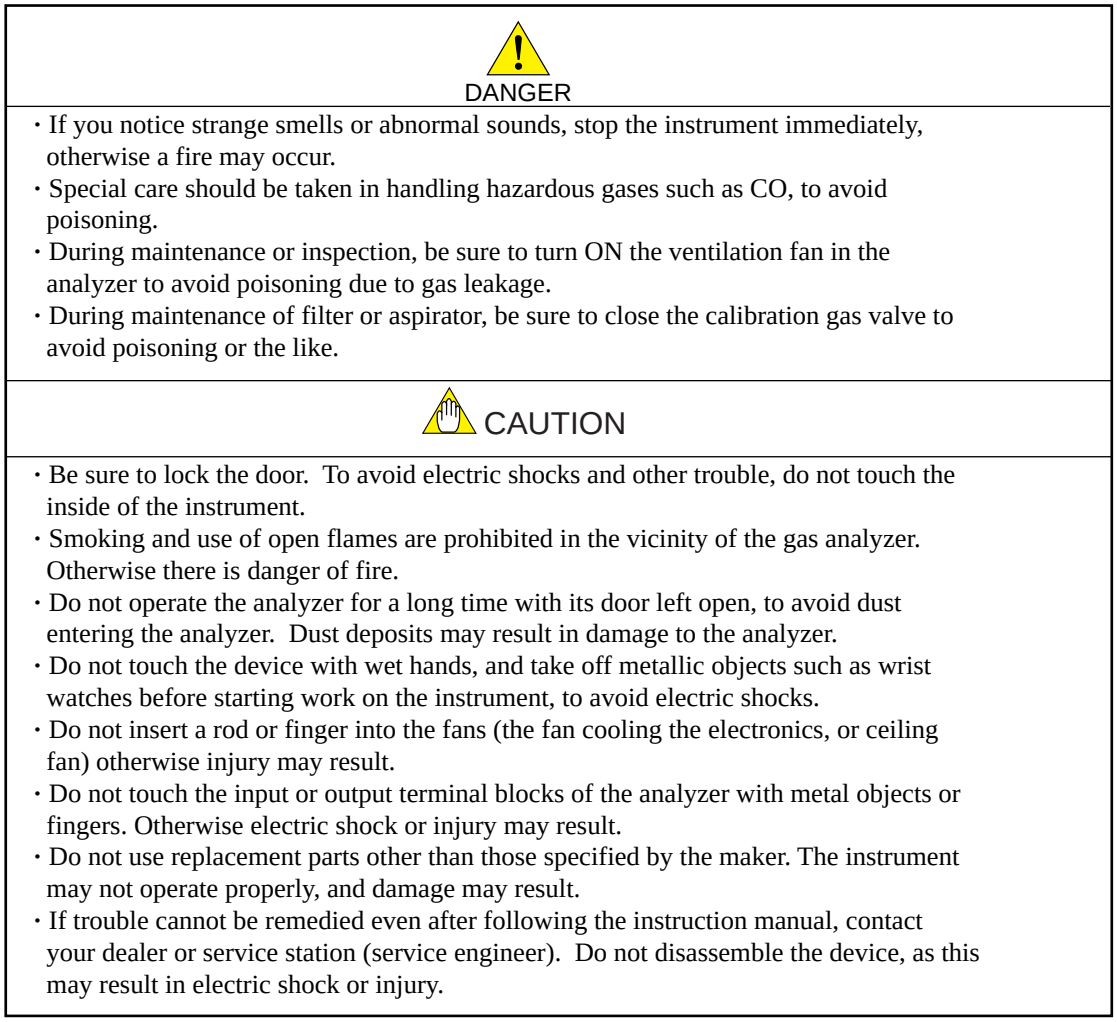
● **Use the unit in a place with good environment.**
The unit should be used in a place free from corrosive or combustible gases.

● **Be careful with electric shocks.**
The unit should be earthed to avoid electric shocks.

● **Key operation**
Do not use any object with a sharp tip when operating the function keys on the instru-ment panel.

● Caution and Warning Labels Attached to the Analyzing System

The following labels are attached to the inside front of the rear panel of the SG700 Stack Gas Analyzing System. For the /T1 or T2 option (for use in cold areas or locations), those like labels are attached to the front panel of the infrared gas analyzer.



Danger and Caution.eps

Note: Explanation on the label may be different from above.

◆ After - Sales Warranty

● Do not modify the product.

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

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

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

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

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

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

● Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.

● Yokogawa will not bear responsibility when the user configures the product into systems or resells the product.

● Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair this product, please contact the nearest sales office described in this instruction manual.

Table of Contents

1. OVERVIEW

The SG700 Stack Gas Analyzing System consists of the stack gas analyzer's main unit and an external sampling unit. These components are available with a variety of specifications, enabling you to choose the desired system configuration to match your process conditions and operating environment.

1.1 System Components and Selections

Table 1.1 System Configurations

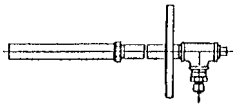
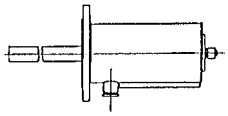
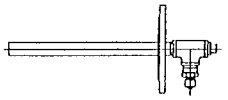
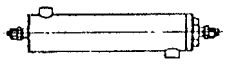
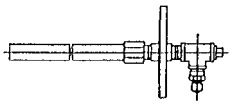
Probe	External Primary filter
Type F filtering probe (K9718VC) 	Unnecessary
Type M1E filtering probe (K9219ED) 	Unnecessary
Type M2 probe (K9718PD) 	Type M1E external primary filter (K9718TA: Electric heating type)  OR Type MS external primary filter (K9718UA: Steam heating type) 
Type M3 probe (K9718QA) 	
Type M2E filtering probe (K9718VE) 	Unnecessary

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Table 1.2 Selection of Filtering Probe

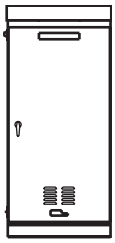
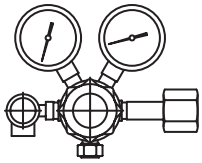
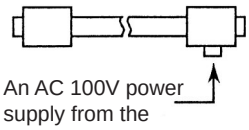
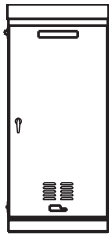
Gas condition / Filtering probe	Dust g/Nm^3		Temperature			SO_2 concentration ppm *1	
	0.1 or less	0.5 or less	below 150°C	150 to 400°C	400 to 700°C	100 ppm or less	100 to 1000 ppm
Type F (K9718VC)	Std.	–	–	Std.	–	–	Std.
Type M1E (K9219ED)	Std.	–	Non-std.	Std.	Std.	–	Std.
Type M2E (K9718VE)	Std.	Std.	Non-std.	Std.	Std.	Std.	Std.

Std. : Applicable, Non-std : Applicable with conditions , – : Not applicable

T1.2E.eps

*1: Normal SO_2 concentration; the median of the measuring range should be taken as reference.

Table 1.3 System Configurations

Ambient Temperature	External Drain Separator (K9641EA)	External Tube	Stack Gas Analyzing System	Standard Gas	Pressure Reducing Valve (L9850BA)
-5 to 40°C	Used when the tilt of the sampling tube between the probe and the analyzer is 15° or less. Use two drain separators when the SO_2 concentration is 500 ppm or greater. 	Sampling tube (10 mm O.D./8 mm I.D.) SG8SAP-L □□ Specify the length in meters (50 m max.) 	Standard type 	* A standard gas cylinder contains 3.4L	Necessary for every standard gas. 
-15 to 40°C	Unnecessary (Can't use this unless anti-freeze measures can be taken.)	Heating sampling tube (10 mm O.D./8 mm I.D.) SG8HSAP-L□□ Specify the length in meters (50 m max.)  An AC 100V power supply from the SG700.	Specify the cold-district version /T1 : -15 to 40°C /T2 : -10 to 40°C 	3.4L 	
Other than the range noted above			Out of scope of the standard specifications		

T1.3E.EPS

Table 1.4 Selection of Open type Probe and External Primary Filter

Gas condition / Probe and Filter	Dust g/Nm³		Temperature		SO_2 concentration ppm *1	
	0.1 or less	0.5 or less	150 to 800°C	800 to 1400°C	100 ppm or less	100 to 1000 ppm
Type M2 open type probe (K9718PD)	Std.	–	Std.	–	–	Std.
Type M3 open type probe (K9718QA)	Std.	–	–	Std.	–	Std.
Type M1E filter (K9718TA) Electric heater (*2)	Std.	–	–	–	–	Std.
Type MS filter (K9718UA) Steam heater (*2)	Std.	–	–	–	–	Std.

Std. : Applicable, - : Not applicable

T1.4E.eps

*1: Normal SO_2 concentration; the median of the measuring range should be taken as reference.

*2: The probe should be used in combination with the external primary filter. Either an electric or steam heater should be used according to the customer's utility.

1.2 Main System Configurations

The stack gas analyzing system consists of the analyzing system and the sampling system for drawing sample gas properly from a stack. A sampling tube is to feed a sample gas from the stack to the analyzing system while eliminating dust from the sample gas and cooling it down. Temperature differences could result in condensation forming from water the flue gas contains and in it adhering to sampling parts together with mist and dust. Such adhesion may preclude a stable measurement. It is essential to prevent such condensation and adhesion and to remove formed drain quickly by applying the appropriate sampling system to the application. Therefore system configurations and installation methods are different depending on each application.

Typical systems as examples, refer to "3.1 Standard System"

1.2.1 Sampling Systems and Functions of Each System Component

SO_2 1st range: less than 500 ppm, Standard type

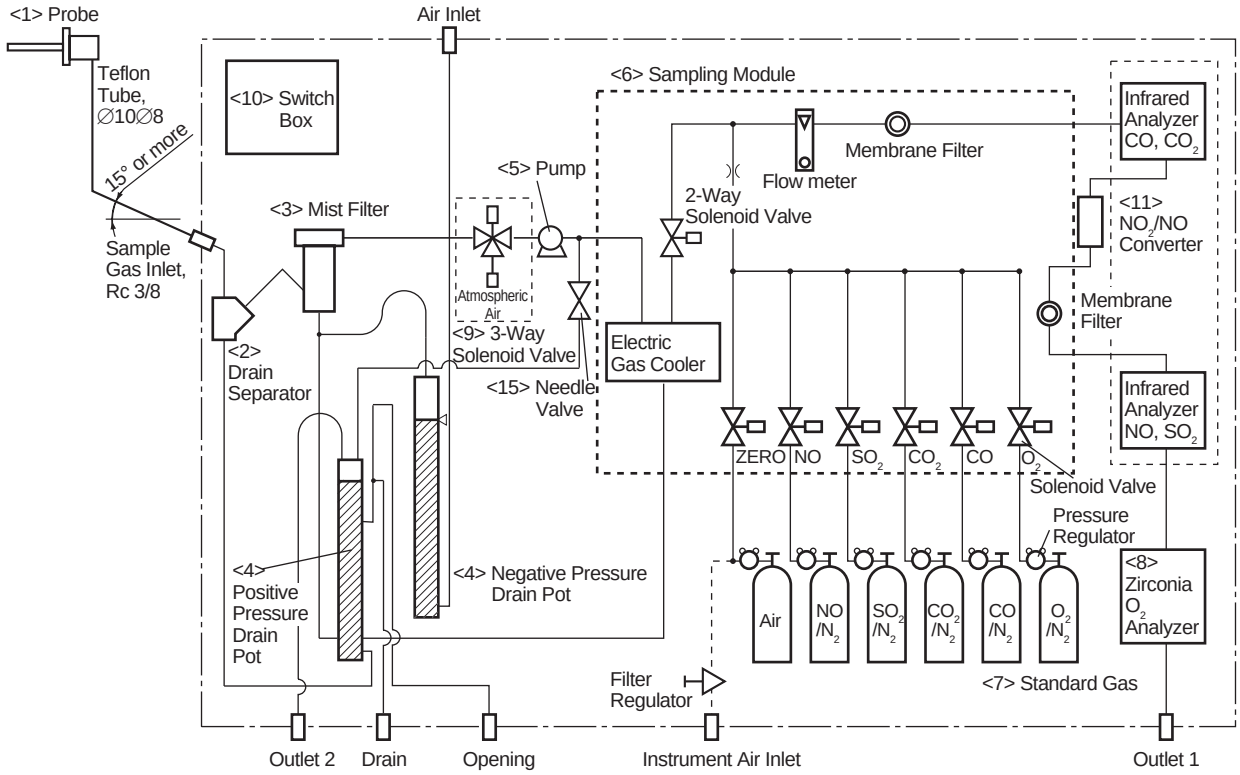


Figure 1.1 Example 1: Five-Component Gas Sampling System Configuration

<1> Probe

A gas sampling probe. Removes dust in sample gas. For details, see Section 2.2.1.

<2> Drain separator

Separates drain in sample gas.

<3> Mist filter

Removes drain, dust and mist in sample gas.

<4> Drain pot

Consists of positive and negative pressure drain pots. Adjusts sample gas pressure.

<5> Pump

A sample gas aspirator. Flow rate of approximately 2 L/min.

<6> Sampling module

Contains an electric gas cooler, solenoid valves, a membrane filter, and a flowmeter.

- Electric gas cooler: Dehumidifies sample gas.
- Solenoid valve: Used for introducing calibration gas.
- Membrane filter: Glass fiber filter or PTFE filter. Removes fine dust. Dust buildup conditions can be monitored through front panel of analyzer.
- Flowmeter: Adjusts and monitors the flow rate of sample gas.

<7> Standard gas

Used for zero and span calibrations of the infrared gas analyzer. When a zirconia oxygen analyzer is used, instrument air (dew point of -10°C or less) /atmospheric air can be used for zero calibration of NO_x, SO_2, CO_2, CO and O_2 analyzers.

<8> Zirconia oxygen analyzer

Measures oxygen concentration (0 to 25%) of sample gas. Used in combination with an infrared gas analyzer.

<9> 3-way solenoid valve

Incorporated when using atmospheric air instead of air standard gas.

<10> Switch box

Contains 7 on/off switches for the following equipment.

- Pump
- Built-in fan
- Fluorescent lamp and service outlet (2A max.)
- Sampling module, built-in recorder, converter (for NO_x measurement) and isolated signal converter.
- Zirconia oxygen analyzer
- Built-in space heater

  Besides the above, contains 3 circuit breakers for main power supply, probe and heating tube.

<11> NO_2/NO converter

Uses a special catalytic material for efficient conversion of NO_2 to NO gas. Also used for reducing errors due to NO_2 interference with SO_2 measurement. Recommended catalyst replacement intervals are 8 months (when NO_2 is 10 ppm).

<12> Pressure Control Valve

Keeps the pressure of sample gas constant.

<13> Gas dryer

A semi-permeable membrane type vapor phase dehumidifier. Dries sample gas to a dew point of approximately -15°C.

<14> Mist catcher

Removes sulfuric acid mist in sample gas. When SO_3 concentration is 30 ppm, replacement intervals are approximately 4 months. Should be used when SO_2 is 500 ppm or higher or for oil/coal boilers.

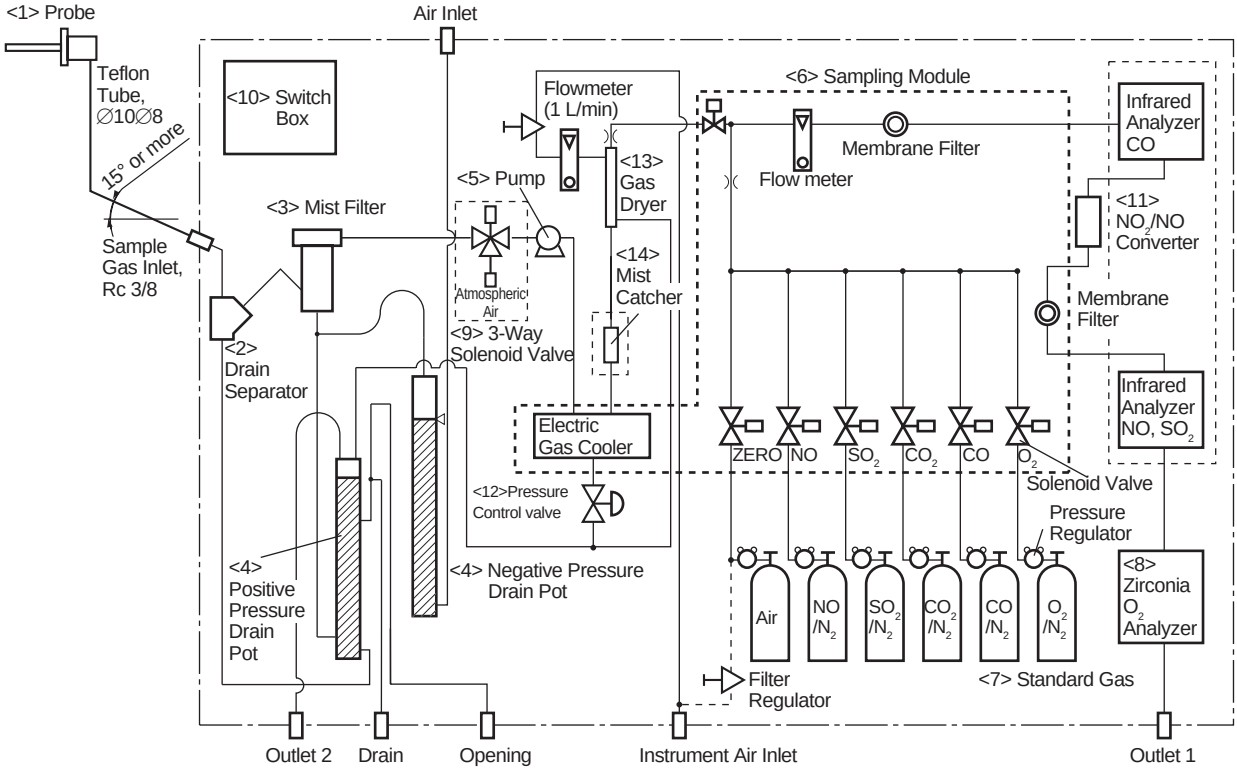
<15> Needle Valve

Adjust the flow of sample gas.

Sampling system with high SO_2 concentration (the SO_2 concentration is in the range of 500 to 1000 ppm and option code "/SO1" is specified)

The system consists of two-stage external drain separator (K9641EA), SO_3 mist catcher, gas dryer (requiring instrument air) and two-stage filter. (Two-stage external drain separator should be purchased separately.)

SO_2 1st range : 500 ppm or higher, or for oil/coal boilers.



* Two external drain separators are additionally required.

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Figure 1.2 Example 2:Five-Component Gas Sampling System Configuration

2. SPECIFICATION

The SG700 Series of Stack Gas Analyzing Systems consist of: (1) Infrared gas analyzers with reliability enhanced by automatic calibration standard function and many built-in self-diagnosis functions; (2) A zirconia oxygen analyzer with excellent stability, and; (3) A sampling unit with proven maintainability. The analyzer can simultaneously measure up to five components —nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2) plus oxygen (O_2). There are several versions of the analyzer, with different suffix codes.The following describes its features and main specifications.

2.1 General specifications

2.1.1 Standard Specifications

Measurement:

Up to 4 components (NOx, SO_2, CO_2, CO) and O_2

Measuring method:

NOx, SO_2, CO_2, CO : Non-dispersive infrared method
O_2 : Zirconia or paramagnetic method

Measuring range:

NOx: 0-50 ppm to 0-5000 ppm
SO_2: 0-50 ppm to 0-1000 ppm
CO_2: 0-1 vol% to 0-20 vol%
CO: 0-50 ppm to 0-5000 ppm
O_2: 0-10/0-25 vol%
Each is 2 range type.
Maximum range ratio is 1:25, except O_2 measurement.

Display:

LCD with backlight

Indication:

Instantaneous value (NOx, SO_2, CO_2, CO, O_2), O_2 correction instantaneous value (NOx, SO_2, CO with O_2 measurement), O_2 correction average value (NOx, SO_2, CO with O_2 measurement), Average O_2 value (When provided with O_2 measurement), Peak count value (CO), Parameter settings

Output signal:

4-20 mA DC or 0-1 V DC

5 outputs for instantaneous values (NOx, SO_2, CO_2, CO, O_2), 3 outputs for O_2 correction instantaneous values (NOx, SO_2, CO), 3 outputs for O_2 correction average values (NOx, SO_2, CO), 1 output for average O_2 value
Permissible load resistance: 550 Ω max. (750 Ω max. for isolated output)

O_2 correction:

NOx, SO_2, and CO are corrected for O_2 reference value. Results are provided in display and 4-20 mA DC or 0-1 VDC signal output.

Example:

$$O_2 \text{ correction concentration} = \frac{21 - O_R}{21 - O_S} \times C_S$$

Where:
O_R : O_2 reference value
O_S : O_2 concentration
C_S : NOx, SO_2 and CO measured concentration

Equation 1.eps

Setting range: 0 to 19%
Reference: O_2 correction reference value
(1) Oil fired boiler 4%
(2) Gas fired boiler 5%
(3) Solid fuel fired boiler/oil heating furnace 6%
(4) Coke oven 7%
(5) Incinerator 12%.

O_2 correction average and average O_2 values:

- NOx, SO_2, and CO are corrected to O_2 and averaged and results are provided in display and 4-20 mA DC or 0-1 V DC output.
- Averaging time is user configurable.
- Setting range: 1 to 59 minutes, 1 to 4 hours (factory default: 1 hour)

Contact output:

(1) Each 1a contact (contact capacity 250V AC/2A, or 30V DC/3A)

- Each component range identification, analyzer failure, calibration failure, calibration status, maintenance status.
- CO peak count alarm

(2) Each 1c contact (contact capacity 250 V AC/1A or 30 V DC/1A)

- Each instantaneous value alarm (H/L/HL, configurable)
- Analyzer power shutdown

Contact input:

- Voltage-free contact (1.5 seconds or longer)
- Auto calibration start, average reset
- Voltage-free contact (status hold)
- Range switching (1st range when contact closes), output hold, remote pump off (off when contact closes.)

Automatic calibration:

- Interval range: 1 to 99 hours (1 hour increments) or 1 to 40 days (1 day increments)
- Time of calibration gas flow: 60 to 599 seconds (1 second increments)
- Manual/automatic calibration failure contact output: Released when calibration volume exceeds 50%FS.
- Automatic calibration status and maintenance status contact output: Released while calibration gas is flowing and being replaced.
- Automatic calibration remote start contact input: Calibration starts when the input is opened after it has been shorted for at least 1.5 seconds.
- Calibration gas consumption: Approximately 1year when 3.4 L cylinder is used at intervals of 7 days.

Remote output hold:

- Whole output signals for concentration values are held by external contact input.
- Outputs are held during the input shorted.

Average reset input:

- Output and display of O_2 correction average value is reset by external contact input.
- Reset when the input is shorted for at least 1.5 seconds.

Automatic range switching:

- Automatically switchable from low to high ranges or vice versa.
  Low to high: Switched at 90% of low range.
  High to low: Switched at 80% of low range.

Remote range switching:

- Switchable between low and high ranges for each measurement component by external contact input.
- High range with the input opened; low range with the input shorted.

Range identification contact output:

- Identification of high/low range by contact output.
- Low range when the contact is closed.

CO peak count alarm:

- Alarm is sounded and displayed when CO instantaneous value exceeds the setpoint for more than the specified times.
  Count setting range: 1 to 99 times
  Alarm setting range: 10 to 1000 ppm (5 ppm increments)
- The number of times it exceeded per hour is displayed.

Analyzer failure contact output:

Contact output is released when the analyzer is abnormal.

Temperature input signal:

2 inputs, K thermocouple (for input of optional recorder)

Power supply:

100/110/115/220/240 V AC ±10%, 50/60 Hz ±0.5 Hz

Power consumption:

Approx. 600 to 1000 VA (depending on specifications), excluding probe and heating sampling tube.

Main wetted materials:

SUS304, neoprene, CaF_2, Teflon, polyethylene, Viton, PVC

Construction:

Outdoor/indoor stand-alone system, non-explosionproof, rainproof, single swing front door, standard plate thickness of 2.3 mm (both housing and door)

Color:

Munsell 5Y7/1 semigloss

Filter:

Mesh: Outside/inside 40 μm or more

Finish:

Melamine resin, baked.

Installation conditions:

Avoid direct sunlight and vibration
Ambient temperature: -5 to 40° C
-15 to 40° C (cold district version: specify "/T1")
-10 to 40° C (cold district version: specify "/T2")
Ambient humidity: 90%RH or less

Weight:

Approx. 350 kg (without standard gases)

Sample conditions

Temperature: 1400° C or less
Dust: 500 mg/Nm^3 or less
Pressure: -5 to 5 kPa

Note

For pressures outside the above range, consult with Yokogawa.

Flow rate: Approximately 2 L/min

Sample gas components and their range:

- SO_2 (*) : 1000 ppm or less
- NOx : 5000 ppm or less
- NO_2 : 10 ppm or less
- CO_2 : 20 vol% or less
- CO : 5000 ppm or less
- O_2 : 0 to 21 vol%
- NH_3 : should be excluded
- H_2O : 0 to 20 vol%
- HF, H_2S : 1 ppm or less
- N_2 : Carrier gas

(*) When the SO_2 concentration exceeds 500 ppm, the option code "/SO1" must be specified.

CAUTION

[Restrictions] The standard system is not applicable to the following applications and sample conditions due to measurement restrictions. Consult with Yokogawa.

1. Sample gas containing SO_3 mist of concentration greater than 30 ppm
2. Exhaust gas of diesel engines
3. Outlet gas of glass melting furnaces
4. Sample gas containing dust whose concentration exceeds 500 mg/Nm^3
5. Sample gas containing corrosive components such as HCl, Cl_2, and Na_2SO_4

2.1.2 Characteristics

Repeatability:

±0.5% of full scale

Linearity:

±1.0% of full scale

Stability:

Zero drift :

±1% of full scale/week, ±2% of full scale/week for the range of 200 ppm or less

±2% of full scale/month for zirconia oxygen analyzers

Span drift :

±2% of full scale/week

±2% of full scale/month for zirconia oxygen analyzer

90% response time: (From the inlet of the system)

Approximately 4 minutes for SO_2

Approximately 2 minutes for others

Warm-up time:

Approximately 4 hours (after power-on)

Note

Fluctuation in the operation period of 4 hours from the end of warm-up time is within ±2%FS.

Effects of interfering gases:

When sample gas contains gas components listed below, the measurement accuracy may suffer. Consult Yokogawa for countermeasures or effect on accuracy.

Table 2.1 Effects of interfering gases

Analyzer	Interfering	Effect
SO_2	NO_2	50 ppm of NO_2 is equivalent to -6 ppm of SO_2
CO	CO_2	15% of CO_2 is equivalent to 7 to 10 ppm of CO
CO	N_2O	1000 ppm of N_2O is equivalent to 80 ppm of CO

T2.1E.EPS

2.1.3 Model Code

Stack Gas Analyzing System

MODEL	Suffix Code	Option Code	Description
SG700	----------	--------	Stack Gas Analyzing System
Measurable component	-A	--------	SO_2-(O_2)
	-B	--------	NO_X-(O_2)
	-C	--------	NO_X-SO_2-(O_2)
	-D	--------	CO-(O_2)
	-E	--------	CO_2-(O_2)
	-F	--------	CO_2-CO-(O_2)
	-G	--------	NO_X-CO-(O_2)
	-H	--------	NO_X-SO_2-CO-(O_2)
	-J	--------	NOx-SO_2-CO_2-CO-(O_2)
O_2 Analyzer	-1	--------	Built-in zirconia type O_2 sensor (note 7)
	-2	--------	Built-in paramagnetic type O_2 sensor (note 7)
	-N	--------	Without O_2 analyzer
1st Component 1st Range (note 1)	A	--------	0-50ppm (note 2)
	B	--------	0-100ppm (note 2)
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
1st Component 2nd Range (note 1)	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available
2nd Component 1st Range (note 1)	A	--------	0-50ppm
	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available

T2.2E.eps

MODEL	Suffix Code	Option Code	Description
SG700	-□-□□□□	--------	Stack Gas Analyzing System
2nd Component 2nd Range (note 1)	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available
3rd Component 1st Range (note 1)	A	--------	0-50ppm
	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available
3rd Component 2nd Range (note 1)	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available
4th Component 1st Range (note 1)	A	--------	0-50ppm
	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available

T2.3E.eps

2. Specification

MODEL	Suffix Code	Option Code	Description
SG700	-□-□□□□□□□□	--------	Stack Gas Analyzing System
4th Component 2nd Range (note 1)	B	--------	0-100ppm
	C	--------	0-200ppm
	D	--------	0-250ppm
	E	--------	0-300ppm
	F	--------	0-500ppm
	G	--------	0-1000ppm
	H	--------	0-2000ppm
	J	--------	0-5000ppm
	K	--------	0-1%
	L	--------	0-2%
	M	--------	0-5%
	P	--------	0-10%
	Q	--------	0-20%
	N	--------	Not available
O_2 Analyzer Range	-1	--------	0-10/0-25%
	-N	--------	Not available
Power supply	-5	--------	100V AC, 50Hz
	-6	--------	100V AC, 60Hz
	-A	--------	110V AC, 50Hz
	-B	--------	110V AC, 60Hz
	-7	--------	115V AC, 50Hz
	-8	--------	115V AC, 60Hz
	-3	--------	220V AC, 50Hz
	-4	--------	220V AC, 60Hz
	-1	--------	240V AC, 50Hz
	-2	--------	240V AC, 60Hz
Output	4	--------	4-20mA
	1	--------	0-1V DC
Isolated output of analog instantaneous value (note 3) (note 4)	1	--------	SO_2 Isolated output
	2	--------	SO_2-O_2 Isolated output
	3	--------	NO_x Isolated output
	4	--------	NO_x-O_2 Isolated output
	5	--------	NO_x-SO_2 Isolated output
	6	--------	NO_x-SO_2-O_2 Isolated output
	7	--------	CO Isolated output
	8	--------	CO-O_2 Isolated output
	9	--------	NO_x-O_2 Isolated output
	A	--------	NO_x-CO-O_2 Isolated output
	B	--------	NO_x-SO_2-CO Isolated output
	C	--------	NO_x-SO_2-CO-O_2 Isolated output
	D	--------	NO_x-SO_2-CO_2-CO Isolated output
	E	--------	NO_x-SO_2-CO_2-CO-O_2 Isolated output
	F	--------	CO_2 Isolated output
	G	--------	CO_2-O_2 Isolated output
	H	--------	CO_2-CO Isolated output
	J	--------	CO_2-CO-O_2 Isolated output
	N	--------	Without isolated output
O_2 correction value insulation output (note 3) (note 4)	1	--------	SO_2 Isolated output
	3	--------	NO_x Isolated output
	5	--------	NO_x-SO_2 Isolated output
	7	--------	CO Isolated output
	9	--------	NO_x-CO Isolated output
	B	--------	NO_x-SO_2-CO Isolated output
	N	--------	Without isolated output
Isolated output of average value after O_2 correction (note 3) (note 4)	1	--------	SO_2 Isolated output
	3	--------	NO_x Isolated output
	5	--------	NO_x-SO_2 Isolated output
	7	--------	CO Isolated output
	9	--------	NO_x-CO Isolated output
	B	--------	NO_x-SO_2-CO Isolated output
	N	--------	Without isolated output
Isolated output of average value on O_2 meter (note 3), (note 4)	A	--------	Isolated output
	N	--------	Without isolated output
Cubicle structure	1	--------	Indoor structure
	2	--------	Outdoor structure
External standard gas cylinder	1	--------	3 cylinders
	2	--------	6 cylinders
	N	--------	Not available
Indication	E	--------	English

T2.4E.eps

Stack Gas Analyzer (Continued)

Model	Suffix Code	Option Code	Description
SG700	-□-□□□□□□□□□□-□-□□□□□□□□□□		Stack gas analyzer
Option:	Built-in recorder (note 5)	/M□	Build-in recorder
	Insulation of sampling tube (note 2)	/S	50 m max. Required for heating sampling tube
	Cold district version	/T1 /T2	-15 to 40°C (2 heaters + insulation) -10 to 40°C (2 heaters)
	Window	/WD	With window
	Instrument air Atmospheric air	/Q /R	Instrument air as zero gas Atmospheric air as zero gas
	Air purge	/A	With air purge
	Arrester, for power supply Arrester, for signal (note 6)	/AP1 /AP2 /AS□□	With arrester for power supply (100 V) With arrester for power supply (200 V) With arrester for signal
	Tag plate, acryl SUS	/U1 /U2	Specified tag No. (attached) Specified tag No. (attached)
	Nameplate, acryl SUS	/V1 /V2	Specified description (screw on) Specified description (screw on)
	Channel base	/W	Enclosed type
	High SO_2 concentration version	/SO1	Gas dryer with instrument air + SO_3 mist catcher (2 spares supplied). Required when SO_2 is 500 ppm or more
	NO_x converter	/NO1	Required when measuring only SO_2 in sludge incinerator to reduce NOx interference.

Footnotes:

1: For measuring ranges, refer to tables on pages 2-11 and 2-12. The 1st, 2nd, 3rd and 4th components in the code correspond to those described in that order in the description of the measurable component. For example, in the SG700-C: NOx - SO_2 - (O_2) analyzer, the 1st component is NOx and the 2nd is SO_2.

2: Option code "/S" must be specified for SO_2 measurement of 100 ppm or less.

3: Combination of isolated outputs and non-isolated outputs is not allowed. When suffix code "N" is selected all for O_2 correction instantaneous value, O_2 correction average value and average O_2 value outputs, all outputs will be non-isolated. If both isolated and non-isolated outputs are selected inconsistently, outputs will be isolated only and outputs for which suffix code "N" is selected will be disabled.

4: For recorder output, suffix code "N" should be specified.
Use Yokogawa's μR10000 (up to 6 points recording) recorder. Output signals should be selected from the table below and specify the appropriate number in □. For details, refer to GS 04P01B01-01E. When using a recorder other than the μR10000, the mounting size and other specifications should be checked.
The output signals for a recorder cannot be used as external outputs. The specification of recorder and external outputs of the same component should be handled as a customized order. In this case, up to 4 components can be specified.
No combination of isolated outputs and non-isolated outputs are allowed.

5: Select output components to the recorder and specify option code "/M□" accordingly.

T2.5E.EPS

		/M1	/M2	/M3	/M4	/M5	/M6
NO_x	instantaneous value			○			○
	average value	○	○	○			○
	O_2 corrected value			○			○
SO_2	instantaneous value			○		○	
	average value	○		○		○	
	O_2 corrected value					○	
CO	instantaneous value		○		○		
	average value	○	○		○		
	O_2 corrected value				○		
O_2 instantaneous value		○	○	○	○	○	○
Combustion temperature		○	○		○		
EP inside temperature		○	○		○		

6: The total number of arresters for signal should be specified in two digits.

7: O_2 sensor is included if suffix code "-1" or "-2" for O_2 Analyzer is specified.

Notes:

- Gas sampling probe with automatic blowback is handled a customized order
- When SO_2 measuring range exceeds 1000 ppm, consult Yokogawa.

T2.6E.EPS

Table 2.2 Standard Accessories (supplied with the instrument at delivery time)

	No.	Name	Part number (*5)	Quantity				Remark
				SG700-A	SG700-C SG700-H SG700-J	SG700-B SG700-G	SG700-D SG700-E SG700-F	
Maintenance parts	1	Filter paper for membrane filter	K9350MD	—	—	1pack	1pack	25 papers per pack, 0.5 μm
	2	Filter paper for membrane filter	K9219BA	5, 10(*1)	5, 10(*1)	—	—	(*1) PTFE 0.1 μm
	3	Filter for gas conditioner	K9350MH	1	1	1	1	
	4	O-ring for gas conditioner	K9350MF	1	1	1	1	G65 chloroprene
	5	Fuse (for device SW)	K9350VN	2	2	2	2	2 A
	6	Fuse (for device SW)	K9350VP	2	2	2	2	3.2 A
	7	Fuse (spare for infrared analyzer)	K9218SB	2	2	2	2	3 A for analyzer
	8	Catalyst for NO_2/NO converter	K9350LP	1(*2)	1	1	—	For NO_x analyzer or (*2)
	9	Glass wool for NO_2/NO converter	K9350LQ	1(*2)	1	1	—	For NO_x analyzer or (*2)
	10	SO_3 mist catcher	K9350XV	2(*1)	2(*1)	—	—	(*1) change every four months
	11	Diaphragm for pump	K9350GE	1(*1)	1(*1)	—	—	With spanner
Accessories	12	Standard gas joint	K9219LA	(*3)	(*3)	(*3)	(*3)	(*3) For pressure regulator Rc 1/4- ϕ6
	13	Hose band for fixing standard gas cylinder	K9219LB	(*4)	(*4)	(*4)	(*4)	(*4) For pressure regulator
	14	Toaron tube for standard gas connection	K9641KA	1	1	1	1	1 m ϕ9/ ϕ5
	15	Polyethylene tube for standard gas connection	K9641KB	1	1	1	1	6 m ϕ6/ ϕ4
	16	Anchor bolt for cubicle installation	K9350ZA	4	4	4	4	
	17	Water bottle for injection	K9219BG	1	1	1	1	For refilling water of gas conditioner
	18	Water bubbler bottle	K9350XR	1	1	1	1	For correction of moisture interference
	19	Cell assembling tool	K9358UA	—	1(*6)	—	1(*6)	For block cell

T2.7E.EPS

(*1) When option code "/SO1" is selected. (*2) When option code "/NO1" is selected.
(*3) [The number of measuring components + 1] fittings are included. For external gas cylinders, the quantity is doubled.
(*4) 4×[The number of measuring components + 1] hose bands are included.
(*5) A part number contains one piece of part. (*6) Supplied when CO_2 measurement is performed.

Table 2.3 One-Year-Usage Spare Parts

No.	Name	Part number (*3)	Quantity				Remark
			SG700-A	SG700-C SG700-H SG700-J	SG700-B SG700-G	SG700-D SG700-E SG700-F	
1	Catalyst for NO_2/NO converter	K9350LP	2(*2)	2	2	—	For NO_x analyzer or (*2)
2	Glass wool for NO_2/NO converter	K9350LQ	2(*2)	2	2	—	For NO_x analyzer or (*2)
3	Fitting for NO_2/NO converter	K9350LV	4(*2)	4	4	—	For NO_x analyzer or (*2)
4	Filter for gas conditioner	K9350MH	2	2	2	2	
5	O-ring for gas conditioner	K9350MF	2	2	2	2	G65 chloroprene
6	Filter paper for membrane filter	K9350MD	—	—	1	1	25 papers per pack, 0.5 μm
7	Filter paper for membrane filter	K9219BA	12	12	—	—	PTFE 0.1 μm
8	O-ring for membrane filter	K9350MG	2	2	2	2	P49 chloroprene
9	O-ring for membrane filter	K9219BK	2	2	2	2	P3 chloroprene
10	Fuse (for device SW)	K9350VN	3	3	3	3	2 A
11	Fuse (for device SW)	K9350VP	4	4	4	4	3.2 A
12	Fixed diaphragm	K9641KC	1(*1)	1(*1)	—	—	50 kPa/0.6 L (*1)
13	Diaphragm for pump	K9350GE	1	1	1	1	
14	Valve for pump	K9350GF	1	1	1	1	
15	SO_3 mist catcher	K9350XW	1(*1)	1(*1)	—	—	Change every four months (*1)
16	Spare parts set for 1 year (*4)	K9641JA	1	—	—	—	For SG700-A (with /SO1 and /NO1)
17	Spare parts set for 1 year (*2), (*5)	K9641JB	1(*2)	1	—	—	For SG700-A (with /SO1 and /NO1) For SG700-C, -H, -J (with /SO1)
18	Spare parts set for 1 year (*6)	K9641JC	—	—	1	—	For SG700-B, -G
19	Spare parts set for 1 year (*7)	K9641JD	—	—	—	1	For SG700-D, -E, -F
20	Spare parts set for 1 year (*1), (*8)	K9641JE	1(*1)	—	—	—	For SG700-A (with /SO1 and /NO1)
21	Spare parts set for 1 year (*1), (*2), (*9)	K9641JF	1(*1)(*2)	1(*1)	—	—	For SG700-A (with /SO1 and /NO1) For SG700-C, -H, -J (with /SO1)

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(*1) When option code "/SO1" is selected. (*2) When option code "/NO1" is selected.
(*3) A part number contains one piece of part or one set of parts.
(*4) K9641JA consists of No.4, 5, No.7–11 and No.13, 14. (*5) K9641JB consists of No.1–5, No.7–11 and No.13, 14.
(*6) K9641JC consists of No.1–6, No.8–11 and No.13, 14. (*7) K9641JD consists of No.4–6, No.8–11 and No.13, 14.
(*8) K9641JE consists of No.4, 5 and No.7–15. (*9) K9641JF consists of No.1–5 and No.7–15.

Table 2.4 Recommended Spare Parts

NO.	Name	Part number (*1)	Quantity per replacement	Recommended quantity
1	Filter element for Type F filtering probe	K9718RS	1	2
2	Filter element for Type M1E filtering probe	K9718RX	1	2
3	Filter element for Type M2E filtering probe	K9718VF	1	2
4	O-ring for Type M2E filtering probe	Y9144XB	2	8
5	Filter element for Type M1E external primary filter	K9718RX	1	2
6	Filter element for Type MS external primary filter	K9718US	1	2

(*1) Part numbers refer to each one piece. When separately ordering more than one of a part, specify the required quantity of the parts as well as the part number. T2.9E.EPS

Note: Order more spare parts at parts replacement time, to maintain the recommended quantity of spare parts.

2.1.4 Measuring Components and Ranges - Availability Table -

2.1.4.1 Single-Component Analyzer (NO_x, SO_2, CO_2, CO)

Table 2.5

1st Range \ 2nd Range		B	C	D	E	F	G	H	J
		0-100 ppm	0-200 ppm	0-250 ppm	0-300 ppm	0-500 ppm	0-1000 ppm	0-2000 ppm	0-5000 ppm
A	0-50 ppm	★□○	★□○	★□○	★□○	★□○	★□○	–	–
B	0-100 ppm	–	★□○	★□○	★□○	★□○	★□○	★□○ (note 1)	–
C	0-200 ppm	–	–	★□○	★□○	★□○	★□○	★□○ (note 1)	★□○ (note 1)
D	0-250 ppm	–	–	–	★□○	★□○	★□○	★□○ (note 1)	★□○ (note 1)
E	0-300 ppm	–	–	–	–	★□○	★□○	★□○ (note 1)	★□○ (note 1)
F	0-500 ppm	–	–	–	–	–	★□○	★□○ (note 1)	★□○ (note 1)
G	0-1000 ppm	–	–	–	–	–	–	★□○ (note 1)	★□○ (note 1)
H	0-2000 ppm	–	–	–	–	–	–	–	★□○ (note 1)
J	0-5000 ppm	–	–	–	–	–	–	–	–
K	0-1%	–	–	–	–	–	–	–	–
L	0-2%	–	–	–	–	–	–	–	–
M	0-5%	–	–	–	–	–	–	–	–
P	0-10%	–	–	–	–	–	–	–	–
Q	0-20%	–	–	–	–	–	–	–	–

1st Range \ 2nd Range		K	L	M	P	Q
		0-1%	0-2%	0-5%	0-10%	0-20%
A	0-50 ppm	–	–	–	–	–
B	0-100 ppm	–	–	–	–	–
C	0-200 ppm	–	–	–	–	–
D	0-250 ppm	–	–	–	–	–
E	0-300 ppm	–	–	–	–	–
F	0-500 ppm	○ (note 2)	–	–	–	–
G	0-1000 ppm	○ (note 2)	○ (note 2)	–	–	–
H	0-2000 ppm	○ (note 2)	○ (note 2)	–	–	–
J	0-5000 ppm	○ (note 2)	○ (note 2)	○ (note 2)	–	–
K	0-1%	–	◎○ (note 2)	◎○ (note 2)	◎	◎
L	0-2%	–	–	◎○ (note 2)	◎	◎
M	0-5%	–	–	–	◎	◎
P	0-10%	–	–	–	–	◎
Q	0-20%	–	–	–	–	◎ (note 3)

★: NOx analyzer measurable range; □: SO_2 analyzer measurable range; ◎: CO_2 analyzer measurable range;
○: CO analyzer measurable range
–: Not available
Note 1: Measuring range over 0-1000 ppm of SO_2 analyzer is a customized order. Consult YOKOGAWA.
Note 2: Measuring range over 0-5000 ppm of CO analyzer is a customized order. Consult YOKOGAWA.
T2.10E.EPS

2.1.4.2 Two-Component Analyzer (NOx-SO_2)

Table 2.6

		SO_2 Range ppm								
		50	100	200	250	300	500	1000*	2000*	5000*
NO_x Range ppm	50	○	○	○	○	○	○	○	○	–
	100	○	○	○	○	○	○	○	○	–
	200	○	○	○	○	○	○	○	○	○
	250	○	○	○	○	○	○	○	○	○
	300	○	○	○	○	○	○	○	○	○
	500	○	○	○	○	○	○	○	○	○
	1000	○	○	○	○	○	○	○	○	○
	2000	○	○	○	○	○	○	○	○	○
	5000	–	–	○	○	○	○	○	○	○

T2.11E.EPS

* Measuring range outside 0-1000 ppm of SO_2 analyzer is a customized order. Consult YOKOGAWA.

2.1.4.3 Two-Component Analyzer (NOx-CO)

Both NOx and CO analyzers should meet the ranges in Table 2.5.

2.1.4.4 Two-Component Analyzer (CO_2-CO)

Table 2.7

		CO_2 Range						
		2000 ppm	5000 ppm	1%	2%	5%	10%	20%
CO Range	100 ppm	–	–	–	–	–	○	○
	200 ppm	–	–	–	–	–	○	○
	250 ppm	–	–	–	–	–	○	○
	500 ppm	–	–	○	–	–	○	○
	1000 ppm	–	–	○	○	–	○	○
	2000 ppm	–	–	○	○	○	○	○
	5000 ppm	–	–	○	○	○	○	○
	1%	–	–	○	○	○	○	○

T2.12E.EPS

2.1.4.5 Three-Component Analyzer (NOx-SO_2-CO)

NOx-SO_2 analyzer should meet the availability in Table 2.6 and CO analyzer the one in Table 2.5.

2.1.4.6 Four-Component Analyzer (NOx-SO_2-CO_2-CO)

NOx-SO_2 analyzer should meet the availability in Table 2.6 and CO_2-CO analyzer the one in Table 2.7.

2.1.4.7 O_2 Analyzer

1st range: 0-10%
2nd range: 0-25%

How to Select Ranges of Multiple-Component Analyzers

For combinations of measuring components and ranges not described above, consult Yokogawa.

Measuring ranges in Tables 2.6 and 2.7 are minimum ranges, respectively, with exception of those of CO_2 in Table 2.7, which is maximum ranges.

Examples:

(1) Model SG700-H, NOx-SO_2-CO-(O_2) analyzer

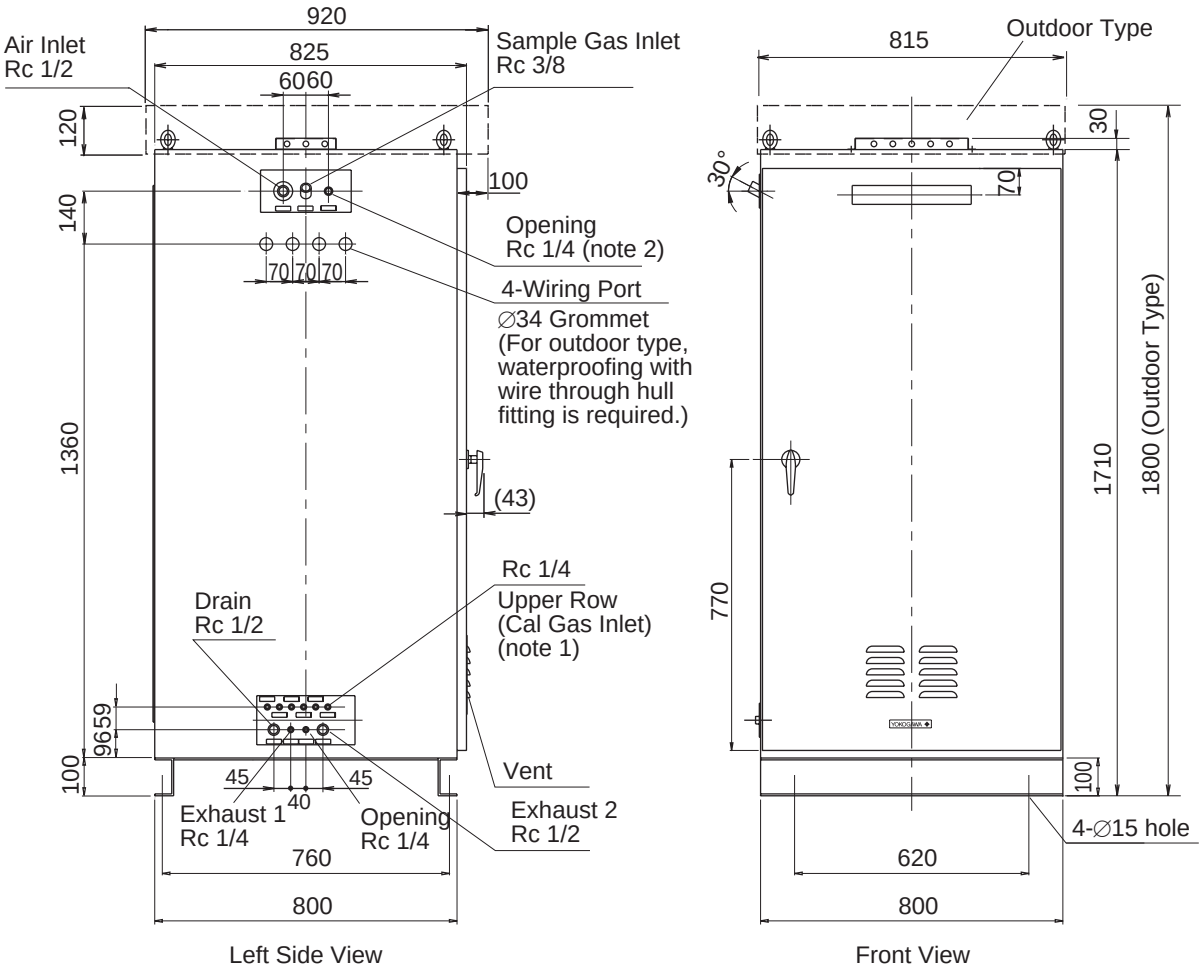
Check the range combination availability of NO_x-SO_2 analyzer with Table 2.6. Then, select the combinations of the first and second ranges from Table 2.5.

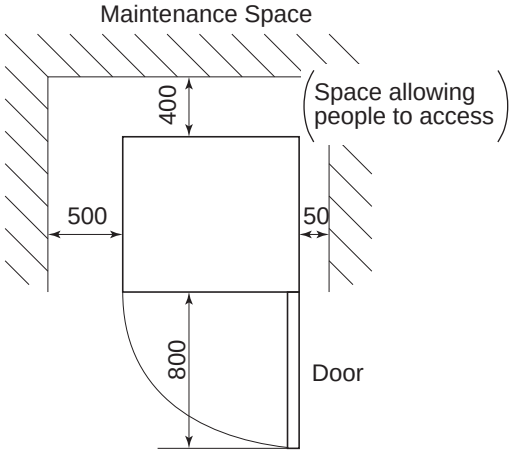
(2) Model SG700-J, NOx-SO_2-CO_2-CO-(O_2) analyzer

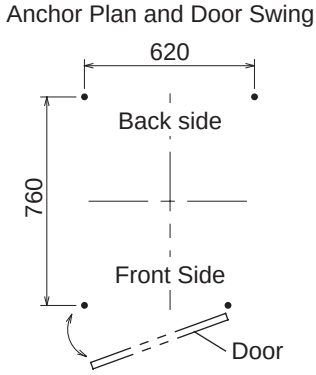
Check the range combination availability of NOx-SO_2 analyzer with Table 2.6, and that of CO_2-CO analyzer with Table 2.7. Then, select combinations of the first and second ranges from Table 2.5.

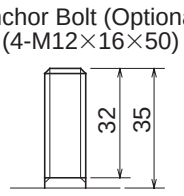
2.1.5 External Dimensions

SG700 Stack Gas Analyzing System









Weight: approx. 350kg

Note 1: Provided when external standard gas cylinders are specified.
Note 2: Provided only when instrument air is used.
(*1) Installation and maintenance spaces and anchor bolt positions are the same for both outdoor and indoor types.
(*2) Both outdoor and indoor type analyzing systems weigh approximately 350 kg.
(*3) On the left side of the system, there are sample gas inlet, drain and exhaust. A space for piping is required.

F2.1E.eps

2.2 Main Sampling Parts

2.2.1 Filtering probes

Since flue gases contain dust of approximately 0.1 g/Nm^3 in general, sampling tubes get clogged unless dust is removed from sampling probes. Filters require maintenance. Filtering probes generally are mounted at heights where a high scaffolding is exposed to the weather and maintenance is very difficult compared to equipment installed on the ground. For this reason, making a filtering probe with maintenance-free construction is the most critical point for stack gas analyzing systems.

The structure of the Type F filtering probe is shown in the figure below. A 20-mm SUS304 wire net is used for a filter element (see specifications below). The Type M2E filtering probe can cover up to 0.5 g/Nm^3 of dust and uses a 5-mm SUS316 filter element.

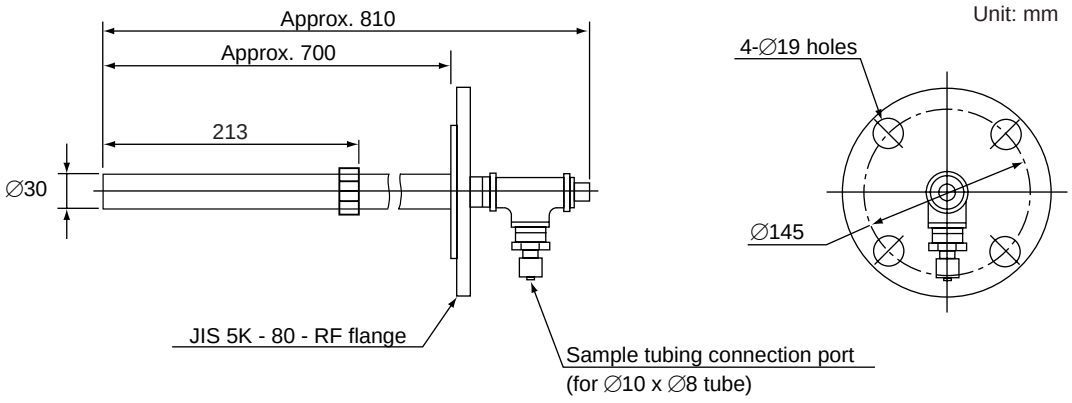
Table 2.8 Kind of Filtering Probe

Name	Type F Filtering Probe	Type M1E Filtering Probe	Type M2E Filtering Probe
Part number	K9718VC	K9219ED	K9718VE
Operating temperature	150 to 400°C	150 to 700°C (*2)	150 to 700°C (*2)
Probe material	SUS304	SUS304	SUS304
Filter	SUS304 (20 μm)	SUS304 (20 μm)	SUS316 (5 μm)
Position of filter	Inside stack	Outside stack	Outside stack
Method for heating filter	None	Electricity at approx. 80 VA (*1)	Electricity at approx. 130 VA (*1)
Flange material	JIS 5K-80-RF (SUS304 Equ.)	JIS 5K-80-FF (SUS304 Equ.)	JIS 10K-50-FF (SUS304 Equ.)
Insertion length	700mm	700mm	1000mm
Weight	Approx. 5 kg	Approx. 11 kg	Approx. 15 kg
Filter element	K9718RS	K9718RX	K9718VF

(*1) When wiring the power supply to the heater of the Type M1E and M2E filtering probes, use a heatproof cable equivalent to JIS C3323-KGB.
(*2) When the temperature at a sampling point is below the acid dew point (150 °C), use Type M1E or M2E filtering probes. As condensation tends to form on the mounting point of the probe, the point requires to be heated or insulated (header/insulator supplied by customers) to more then the acid dew point (150°C).

T2.13E.EPS

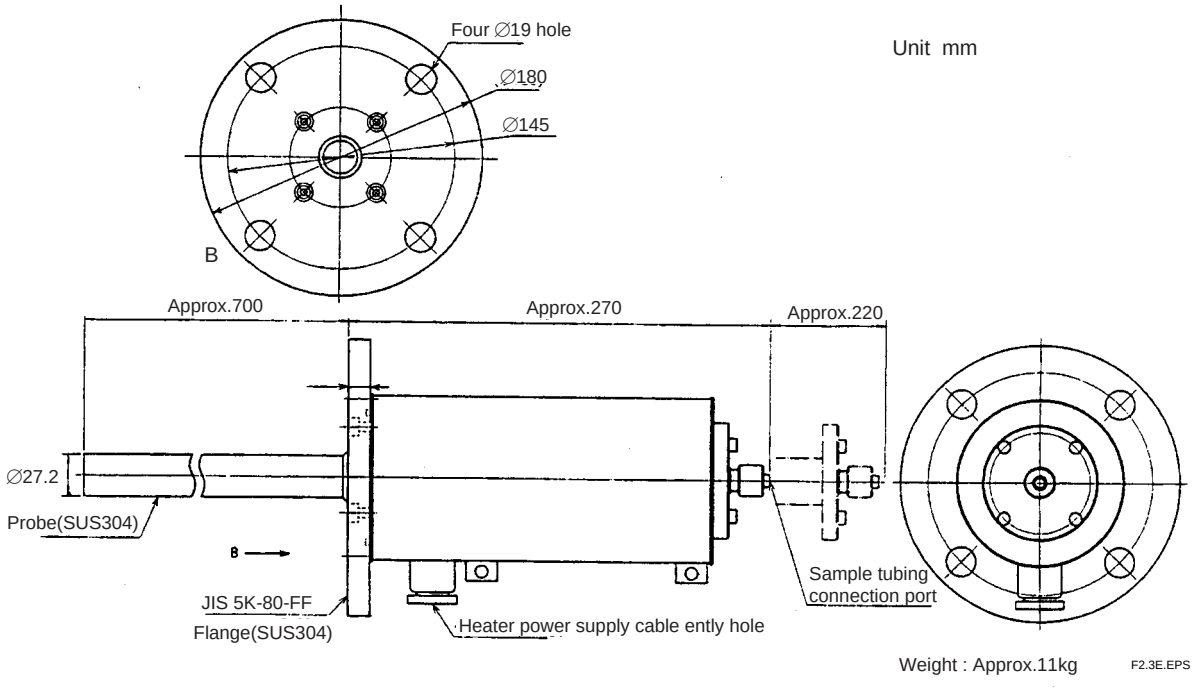
● **Type F Filtering Probe (K9718VC)**



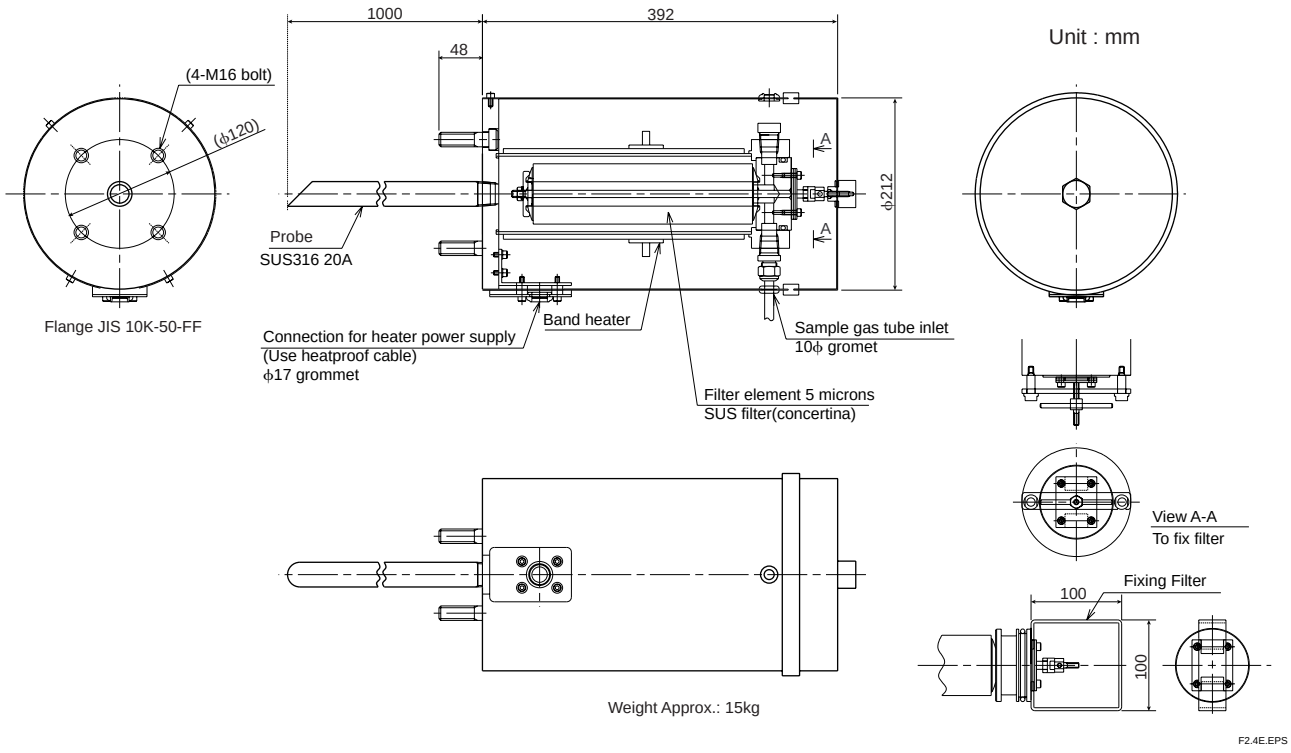
Weight : Approx. 5kg

F2.2E.EPS

● Type M1E Filtering Probe (K9219ED)



● Type M2E Filtering Probe (K9718VE)



2.2.2 Open-type probes

The open-type probes are resistant to the high temperature, but do not have built-in filters.

They should be used in combination with external primary filters to eliminate dust. Type M2 probe is made of SUS310S, allowing its use at up to 800° C. Type M3 probe is made of SiC, allowing its use at up to 1400° C.

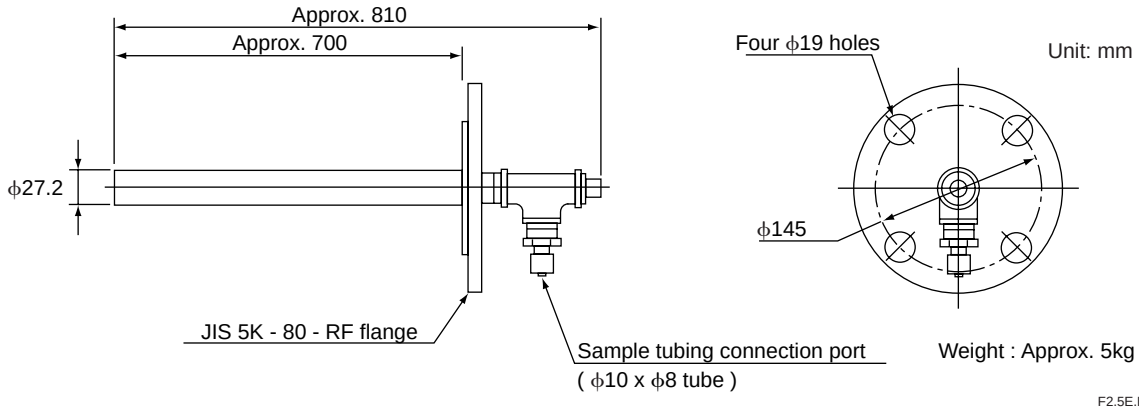
Table 2.9 Kind of Open-type Probe

Name	Type M2 Open type Probe	Type M3 Open type Probe
Part number	K9718PD	K9718QA
Operating temperature range	800 °C max	1400 °C max.
Probe material	SUS310S	SiC
Flange material	JIS 5K-80-RF (SUS304) equivalent	JIS 5K-80-RF (SUS304) equivalent
Insertion length	700 mm	1040 mm
Weight	Approx. 5 kg	Approx. 5 kg

(note) As probe material of M3 is SiC, do not add a mechanical impact.

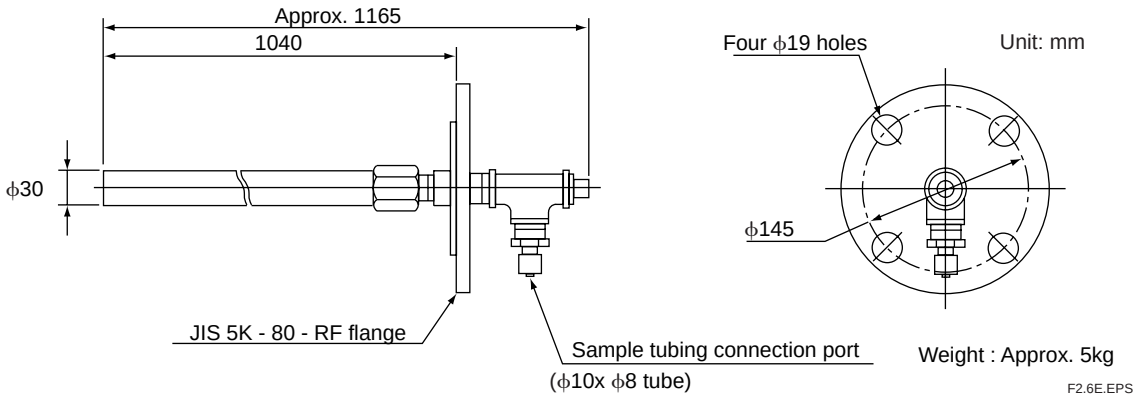
T2.14E.EPS

● **Type M2 Probe (K9718PD)**



F2.5E.EPS

● **Type M3 Probe (K9718QA)**



F2.6E.EPS

2.2.3 External primary filters

Flue gases contain moisture of 10 to 15% besides dust.
When a sample gas get cooled, dust becomes sludgy, resulting in clog in filters in short time.
To prevent this, filters are heated to above the acid dew point of the sample gas by either electric or steam heater. When using the steam heater, a steam trap should be provided by customers.

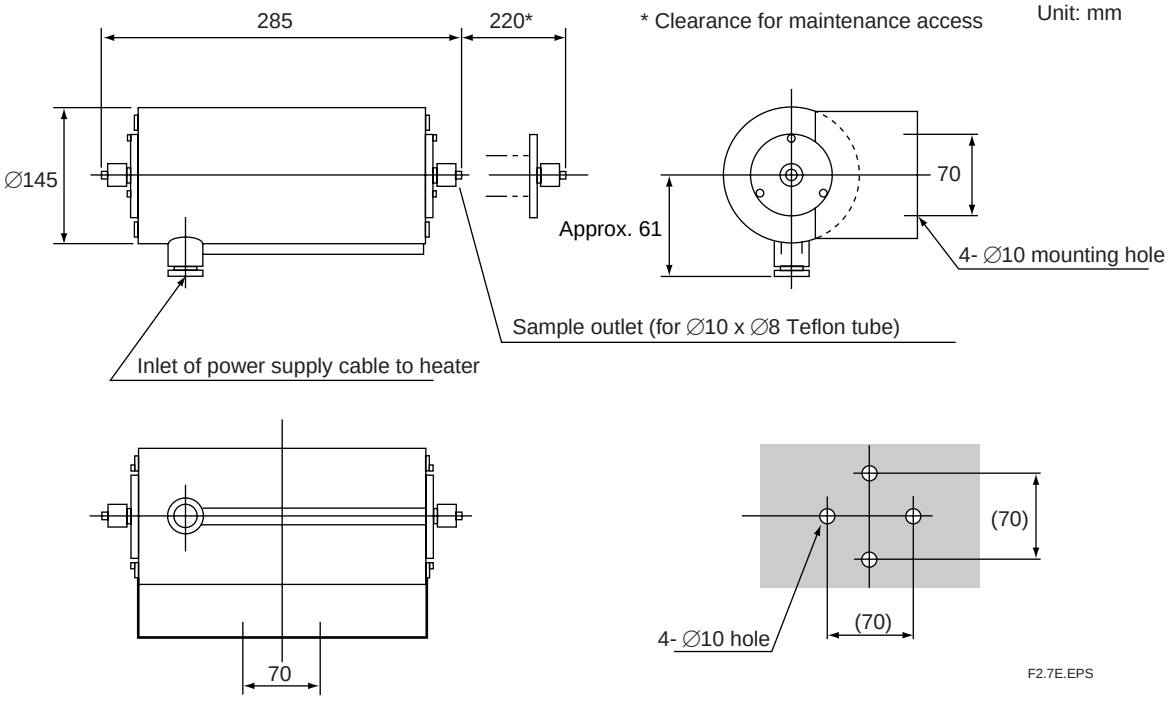
Table 2.10 External Primary Filters

Name	Type M1E External Primary Filter	Type MS External Primary Filter
Part number	K9718TA	K9718UA
Filter container material	SUS304	SUS304
Filter	SUS304 (20μm)	SUS304 (20μm)
Heating method	Electricity, approx. 80 VA	Steam, 100 to 300 kPa
Weight	Approx. 7 kg	Approx. 7 kg
Filter element	K9718RX	K9718US

(note) Use a heat-proof cable which is equivalent to JIS C3323 - KGB for ME1 External primary filter.

T2.15E.EPS

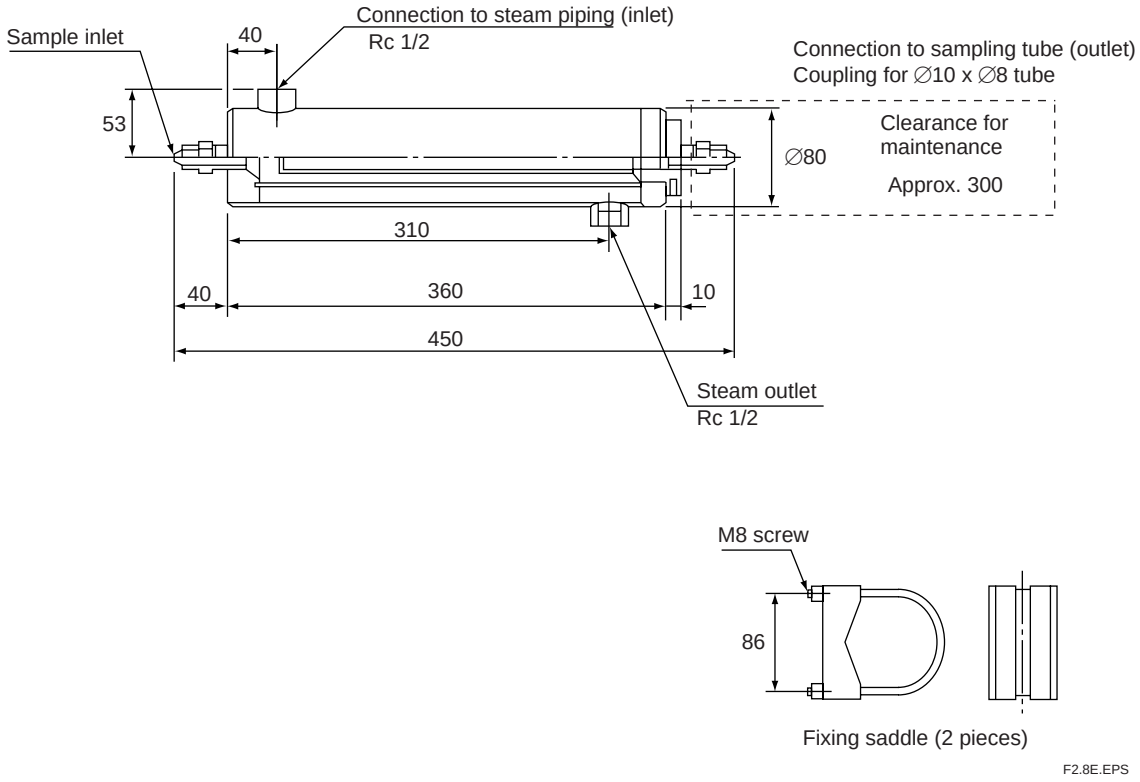
● **Type M1E External Primary Filter (K9718TA)**



F2.7E.EPS

● Type MS External Primary Filter (K9718UA)

Unit : mm



F2.8E.EPS

2.2.4 External tubes (sampling tubes)

Water drops in a sampling tube could cause reading errors since such components as SO_2 in sample gas dissolve in water. Teflon tubes that are excellent in water repellency and corrosion resistance are recommended to use as a standard sampling tube. If the SO_2 concentration in a sample gas is below 100 ppm or anti-freeze measures cannot be taken, the heating sampling tube (SG8HSAP), heated by a build-in electric heater, should be used.

Its specifications outline is shown below.

• Sampling tube (SG8SAP)

Length: 50 m max.
Material: Polytetrafluoroethylene (Teflon)
Diameter: 10 mm O.D./8 mm I.D.
Operating temperature: -5 to 200 ° C

• Heating Sampling tube (SG8HSAP)

Length: 50 m max.
Material: Polytetrafluoroethylene (Teflon), Sheath: PVC (93 ° C max.)
Diameter: 10 mm O.D./8 mm I.D., Heating tube: 33 mm O.D.
Tracing temperature: Outdoor temperature plus approximately 90 ° C
Power consumption: Approximately 36.5 VA/m (at 100V AC)

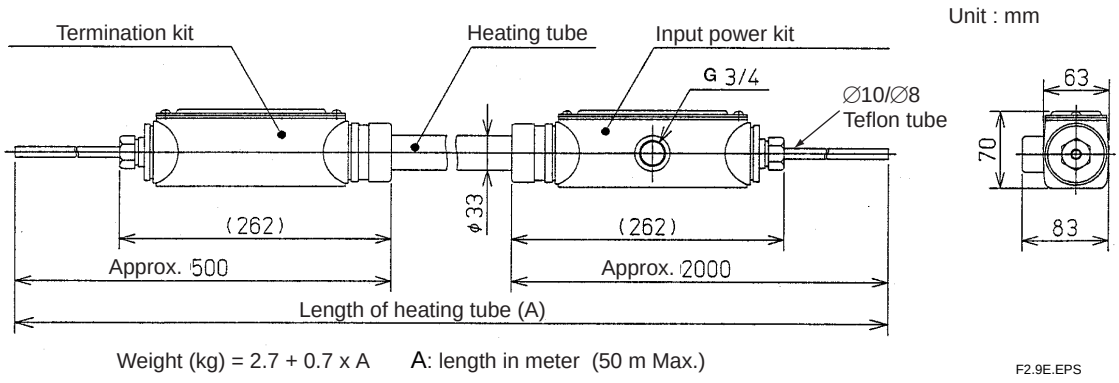


Figure 2.1 Heating sampling tube

2.2.5 External drain separator (K9641EA)

External dimensions of the external drain separator are shown below. This drain separator is designed so that it automatically removes the drainage from a sample gas and, in addition, it works as a safety trap to prevent back flow of the drainage into the analyzing system even if the probe or the sampling probe gets clogged. Note that it can be used within the range of measuring gas pressure from -5 to 5 kPa. For conditions outside of this range, consult with Yokogawa.

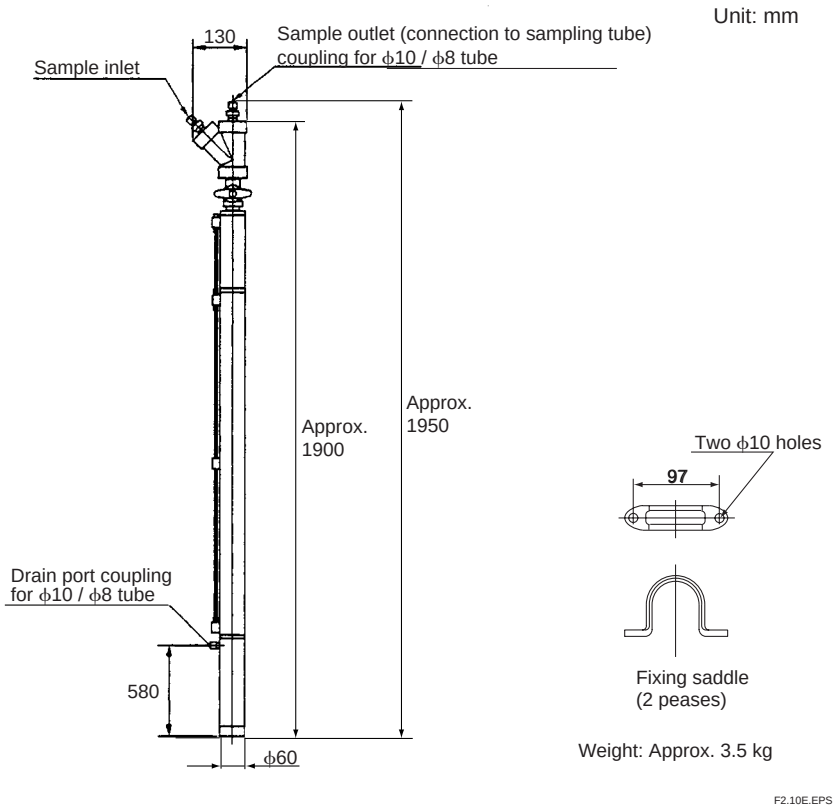


Figure 2.2 External Drain Separator with Safety Trap

The external drain separator is required if any of the following conditions is met.

- No sufficient length of the tube for cooling sample gas is provided due to the short distance between the probe and the analyzing system.
- Long tubing between the probe and the analyzing system is provided; Drain may form in the tube and some gas components of sample gas may dissolve in drain, causing errors.
- No sufficient tilt (more than 15°) of the sampling tube is given due to the positions of the probe and the analyzing system.
- Saggy tubing that may cause drain to form in the tube is provided.
- When the SO_2 range is 500 ppm or higher, two external drain separators must be used to minimize the dissolution loss of SO_2 in drain.

CAUTION

The external drain separator may only be used on freeze-free sites or in places where anti-freeze measures are taken.

2.3 Standard Gas

2.3.1 Standard Gas Cylinder

● **Specifications**

Pressure : Approx. 10 MPa

Capacity : 3.4 L

Weight : Approx. 6 kg

● **External Dimensions**

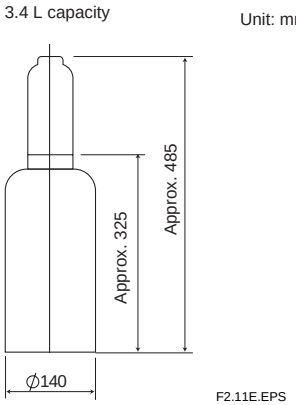


Figure 2.3

● **Standard gas cylinder for NO: NO + N_2**

Table 2.11

Range	NO Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0 to 50 ppm	45 to 50 ppm	K9354DA	L9850BA
0 to 100 ppm	90 to 100 ppm	K9354DB	L9850BA
0 to 200 ppm	180 to 200 ppm	K9354DC	L9850BA
0 to 250 ppm	225 to 250 ppm	K9354DD	L9850BA
0 to 300 ppm	270 to 300 ppm	K9354DH	L9850BA
0 to 500 ppm	450 to 500 ppm	K9354DE	L9850BA
0 to 0.1%	0.09 to 0.1%	K9354DF	L9850BA
0 to 0.2%	0.18 to 0.2%	K9354DG	L9850BA
0 to 0.5%	0.45 to 0.5%	K9354DJ	L9850BA

T2.16E.EPS

Note

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

● **Standard gas cylinder for SO_2: $SO_2 + N_2$**

Table 2.12

Range	SO_2 Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0 to 50 ppm	45 to 50 ppm	K9354HA	L9850BA
0 to 100 ppm	90 to 100 ppm	K9354HB	L9850BA
0 to 200 ppm	180 to 200 ppm	K9354HC	L9850BA
0 to 250 ppm	225 to 250 ppm	K9354HD	L9850BA
0 to 300 ppm	270 to 300 ppm	K9354HN	L9850BA
0 to 500 ppm	450 to 500 ppm	K9354HE	L9850BA
0 to 0.1%	0.09 to 0.1%	K9354HF	L9850BA
0 to 0.2%	0.18 to 0.2%	K9354HG	L9850BA

T2.17E.EPS

● **Standard gas cylinder for CO: $CO + N_2$**

Table 2.13

Range	CO Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0 to 50 ppm	45 to 50 ppm	K9134UA	L9850BA
0 to 100 ppm	90 to 100 ppm	K9134UB	L9850BA
0 to 200 ppm	180 to 200 ppm	K9134UC	L9850BA
0 to 250 ppm	225 to 250 ppm	K9354YB	L9850BA
0 to 300 ppm	270 to 300 ppm	K9354NA	L9850BA
0 to 500 ppm	450 to 500 ppm	K9134UD	L9850BA
0 to 0.1%	0.09 to 0.1%	K9134UE	L9850BA
0 to 0.2%	0.18 to 0.2%	K9134UF	L9850BA
0 to 0.5%	0.45 to 0.5%	K9134UG	L9850BA
0 to 1%	0.9 to 1%	K9134UH	L9850BA
0 to 2%	1.8 to 2%	K9134UJ	L9850BA

T2.18E.EPS

● **Standard gas cylinder for CO_2: $CO_2 + N_2$**

Table 2.14

Range	CO_2 Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0 to 1%	0.9 to 1%	K9134WH	L9850BA
0 to 2%	1.8 to 2%	K9134WJ	L9850BA
0 to 5%	4.5 to 5%	K9134WK	L9850BA
0 to 10%	9 to 10%	K9134WL	L9850BA
0 to 20%	18 to 20%	K9134WM	L9850BA

T2.19E.EPS

● **Standard gas cylinder for O_2: $O_2 + N_2$**

Dry air cylinders are used as zero gas for NO, SO_2, CO and CO_2 analyzers.

Table 2.15

Range	O_2 Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0 to 10%	9 to 10%	K9354ZF	L9850BA
0 to 25%	20 to 21.5%	K9354ZG	L9850BA

T2.20E.EPS

● **Zero gas cylinder for NO, SO_2, CO, CO_2, O_2 (Paramagnetic): N_2**

Table 2.16

N_2 Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
more than 99.99%	K9134TA	L9850BA

T2.21E.EPS

● **Zero gas cylinder for O_2: O_2 + N_2**

Used only with the system using a zirconia oxygen analyzer

Table 2.17

N_2 Concentration	Part Number (3.4L)	Part Number of Pressure Reducing Valve
0.95 to 1.0%	G7001ZC	L9850BA

T2.22E.EPS

● **Pressure Reducing Valve for Gas Cylinder**

Table 2.18

Application	Part Number	Description
Span gas cylinder	L9850BA	For low-concentration cylinders, containing less than 5% of combustible gases, used for CO analyzers and others, and for non-combustible gas cylinders non-combustible gas cylinders
Zero gas cylinder	L9850BA	For any non-combustible gas cylinder

T2.23E.EPS

2.3.2 Pressure Reducing Valves for Gas Cylinders Specifications

Pressure reducing valve 1 (for combustible gases at a concentration below 5 %)

Part number: L9850BA

Pressure gauge:

Primary: 0 to 25 MPa
Secondary: 0 to 0.1 MPa

Operating pressure range: 10 to 60 kPa (30 kPa for the SG700 analyzing system)

Connection: Inlet: W22 14-t.p.i. (female) right-hand thread Outlet: Rc1/4

Weight: Approximately 1.5 kg

● **External Dimensions**

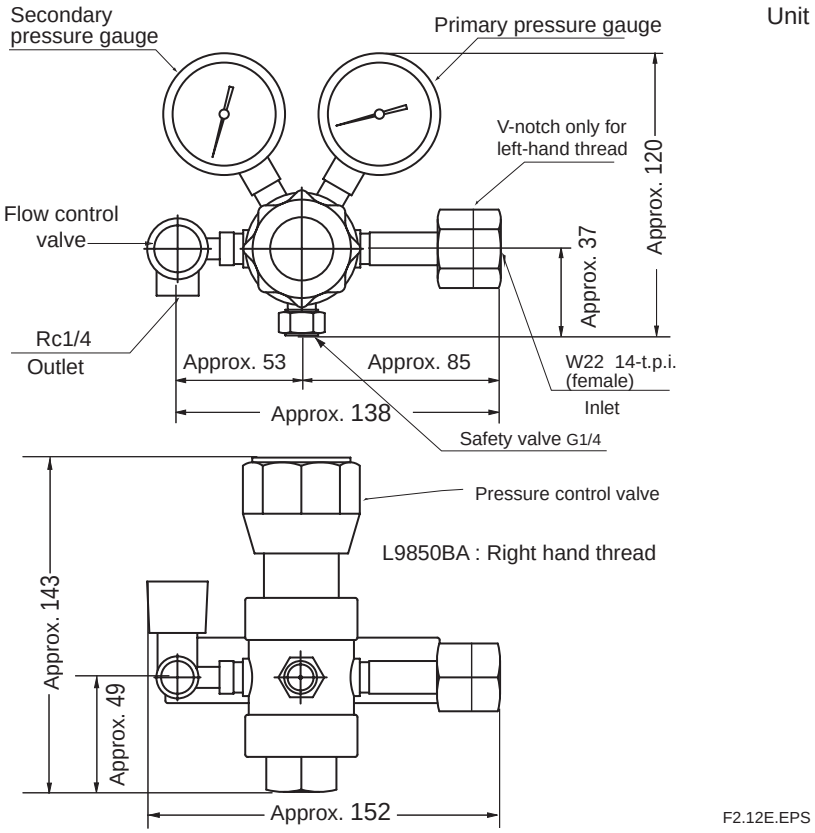


Figure 2.4

3. INSTALLATION

This section explains installation of an external sampling system and a stack gas analyzing system, constituting the SG700 Stack Gas Analyzing System, focusing on precautions in installation, wiring and piping of each component. System configurations and installation plan should be examined in consideration of components in the analyzed gas, temperature, moisture content, ambient temperature and maintenance space requirements. In order to measure the analyzed gas correctly, pay attention to the followings especially the sampling system.

● **Selecting mounting location of the gas intake probe**

The probe must be positioned where the stack gas flow and concentration is even so that the gas it intakes is representative of the process. Generally the probe is positioned in the duct so that the probe head reaches 1/3 to 1/2 of the duct diameter. The intake point should be selected so that the process gas pressure falls within the range of -5 to 5 kPa and there should be little dust (less than 0.5 g/Nm^3, and if possible, less than 0.1 g/Nm^3) present. An ideal location for the probe has easy access for maintenance work like replacing a filter and allows the sampling tube running from the probe to the analyzing system to be inclined downward at greater than a 15° tilt.

Select an appropriate probe according to the gas components and temperature of the intake gas sample. Tube sections in which drainage easily forms should be insulated and the probe should be mounted inclined to feed the drain toward the outlet smoothly.

● **Selecting sampling method of intake gas to the SG700 gas analyzing system**

The sampling method should be carefully examined so that an analyzed gas does not dissolve and get lost in the drainage condensed in the sampling tube, and the dust and drainage should not cause clogging of the tube. When using the open-type probe, an external primary filter should be used to eliminate dust. The external drain separator can be used to exhaust the drainage quickly or a heating sampling tube can be used to prevent the formation of condensation.

An ideal location for the external drain separator is right under the probe. Direct sunlight should not be allowed on the external drain separator.

● **Installation construction of the SG700 Stack Gas Analyzing System**

Refer to Section 3.4.

● Preliminary construction before installing

For smooth installation construction, the following work is recommended to be arranged and conducted.

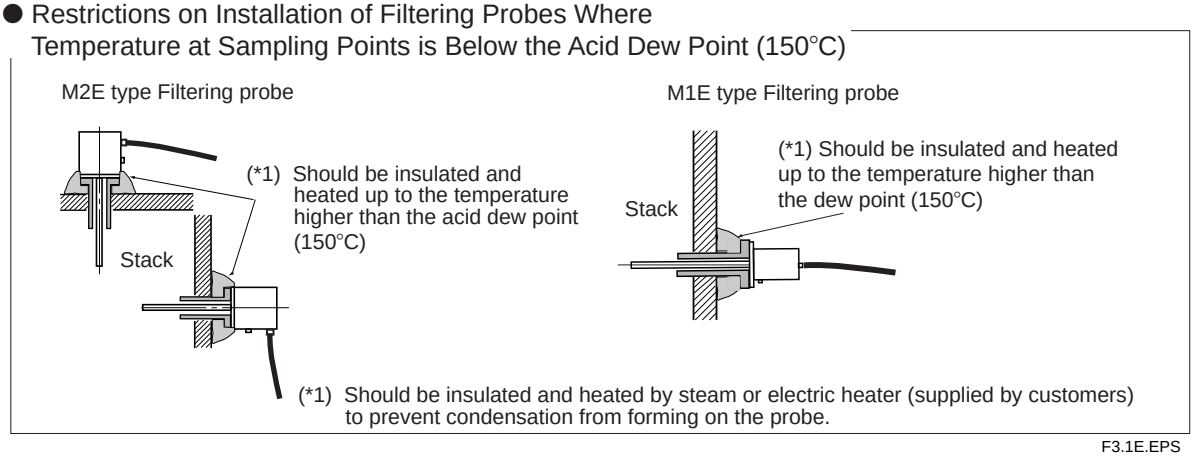
- **Scaffolding for installing the gas intake probe and making a hole in the stack wall**
  Before making the hole, prepare a companion flange and a blind flange to be used until the probe is installed.
- **Preparation of installing the gas intake probe, external primary filter and external drain separator**
  Supporting wires for retaining tubes and wires, a retaining strut, and brackets should be prepared. In addition, electric wiring (heatproof cable) to the heater of a filter, and if a steam heater is used, steam piping should be provided. When using heating sampling tubes, it is needed to examine how to fix an input power kit and a termination kit. Do not allow the probe and the external primary filter to be exposed to ambient weather conditions - install a cover or the like.
- **Installation station and basic construction of the SG700 Stack Gas Analyzing System**
  Anchor bolts should be embedded in the base of the analyzing system. Perform the basic construction for the cable pit, duct and conduit for constructing the power and signal lines. Construct drainage work, including installing drain pots, and install gas exhaust pipes. Piping for instrument air should be provided, if necessary.

3.1 Standard System

● **Filtering probe + (external drain separator) + analyzing system**

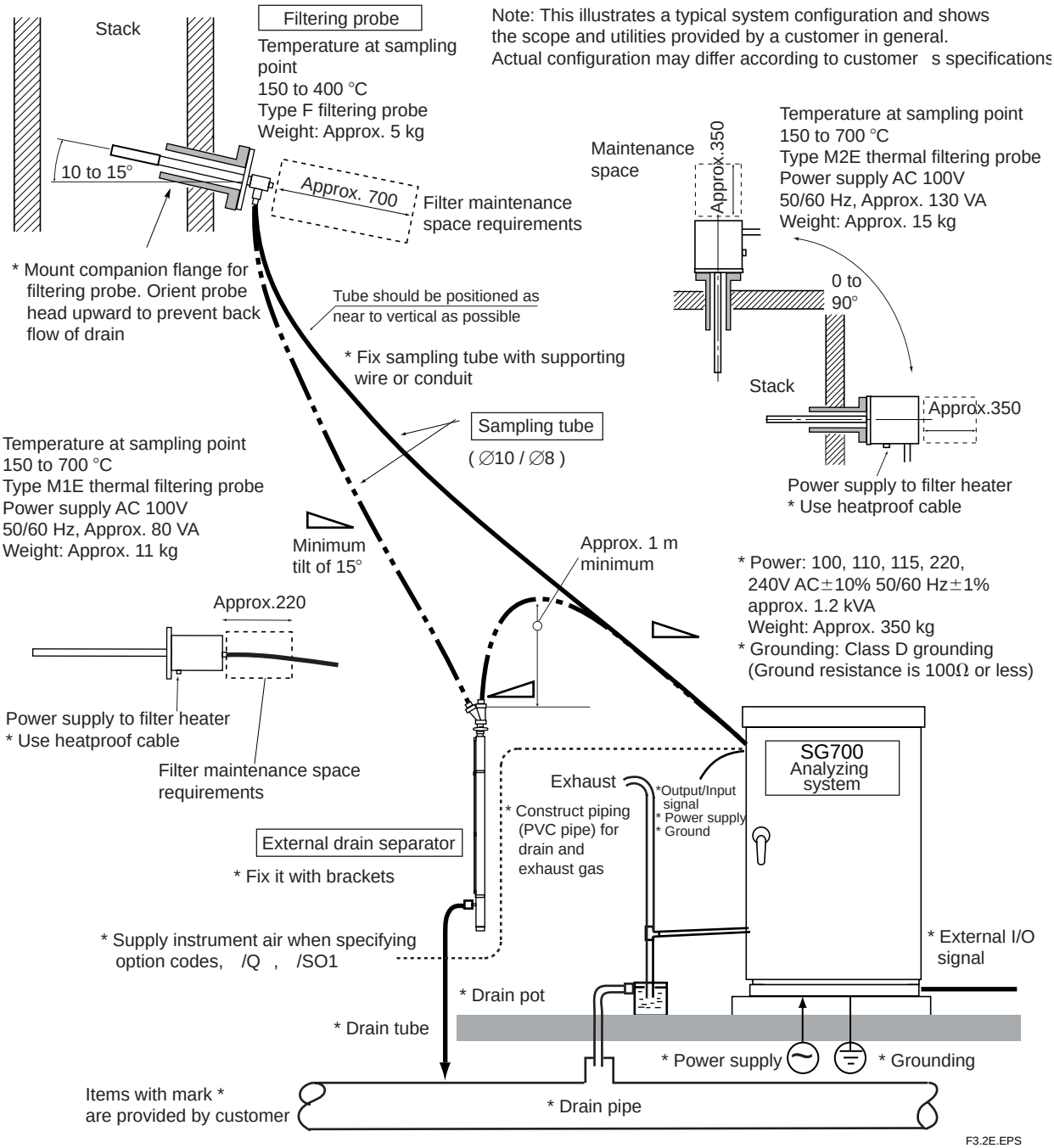
- Flue gases of general boilers and oil heating furnaces have relatively low temperature and contain moisture below its saturation point. For sampling this kind of flue gas, a filtering probe should be used. The type F filtering probe, its filter positioned inside stack, can be used for sampling flue gases of up to 400°C. The types M1E and M2E filtering probes, their filters positioning outside stack, can be used for sampling flue gases of up to 700°C. With any type of filtering probe, allow the drain to run smoothly toward the sample outlet or heat the probe to prevent drain from forming.
- The type F filtering probe is used where the temperature at the sampling point falls within the range of the acid dew point (150°C) to 400°C. Its filter is located on the probe head and exposed to the flue gas. To prevent clogging of the filter, the probe is placed at a 10 to 15° tilt with the probe head facing upward so that the drain which forms in the sampling tube cannot run back to the filter.
- The type M1E and M2E filtering probes are used where the temperature at a sampling point falls within the range of the acid dew point (150°C) to 700°C. Their use at a temperature of less than the acid dew point has restrictions in terms of installation (see Figure below). Their filters are located at the probe foot and heating the filters prevents drain, which would cause corrosion of the probe, from forming on flanges. The filters are heated by an electric heater using heatproof cables that can stand the high temperature. The type M1E filtering probe should be horizontally mounted to prevent back flow of drain toward the filter. The type M2E filtering probe can be mounted from horizontally to vertically (0 to 90°). Filter elements of the filtering probes should be periodically maintained and replaced. Clearance for maintenance access is required at rear side of the filtering probes.
- The drain separator is used to quickly exhaust the drainage that forms in the sampling tube. Its ideal installation location is right under the probe. Refer to "2.2.5 External drain separator (K9641EA)" for detailed operating conditions.
- The sampling tube should be placed at greater than 15° tilt to prevent drainage from forming and standing, and dust from accumulating.
- When installing the external sampling system outdoors, retaining equipment should be provided to prevent tubes from sagging and junctions from loosing under weather conditions.

● Restrictions on Installation of Filtering Probes Where Temperature at Sampling Points is Below the Acid Dew Point (150°C)



F3.1E.EPS

Figure3.1 Restriction on Installation of Filtering Probes Where Temperature at Sampling Points Below the Acid Dew Point (150 °C)



Note1: For external dimensions of each component refer to Section 2.2.3, External Dimensions
Note2: Power consumption differs depending on system configurations
Note3: Instrument air is required when specifying the option code /Q to use it as a zero gas or specifying the option code /SO1 because of the SO_2 range falling within the range of 500 to 1000 ppm.

Figure3.2 Installation of Standard System

3.2 System with Heating Sampling Tube

● **Filtering probe + heating sampling tube + analyzing system**

- Heating sampling tubes are used when drain forming in the sampling tube may freeze under the ambient low temperature in cold districts or in winter nights.
- The cold-district version should be used for anti-freeze measures for analyzing systems.
- Either type M1E or M2E thermal filtering probe (the temperature at a sampling point: from the acid dew point (150°C) to 700°C) can be used for sampling a flue gas. The use where the temperature at a sampling point is below the acid dew point (150°C) has restrictions in terms of installation. The filter is located at the foot of the filtering probe and heated to prevent the drain that causes corrosion of the probe from forming on the flange.
- The filter is heated by an electric heater using a heatproof cable that stands high temperature.
- The probe head should be horizontally mounted to prevent back flow of the drain.
- Type M2E filtering probe can be mounted from horizontally to vertically (0 to 90°) as shown below.
- Filter elements of the filtering probes should be periodically maintained, which requires clearance for maintenance access at the rear side of the filtering probe.
- The length of the tube between the filtering probe and the termination kit of the heating sampling tube should be minimized. The tube should be insulated by a retractable insulating material to prevent drain from forming in the tube.
- Fix the termination kit of the heating sampling tube onto a mounting bracket with U bolts. Wire the power supply cable to the heater to the input power kit of the heating sampling tube. Retaining equipment should be provided to prevent tubes from sagging and junctions from loosing by weather conditions.
- This system cannot be used in combination of the heating sampling tube and the external primary filter.

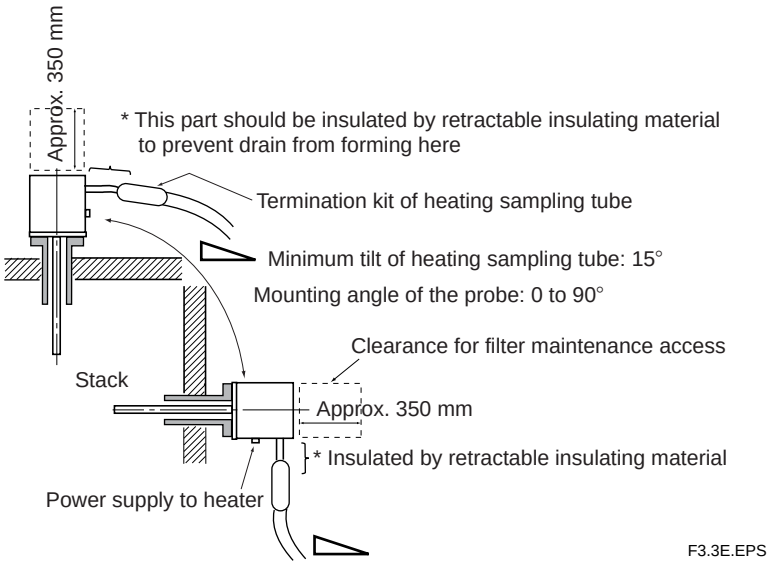
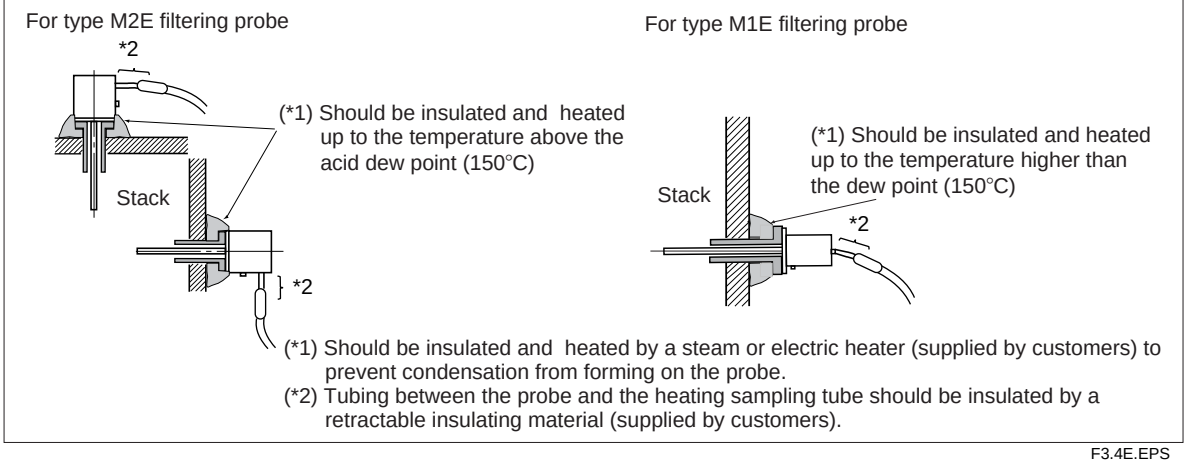


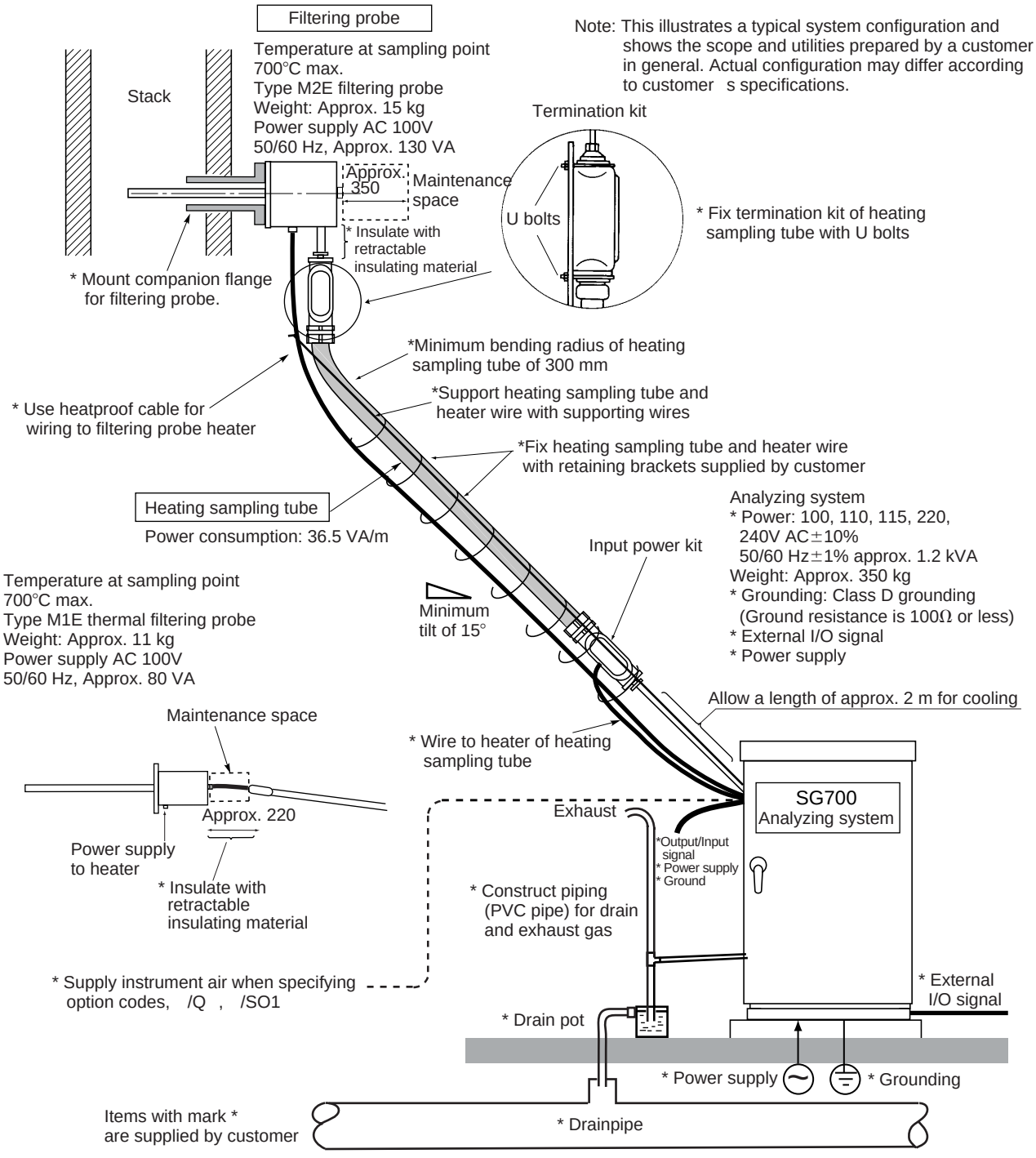
Figure3.3 Mounting Angle of Type M2E Filtering Probe

● Examples of installation of the probe when the temperature at a sampling point is lower than the acid dew point (150°C)



F3.4E.EPS

Figure 3.4 Installation Restrictions Where Temperature at Sampling Point is Below the Acid Dew Point (150 °C)



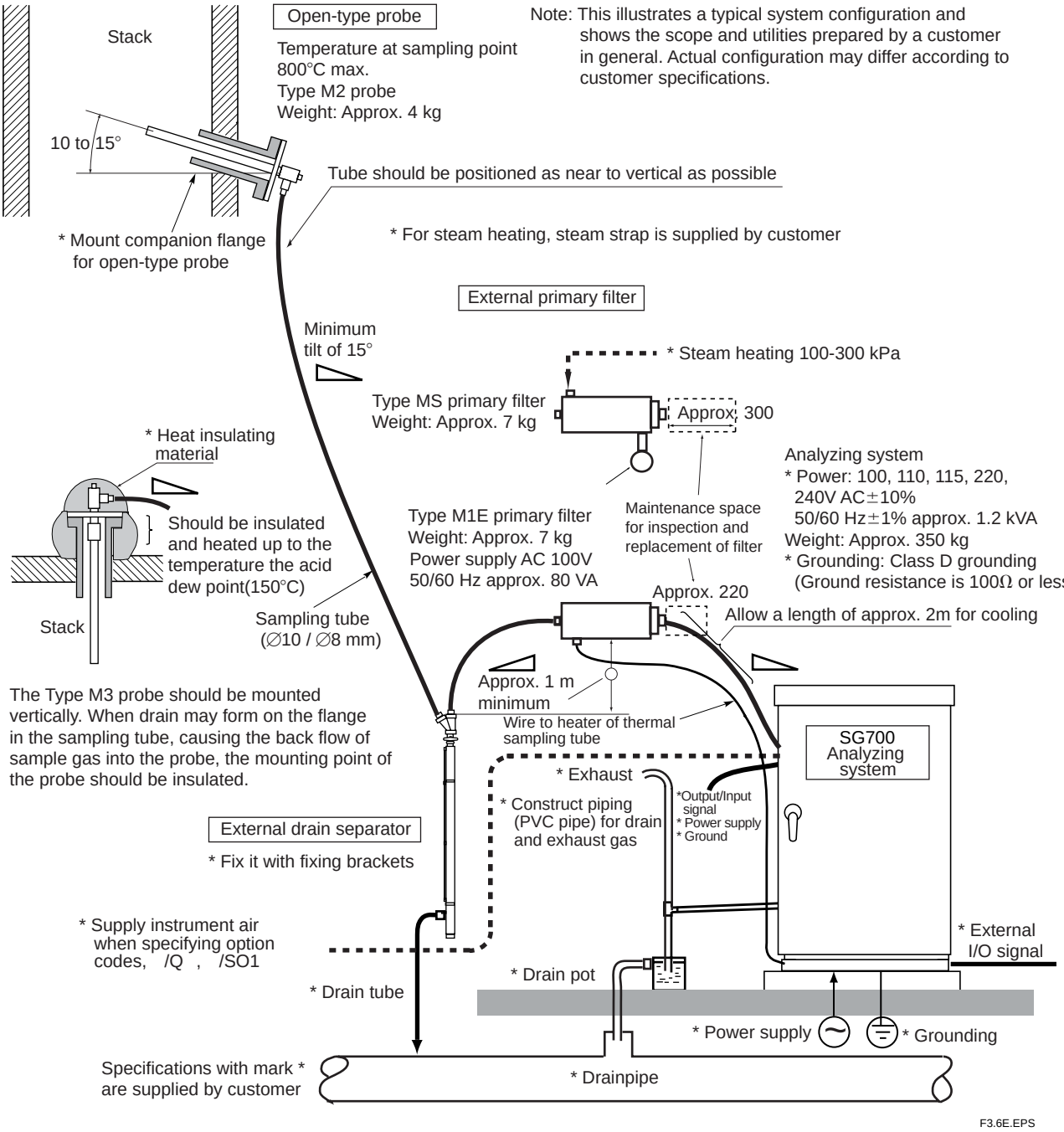
Note1: For external dimensions of each component refer to Section 2.2.3, External Dimensions
Note2: Power consumption differs depending on system configurations
Note3: Instrument air is required when specifying the option code /Q to use it as a zero gas or specifying the option code /SO1 because of the SO_2 range falling within the range of 500 to 1000 ppm.

Figure3.5 Installation of System Using Heating Sampling Tube

3.3 System with External Primary Filter

● Open-type probe + external drain separator + external primary filter + analyzing system

- Flue gases of sludge incinerators and iron and steel stoves have high temperature and high moisture content. For sampling such flue gas, the type M2 probe, which can sample gas up to 800°C, or the type M3 probe, which can sample gas up to 1400°C should be used.
- The type M2 probe should be mounted upward at a 10-15° tilt to prevent back flow of drain forming in the sampling tube.
- The foot of the type M3 probe is made of silicon carbide. To avoid deformation due to high temperature, the probe should be mounted vertically with the probe top end facing downward. The foot of the probe and flange area should be insulated to greater than the dew point (150°C) in order to prevent the formation of drain, which causes corrosion.
- The type M3 probe should be mounted without giving a mechanical shock. The silicon carbide part is likely to get damaged by a mechanical shock.
- Since both types M2 and M3 probes are an open-type probe, The external primary filter is required to eliminate dust from a sample gas. It should be mounted after the external drain separator where the sample gas gets cooled down and moisture content of it decreases. The filter is heated by electric (type M1E) or steam (type MS) heaters.
- A heatproof cable should be used for wiring to the heater of the type M1E primary filter. Conduct steam piping for the type MS external primary filter and mount a steam strap on the exit.
- When installing the external primary filter outdoors, it should be protected against the weather conditions by mounting an awning. The filter element of the external primary filter should be periodically maintained, which requires clearance for maintenance access at the rear side of the external primary filter.
- This system always requires the external drain separator. The external drain separator should be mounted in a position that can collect drain and dust forming in the sampling tube.
- Construct the sampling tube with consideration to prevent drain from forming and standing and dust from accumulating. The sampling tube form the probe should be tilted sharply in a way to the external drain separator.
- When the external sampling system is installed outdoors, it is recommended to provide retaining equipment to prevent tubes from sagging and to junctions from loosing by weather conditions.



Note1: For external dimensions of each component refer to Section 2.2.3, External Dimensions
Note2: Power consumption differs depending on system configurations
Note3: Instrument air is required when specifying the option code /Q to use it as a zero gas or specifying the option code /SO1 because of the SO_2 range falling within the range of 500-1000 ppm.

Figure3.6 Installation of System Using External Primary Filter

3.4 Precautions in Installing the Stack Gas Analyzing System

3.4.1 Installation Site

The stack gas analyzing system can be installed outdoors. To ensure that the analyzing system keep stable performance for a long term, select an installation site conditions satisfying the followings.

- **Close to a sampling point**
  It is recommended that the analyzing system be installed right under the sampling point. This is the best to keep drain repellency in the sampling tube as well as good response.

- **Avoid direct sunlight**
  To avoid a sudden change of temperature and a temperature increase inside the analyzing system in summer, direct sunlight should not be allowed on an installation site. Select a site which is free from radiant heat from high-temperature substances and direct sunlight, and which has minimum temperature change a day.

- **Secure enough space for inspection and maintenance**
  Negligible vibration should be allowed since vibration could affect an optical measurement, a method the analyzing system employs. If by any chance the analyzing system is installed in a vibration environment, protect it by placing vibration-proof rubbers to absorb the vibration.

- **No EMI and no vibration**
  If vibration occurs in the installation location, use vibration-proof rubber between the concrete installation benchi and the bottom of the Analyzing System cabinet.

- **Free from dust and corrosive gases**
  An installation site should have ambient humidity of less than 90%RH and no combustible gases. Note that the analyzing system itself is not explosion-proof contruction.

- **Measures against specific conditions**
  The standard specification of ambient temperature falls in the range from -5 to 40℃. For use in cold districts, the following measures are available. When using the analyzing system in cold districts, take measures to prevent freezing of drainage. Yokogawa offers a built-in heater for the analyzing system. (Cold-district version: down to -15℃)

  However, in a cold district where it keeps the temperature under -15℃ for a long term, installing a built-in heater alone cannot help the analyzing system work in good condition: the temperature of the sampling line near the bottom of the analyzing system cubicle could drop under the set temperature of the electric gas cooler and a gas conditioner installed inside could freeze, even if the built-in heater can afford to control the capability of the detector and electric gas cooler.

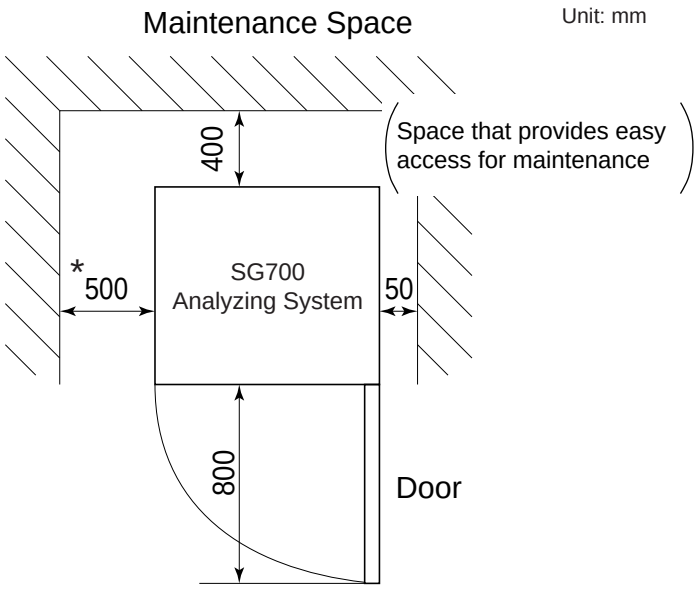
  Therefore in such a case, an insulated shelter is required. From the same reason, some measures should be considered for the probe, external drain separator, and sampling line between analyzing systems by using, for instance, a heating sampling tube.

  Yokogawa recommends that, as measures against cold weather, the analyzing system and external drain separator be housed in a shelter whose temperature is kept in the range of 0-25℃ even in winter, and the sampling lines be insulated, and if necessary be heated by a steam trace or an electric device. In this case piping immediately before the external drain separator and the analyzing system requires a non-heating section of approximately 2 m for allowing the sampling tube to cool down.

  With the option code “/T1”: Ambient temperature -15 to 40℃
  With the option code “/T2”: Ambient temperature -10 to 40℃

3.4.2 System Space Requirements

The stack gas analyzing system measures approximately 800 x 800 x 1800(H) in millimeters and weighs approximately 350 kg. Secure a space for easy maintenance access as follows.



(*) There are sample gas inlet, drain, exhaust gas outlet on a left side when viewing it from the front.
Additional space for connecting the tube is required.

F3.7E.eps

Figure 3.7 System Space Requirements

DANGER

This instrument is not explosion-proof construction. Do not use it in hazardous atmosphere of explosive gases. The use in hazardous areas could result in serious accidents such like explosion and fire.

3.4.3 Installation Construction work

Installing the stack gas analyzing system involves cable wiring for power supply and signals and piping for sampling.

Implement basic construction in consideration of the following points.

- The risk of flood and high tide
- Exhaust and drain treatments of exhaust and bypass gases
- Indoor installation: Install a drain pot and construct piping as shown below
- Drain treatment

A drain pot should be installed on the ground or under the ground level.

The drain treatment should be constructed in a way to eliminate the accumulation of drain in the drainpipe.

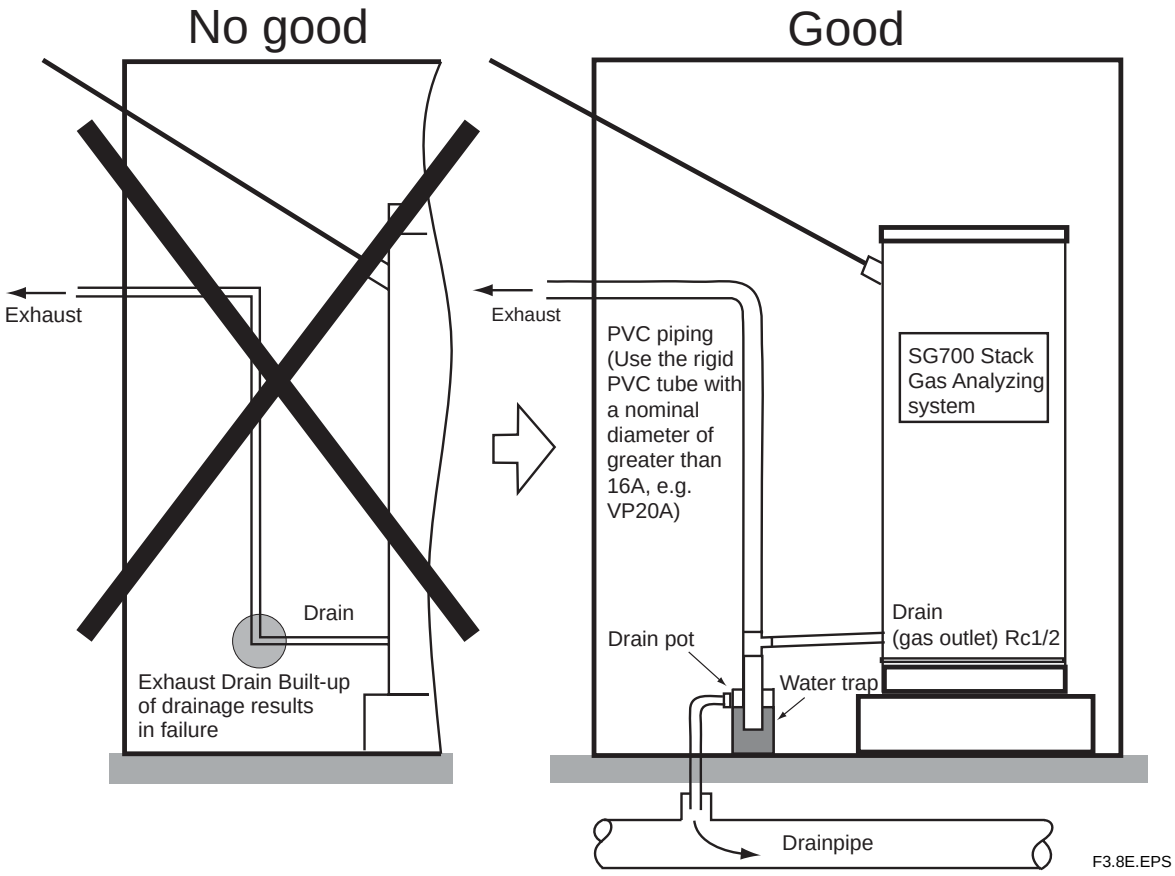
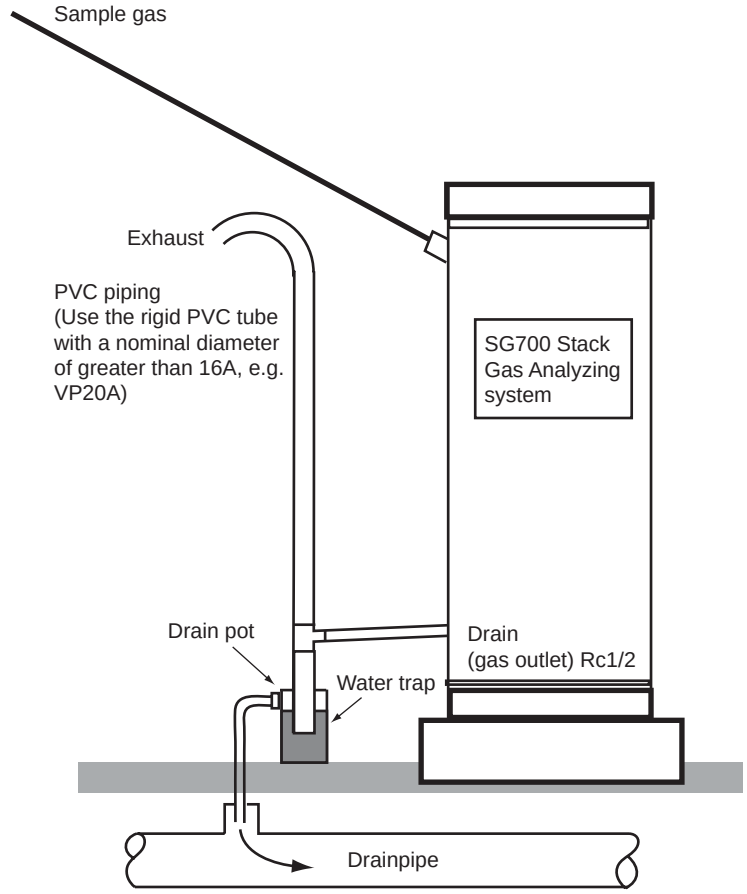


Figure3.8 Example of Indoor Installation

● Example of Outdoor Installation



Note: Outdoor installation version is rainproof construction equivalent to IP54.

F3.9E.EPS

Figure3.9 Example of Outdoor Installation

CAUTION

- Ask qualified constructors or sales office where you have purchased the instrument for installation, moving and reinstallation. Inadequate installation may result in accident or injury such like falling down, electric shock and fire.
- The stack gas analyzing system is heavy. Take great care in installing. Falling down or dropping may result in accident or injury.
- Always wear gloves when lifting the analyzing system. Lifting it with bare hands may result in injury.
- Do not stand on the analyzing system during construction. It may result in damage to the instrument.
- Install the instrument in a location where the conditions described in this manual are met. Using the instrument in conditions outside the specification may result in electric shock, fire and malfunction.
- Do not leave foreign matter such like scraps of wires into the inside instrument during construction. It may result in fire, failure and malfunction.
- Exhaust gas and drain may contain poisonous substances. They should be treated in accordance with local environmental control regulations.

● Example of Basic Construction

An example of basic construction is shown below.

Unit: mm

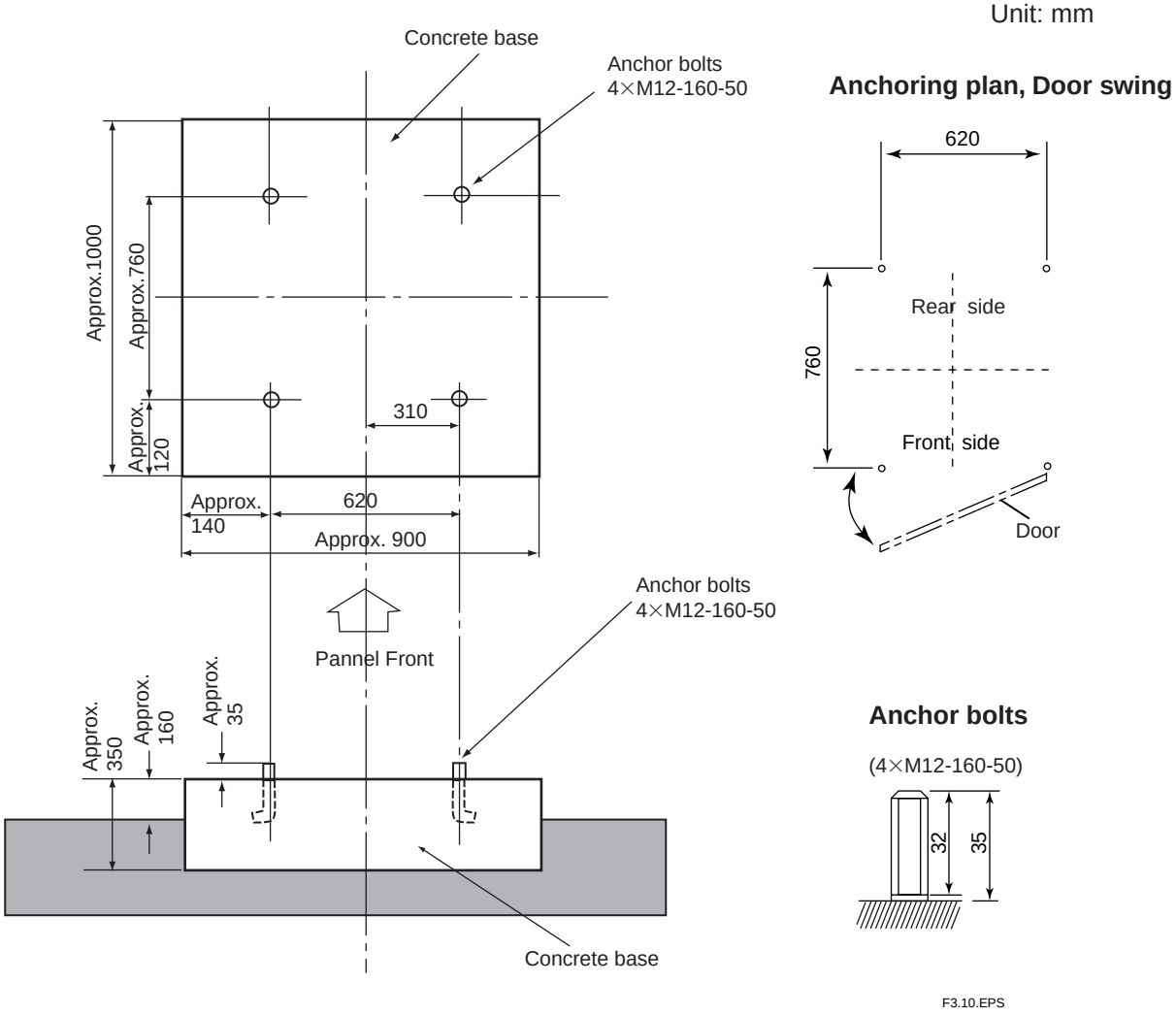


Figure 3.10 Example of Basic Construction

3.5 Installation Site of External Sampling Systems

The external sampling system comprises the probe, the sampling tube and others. It should be installed so that the sampling gas can be introduced into the analyzing system always in the best condition and it requires minimum maintenance workforce. The followings describe precautions in mounting the external sampling system and in selecting an installation site of the probe.

● **Precautions in mounting the external sampling system**

- No drain should be formed in the probe
- Minimum dust and mist should be allowed to come in
- No drain should be stood in the sampling tube
- The shorter the sampling tube is the better
- Sample gas should be cooled down to under 40°C before being fed to the stack gas analyzing system

● **Precautions in selecting an installation site of the probe**

The probe should be installed in a place with the following conditions.

- A representative sample gas can be taken
- A process gas flows smoothly: A corner of stacks where the process gas flows turbulently is not suitable for sampling
- A sampling point that responds to and reflects changes in process operation conditionsAir contaminated in the process gas may result in errors in measurements. Check the stack wall for cracking, if any, repair it before installing the probe.
- Easy access for inspection and maintenance of the probe

3.6 Precautions in Installing Sampling Parts

■ Mounting Positions of Sampling Probes

Yokogawa offers two types of sampling probes.

Table 3.1 Probe Types

Probe with filter type	Type F	Flue gas of 150 to 400°C
	Types M1E and M2E (electric heating)	Flue gas of 150 to 700°C *1
Probe without filter	Type M2	Flue gas of 150 to 800°C
	Type M3	Flue gas of 150 to 1400°C

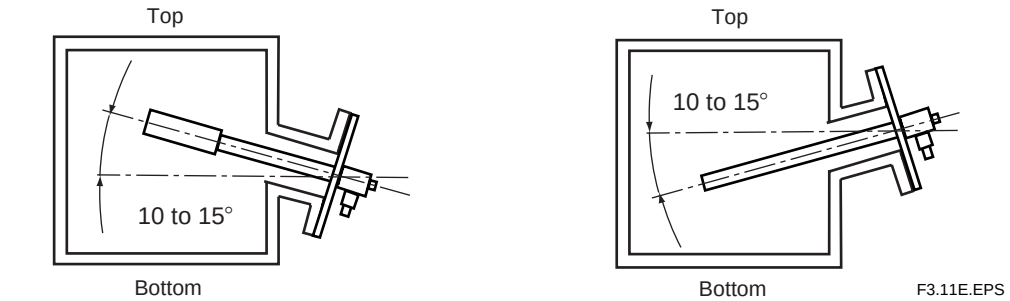
*1 When using it where the temperature of sample gas is under the acid dew point (150°C), there are restrictions for installation.

T3.1E.EPS

Normally the probe with filter is used. If the temperature of the filter falls under the acid dew point (Note), corrosion by sulfuric acid shortens a filter's life. In addition, if the filter is exposed to too much high temperature, it also affects the filter's life. In these cases use the type M2 or type M3 open type probe in combination with thermal primary filter (type MS: steam heating type, or type M1E: electric heating type).

CAUTION

Acid dew point : While a dew point of the gas containing much steam only is below 100 °C at atmospheric pressure, that of the gas containing acid gases such as SO_3 is higher than 100 °C. This is called an acid dew point. The greater acid gases the gas contains, the greater the acid dew point of it increases. Normally the acid dew point of flue gases is 150°C at maximum. In areas which temperature falls under the acid dew point, moisture in together with acid gases forms acid drain, which causes corrosion of metal parts.



When temperature of boiler and flue gas is high

When temperature of flue gas is low

Figure 3.11 Mounting Positions of Probe

Type F filtering probe differs from type M2 or type M3 open type probe in mounting position based on the following points. The detailed mounting positions of the probes are illustrated below. If your installation condition does not match the following, consult with Yokogawa.

● **Tilt the filtering probe (type F) upward to allow internal drain to drop into the drain separator**

Since this type F filtering probe is applicable to be used in the range of flue gas temperature from the acid dew point (normally 150°C at maximum) to approximately 400°C, usually drain is not likely to form in the probe. However, in order to prevent filter tip from corroding by drain that forms around the flange or by acid drain that forms during furnace downtime, the probe should be tilted upward at from 10 to 15°.

● **Tilt the probe upward when the temperature of the flue gas falls within a range of 400°C to 800°C**

With the probe tilted downward, when the drain goes back to the furnace, the drain may be evaporated due to its exposure to the high temperature and could cause high readings of SO_2 and NO_x intermittently. Furthermore it could cause clogging in the probe. It is recommended that the probe should be tilted upward in principle.

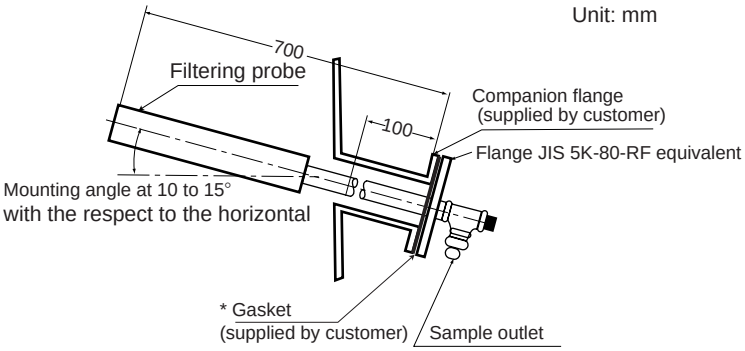
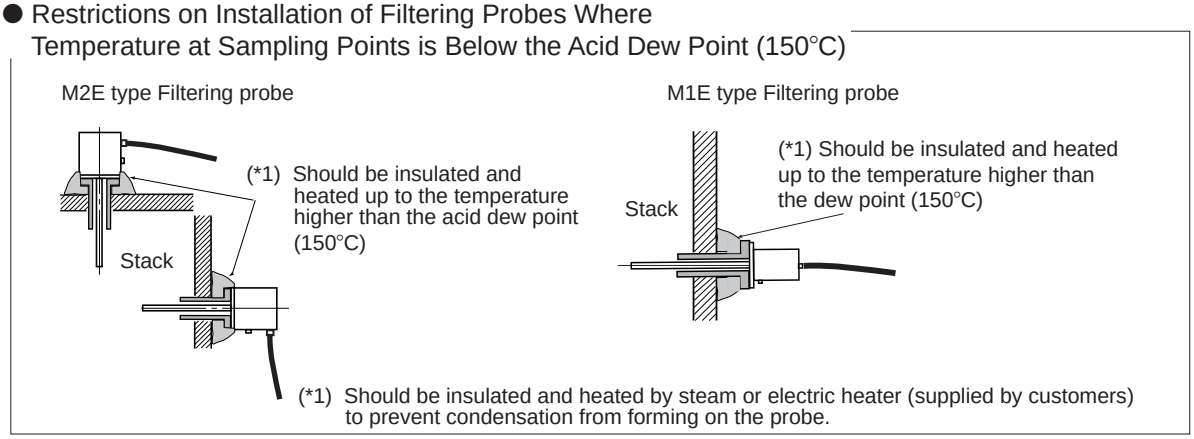


Figure 3.12 Typical Mounting of Type F Filtering Probe

● Restrictions on Installation of Filtering Probes Where Temperature at Sampling Points is Below the Acid Dew Point (150°C)



● Mounting the probe vertically from the top of the duct

This is not a recommended mounting method. In a short-term field-test, it happens to run the SO_2 and NO_x analyzers with a horizontal stack that already had a sample intake hole on the upper side of the stack. In this case the following cautions should be taken. Especially take extra care not to allow the drain to flow back to the stack, or keep the back flow as small as possible.

For the reason above, piping from the probe should be kept short in length and insulated until it reaches the top of the piping or heated with a steam trace or relevant equipment.

If a furnace is shut down frequently, insulation only at the probe outlet cannot prevent the probe from getting clogged. Therefore it is required to conduct purge (with dry air) in the probe during downtime.

In this case type F filtering probe is not applicable because of easy corrosion of the filter tip. Use type M2 or M3 open type probe in combination with the external primary filter.

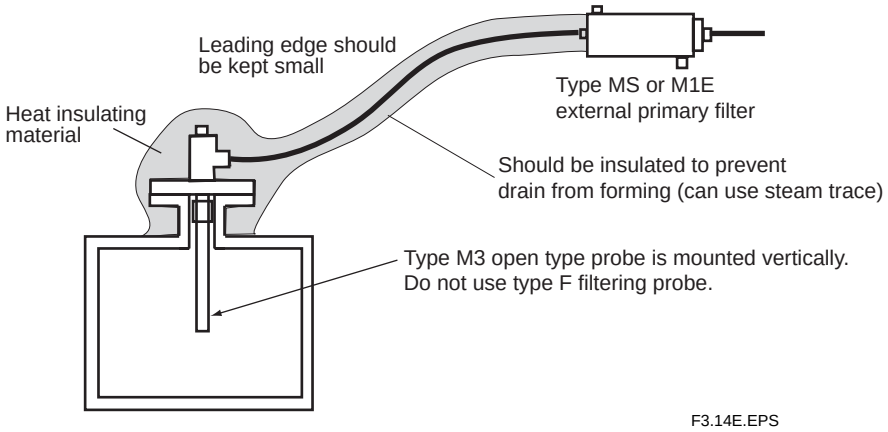


Figure 3.13 Vertical Mounting

3.7 Piping for Sampling

There are two critical points on sampling: elimination of dust and moisture.

To eliminate dust, the built-in filtering system incorporating a mist filter and a membrane filter can be used.

As for moisture, it is necessary that moisture in a sample gas should be condensed and eliminated before the sample gas goes into the analyzing system.

If a sample gas flowing through the heating sampling tube is not allowed to cool down (at least down to the temperature equivalent to the ambient temperature) before going into the analyzing system, drain and mist get condensed in the tube. They could clog the filter, resulting in problems such as drift. Allow the sampling gas to cool down by stripping off the last 2 m approximately of the outer covering of the heating sampling tube before the analyzing system.

● **Yokogawa's idea on sampling system of flue gas**

Allow the sample gas to cool down to the normal temperature before it goes into the analyzing system.

While other manufacturers employ a method that the sample gas is insulated until it reaches the analyzing system and drain is eliminated inside the analyzing system,

Yokogawa adopts a method of letting the sample gas cool down naturally and that drain is eliminated by an external drain separator. Yokogawa recommends a multi-step drain elimination method that is likely to reduce the dissolution loss of analyzed compounds in drain.

● **Recommendation to use a Teflon tube (ϕ10/ϕ8) for sampling piping**

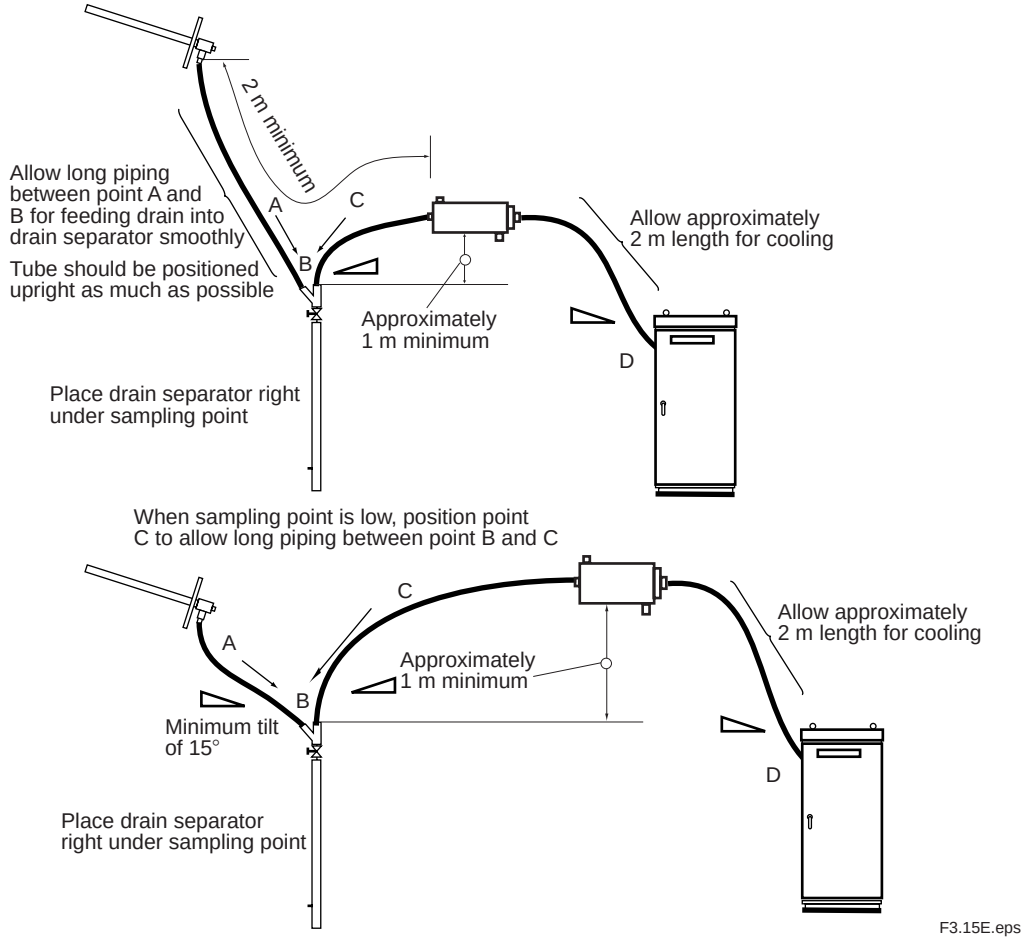
- Teflon tubes feature corrosion resistance and water repellency. Although there are options: polyethylene tubes and stainless tubes, they have some restrictions. Polyethylene tubes are suitable for indoor piping, but not for outdoor piping in terms of the weatherproof aspect. Stainless tubes require steam trace to avoid a risk of drain-caused corrosion and cannot be used for the whole of the piping, i.e. they should be partially replaced with Teflon tubes to eliminate drain in early stages. Piping should be conducted so that condensed drain in the Teflon tube can flow toward the external drain separator. This is the reason why the piping should be tilted greater than 15° and mounted without sagging. The figure below illustrates examples of its mounting. It is essential to prevent drain from standing in the tube from point C to point D, sample inlet to the analyzing system. For this, if necessary, the length of piping from point A to point C should be long.
- Allow a minimum length of 2 m for piping between point A-B-C. In general it is recommended that you allow long piping between point A and B to convert moisture in a sample gas into drain. When the sampling point is high, a better installation can be achieved by installing the external drain separator right under the sampling point with a tube of longer than 2 m. When the sampling point is low, position point C high to allow an adequate length of piping between point B and C.

● **Position point C at the top where the external thermal filter (Types M1E and MS) should be mounted**

The external filter is mounted to protect the external filter mesh from the high temperature, and to prevent corrosion of the filter mesh due to drainage at low temperature. From the latter standpoint, take care not to allow drain to flow into the external thermal filter. If drain forms in piping from point C to D, allow long piping between point B and C.

If long sampling pipe is needed, install the external drain separator near the probe.

● **Open-type probe + external drain separator + external primary filter**



● **Installation of two external drain separators when the SO_2 concentration is in a range of 500 to 1000 ppm**

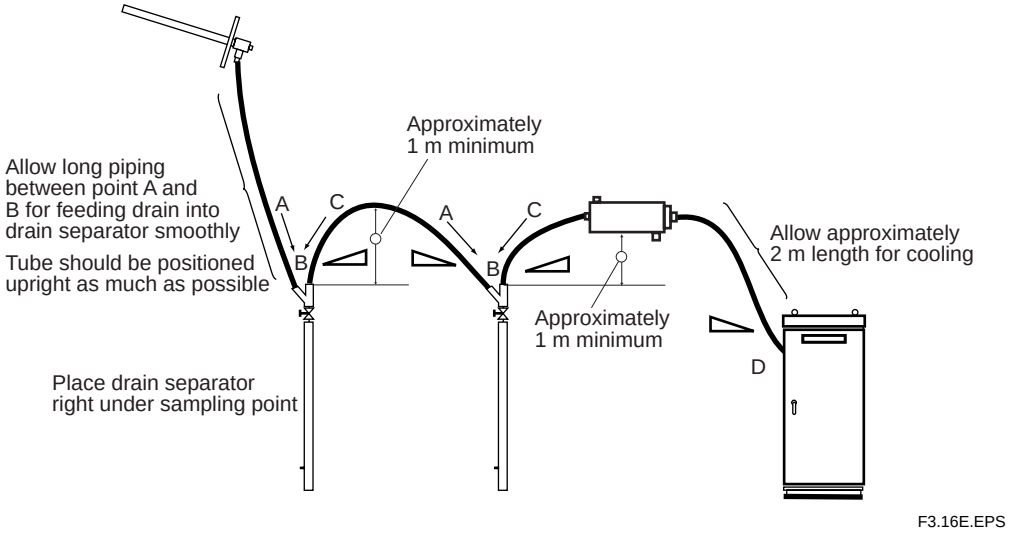


Figure 3.14 Piping for Sampling

See section 4 for piping procedures

3.8 Installation Procedures

3.8.1 Installation of SG700 Stack Gas Analyzing System

The stack gas analyzing system weighs approximately 350 kg. Lift four hooks on top of the analyzing system using a crane to install the analyzing system. Do not apply any excessive pressure on the analyzing system while moving it. Install the analyzing system on the horizontal surface with strong enough solidity and fix the cannel base with anchor bolts firmly. If the analyzing system is forced to be installed in a place affected by vibration, use vibration-proof rubber to protect the analyzing system from receiving vibration directly.

Wiring opening for cables to the analyzing system is located at the bottom of the analyzing system. Prior to the installation, make sure that there are no obstacles to wiring work.

3.8.2 Installation of Equipment for External Sampling System

● **Open type Probes and filtering probes**

Flanges of the open-type probes (types M2 and M3) and the type F filtering probe are all equivalent to the JIS 5K-80-RF standard, ones of the type M1E is to JIS 5K-80-FF equivalent, and ones of type M2E filtering probe is to JIS 10K-50-FF equivalent. Make a hole for the probe intake at the sampling point, place a companion flange on it, and fix the probe on the companion flange trough a gasket with 4 bolts.

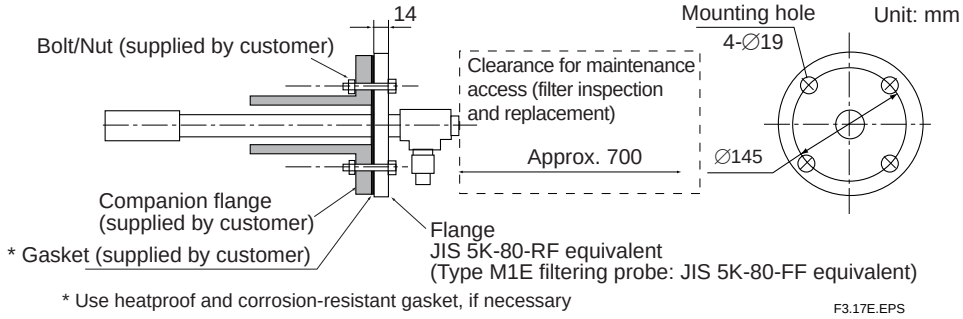


Figure 3.15 Mounting of Types F, M1E, M2 and M3 Probes

When using the type M3 open type probe, made of silicon carbide, install the probe almost vertically with the probe head facing downward. Secure a hole diameter of greater than 35 mm for the probe intake.
Do not apply mechanical shock during installing the type M3 open type probe, otherwise the silicon carbide-made probe may be damaged.
The M16 bolts are mounted on the type M2E filtering probe. Place the gasket between the companion flange and the probe flange, and fix the probe flange with nuts and washers (4 pairs).

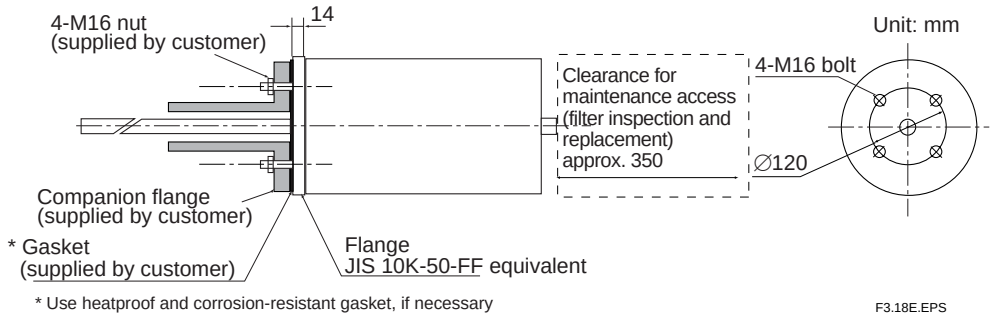


Figure3.16 Mounting of Types M2E Filtering probes

● External drain separator (K9641EA)

The external drain separator should be installed at lower position where the sampling tube to the drain separator can be tilted greater than 15° and direct sunlight should not be allowed. Using the accompanied saddle, fix the external drain separator on vertical surface of a structure.

The installation site should be free from freezing or covered by anti-freeze measures.

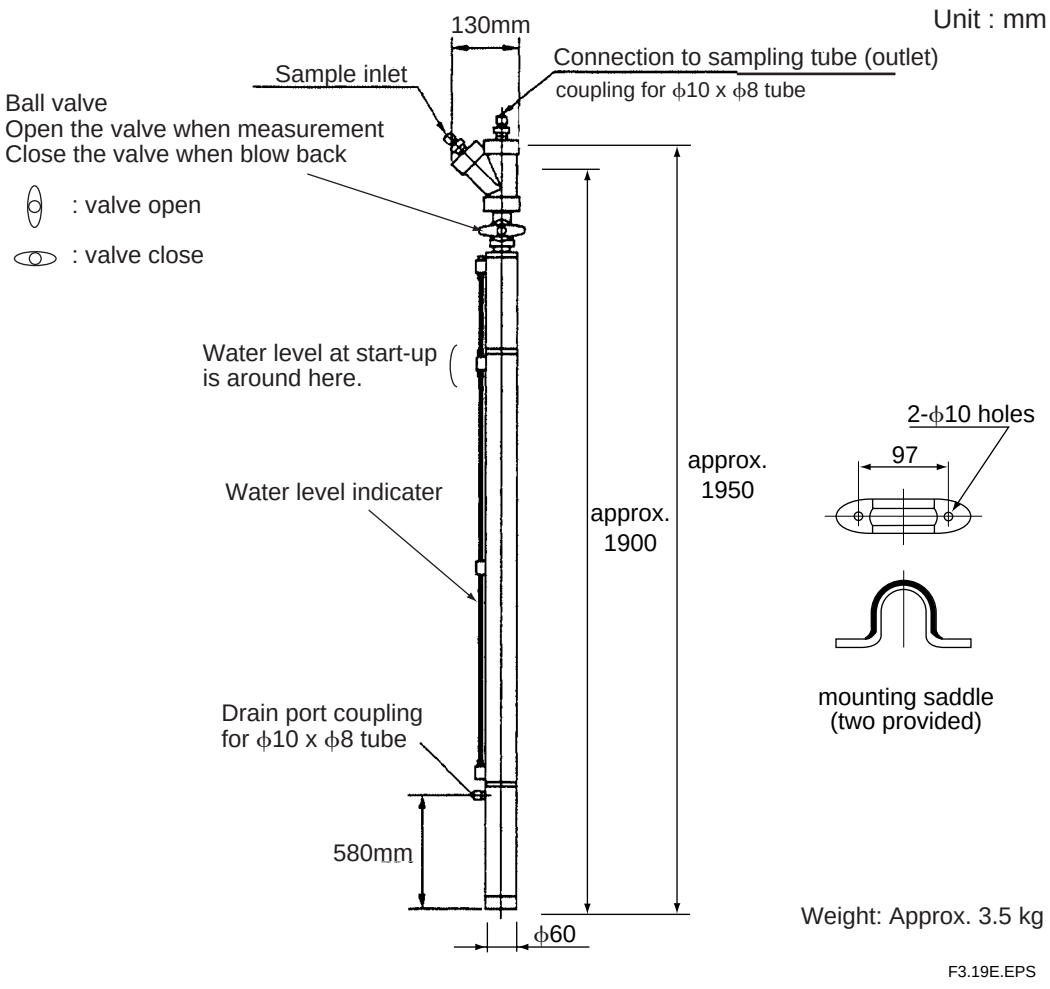


Figure 3.17 Installation of External Drain Separator

● External primary filter

The external primary filter, which is used in combination with types M2 or M3 open type probe, should be installed so that its sample inlet is aligned with its sample outlet horizontally and the height from the sample outlet of the external drain separator can be kept at least 1 m.

Allow a minimum length of 2 m for the sampling tube connecting to the analyzing system and a minimum tilt of 15° for the angle of the sampling tube. The electric wiring for power supply to the heater is required for the type M1E external primary filter. Conduct steam piping for the type MS external primary filter and mount a steam trap on the steam outlet.

The following illustrates how to fix the types M1E and MS external primary filters. The external primary filter should be mounted under a roof or covered by an awning to protect it from weather conditions.

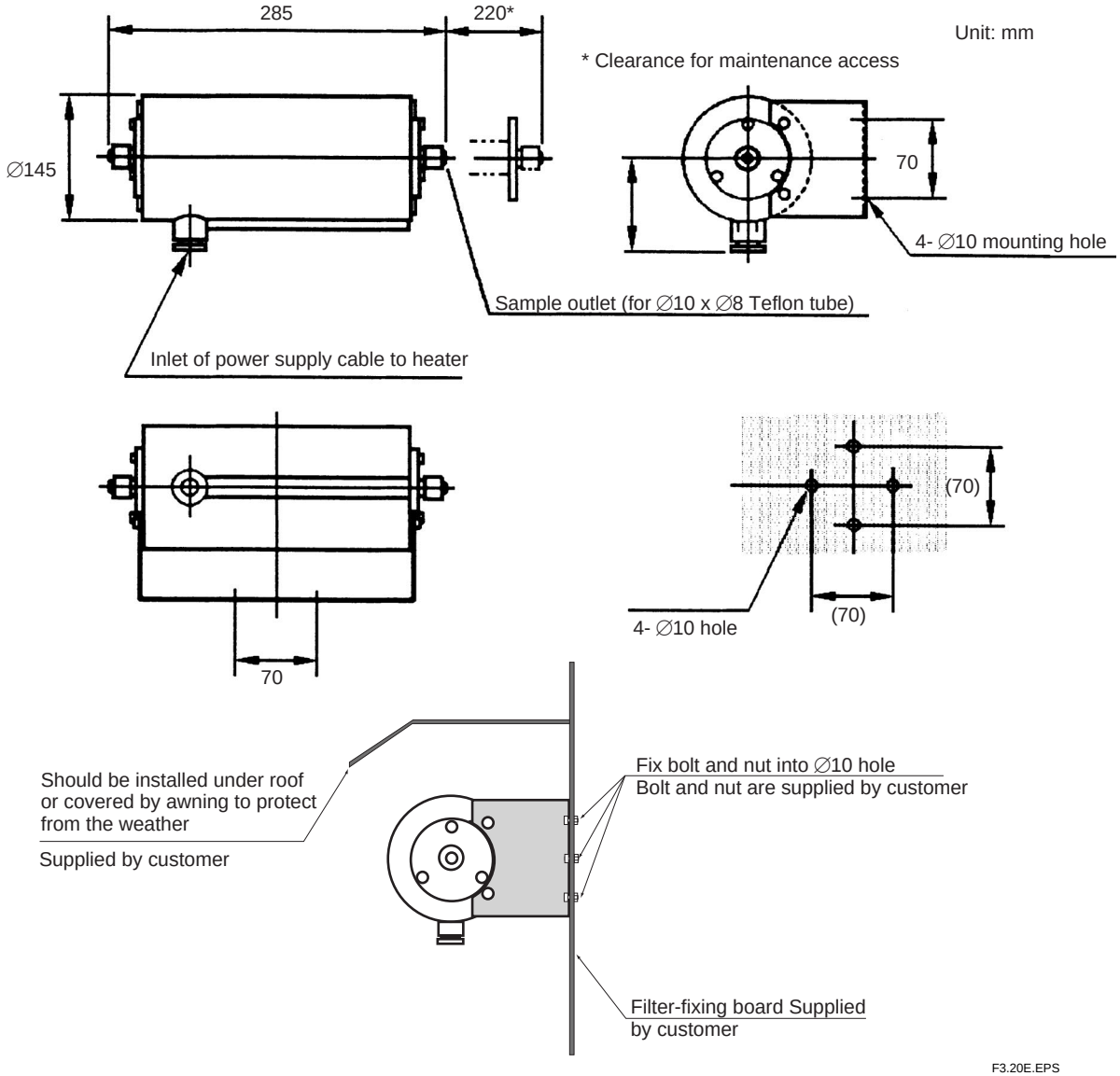


Figure 3.18 Installation Example of Type M1E External Primary Filter

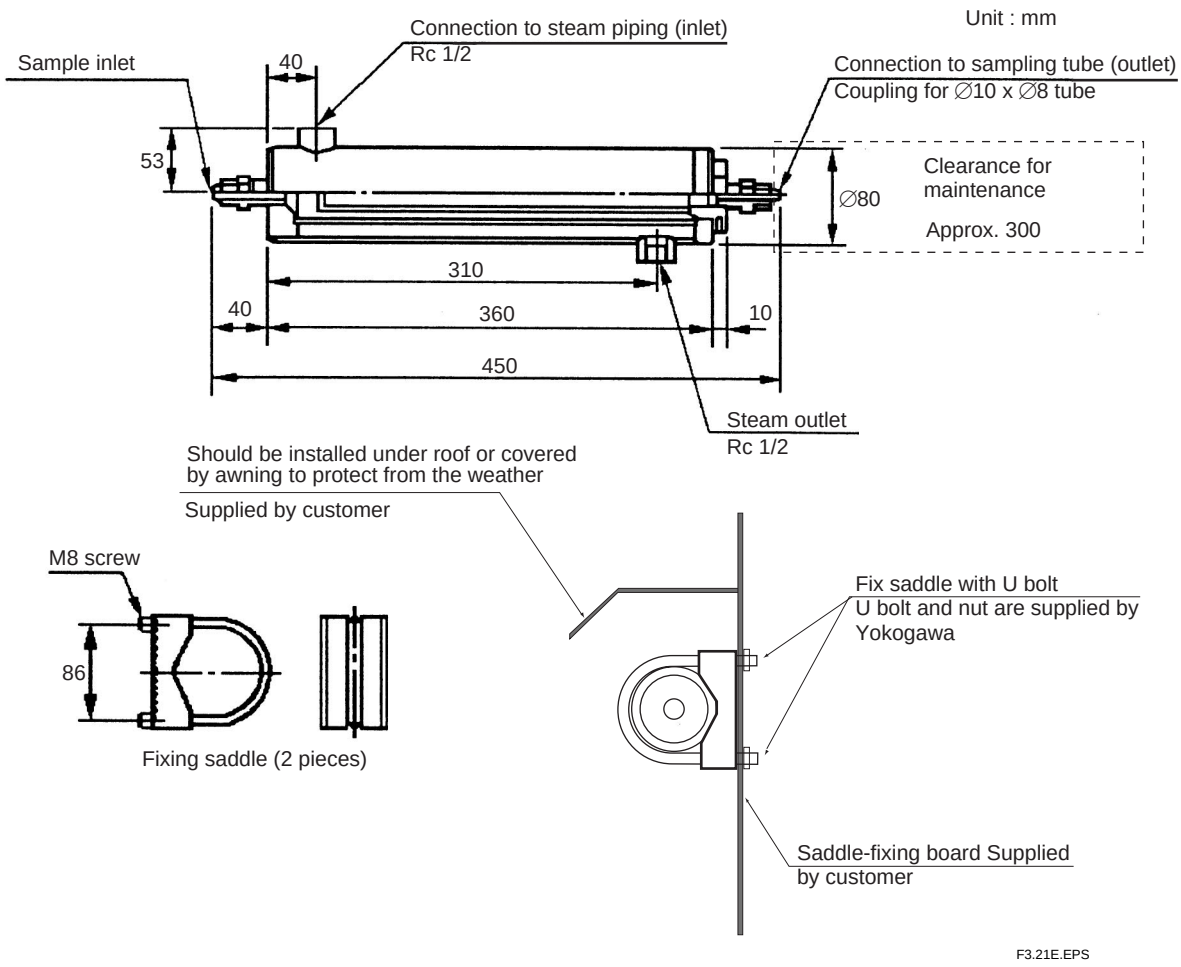


Figure3.19 Installation Example of Type MS External Primary Filter

● Sampling tube

There are two types for sampling tube: the general type and the cold-district version. The cold-district version of sampling tube, which can be heated electrically, is used in atmosphere where the ambient temperature falls under -5°C and drain could freeze in a sampling tube. When using the cold-district version of sampling tube (heating sampling tube), always allow a minimum length of 2 m of sampling tube immediately before the analyzing system for cooling a sample gas.

Usually construct supporting equipment and fix the sampling tube on this equipment to prevent the tube from sagging.

3.8.3 Installation of Calibration Equipment

Standard gas cylinders and pressure reducing valves (parts number : L9850BA) mounted on these cylinders are calibration equipment. The required number of them differs according to the specifications.

Standard gas cylinders are housed in rear side of the analyzing system cabinet. They are shipped individually. Upon delivery, first make sure that their compounds and concentration are identical with what is specified, and then house them into the analyzing system cabinet.

Six gas cylinders at maximum can be housed and there are no restrictions for housing positions. However, to avoid handling mistakes, it would be useful that the positions of cylinders are previously decided, e.g. from the left, dry air-sealed cylinder for zero calibration of the oxygen analyzer/infrared analyzer, standard gas cylinder for span calibration of component 1, standard gas cylinder for span calibration of component 2, standard gas cylinder for span calibration of component 3, standard gas cylinder for span calibration of component 4, standard gas cylinder for span calibration of the oxygen analyzer.

Cylinders housed must be fixed with chains to avoid falling down.

4. PIPING

The piping system for the stack gas analyzing system is divided into three types.

(1) Piping for the external sampling system
(2) Piping for exhaust gas and drain
(3) Piping for calibration gases

This chapter explains how to conduct the piping. Refer to Section 3 as well as to the piping for the external sampling system (installation of sampling tubes). The following illustrates an example of piping for the system using the heating sampling tube.

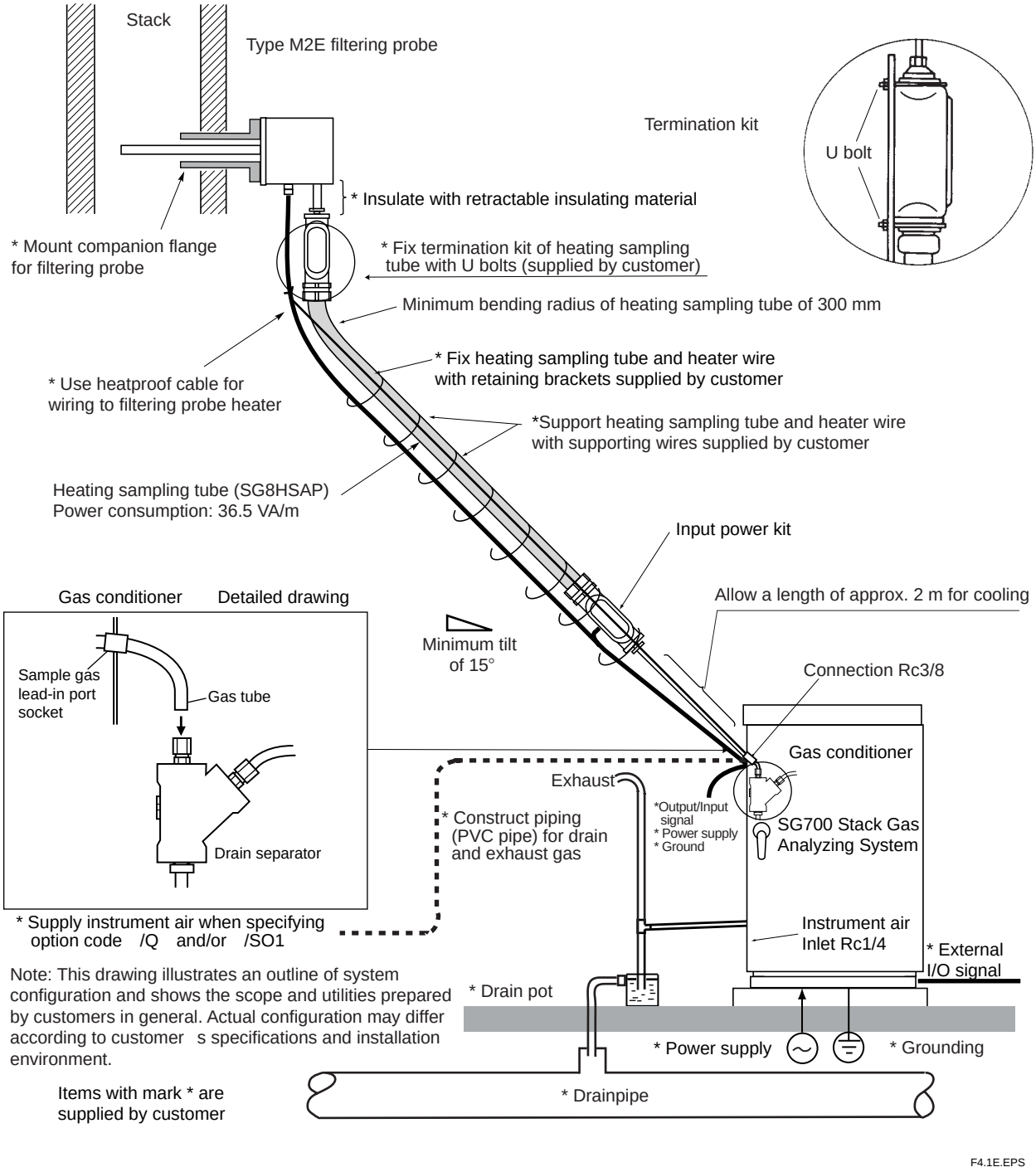


Figure 4.1 Installation of System Using Heating Sampling Tube

4.1 Piping for External Sampling Systems

This section explains how to install piping for the sampling tube from a sampling point to the stack gas analyzing system. Read Section 3.7, Piping for Sampling, as well.

4.1.1 Installation of Sampling Tubes

A sampling tube is installed from the probe, installed at a sampling point, to the analyzing system through some external equipment like a drain separator.

There are two types for sampling tube: the general type (ϕ 10 x ϕ 8 mm, polytetrafluoroethylene) and the cold-district version. The cold-district version is a sampling tube heated with electricity and used where condensed water may freeze in the sampling tube. When using the heating sampling tube, conduct the termination treatment referring this manual.

A coupling for the tube (ϕ 10 x ϕ 8 mm) is equipped with the connection to sampling tube on each equipment. The sampling tube should be connected without any leakage. Refer to Section 3.7, Piping for Sampling, for installation procedures of the sampling tube.

● **Precautions on installation of the sampling tube**

Do not allow condensed water to stand, dust to accumulate, and condensed water to freeze in the sampling tube in winter. The sampling gas must be cooled down to below 40ºC before it reaches the analyzing system. Secure easy access to the probe for maintenance.

● **Installation of the heating sampling tube**

Where drain in the sampling tube may freeze in cold places and the SO_2 concentration in the sample gas is below 100 ppm, the heating sampling tube is used. Mount an input power kit (for electric supply) and a termination kit (for termination), accompanied with the heating sampling tube, in a field. Refer to Section 4.1.3 for termination of the heating sampling tube.

4.1.2 Piping for Steam Heating

This piping should be installed only when the type MS external primary filter is used. Piping requires saturated steam of 100 to 300 kPa. Connections of piping are Rc1/2 for both inlet and outlet. The steam outlet of the type MS external primary filter must be positioned downward. Install a steam trap (supplied by customer) on the outlet side of the piping.

4.1.3 Termination of Heating Sampling Tube

● **Overview**

(1) Configuration

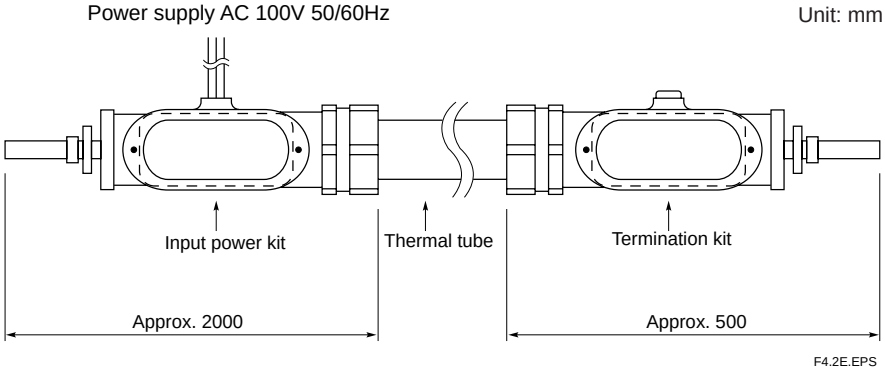


Figure 4.2 Heating Sampling Tube

(2) Precautions on installation of piping of the heating sampling tube

- The distance between clamp supports should be approximately 1.2 m horizontally and approximately 3 m vertically.
- When bending the piping, allow a minimum bending radius of 300 mm.

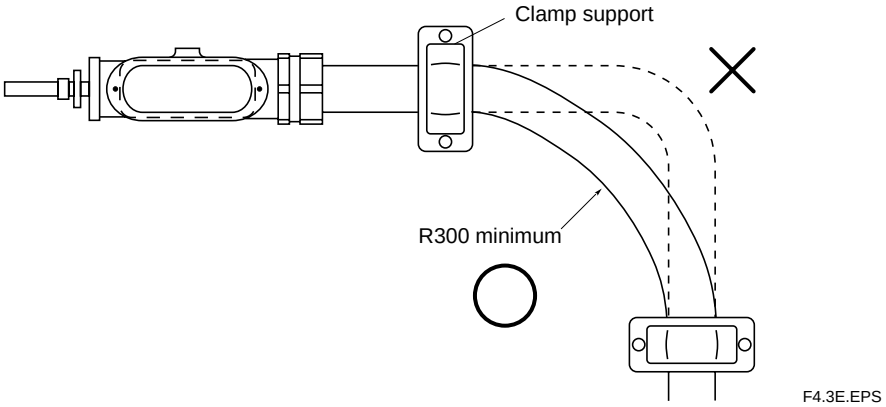
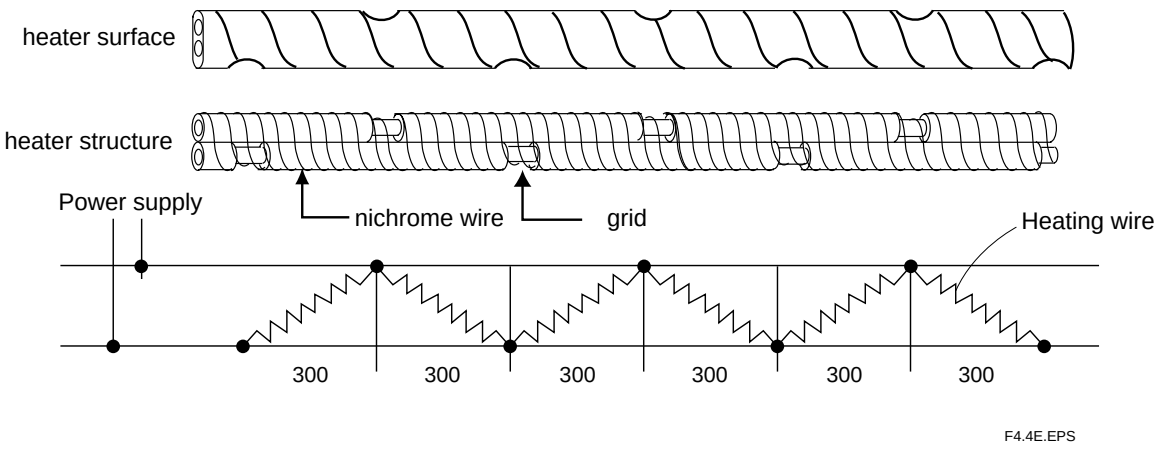


Figure 4.3 Installation of Heating Sampling Tube

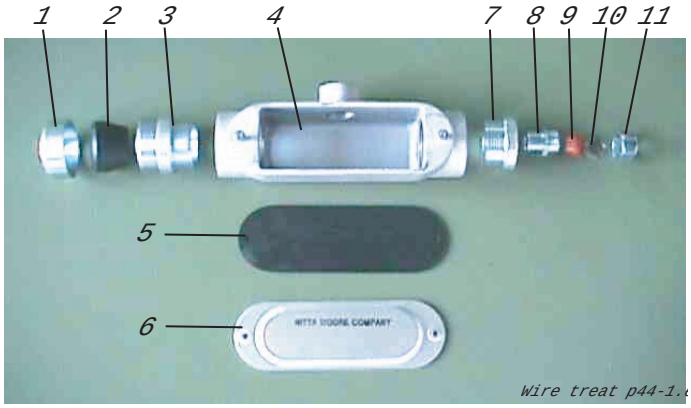
(3) Connection diagram

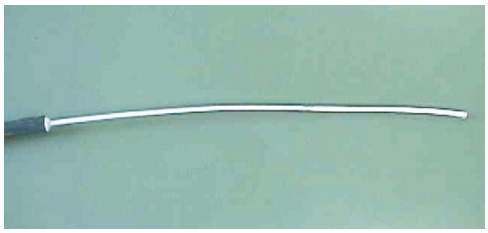
The two individually insulated cores are wound with a heating wire, which alternately contacts with one core and another at intervals of 300 mm. (heating unit)



● Termination procedure

(1) Input power kit side

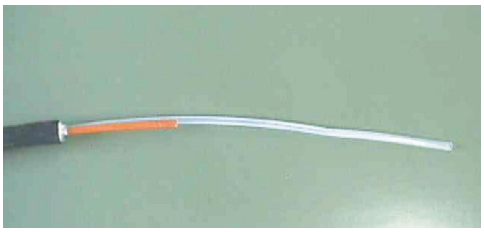




1. Remove PVC cover and thermal insulation
   Length to be removed: (200 + L) mm, where
   L is distance from input power kit to process piping connection.
   Taking care not to nick process piping or heater, cut a slit in the sheath with a cutter and tear sheath by hand.

3. Expose about 50 mm of heater at free end of cable. Use crimp-on sleeve to connect golden lead wires to power supply leads. Insulate end of crimp-on sleeve and end of nichrome heater wire with heatproof tape.

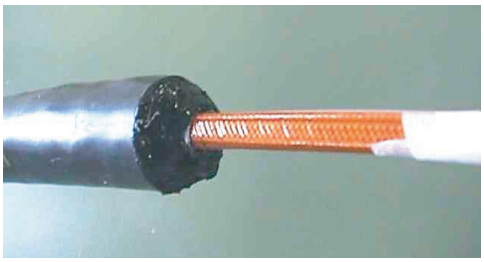
Wire treat p44-2.eps



2. Remove insulating tape, and cut heater wires about 120 mm from end.

4. Pass piping bundle through (1) gland nut and (2) sealing bush.

Wire treat p44-3E.eps



5. To discourage water or corrosive gas from entering the end of the piping bundle, paint end with sealant. It takes 24 hours for the sealant to dry completely, so after painting do not move it for 24 hours.

8. Pass the bundle through the connector body (8) on the process piping, the sealing bush (9), washer (10) and nut (11), then securely tighten the bundle-side gland nut.

Wire treat p45-1E.eps

6. Wrap (3) connector body and (7) reducer with sealing tape, then screw up connection box (4).

9. Close the gasket (5) and cover (6).

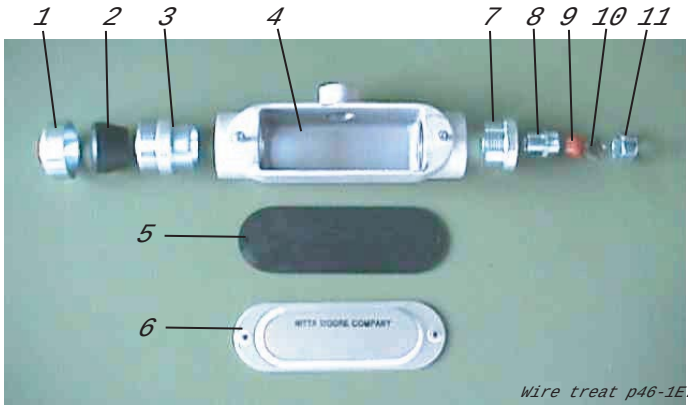
Wire treat p45-2E.eps

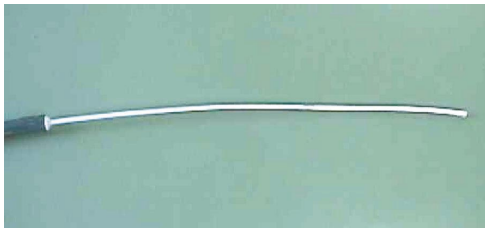
7. First pass process piping and power supply wiring, then push bundle into connection box. The power supply wiring is bent and fed out , but the heater and its connection should not be bent.

10. Securely tighten screws on cover.

Wire treat p45-3E.eps

(2) Termination kit side

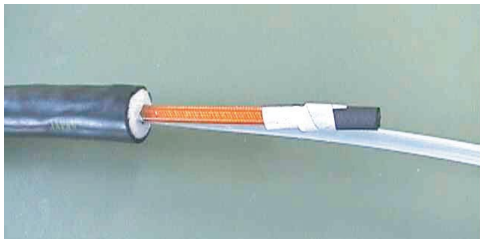




1. Remove PVC cover and thermal insulation
   Length to be removed: (200 + L) mm, where
   L is distance from input power kit to process
   piping connection.

3. Pass piping bundle through (1) gland nut and (2)
   sealing bush.
   Paint end of bundle with sealant.

Wire treat p46-2E.eps



2. Remove insulating tape, and cut heater wires
   about 80 mm from end.
   Attach terminals as described in manual.

4. Pass process piping and bundle in turn into
   connection box (4). The power supply wiring is
   bent and fed out , but the heater and
   its connection should not be bent.

Wire treat p46-3E.eps

5. Attach tightening hardware (1) to (3) and (7) to (11)
   on bundle side and process piping side, attach gasket
   (5) and cover (6) and screw cover tight.

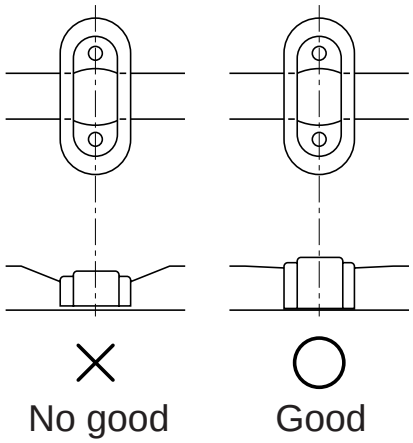
● **Check after completing piping:**

Make sure that:

- When a heated pipe is used, visually check that it has not been crushed or damaged by over-tightening supporting clamps.
- Check that minimum recommended bend radiuses have been observed.
- Check that electrical connections are secure.
- Check that heater wiring terminals are not shorted together.
- Check that all parts of the supplied connection kit were used, i.e. nothing is left over.
- Check that all screws of the connection kit have been securely tightened.

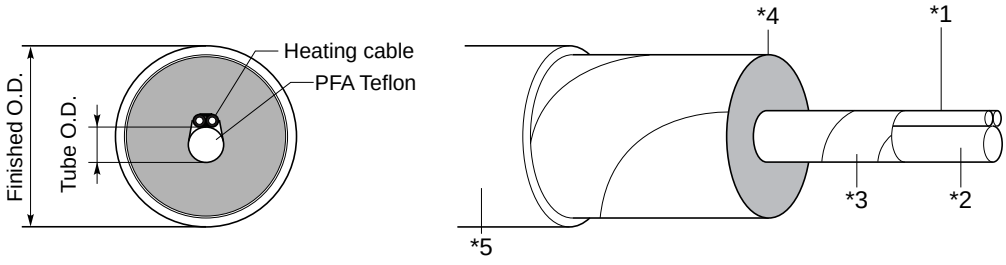
● **Clamp support**

Use clamps intended for electrical conduit. For external dimensions of the heated pipe, refer to Sec. 2.2.4. Be careful not to apply excess force such as to crush the pipe.



F4.5E.EPS

● **Specification of tube trace**



F4.6E.EPS

- 1 Heating cable (Power limiting cable)
- 2 Process tube
- 3 Aluminum tape
- 4 Fiberglass insulation
- 5 PVC jacket

4.2 Piping for Exhaust and Drain

This section describes piping for a gas outlet and a drain port, both located at low side of the analyzing system. Piping is constructed for the drain port of the external drain separator, if necessary.

CAUTION

Exhaust gas and drain may contain noxious substances. They should be treated in accordance with local environmental control regulations.

4.2.1 Piping for Gas Outlet

Exhaust gas from the analyzing system contains drain. A drain pot must be installed to trap water in the exhaust gas piping.

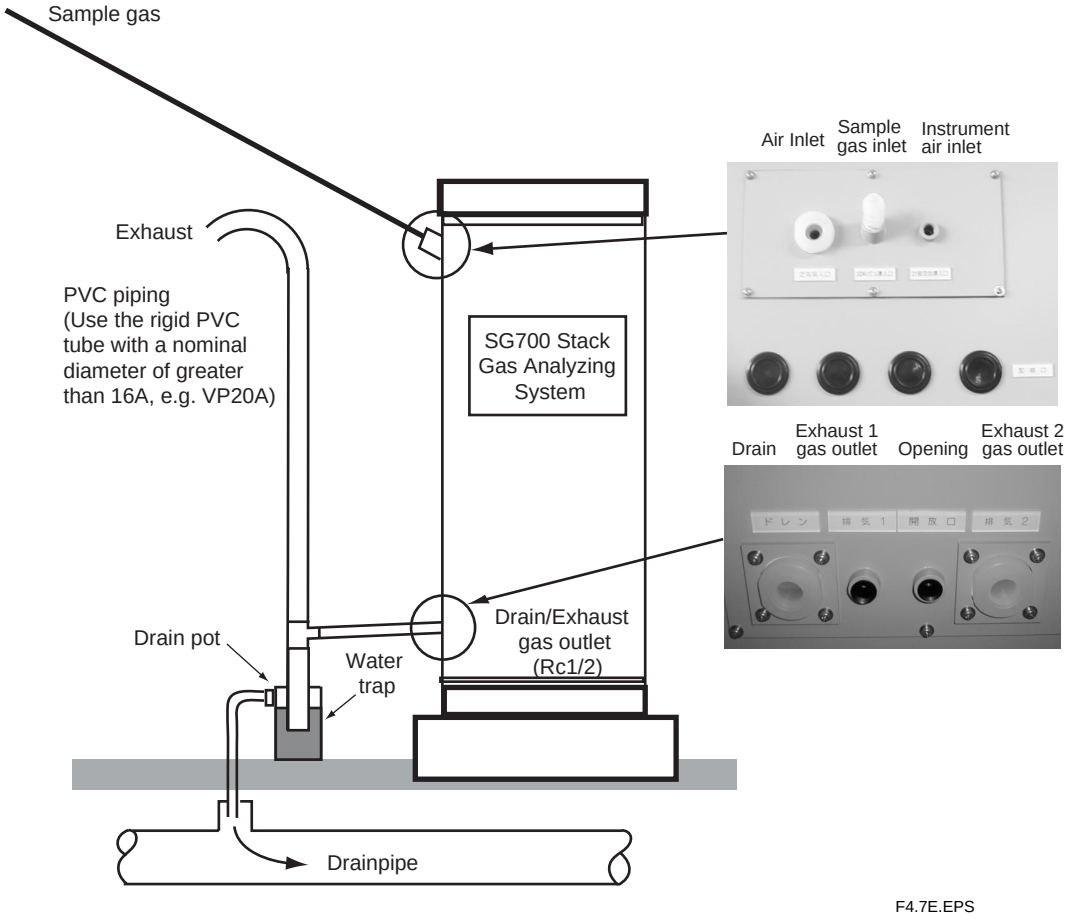


Figure 4.4 Example of Piping for Gas Outlet

Use the pipe with as wide diameter as possible (nominal diameter of 16A, PVC tube, etc.) for exhaust piping.

4.2.2 Piping for Drain Port

The piping connection is Rc1/2. Use an appropriate material to this connection for piping to feed drain to a drain pot. Insulate the drain pot if drain in it may freeze.

4.2.3 Piping for Drain Port of External Drain Separators

Condensed water flowing from the sampling tube to the external drain separator overflows and come out from the drain port. Construct the piping to feed the drain to a specified disposal place, if required.

A coupling for the tube (ϕ10 x ϕ8 mm) is attached on the drain port. Construct the piping using a polyethylene resin tube or relevant tubes.

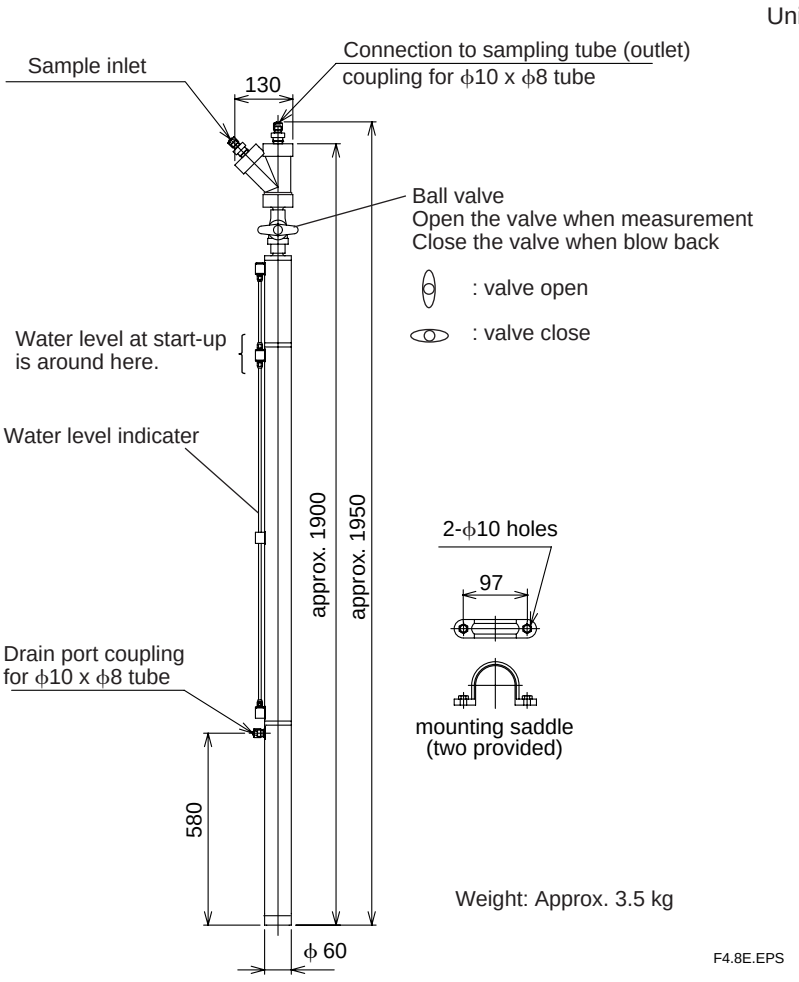


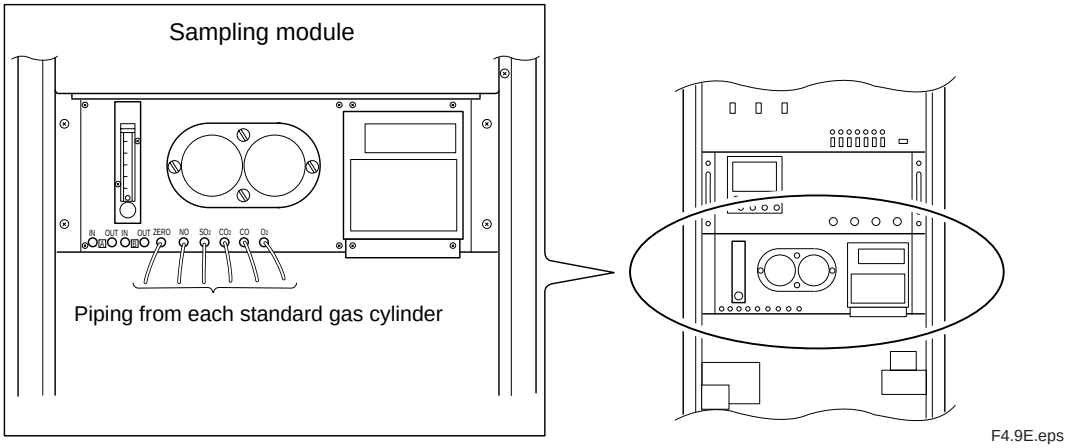
Figure 4.5 Piping for Drain Port of External Drain Separator

4.3 Piping for Calibration Gas

The specified piping (preinstalled) should be connected to appropriate standard gas cylinders housed in the analyzing system cabinet. When instrument air is used for span calibration of the oxygen analyzer, construct the piping from the air source to the analyzer.

4.3.1 Piping Connections to Standard Gas Cylinders

(1)Install the standard gas cylinder in the lower section of the analyzer locker. The number of cylinders depends on the number of components and the type of zero gas.
(2) Attach a polyethylene tube (ϕ 6/ϕ 4mm) at the automatic calibration standard gas inlet of the sampling module. Then, cut the polyethylene tube at a proper length not so as to contact a space heater (option)
(3) Install pressure regulators at the gas cylinders.



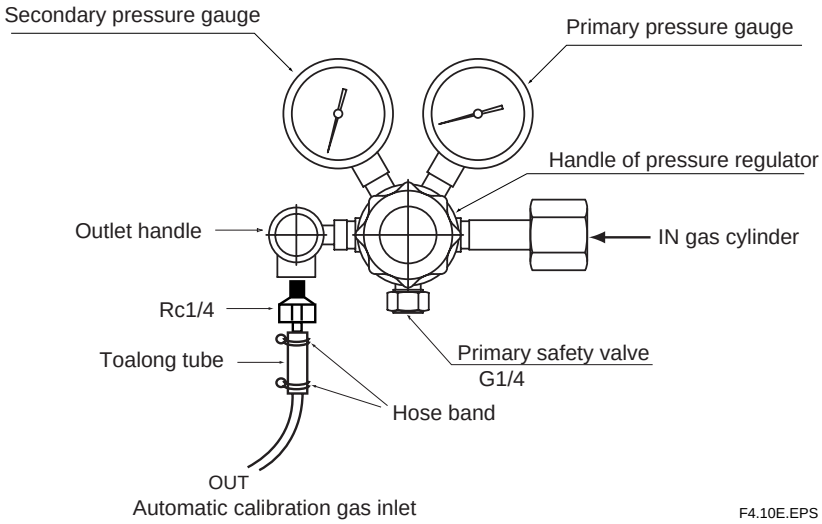


Figure 4.6 Pressure Reducing Valve for Gas Cylinder

WARNING

Make piping connections so that the standard gas will not leak, especially using a CO gas for a calibration gas. DO NOT make a mistake in handling.
Otherwise, you may get poisoned.
Turn on the fan to flow out the gas from the cubicle even if any leaks are present.

To install the standard gas cylinder pressure regulator, follow these steps:

1. Clean the gas cylinder connections to prevent dust from entering the pressure regulator.
   If any dust gets inside, the standard gas will leak.
2. Check the rubber packing inside the cylinder-mounting nut .
   If the packing is damaged, replace it with new packing.
3. With an appropriate wrench, attach the nut to the gas cylinder and tighten it completely.
4. Attach the supplied joint to the pressure regulator outlet where the corresponding tube through which the "Toalon-G" tube is connected. Secure both ends of the Toalon-G tube with hose bands.
5. Loosen the secondary pressure adjustment knob and then the outlet flow adjustment knob.
6. Open the gas cylinder valve and check that the primary pressure indicates the cylinder gas pressure.
7. Turn the secondary pressure adjustment knob clockwise to increase the secondary pressure until the associated pressure gauge indicates 30 kPa. If the outlet pressure adjustment knob is loosened, the cylinder gas will try to vent to the outside; however, the calibration solenoid valve remains closed, so the gas will not flow out. In practical use, first carry out the operations to cause the calibration gas to flow. Then check that the secondary pressure is normal.

4.3.2 Piping for Instrument Air Supply

The instrument air can be used for calibration of the zirconia oxygen analyzer, if specified (specified by the option code “/Q”). When using the stack gas analyzing system under this specification, connect the piping from the air source to the inlet of the instrument air of the analyzing system. If the SO_2 concentration falls in the range of 500 to 1000 ppm and the option code “/SO1” is specified, the instrument air (approximately 1 L/min) is required for the permapure dryer.

The inlet connection of the instrument air is Rc1/4. Use a ø6 x ø4 mm copper tube (or stainless steel tube) for piping. An air regulator is accompanied in the stack gas analyzing system.

5. WIRING

This chapter explains installation procedures of wiring for the SG700 Stack Gas Analyzing System.

The wiring for the SG700 is divided into main two types: the power wiring and the signal wiring. Wiring materials and installations to a duct/pit should be conducted differently for the power and signal wiring. Refer to the table below for cable materials. Note that heatproof cables are required for the power wiring to the heater for the filtering probe and the primary filter. Required wiring types vary depending on specifications. Prior to the installation make sure of required wiring types. Based on the requested specification, only required terminals for the external wiring on the stack gas analyzing system are provided.

● **Power wiring**

(1) Power and ground wiring for the analyzing system
(2) Power wiring to the heater for the filtering probe
(3) Power wiring to the heater for the external primary filter
(4) Power wiring to the heater for the heating sampling tube, used in cold districts

● **Signal wiring**

(1) Wiring for signal output wires for each component (instantaneous value, moving average, etc.)
(2) Wiring for output signal corresponding to reference O_2-based value
(3) Wiring for alarm contact output
(4) Wiring for contact input/output of remote range switching and range identification
(5) Wiring for contact output for failure, under-maintenance and under-calibration
(6) Wiring for contact input/output of automatic calibration start command and automatic calibration failure
(7) Wiring for contact output of power-off

Table 5.1 Types of Cable Material

Power line to analyzing system, power line to thermal sampling tube	600-IV wire, diameter 2 to 5.5 mm^2
External input/output signal line	600-IV wire, diameter 0.5 to 0.9 mm^2 (*1)
Earth line	600-IV wire, diameter 2 to 5.5 mm^2
Power line to heater for filtering probe and primary filter	Heatproof wire equivalent to JIS C3323-KGB

(*1) Use shielded cables for signal lines. The assignment order of signals on the terminal board is not fixed. Before constructing wiring, confirm the positions and polarity of the signal assignment by terminal marks marked on the terminal board.

T5.1E.EPS

■ Wiring Work for Stack Gas Analyzing system

Open the door of the cabinet, feed the cables through the opening at the side, and screw them on the terminal board. Construct the power line and the signal line separately using, if necessary, a separator between them.

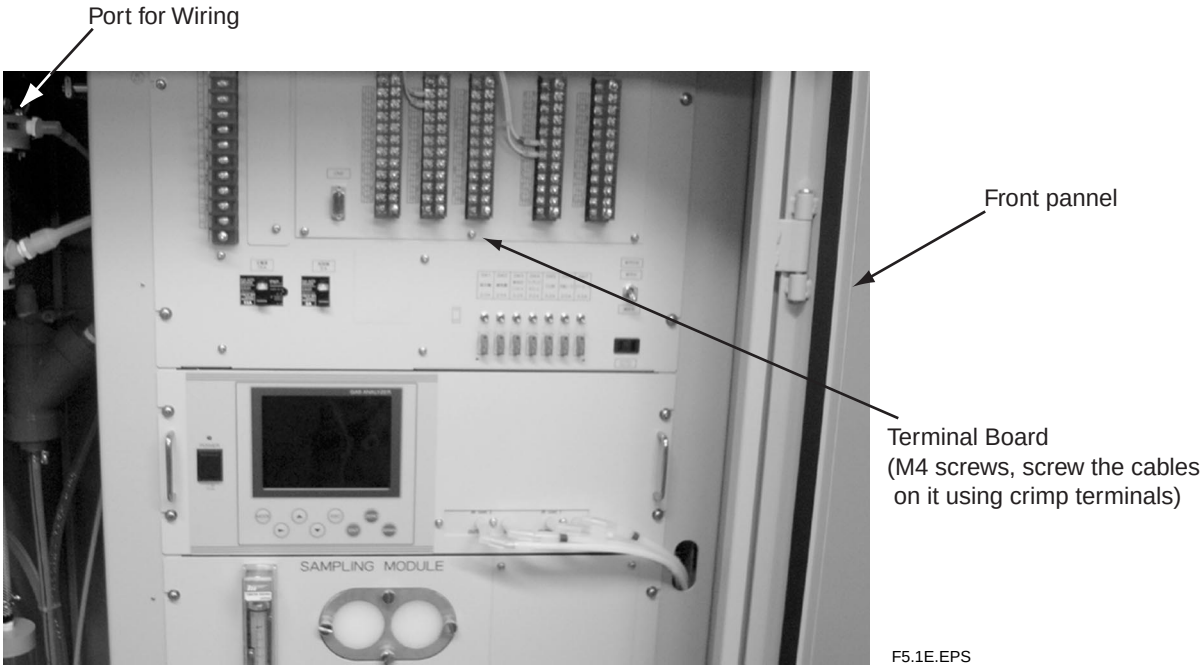


Figure 5.1 Wiring Work for Stack Gas Analyzing system

■ Wiring for Outdoor Installation

For outdoor installation, use waterproof glands (not supplied by Yokogawa) at the inlet ports when running cables to the analyzer. As shown in the figure below, run a cable through a waterproof gland and tighten it. When using a conduit, an appropriate fitting should be used.

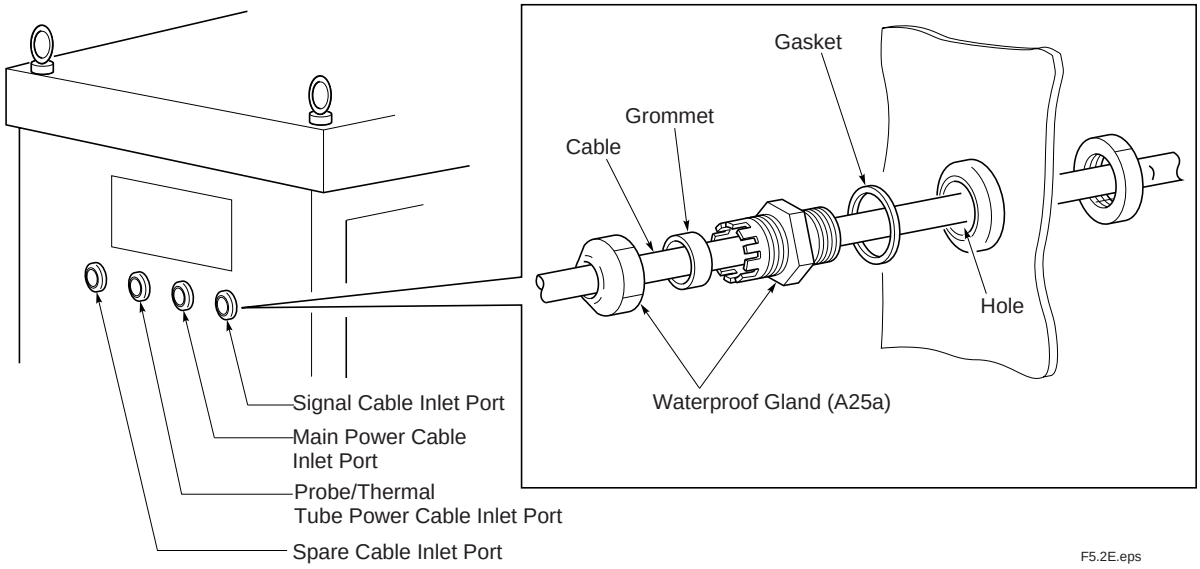


Figure 5.2 Wiring Connections via Glands

CAUTION

- Ask a qualified contractor or a salesperson for wiring construction. Improper wiring construction may result in electric shock, injury and malfunction.
- JIS Class D (100V or less) ground is required for grounding of the analyzing system. A grounding construction that is out of specification may result in electric shock and malfunction.
- In wiring work, first conduct wiring for protective ground. Prior to wiring, turn off the original power, otherwise there may be the hazard of electric shock.
- The use of improper wiring materials may result in electric shock and malfunction.
- Use a grounding wire with insulation resistance of greater than 2 mm^2 of 600V-IV wires.
- Use the rated power supply. The use of power that is different from the rated one may result in fire.
- Select a wire diameter on the rated current of the gas analyzing system for input/ output wiring. The use of wiring materials which is out of the rated one may result in fire.
- Always use crimp terminals for the connection to the input and output terminal board.
- Fix the input and output wiring on a floor or a wall and use guards for wiring.
- Keep the power supply of the analyzing system away from such waveform-disturbing equipment as a high-frequency furnace and an electric welder, and avoid a concurrent use of the same powering system as theirs.

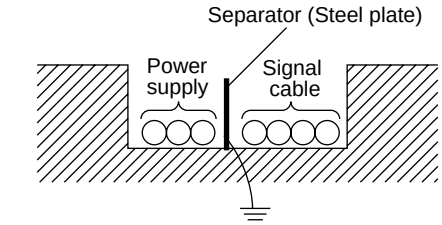


Figure 5.3 Example of Wiring Construction

5.1 Wiring for Stack Gas Analyzing System

External wiring terminals of the stack gas analyzing system are located on the rear side. The terminal thread is M4 & M3.5. Use appropriate crimp terminals to this thread for the termination of cables. The cables can be introduced from the bottom of the stack gas analyzing system cabinet through the wiring opening.

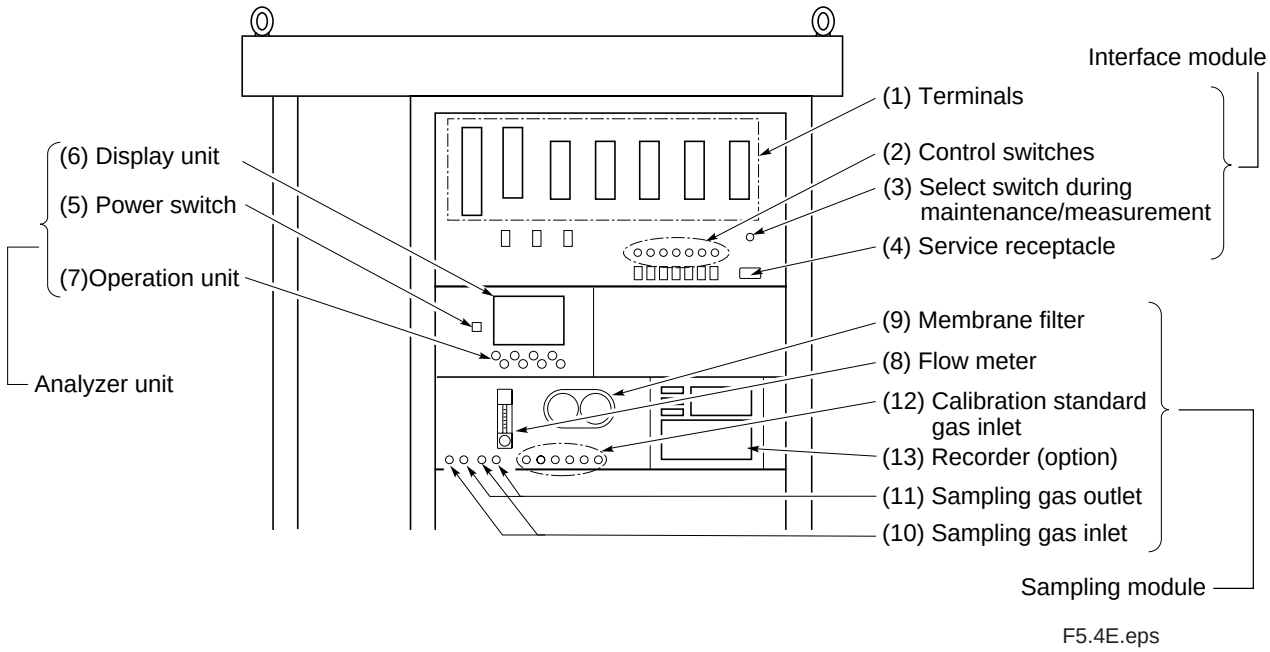


Figure 5.4 Name of Each Component

External Terminal Cnnection Diagram

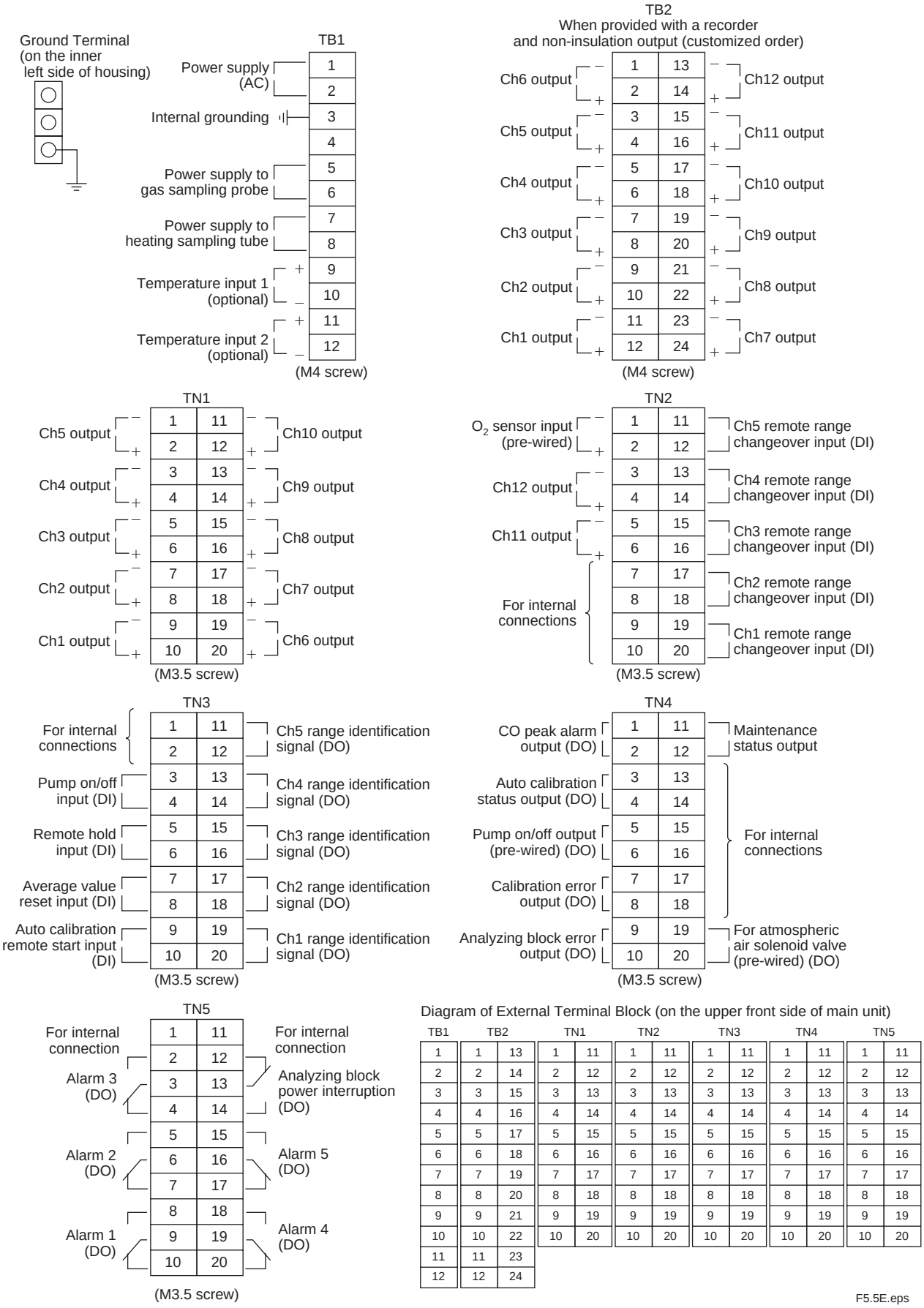


Diagram of External Terminal Block (on the upper front side of main unit)

TB1	TB2		TN1		TN2		TN3		TN4		TN5	
1	1	13	1	11	1	11	1	11	1	11	1	11
2	2	14	2	12	2	12	2	12	2	12	2	12
3	3	15	3	13	3	13	3	13	3	13	3	13
4	4	16	4	14	4	14	4	14	4	14	4	14
5	5	17	5	15	5	15	5	15	5	15	5	15
6	6	18	6	16	6	16	6	16	6	16	6	16
7	7	19	7	17	7	17	7	17	7	17	7	17
8	8	20	8	18	8	18	8	18	8	18	8	18
9	9	21	9	19	9	19	9	19	9	19	9	19
10	10	22	10	20	10	20	10	20	10	20	10	20
11	11	23										
12	12	24										

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5.1.1 Power and Ground Wiring

The power applied to the stack gas analyzing system is distributed to each instrument through the circuit breaker of the 15A rating. Total power consumption of whole instruments is approximately 600 to 1000 VA. When the type M1E filtering probe or the M1E external primary filter is used, it takes about 80 VA (for 100V power supply) additionally for the heater power. When M2E filtering probe is used, it takes about 130 VA (for 100 V power supply) additionally for the heater power. The stack gas analyzing system is equipped with a receptacle (maximum current of 2A) for the convenience in maintenance.

In the use of the heating sampling tube, the heater requires the power of about 36.5 VA per meter (for 100V power supply), which is supplied through a circuit breaker installed separately.

For the power wiring, use an appropriate cable with a sufficient diameter to the power consumed. The cable should have 3 cores (or 2 cores shield), two of which should be connected to the power terminals, and the rest core (or shield) to the grounding terminal. This core (or shield) is grounded with the Class D grounding (JIS Class 3 grounding, grounding resistance: 100Ω maximum) on the power supply side.

The stack gas analyzing system houses a cubicle grounding terminal. Ground the cubicle with the Class D grounding (JIS Class 3 grounding, grounding resistance: 100Ω maximum) by connecting the grounding wire to the terminal.

5.1.2 Wiring for Output Signal

This is to transmit the output signal of 4-20 mA DC or 0-1 V DC corresponding to measured values of the infrared analyzer (components 1 to 4) and of the oxygen analyzer and to O_2 corrected instantaneous value output and O_2 corrected average output to an external receiver. (Note)

The analyzing system converts a measured value of the infrared analyzer into the concentration of the component corresponding to the reference oxygen concentration and releases it as a transmission signal (4-20 mA DC or 0-1 V DC) .

A measured value of the infrared analyzer (components 1 to 4) is sampled at a certain period. The data sampled are accumulated for the specified time (1 to 59 minutes or 1 to 4 hours) and averaged. The averaging is conducted subsequently as sampling a new data and discarding the oldest data.

Use a shielded cable with 2 to 6 cores, according to the number of the output signal to be transmitted externally, for wiring for the output signal. The shield of the cable is grounded at the receiver side. The allowable load resistance for 4-20 mA DC is 550Ω for non-isolated signal and 750Ω for isolated signal. For the channel numbers and output items, see Table 5.2.

Note

With the analyzing system with the option of built-in recorder, taking out the output signal that has been transmitted to the recorder should be handled as a customized order. Terminal codes also changes accordingly.

5.1.3 Wiring for Remote Range Switching Input

The stack gas analyzing system can feature a function of switching the first and second ranges of the infrared analyzer (components 1 to 4) and the oxygen analyzer.

- The first range is selected when the input is shorted and the second range is selected when the input is open.
- For the channel numbers and output items, see Table 5.2.
- The channel number in a remote range input is effective only when it corresponds to an instantaneous value. The corrected value is linked with the range of instantaneous value.

Table 5.2

Suffix Code		Output Channel											
Measurable Component	O_2 Analyzer	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch10	Ch11	Ch12
– A	– N	SO_2											
– B	– N	NO_X											
– C	– N	NO_X	SO_2										
– D	– N	CO											
– E	– N	CO_2											
– F	– N	CO_2	CO										
– G	– N	NO_X	CO										
– H	– N	NO_X	SO_2	CO									
– J	– N	NO_X	SO_2	SO_2	CO								
– A	– 1, – 2	SO_2	O_2	Corrected SO_2	Corrected SO_2 average	O_2 Average							
– B	– 1, – 2	NO_X	O_2	Corrected NO_X	Corrected NO_X average	O_2 Average							
– C	– 1, – 2	NO_X	SO_2	O_2	Corrected NO_X	Corrected SO_2	Corrected NO_X average	Corrected SO_2 average	O_2 Average				
– D	– 1, – 2	CO	O_2	Corrected CO	Corrected CO average	O_2 Average							
– E	– 1, – 2	CO_2	O_2	O_2 Average									
– F	– 1, – 2	CO_2	CO	O_2	Corrected CO	Corrected CO average	O_2 Average						
– G	– 1, – 2	NO_X	CO	O_2	Corrected NO_X	Corrected CO	Corrected NO_X average	Corrected CO average	O_2 Average				
– H	– 1, – 2	NO_X	SO_2	CO	O_2	Corrected NO_X	Corrected SO_2	Corrected CO	Corrected NO_X average	Corrected SO_2 average	Corrected CO average	O_2 Average	
– J	– 1, – 2	NO_X	SO_2	CO_2	CO	O_2	Corrected NO_X	Corrected SO_2	Corrected CO	Corrected NO_X average	Corrected SO_2 average	Corrected CO average	O_2 Average

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5.1.4 Pump ON/OFF Input

Pump is turned on when the input is open and pump is turned off when shorted.

If an NOx and a CO analyzer are used in mixture, there is a possibility where the reading of the CO meter rises when the pump stops running, because minor CO is generated due to chemical changes in the NO_2/NO converter and this CO accumulates. If this phenomenon becomes a problem, hold the output before pump stop.

5.1.5 Remote Hold Input

Contact input to hold each output signal. Refer to section 5.1.2.
Output is not held when the input is open and output is held when shorted.

5.1.6 Wiring for Moving Average Reset Signal Input

This is a contact input allowing an external reset of moving average task. All average O_2 values and O_2 corrected average values are reset when the input is shorted for at least 1.5 seconds. Averaging restarts when open.

5.1.7 Wiring for Automatic Calibration Remote Start Input

One sequence of automatic calibration is performed when the input is shorted for 1.5 seconds.

5.1.8 Wiring for Range-Identifying Contact Output

This wiring should be constructed only when the stack gas analyzing system has the relevant specification.

Two ranges, the first and second ranges, can be specified for the measuring range of the infrared analyzer (components 1 to 4) and of the oxygen analyzer respectively.

The contact output of the range identification is to recognize which range is used at present and the contact signal is released when the first range is used (contact “closed”). The contact capacity is 250V AC, 2A.

5.1.9 Peak Count Alarm Contact Output

If CO concentration exceeds the alarm value, counting will begin. If the number of peaks is over the set times, a peak alarm contact output becomes closed (ON). Open otherwise. For setting and action, refer to Section 9.8, “Peak Alarm Setting.”

5.1.10 Wiring for Automatic Calibration Status Contact Output

Conductive during automatic calibration. Open otherwise.

5.1.11 Wiring for Calibration Error Contact Output

Conductive when error is produced at zero or span calibration. Normally open.

5.1 12 Wiring for Analyzing Block Error Output

Conductive when analyzer unit error is produced. Normally open.

5.1.13 Wiring for Maintenance Status Contact Output

Conductive when maintenance status switch is ON.

5.1 14 Wiring for Alarm Contact Output

Contact outputs for high and low alarms that respond to an instantaneous value of each measurement component.

When a measured value exceed the limit value, conductive at 2-3, 5-6, 8-9, 15-16, or 18-19 and open at 3-4, 6-7, 9-10, 16-17, or 19-20, respectively, on the terminal block 5 <TN5>. Otherwise open at 2-3, 5-6, 8-9, 15-16, or 18-19 and conductive at 3-4, 6-7, 9-10, 16-17, or 19-20, respectively.

For setting and action, refer to Section 9.5, “Alarm Setting.”

5.1.15 Wiring for Analyzing Block Power Interruption Output

Conductive at 12-13 and open at 13-14 when analyzer unit is energized. Open at 12-13 and conductive at 13-14 when analyzer unit is de-energized.

5.2 Wiring for External Sampling Systems

5.2.1 Wiring for Heater Power Supply to Types M1E and M2E Filtering Probes

The filters of the types M1E and M2E filtering probes are heated by an electric heater, the power of which is supplied from the stack gas analyzing system. The power consumption of the electric heater of the type M1E filtering probe is approximately 80 VA (for 100 V power supply). Use a cable with 2 cores and sufficient diameter for wiring. The temperature of the connecting section of the probe wiring goes to around 100°C. The power consumption of the electric heater of the type M2E filtering probe is approximately 130 VA. A heatproof cable, which is equivalent to JIS C3323-KGB, 600V wire with silicon insulated glass braid, must be used. Use the external terminals 5 and 6 of terminal box TB1 on the stack gas analyzing system for this wiring.

The following indicates an example of installing the heater of the type M1E electric-heating filter.

(1) Unscrew 2 cover-mounting screws (M4) and remove the cover.
(2) Route the power line for the heater through the connection and connect it to the terminal. Use a heatproof wire for the power line and a heatproof terminal of M4 or a bare terminal for a crimp terminal.
(3) Upon completing the wiring, replace the cover and fix it with mounting screws.

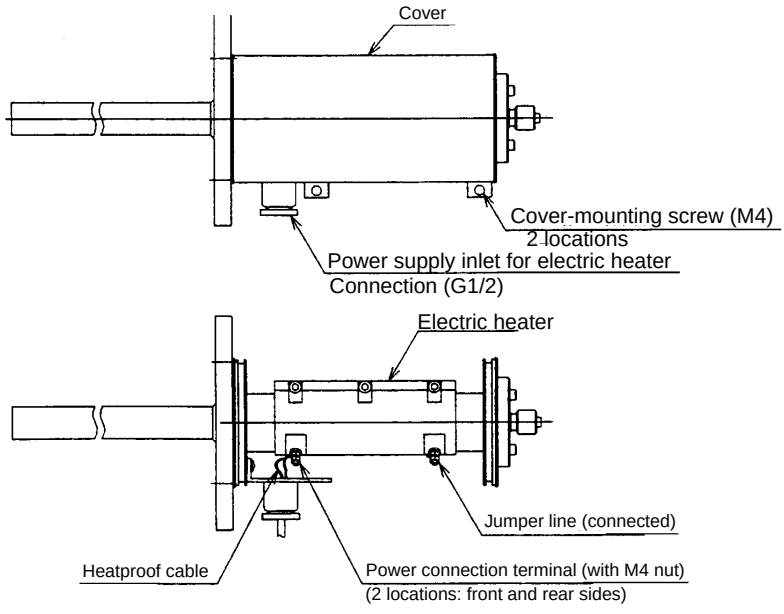

Figure 5.5 Example of Wiring for Filter's Heater

5.2.2 Wiring for Heater Power Supply to Type M1E External Primary Filter

This is to supply the power to the electric heater of the type M1E external primary filter. Conduct this wiring referring the procedure described in Section 5.2.1.

CAUTION

A heatproof cable that is equivalent to JIS C3323-KGB must be used for the power wiring of the heaters of the filtering probes and primary filters. With a normal cable, the high temperature melts the covering, resulting in short-circuit.

5.2.3 Wiring for Heater Power Supply to Heating Sampling Tube for Use in Cold Districts

The power consumption of the heating sampling tube (heat insulating type) of the cold-district version is approximately 36.5 VA per meter (for AC 100 V power supply). Construct the wiring using a cable with 2 cores and sufficient diameter in consideration of the length of the using heating sampling tube.

The cable inlet of the input power kit of the heating sampling tube is designed for G3/4. For the details refer to Section 4.1.3, Termination of Heating Sampling Tubes.

Use the external terminals 7 and 8 of terminal box TB1 on the stack gas analyzing system for this wiring.

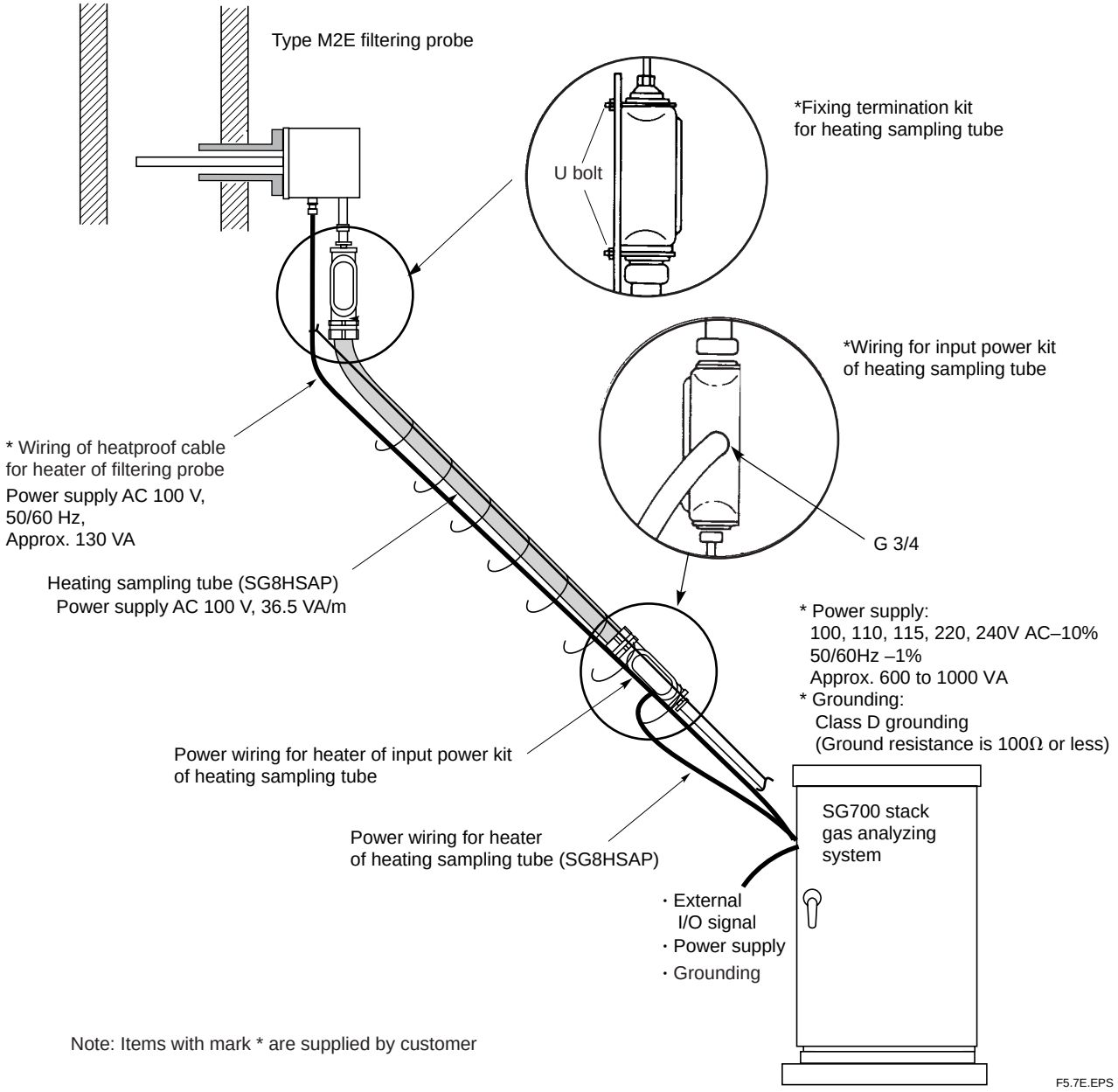

Figure 5.6 Power Wiring for Heater of Heating Sampling Tube

6. COMPONENT NAMES AND FUNCTIONS

6.1 Stack Gas Analyzing Systems Component Names and Functions

6.1.1 Composition and functions of gas analyzer

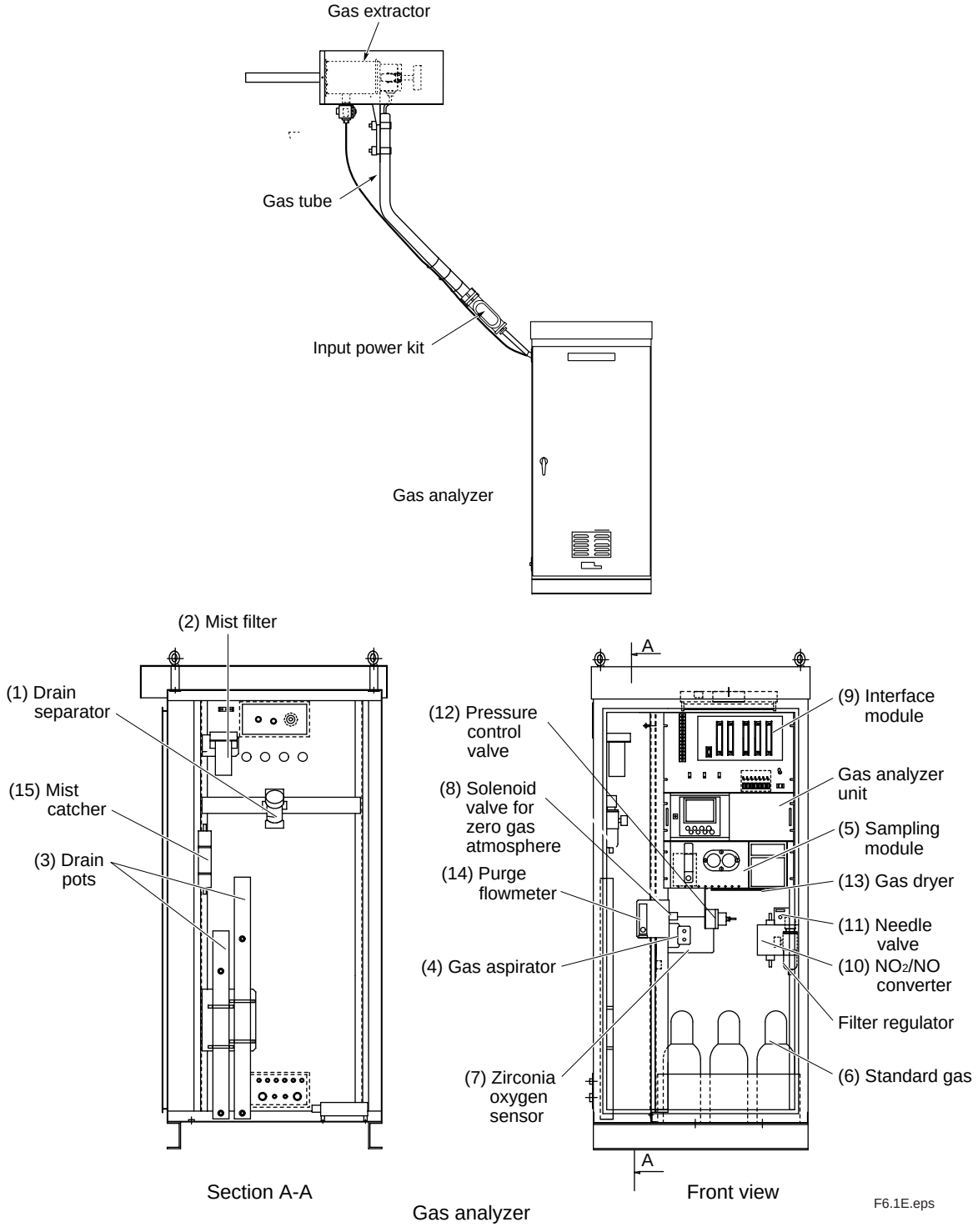

Figure 6.1 Component Names of Devices Inside Front Door (5 components type)

6.1.2 The functions of each component

Table 6.1

Unit name	Name	Description
Gas extractor		Collects sample gas at high efficiency. (A heater and filter are built in.)
	Heater	Prevents plugging of the filter. About 250°C
	Filter	Removes dust. Standard 40 µm
Gas tube		Lead tube that feeds sample gas to the gas analyzer unit from the gas extractor.
	Teflon tube	Standard ϕ10/ϕ8 tube
	Heating tube	Used if there is a fear that the drain freezes in a cold area. Also used for measurement of SO_2.
Input power kit		Power supply terminal kit for heating tube
Gas analyzer unit		Measures the concentration of the fed sample gas, and outputs electrical signals.
	(1) Drain separator	Drain separation
	(2) Mist filter	Removes drain, dust and mist
	(3) Drain pots	Controls the pressure of the sample gas, as divided to positive pressure and negative pressure.
	(4) Gas aspirator	For suction of sample gas. About 2 L/min (but 3 L/min while a gas dryer is used)
	(5) Sampling module	Electric gas cooler, solenoid valve, flowmeter and membrane filter are built in. Electric gas cooler: Eliminates moisture from the sample gas. Solenoid valve: Used for lead-in of calibration gas. Flowmeter: Controls and monitors the sample gas flow rate. Standard flow rate 0.5 L/min Membrane filter: Removes fine dust by glass filter paper and Teflon filter.
	(6) Standard gas	Gas cylinder for zero and span calibration. 3.4 L
	(7) Zirconia oxygen sensor	Measures O_2 concentration. (Paramagnetic O_2 sensor is incorporated in the gas analyzer unit.)
	(8) Solenoid valve for zero gas atmosphere	Used in the case where atmosphere is used as zero calibration gas.
	(9) Interface module	Provided with circuit breaker, various switches and input/output terminals.
	(10) NO_2/NO converter	Converts NO_2 in the sample gas to NO.
	(11) Needle valve	Controls the sample gas flow rate.
	(12) Pressure control valve	Controls the sample gas pressure.
	(13) Gas dryer	Dries the moisture in the sample gas to dew point −10°C or less.
	(14) Purge flowmeter	Controls the flow rate of the gas dryer purge air.
	(15) Mist catcher	Removes SO_2 mist.

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● **Internal view of SG700**

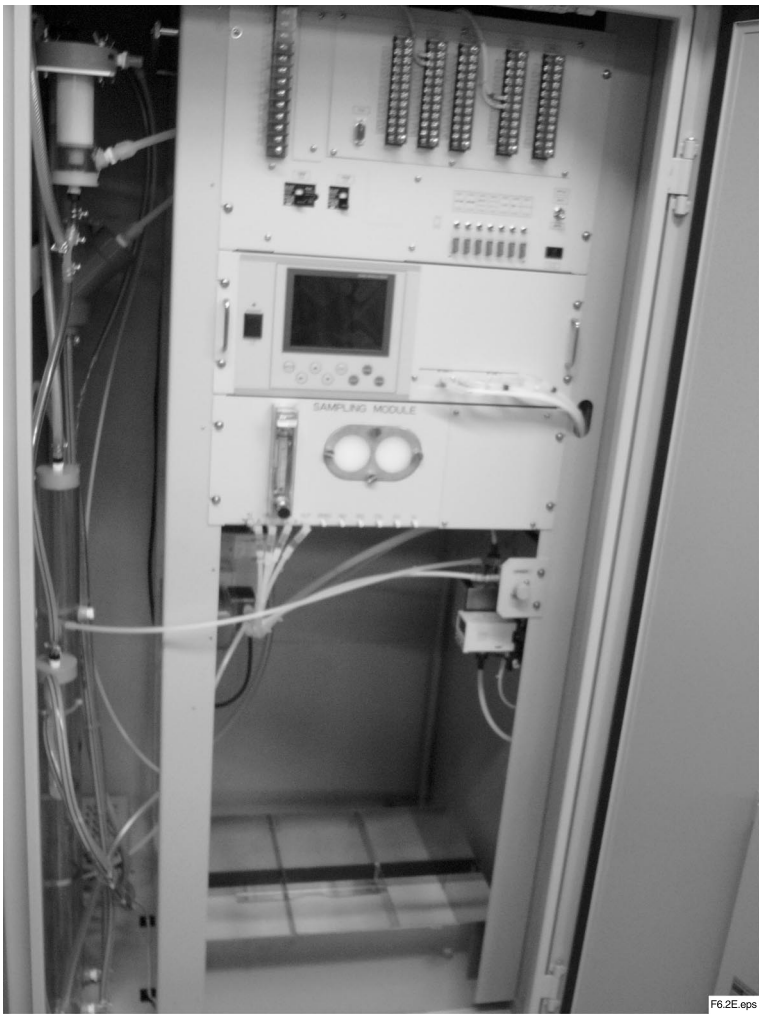

Figure 6.2

6.1.3 The functions of each component

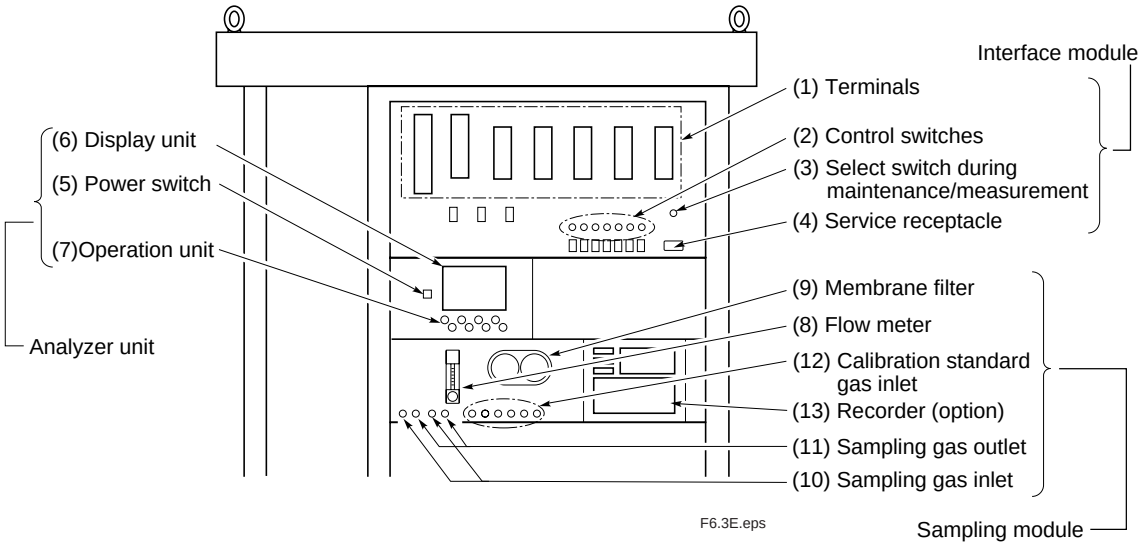

Figure 6.3 Name of Each Component

Table 6.2 Function of Each Component

Name of unit	Name	Description
Interface module	(1) Terminals	Power supply terminal, external I/O terminals
	(2) Control switches	Main power supply; circuit breakers for devices Extractor; circuit breaker for gas extractor Heating tube; circuit breaker for heating tube (option) PUMP; power switch for gas aspirator FAN; power switch for ventilating fan LAMP RECEPT.; power switch for fluorescent lamp receptacle Sampling module; power switches for driving gas sampling module and recorder (option) , power switch for NO_2/NO converter and isolation signal converter (option). O_2 sensor; power switch for O_2 sensor External heater; power switch for gas conditioner heater Space heater; heater power switch (option)
	(3) Select switch during maintenance/measurement	Used to hold the output signal by switching during maintenance.
	(4) Service receptacle	100V AC, 50/60 Hz, 2A
Analyzer unit	(5) Power switch	Power switch for the gas analyzer unit
	(6) Display unit	Displays components and concentration of the sample gas, setting of various kinds and operation method.
	(7) Operation unit	Permits setting of various kinds and operation.
Sampling module	(8) Flow meter	Used for checking the gas flow.
	(9) Membrane filter	Removes fine dust by glass filter paper and Teflon filter.
	(10) Sample gas inlet	Sample gas inlet
	(11) Sample gas outlet	Sample gas outlet
	(12) Calibration standard gas inlet	Inlet of standard gas for calibration
	(13) Recorder	Option

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6.1.4 Example for sampling system

● **Example 1: Five-Component Gas Sampling System Configuration SO_2 1st range: less than 500 ppm, Standard type**

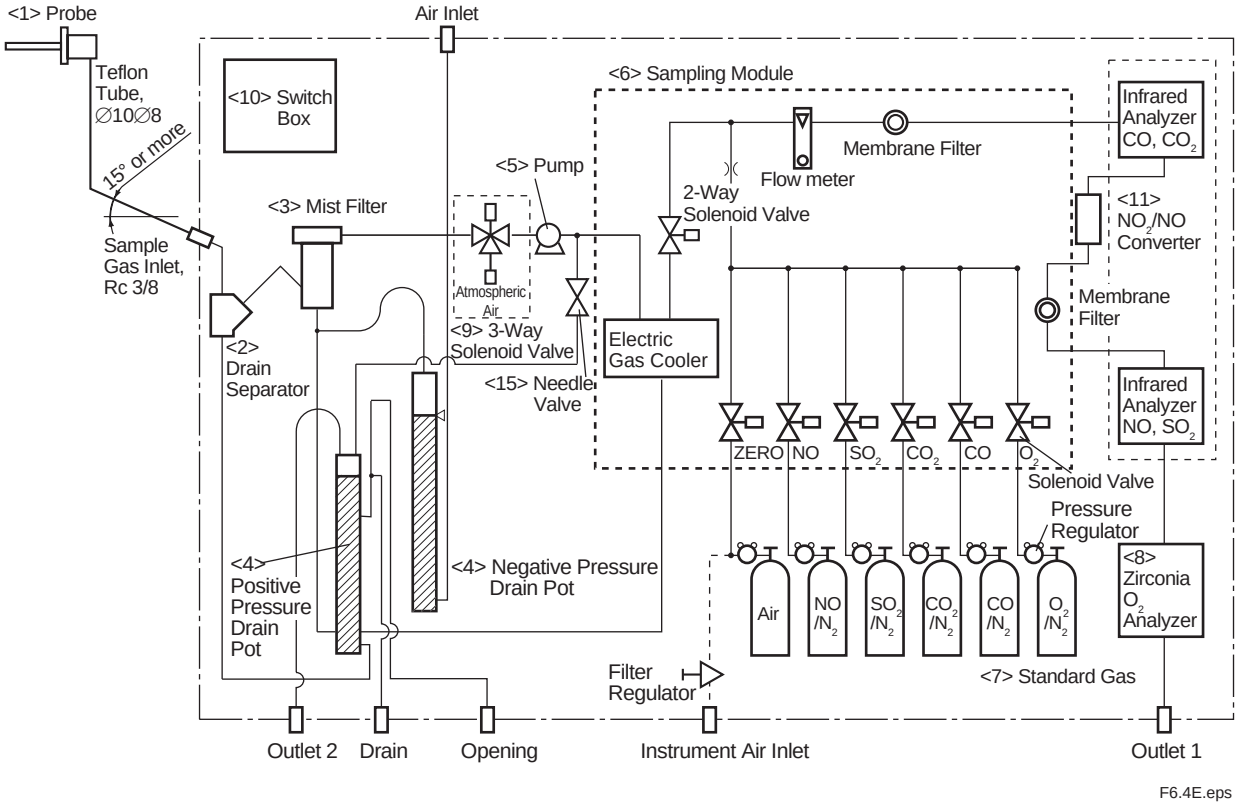
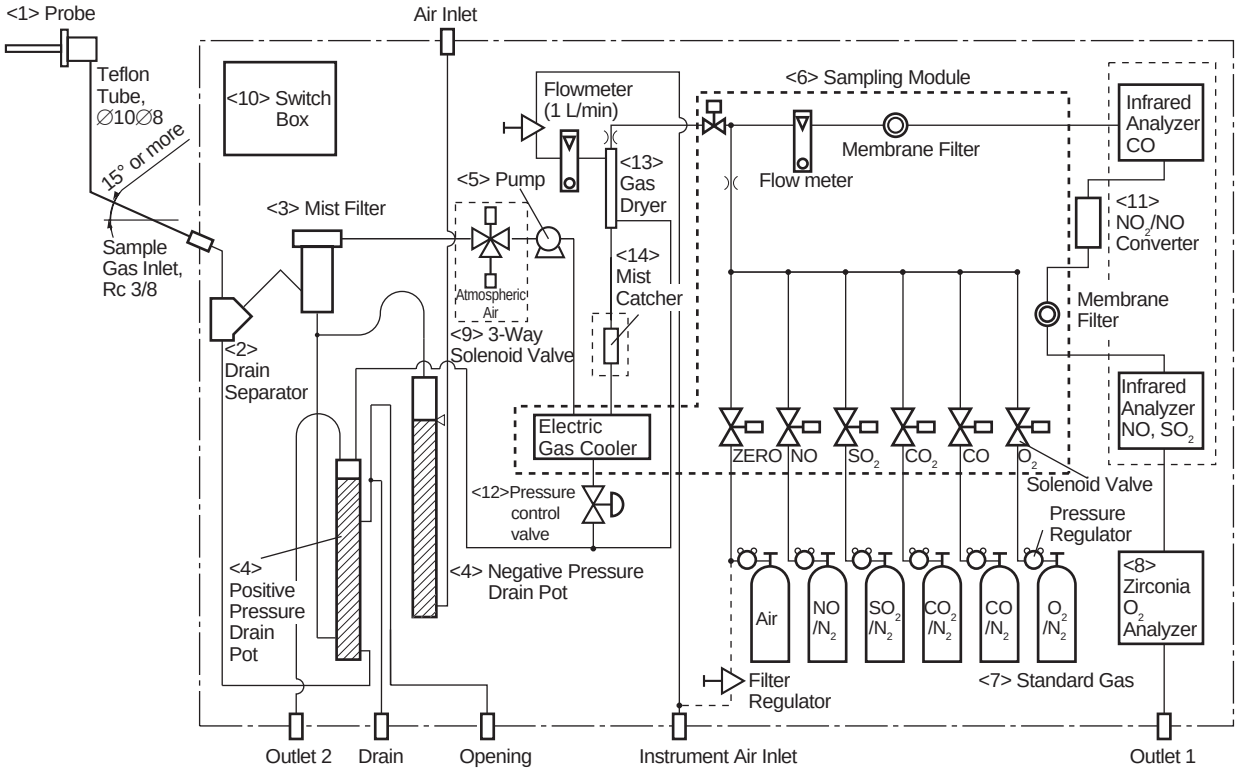


Figure 6.4 Example of Sampling System

Note : Refer to 1.2.1 for each system component.

● **Example 2:**

Five-Component Gas Sampling System Configuration SO_2 1st range : 500 ppm or higher, or for oil/coal boilers.



* Two external drain separators are additionally required.

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Figure 6.5 Example of Sampling System

7. GENERAL OPERATION

7.1 Startup

To place the analyzer in operation, perform the procedures described below in sequence.

7.1.1 Inspection of Piping, Tubing and Wiring

- Check that the piping, tubing, and wiring to the stack gas analyzing system main unit are correctly installed. When checking the piping and tubing, check that there are no loose connections that can cause leaks.
- Check also that piping for calibration gas is correctly installed (see 4.3.1).
- When checking the piping, confirm that there is no looseness (play) in the connections.
- The condition of the piping and tubing within the stack gas analyzing system main unit was inspected before it was shipped. Except under special circumstances, such as if the unit has been in storage for a long period, it should not be necessary to check the air-tightness.

To check air-tightness, follow the procedure below.

(1)Tubing inside panel

(a) Seal exhaust 1, exhaust 2, drain and open ports.
(b) Connect standard gas to the mist filter inlet. (Make connection in the state where the pressure is zero.)
(c) Supply the standard gas slowly until a pressure gauge indicates about 2 kPa. Then, close the pressure regulator needle valve.
(d) Check if the water level in the negative pressure drain pot air suction tube has risen by about 200 mm.
(e) After wait for 1 minute, assure that water level is not fluctuated.
(f) For check for leaks, use soapy water at joints and fixture.

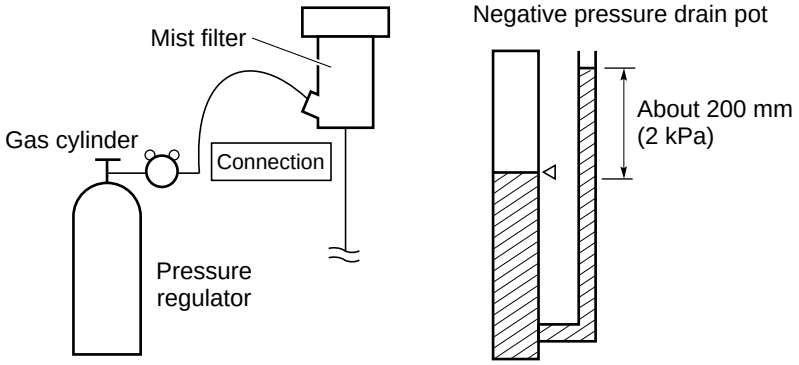

Fig 7.1

(2) Tubing outside panel

Check that tubing joints are securely tightened. Apply pressure from the gas extractor outlet side as needed, and check a water level in the darin pot using the same procedure as (1).

Note

If the air tightness is poor, test each of sections until the inconvenience is located and remedy it properly. If the faulty point is upstream the aspirator, air may be sucked in the gas capillary tube, thereby lowering the indication.

7.1.2 Supplying Water to the Safety Drain Trap and External Drain Separator

(1) Supplying Water to the Positive Drain Pot

Remove the case of the mist filter (see figures in Section 10.3.3, “Maintenance of sampling device.”), and supply tap water to level A using a water bottle. Water is discharged through the drain port when the water level exceeds a certain level.

(2) Supplying Water to the Negative Drain Pot

Remove the plug on the upper part of the sides of the negative drain pot, and supply water through the opening up to level B (red line). (See Figure 10.1 in Section 10.3.1, Routine Maintenance and Inspection.”)

Water is supplied to the external drain separator from the sample gas outlet at the end. Remove the sample tubing connected to the outlet, and flow in water. The amount of water required will be that amount that results in overflow from the drain port with the water level in the indicator near the center coupling. Note that the ball valve in the external drain separator should be fully open. See Section 4.2.3

Note

The ball valve is added for use in back-flushing the system. During measurement, the ball valve should be fully open.
Add sufficient water to the drain pot so that the water level closes off the exhaust gas line.

7.1.3 Preset Manual Valves and Manual Switches

Preset the manual valves and switches for the wiring system as follows to ensure a smooth startup of the stack gas analyzing system.

(1) Preset Manual Valves

- Pressure regulators on standard gas cylinders
  Turn the secondary pressure setting knob counterclockwise as far as it will turn.
  Also fully open the needle valve.
  Open the main stopper on the cylinder.

(2) Preset Power Supply Switches

- Circuit breaker and switch board switches
  Set the circuit breaker and all switches on the switch-board inside the stack gas analyzing system to ‘OFF’.

7.1.4 Turning ON Power

Verify first that the voltage is proper for the stack gas analyzing system being used, and then turn 'ON' power to the power wiring leading to the analyzer. Next, set the main circuit breaker 'ON' the interface module to 'ON'. Also turn 'ON' the ventilation fan and fluorescent light receptacle switches on the switch-board. Do not turn 'ON' any other switches at this time.

If it is necessary to raise the temperature in the stack gas analyzing system main unit cubicle, also turn 'ON' the switch to the space heater.

For the cold-climate versions with option codes [/T1] and [/T2], also turn 'ON' the "space heater" circuit breaker.

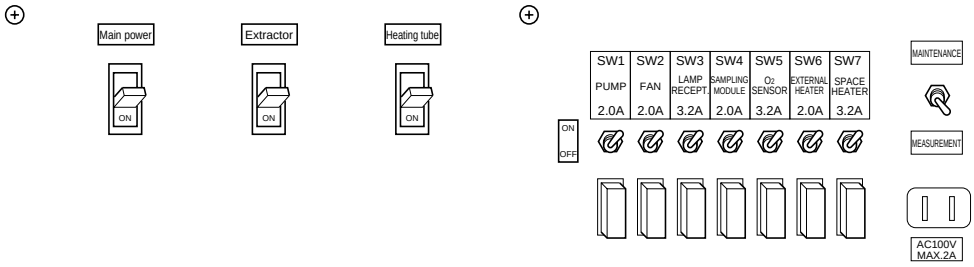

Figure 7.2 Interface module power switch

7.1.5 Warm-up

- Turn 'ON' all switches except the PUMP switch which should be kept off. (The LAMP RECEPT. and SPACE HEATER switches should be turned 'ON' as required.)
- After warm-up, turn 'ON' the PUMP switch and check that the flowmeter ball is positioned at 0.5 L/min.

(1) Filtering Probe, External Primary Filter

If using a Model M1E or M2E filtering probe or a Model M1E external primary filter, turn the probe power supply switch to 'ON'.

If using a Model MS external primary filter, supply 100 to 300 kPa saturated steam (temperature, approximately 99 to 133°C) to the filter.

After supplying power or steam to the filter probe and external primary filter for approximately one hour, the system will be ready for normal operations.

(2) Cold-Climate (Heat Traced) Sample Tubing(Option [/S] is specified)

Supply power to the cold-climate (heat traced) sample tubing only when there is a risk that the condensation that forms in the sample tubing will freeze in cold weather.

To supply power to this heat traced sample tubing, set the sample line tubing heater circuit breaker on the interface module to 'ON'.

Supply power to the heated sample tubing for approximately one hour before beginning normal operations.

(3) Electronic Gas Cooling Unit

To supply power to the electronic gas cooling unit by setting the electronic dehumidifier switch on the sampling module to 'ON'.

After power has been 'ON' for approximately 10 minutes, the operation of the electronic gas cooling unit should stabilize.

(4) NO_2/NO Converter

When a stack gas analyzing system for measuring NOx or with option code “/NO1,” heater power must be supplied to the NO_2/NO converter. Turn 'ON' the SAMPLING MODULE switch. Then, set the temperature setpoint of the converter temperature controller to 220 °C.

After power has been 'ON' for approximately 30 minutes, the temperature of the NO_2/NO converter stabilizes, and the temperature controller lamp will begin to blink 'ON' and 'OFF'.

(5) Oxygen Analyzer

Set the oxygen analyzer switch on the switch board to 'ON' to activate the oxygen analyzer.

For a zirconia oxygen analyzer, let the analyzer warm up for approximately 30 minutes.

(6) Infrared (IR) Gas Analyzer

If the main breaker switch is ‘ON’, the IR gas analyzer will be 'ON' also. The measuring mode is assumed when power is turned 'ON'.

When you power-on the system, sector motor rotating sounds are emitted. This is because the motor increases speed gradually. This is not caused by a defective motor. After the motor reaches normal speed, these sounds still remain somewhat.

Warm-up time for the IR gas analyzer is approximately 4 hours. (fluctuation in the operation period of 4 hours from the end of warm-up time is within ±2%FS)

7.1.6 Setting the Operating Parameter Data

Note

Enter setting data into check sheet in section 10.3.6

Proceed to set the following parameters. All of these settings are entered through the operating panel. See Section 8 for the displays and the keys on the operating panel used to make these settings.

1) Calibration gas concentration
2) Concentration alarms
   Alarm values (high/low limit alarms)
   Hysteresis settings
3) Output signal hold ON/OFF selection
4) Remote range switching enable/disable
5) Setting oxgen-based converted output
6) Calibration

The above items are described as follows

(1) Calibration Gas Concentration

Enter the concentrations of the standard gases in the standard gas cylinders.

Standard gas cylinders are normally used for infrared gas analyzer span calibration (one for each component), and for zero calibration. The standard gas cylinder for zero calibration is filled with nitrogen gas (N_2). However, if the device is equipped with a zirconia oxygen analyzer, a dry air cylinder is used, and is also used for oxygen analyzer zero calibration. Moreover, if the system is equipped with a paramagnetic oxygen analyzer, a standard gas (zirconia O_2 analyzer zero gas) cylinder will also be used for its span calibration.

Set the span calibration concentration for each component to the value displayed on the span gas cylinder for that component. Set the paramagnetic oxygen analyzer span gas concentration to 21.0 (vol% O_2). Also set the zero gas concentration for the oxygen analyzer.

(2) Concentration Alarm

<Alarm Value (High, HH, Low, LL, High or Low)>

The alarm contact assigned the same number as the alarm is operated accordingly.

Channel : Channel setting targeted for issuance of alarm (Power off alarm can be selected for alarm 6.) One Ch No. can be selected for multiple alarms.
H-Limit value : Sets the high limit value (concentration) of alarm.
L-Limit value : Sets the low limit value (concentration) of alarm.
Kind of Alarm: Selects one of High limit alarm, Low limit alarm, and High limit or Low limit alarm, HH limit alarm, and LL limit alarm.
High, HH ... Alarm contact closes when above H-limit alarm.
Low, LL ... Alarm contact closes when below L-limit alarm.
High or Low ...Alarm contact closes when above H-limit value or below L-limit value.

If “Power off” is selected for "Channel" displayed on LCD, the contact is closed at all times while the power is on irrespective of the setting made here.

ON/OFF : Enables the alarm function if set at 'ON', or disables the alarm function if set at 'OFF'.

* The H-limit value cannot be set below the L-limit value, and the L-limit value cannot be set above the H-limit value.

If it is desired to set the H-limit value below the L-limit value already stored in the memory, reduce the L-limit value beforehand, and vice versa.

<Hysteresis>

An alarm output is turned 'ON' if measurement value exceeds the upper limit value as shown below. Once the alarm output has been turned 'ON', it is not turned 'OFF' as long as the indication does not fall below the hysteresis width from the upper limit value.

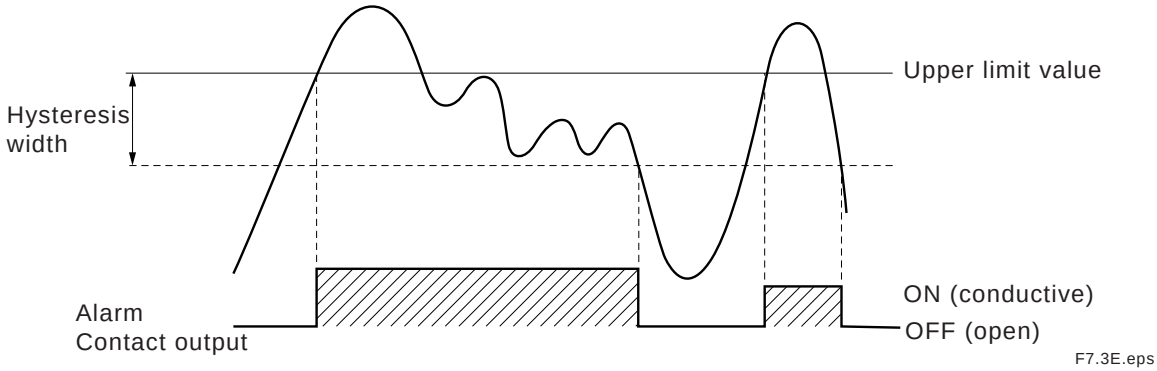

Figure 7.3 Hysteresis (In case-of upper limit Alarm)

(3) Output Signal Hold ON/OFF Selection

If necessary, you can set the analyzer up to hold the output signal constant during calibration.

With the output signal hold ON/OFF selection you specify whether or not you want the output signal put 'ON' hold during calibration.

Select 'ON' to hold the signal; select 'OFF' if the signal should not be put 'ON' hold. If 'ON' is selected, the output signal is held at its last pre-calibration value while calibration is in progress.

(4) Remote Range Switching Enable/Disable

The range for each component can be switched by an external contact signal. The primary range is selected when the contact signal is closed; the secondary range is selected when the signal is open.

(5) Setting O_2 Correction Output

This function is optional (included only upon request). For this optional specification, the O_2 correction output is preset. Unless specified, the factory default setting is 4%. Refer to "9.10 Maintenance mode".

$$O_2 \text{ correction concentration} = \frac{21 - \text{oxygen (reference value) (\%)}}{21 - \text{oxygen (concentration) (\%)}} \times Cs$$

where,
Cs: NOx concentration or SO_2 concentration or CO concentration

Note: The coefficient can be a maximum of 4, e.g.,
[(21 - oxygen reference value) / (21 - oxygen concentration value)] ≦ 4.0

Equ7.1E.EPS

Note

If an O_2 correction concentration output is specified, be sure to check the O_2 correction reference value to set the correct value. If the reference value is not correct, the O_2 correction output will not be correct.

(6) Calibration

When you have completed all of these preparations, perform a calibration. See Chapter 9.4 concerning calibration procedures.

7.2 Normal Operation

7.2.1 Starting Normal Operations

- If no particular problems are encountered in the startup procedures, the stack gas analyzing system can be put into measurement mode and placed in normal operation.
- For safety, re-check the operating data set up in Section 7.1.6, and make sure that there are no problems. Also, verify that the power supply switch for every device that must be used in operation is set to 'ON'. If there are any units requiring adjustment of settings, such as a converter temperature controller, etc., also check the settings for these units.
- Be especially careful to re-check all hardware that was touched in the course of the startup procedure, such as the standard gas cylinder pressure regulator adjustments. Also examine the flow-meter, and check that the sample gas is flowing at the proper rate (0.5 L/min).
- The stack gas analyzing system does not require any manipulation by the operators during normal operation. However, to maintain good operation, follow the inspection procedures outlined in Section 10.

7.2.2 Shutting Down and Restarting Operation

- Care must be taken during shutdown to ensure that no performance down occurs during shutdown, and that restart can be smoothly accomplished. If possible, do not turn 'OFF' power to the analyzer main unit, and leave running those devices that are generally better left operating (such as power for external sampling system temperature maintenance, etc.)
- If you are going to turn 'OFF' power to the analyzer main unit, you must flush the sample gas from the lines and replace it with air. To do this, disconnect the sample tubing connected to the analyzer main unit, and allow it to draw in air for 30 minutes.
- To restart the system after a long shutdown, follow the startup procedure.

7.2.3 Response for Error Code

Error message

If errors occur, the following contents are displayed

Table 7.1 Error Message

Error display	Error contents	Probable causes
Error No.1	Motor rotation detection signal faulty	・Motor rotation is faulty or stopped. ・Motor rotation detector circuit is faulty.
Error No.4	Zero calibration is not within the allowable range.	・Zero gas is not supplied. ・Zero is deflected much due to dirty cell. ・Detector is faulty. ・Optical balance is maladjusted.
Error No.5	Amount of zero calibration (indication value) is over 50% of full scale.	
Error No.6	Span calibration is not within the allowable range.	・Span gas is not supplied. ・Calibrated concentration setting does not match cylinder concentration. ・Zero calibration is not performed normally. ・Span is deflected much due to dirty cell. ・Detector sensitivity has deteriorated.
Error No.7	Amount of span calibration (difference between indication value and calibrated concentration) is over 50% of full scale.	
Error No.8	Measured values fluctuate too much during zero and span calibration.	・Calibration gas is not supplied. ・Time for flowing calibration gas is short.
Error No.9	Calibration is abnormal during auto calibration.	・Error corresponding to No. 4 to No. 8 occurred during auto calibration.
Error No.10	Output cable connection is improper.	・Wiring is detached between analyzer and interface module. ・Wiring is disconnected between analyzer and interface module

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When error No. 1 or No. 10 occurs, analyzing block error contact output is closed.

When an error from No. 4 to No. 9 occurs, calibration error contact output is closed.

Screen display and operation at the occurrence of error

In case of Error No. 1 to No. 4, No. 6, No. 8 to No. 10

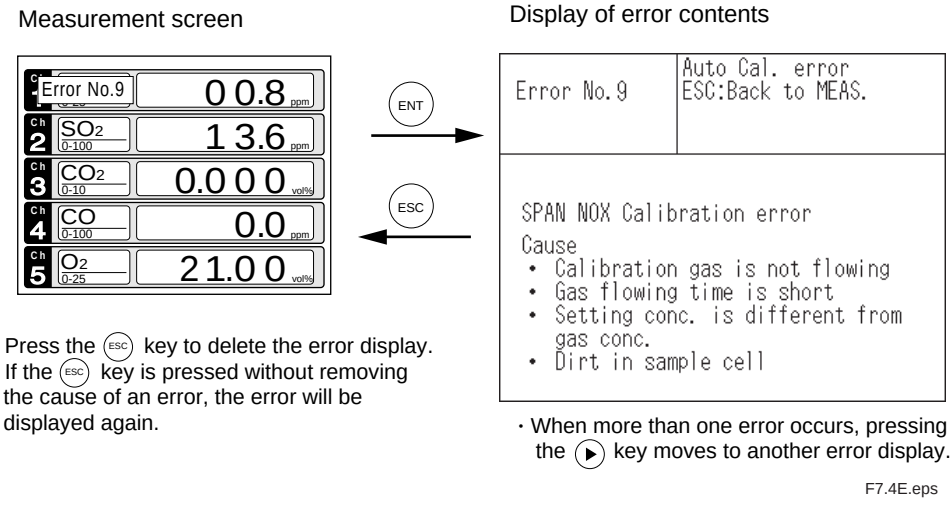

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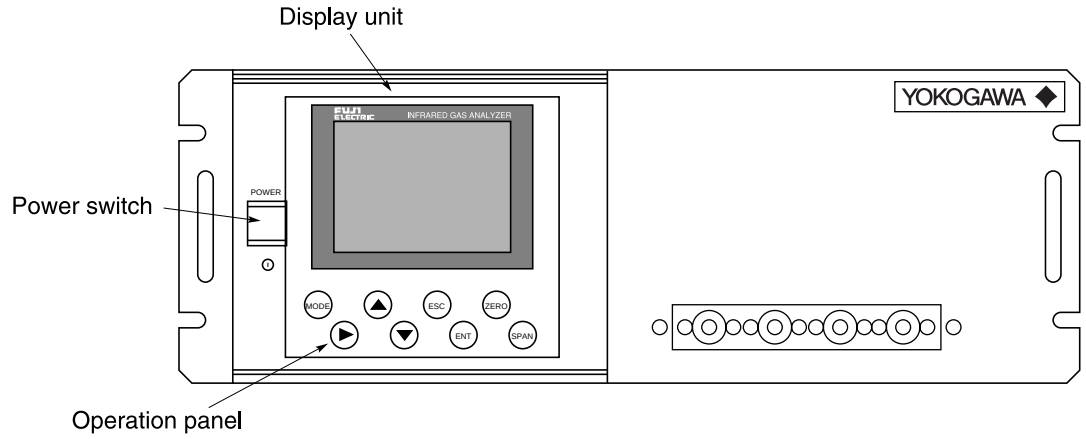
Figure 7.4

8. DESCRIPTION OF DISPLAY AND OPERATION PANELS

This section describes the display unit and operation panel of the analyzer unit. It also explains the name and description of function on the operation panel.

8.1 Name and Description of Operation Panel



- Display unit: The measurement screen and the setting items are displayed.
- Operation panel: The configuration is as shown below.

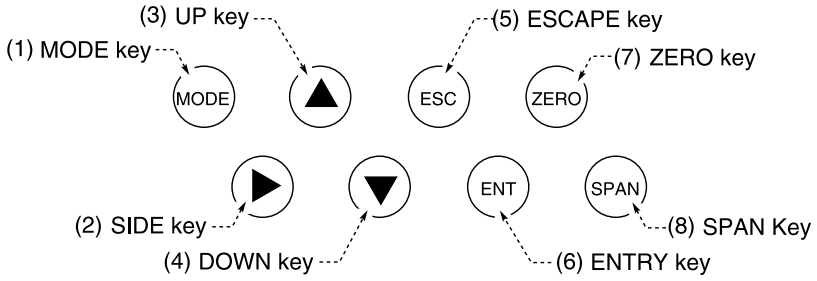


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Figure 8.1 Operation Panel (Front View)

Table 8.1

Name	Description
(1) MODE key	Used to switch the mode.
(2) SIDE key	Used to change the selected item (by moving the cursor) and numeral digit.
(3) UP key	Used to change the selected item (by moving the cursor) and to increase numeral value.
(4) DOWN key	Used to change the selected item (by moving the cursor) and to decrease numeral value.
(5) ESCAPE key	Used to return to a previous screen or cancel the setting midway.
(6) ENTRY key	Used for confirmation of selected items or values, and for execution of calibration.
(7) ZERO key	Used for zero calibration.
(8) SPAN key	Used for span calibration.

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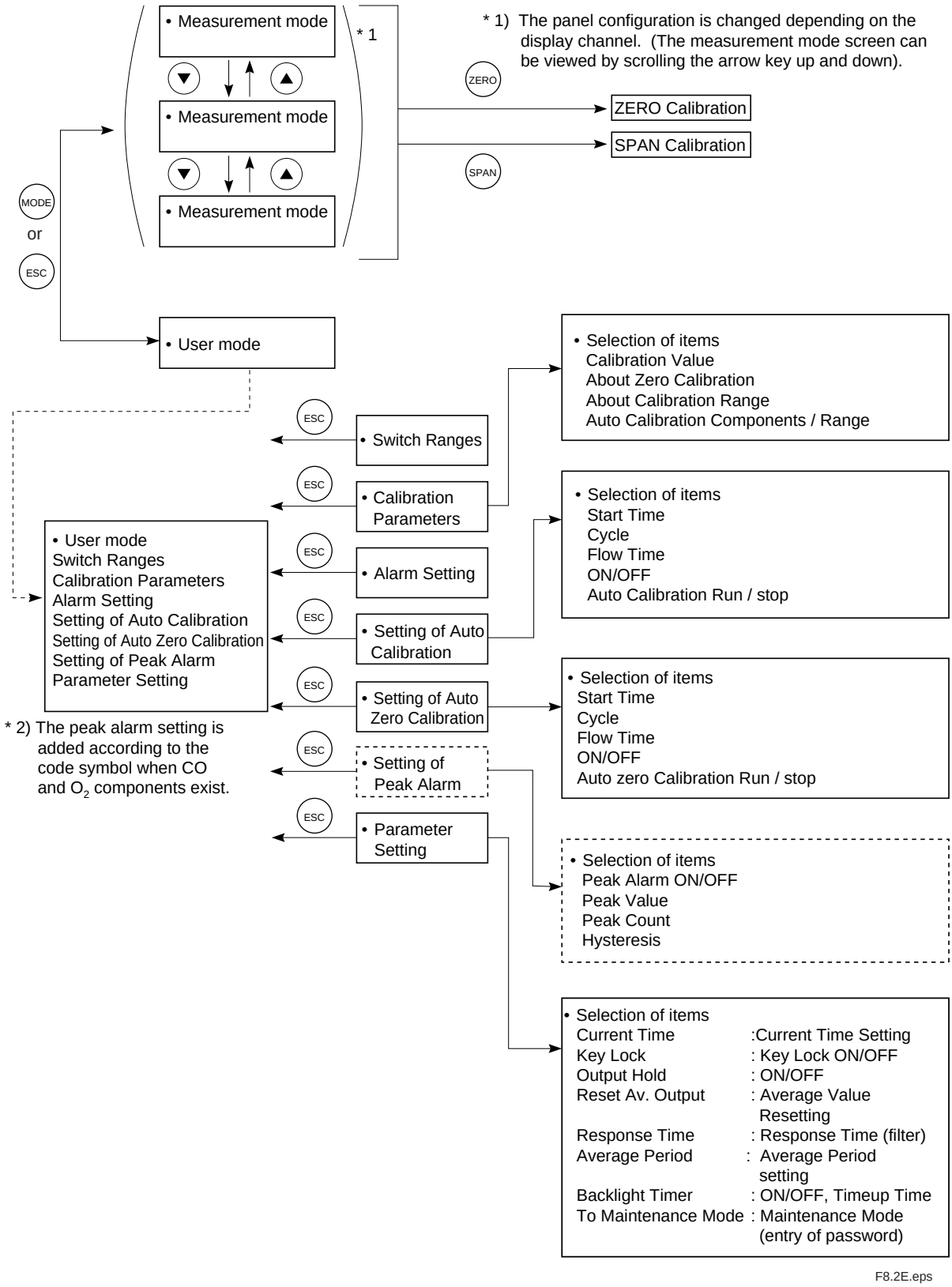
8.2 Overview of display and operation panels



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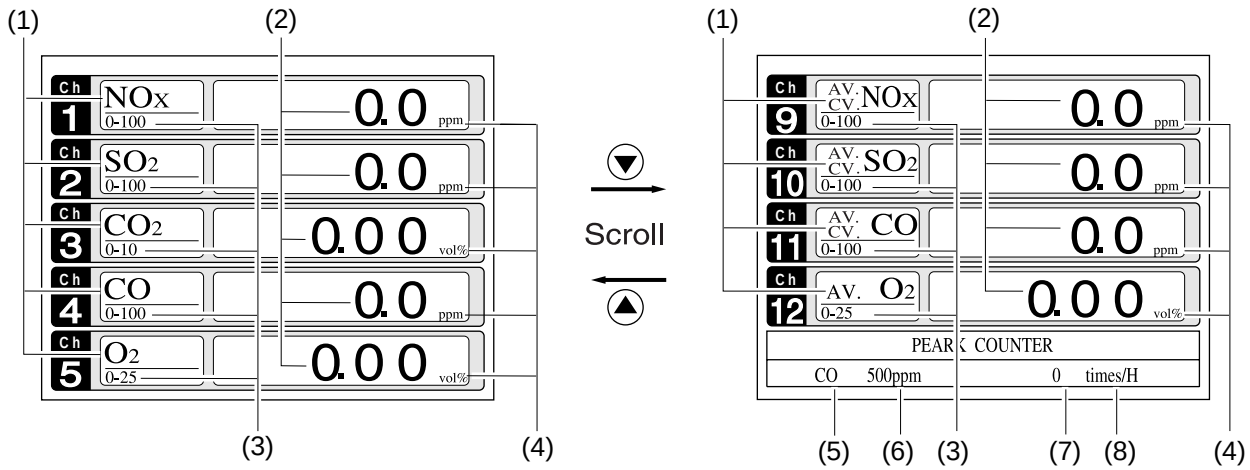
8.3 Outline of display screen

(1) Measurement mode screen (appears when the power is turned ON)

The measurement screen depends on the number of components. The following screen configuration as shown as an example is for NO, SO_2, CO_2, CO and O_2 (output: 12 channels).



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* corrected instantaneous value.....CV.

** corrected average value.....$\overset{AV}{CV}$

Figure 8.2 Name and function of measurement mode screen

* For outputs of more than 5 channels, scroll the arrow key ▲ or ▼ to view.

Table 8.2

No.	Name	Function
(1)	Component display	Displays component of instantaneous value, corrected instantaneous value, corrected average value, etc.
(2)	Concentration display	Displays measured value of concentration.
(3)	Range display	Displays range values.
(4)	Unit display	Displays unit with ppm and vol%.
(5)	Peak alarm component display	Displays peak alarm component.
(6)	Peak alarm concentration display	Displays peak alarm concentration display. (Upper limit value)
(7)	Peak alarm times	Displays the alarm times exceeding the peak value.
(8)	Peak alarm unit display	Displays units of peak alarm with times/h.

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・ Instantaneous value and concentration value:

The concentration display of Ch (component) where sampling components such as "CO_2", "CO" or "O_2 are displayed in the component display, indicates current concentration values of the measured components contained in gas that is now under measurement.

・O_2 correction concentration values:

Ch components where "$^{AV}_{CV}$**" is displayed as "$^{AV}_{CV}$CO" in the component display are calculated from the following equation, by setting sampling components, O_2 instantaneous/concentration values and O_2 correction reference value (see item 9.10.7).

$$O_2 \text{ correction output} = \frac{21 - On}{21 - Os} \times Cs$$

On: The value of the O_2 correction referance value (Value set by application)
Os: Oxygen concentration (%)
Cs: Concentration of relevant measured component. Note that Os does not exceed the O_2 limit value set in Other Parameter in 9.10 Maintenance mod

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The converted sampling components are NO_x, SO_2 and CO only.

・O_2 correction concentration average value:

In the Ch (component) and O_2 average value where " $^{AV}_{CV}$**" is displayed as "$^{AV}_{CV}$ CO" in the component display, a value obtained by averaging O_2 correction concentration value or O_2 average value in a fixed time is output every 30 seconds.

Averaging time can be changed between 1 minute and 59 minutes or 1 hour and 4 hours according to the average time settings (See 9.9, Parameter setting).
(The set time is displayed as "1h" , for instance, in the range display.)

* The measurement ranges of O_2 correction concentration value and O_2 correction concentration average value are the same as that of the measuring components. Also, the measurement range of O_2 average value is the same as that of O_2.

(2) Setting/selection screen

The setting/selection screen is configured as shown below:

- In the status display area, the current status is displayed.
- In the message display area, messages associated with operation are displayed.
- In the setting item and selection item display area, items or values to be set are displayed, as required. To work on the area, move the cursor to any item by using ▲, ▼ and ▶ keys.

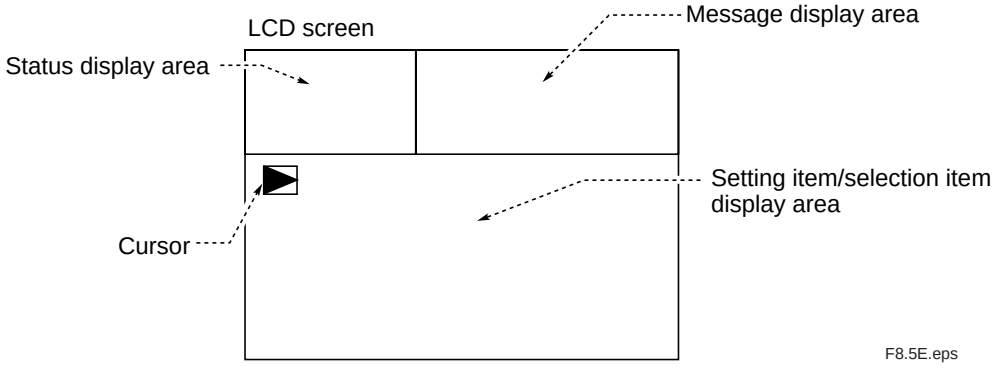
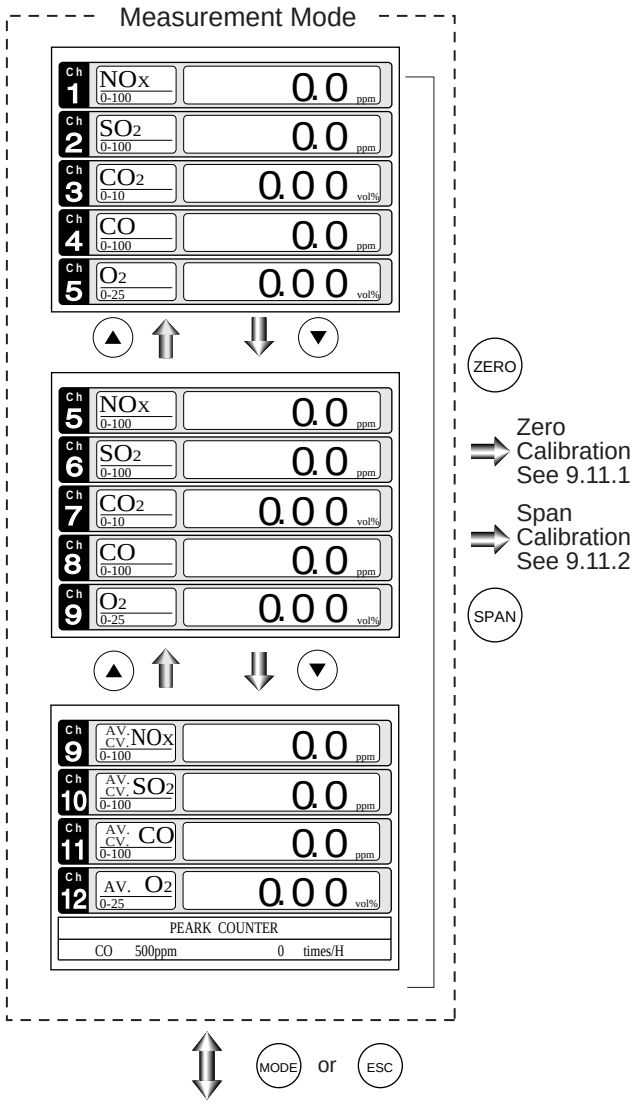


Figure 8.3 LCD Screen

(3) General operation

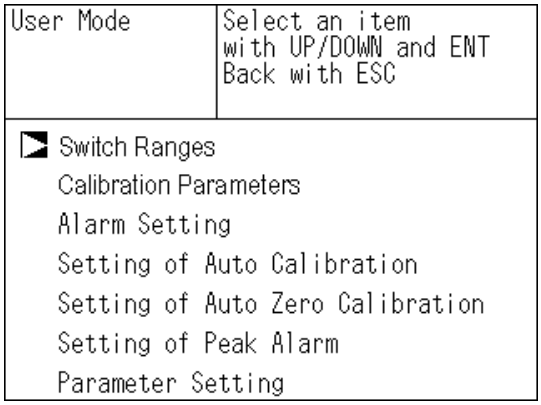
· Measurement mode

The measurement mode can be displayed up to 5 channels in a single screen. If 5 channels or more are to be displayed in a single screen, press the ▲ or ▼ key to scroll the channel one by one.



· User mode displays;

Switch Ranges
Calibration Parameters
Alarm Setting
Setting of Auto Calibration
Setting of Auto Zero Calibration
Setting of Peak Alarm
Parameter Setting.



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For the setting contents, refer to "Chapter 9. Setting and calibration".

9. SETTING AND CALIBRATION

Note

Calibrate the system after the analyzer indication has stabilized. For outdoor installation a cold area or location, bear in mind that the analyzer indication will change with the rapid temperature change that occurs if the system door is opened. Be sure to enter the set data into Check Sheets in Section 10.3.6.

9.1 Kinds of Standard Gas

9.1.1 When not using zirconia O_2 sensor

(1) Zero gas : N_2 or atmospheric air/instrument air depending on specification
(2) Span gas : gas of 90% or more full scale for each component, remainder is N_2

9.1.2 When using zirconia O_2 sensor

(1) Zero gas : air
(2) Span gas : 1 to 2% O_2, remainder is N_2.
Gas of 90% or more full scale for other than zirconia O_2 sensor, remainder is N_2

Note

For separately calibrating the low and high ranges of the zirconia O_2 sensor, supply 9 to 10% O_2 and the remainder N_2 for the low range (10%) and use air for the high range (25%).

9.1.3 When using paramagnetic O_2 sensor

(1) Zero gas: N_2 gas
(2) Span gas: Air

9.2 Preparation of Standard Gas

The standard gas to be used for calibration is delivered in separate crates than the cabinet. Check the kinds of standard gas to be used, and install the gas cylinder in their correct places in the cabinet as described in Sec. 4.3.1.

Before starting calibration, adjust the standard gas pressure controller secondary-side pressure adjustment. If the gas cylinder tap is closed, follow the procedure below.

After loosing the secondary pressure controller lever, loose the output-side flow controller lever. If you now open the gas cylinder valve, gas flows into the pressure controller and the primary-side pressure gauge shows the gas cylinder pressure. Turn the secondary pressure control lever clockwise, and the secondary pressure rises. Watching the reading, adjust the pressure to 30 kPa.

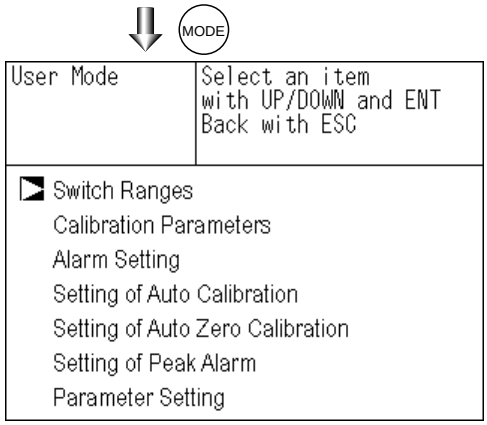
If you open the output side flow controller lever, gas flow but if the calibration solenoid valve is closed then gas will not flow out. When calibration starts and gas is flowing, recheck the secondary pressure and fine-adjust to 30 kPa if necessary, and also check that the flowmeter reading is 0.5 $\pm$0.2 L/min.

9.3 Switch of range

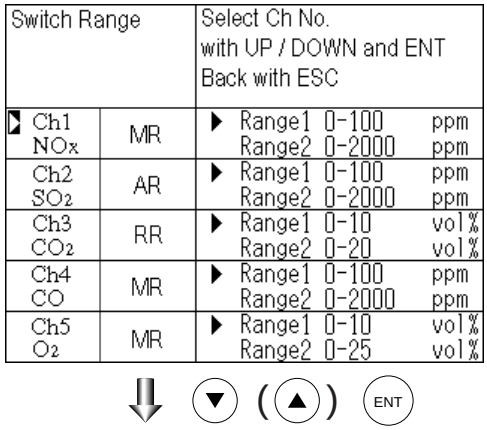
9.3.1 Setting of range switch mode

Set the range switch mode as follows.

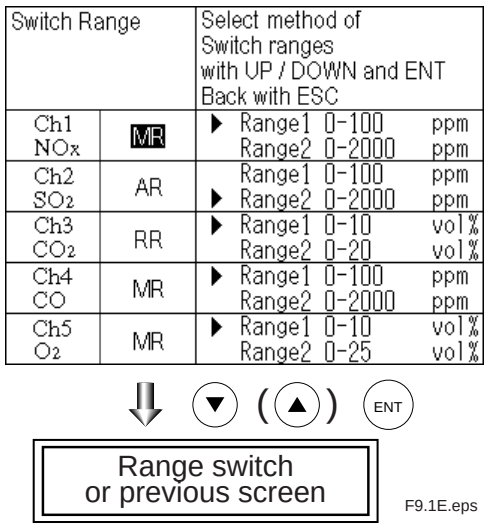
(1) Press the "MODE" key in measurement mode to display the User mode screen.
(2) Move the cursor to “Switch Ranges” and press the "ENT" key.



(3) The “Channel Selection” screen appears. Move the ▶ cursor by pressing the ▲ or ▼ key on the channel selection screen that appears, and select Ch (component).
(4) Then press the "ENT" key.



(5) Selected range switch mode is highlighted. Press the ▲ or ▼ key to select a desired switch mode.
(6) Then press the "ENT" key to confirm the selection. If “MR” is selected, the cursor moves to “Range Switch.”



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Note

Description of setting

MR: Select a desired range on this screen.
RR: Select a desired range according to the remote range switch contact input.
AR: Automatically switched from Range 1 to Range 2 when the measured concentration exceeds 90% of Range 1. Automatically switched from Range 2 to Range 1 when the measured concentration becomes smaller than 80% of Range 1.

* Operation set for each Ch only can be performed.

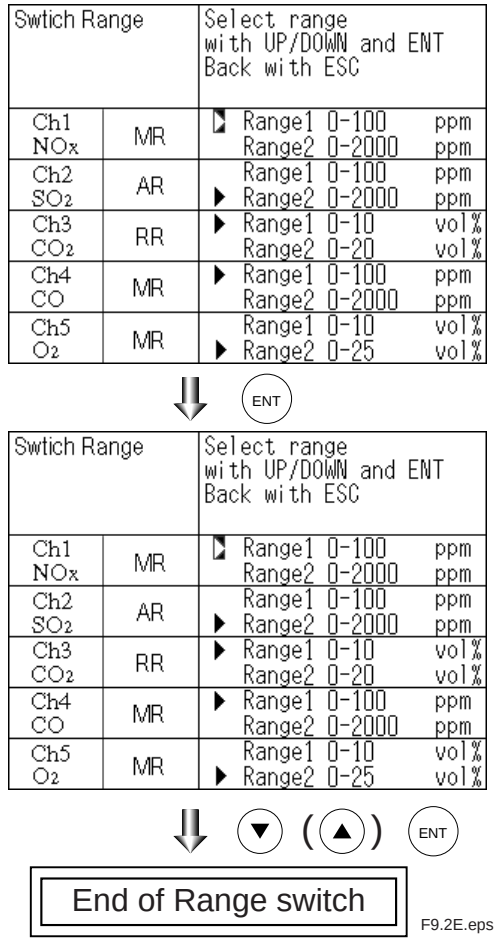
9.3.2 Manual range switch

The range of the measured component can be switched manually as follows.

(1) Select “MR” as range switch mode, and then press the "ENT" key.

(2) Move the highlight of the cursor to range selection, and then select a desired range by pressing the ▲ or ▼ key. (The mark indicates the currently selected range.)

(3) Then press the "ENT" key, and the measurement is carried out in the selected range.



F9.2E.eps

Note

If “RR” or “AR” is selected as range switch mode, this operation cannot be performed. The range for O_2 correction value, O_2 correction average value, and O_2 average value is automatically switched if corresponding instantaneous value range is switched.

To close the setting

Press the "ESC" key to end the setting of range switch mode or range switch operation or stop the operation in the middle, and the setting operation is made invalid and the previous screen appears.

Range identification contact operation

The range identification contact output corresponding to each Ch (component) is conductive when Range 1 is selected, and open when Range 2 is selected, which is applicable to any of the range switch mode selected.

Note that even if the range is switched during the hold of measurement value by remote hold contact input or the hold of measurement value at the time of calibration, the range identification contact output maintains the contact state immediately before the hold. After stop of the hold, the contact state of the current range is resumed.

9.4 Calibration setting

This mode is used to set calibration concentration and actions. The calibration setting involves calibration concentration, zero calibration, calibration range and auto calibration component /range.

9.4.1 Setting of calibration concentration

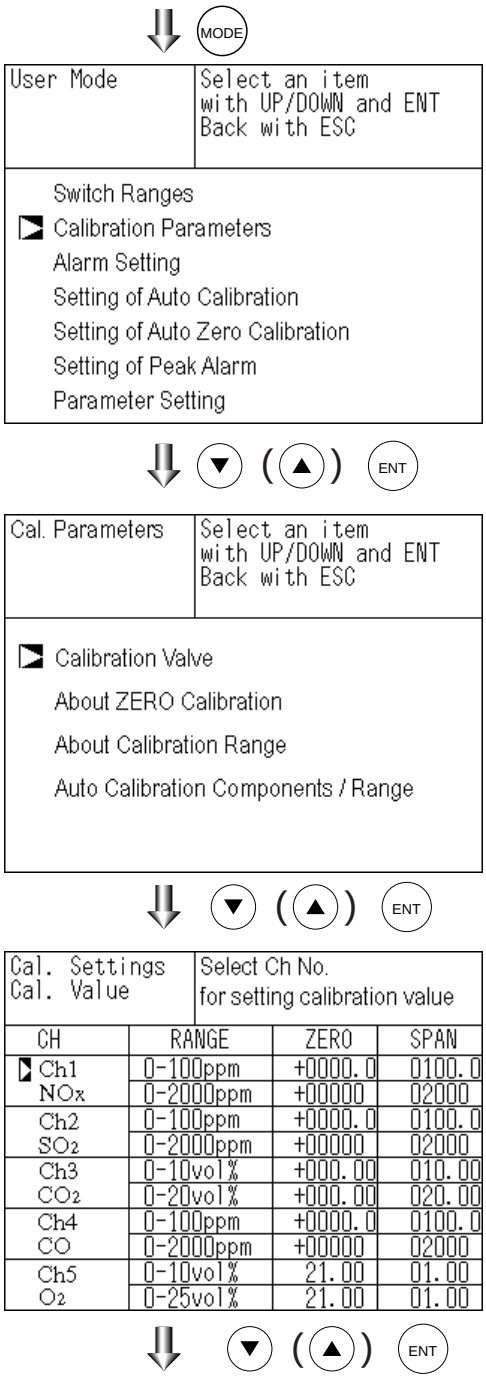
It allows you to set concentrations of the standard gas (zero and span) of each channel used for calibration.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Calibration Parameters” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Calibration Parameters” screen that appears, point the cursor to “Calibration Value” by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) In the “Calibration Concentration Ch Selection” screen that appears, point the cursor to Ch you want to set by using the ▲ or ▼ key. Press the "ENT" key.



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(5) In the “Calibration Concentration Selection” screen that appears, select any concentration item you want to set by pressing the ▲ , ▼ key. Then press the "ENT" key, and the selected value is highlighted.

Cal. Settings Cal. Value	Select setting value		
CH	RANGE	ZERO	SPAN
Ch1 NOx	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch2 SO_2	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch3 CO_2	0-10vol%	+000.00	010.00
	0-20vol%	+000.00	020.00
Ch4 CO	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch5 O_2	0-10vol%	21.00	01.00
	0-25vol%	21.00	01.00

▼ (▲) ENT

(6) In the “Calibration Concentration Value Setting” screen that appears, enter calibration gas concentration values (zero and span). For value entry, press the ▲ or ▼ key, and a 1-digit value increases or decreases. By pressing the ▶, the digit moves. After setting, save the entry by pressing the "ENT" key. The saved value becomes valid from the next calibration process.

Cursor for setting value

Cal. Settings Cal. Value	Set calibration value		
CH	RANGE	ZERO	SPAN
Ch1 NOx	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch2 SO_2	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch3 CO_2	0-10vol%	+000.00	010.00
	0-20vol%	+000.00	020.00
Ch4 CO	0-100ppm	+0000.0	0100.0
	0-2000ppm	+00000	02000
Ch5 O_2	0-10vol%	21.00	01.00
	0-25vol%	21.00	01.00

▼ ▲ ▶ ENT

End of Calibration Concentration Setting

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Note

Enter settings that correspond to each range. If zirconia type is used as O_2 sensor, select 21.00 for the field of Zero (when air is used), and select the concentration listed on the cylinder if the air contained in a cylinder is used.

To close the setting

To close the calibration concentration value setting process or cancel this mode midway, press the "ESC" key. A previous screen will return.

Setting range of values

NO_x, SO_2, CO_2, CO, buit-in Zirconia O_2 sensor and buit-in paramagnetic O_2 sensor
Span gas: 1 to 105% of full scale (Full scale (FS) is the same as each range value.)

External Zirconia O_2 measurement
Zero gas: 5 to 25 vol%
Span gas: 0.01 to 5 vol%

Note

The setting cannot be performed beyond the range.

9.4.2 Setting of manual zero calibration

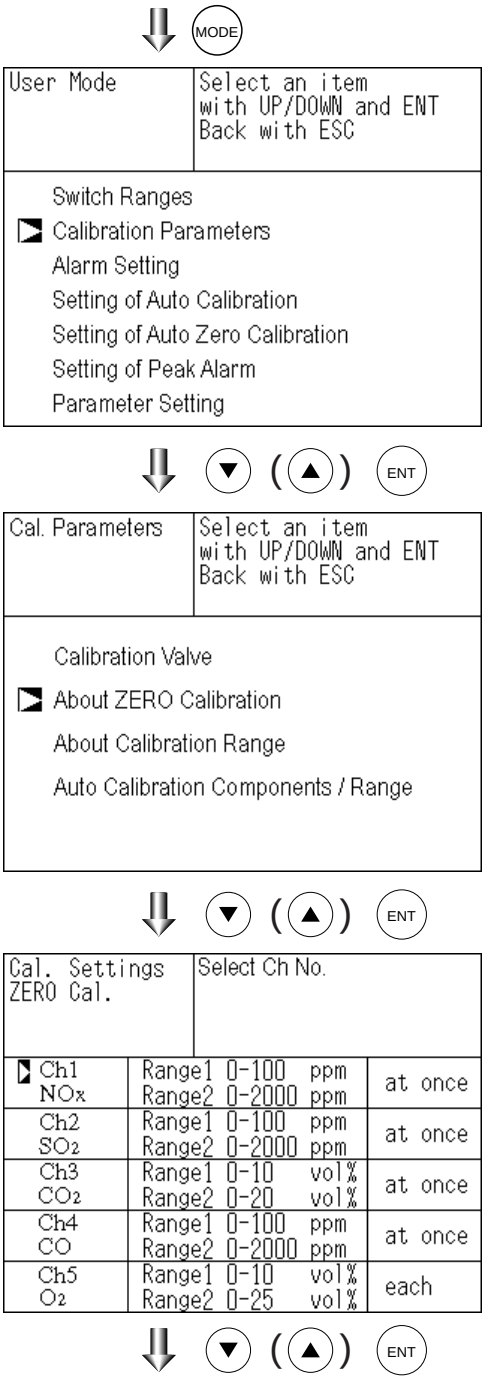
When zero calibration is made manually, set either all measurement components should be calibrated simultaneously or each component should be calibrated while selecting one by one.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Calibration Parameters” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Calibration Parameters” screen that appears, point the cursor to “About ZERO Calibration” by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) In the “Manual ZERO Calibration Ch Selection” screen that appears, point the cursor to Ch (component) you want to set by using the ▲ or ▼ key. Press the "ENT" key.



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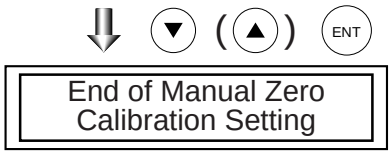
(5) In the “Manual ZERO Calibration Selection” screen that appears, select “at once” or “each” by pressing the ▲ or ▼ key. When selecting “at once”, the Ch (components) to be set can be zero-calibrated at the same time. When selecting “each”, either of the Ch (components) to be selected is zero-calibrated. After setting, press the "ENT" key.

Cal. Settings ZERO Cal.	Set each or both Ch at ZERO Calibration	
Ch1 NOx	Range1 0-100 ppm Range2 0-2000 ppm	at once
Ch2 SO_2	Range1 0-100 ppm Range2 0-2000 ppm	at once
Ch3 CO_2	Range1 0-10 vol% Range2 0-20 vol%	at once
Ch4 CO	Range1 0-100 ppm Range2 0-2000 ppm	at once
Ch5 O_2	Range1 0-10 vol% Range2 0-25 vol%	each



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To close the setting

To close the manual zero calibration setting or to cancel this mode midway, press the "ESC" key. A previous screen will return.

Example

Whether “each” or “at once” can be determined for each Ch (component).

・Setting “each”

Select the Ch (component) on the manual zero calibration screen and then perform zero calibration.

・Setting “at once”

At a manual zero calibration, zero of Ch (components) for which “at once” was selected can simultaneously be calibrated.

Note

When the cylinder air or atmospheric air is used for the zero gas, select “at once.”

Manual Calibration screen

・When setting all components to each :

ZERO Cal.	ENT : Go on Calibration of selected Ch ESC : Not calibration	
Ch1 NOx	▶Range1 0-100 ppm Range2 0-2000 ppm	-2.1
Ch2 SO_2	▶Range1 0-100 ppm Range2 0-2000 ppm	-0.5
Ch3 CO_2	▶Range1 0-10 vol% Range2 0-20 vol%	0.00
Ch4 CO	▶Range1 0-100 ppm Range2 0-2000 ppm	0.0
Ch5 O_2	Range1 0-10 vol% ▶Range2 0-25 vol%	21.00

A single cursor will appear.

・When setting all components to at once :

ZERO Cal.	ENT : Go on Calibration of selected Ch ESC : Not calibration	
Ch1 NOx	▶Range1 0-100 ppm Range2 0-2000 ppm	0.0
Ch2 SO_2	▶Range1 0-100 ppm Range2 0-2000 ppm	0.3
Ch3 CO_2	▶Range1 0-10 vol% Range2 0-20 vol%	0.00
Ch4 CO	▶Range1 0-100 ppm Range2 0-2000 ppm	-0.1
Ch5 O_2	Range1 0-10 vol% ▶Range2 0-25 vol%	21.00

Cursors will appear at all components where "at once" is set.

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9.4.3 Setting of calibration range

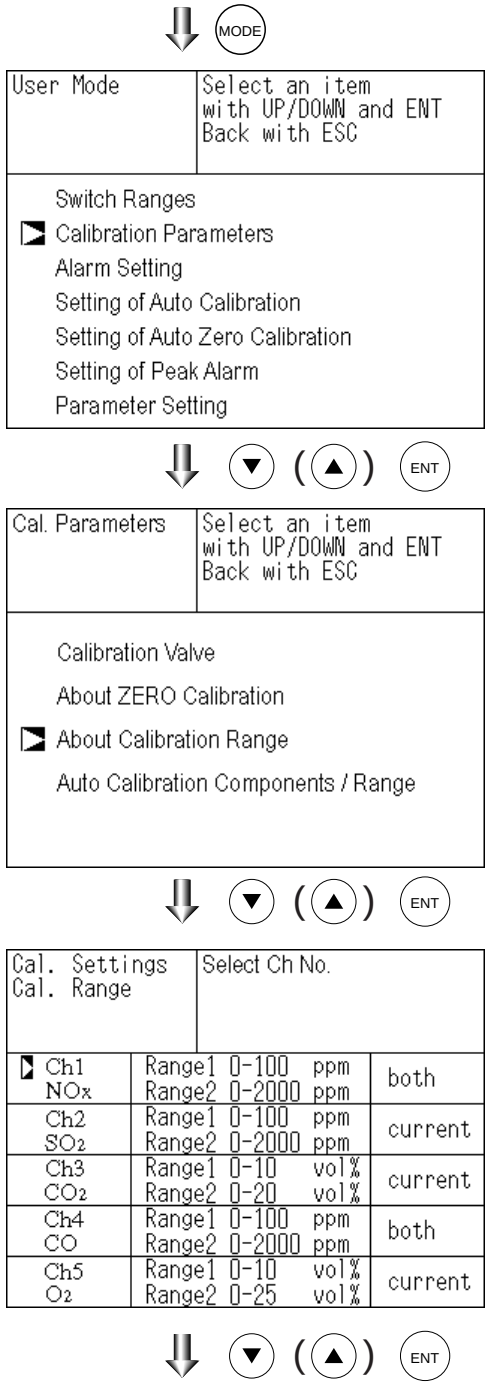
This mode is used to set if the range of each Ch (component) at the calibration (manual calibration or auto calibration) should be calibrated with a single range or 2 ranges.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Calibration Parameters” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Calibration Parameters” screen that appears, point the cursor to “About Calibration Range” by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) In the “Calibration Range Ch Selection” screen that appears, point the cursor to the Ch you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.



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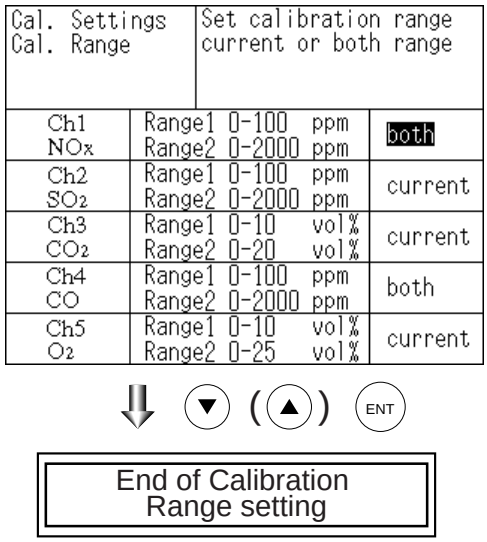
(5) On the “Calibration Range Selection” screen that appears, select “both” or“ current” by pressing the ▲or ▼ key.

・If “both” is selected, zero or span calibration is performed with Range 1 and Range 2 of the selected Ch inter locked.
・If “current” is selected, zero or span calibration is performed only for the range displayed when calibration of selected Ch is performed.
Press the "ENT" key after the selection, and the specified calibration is performed.



F9.9E.eps

To close “Setting of Calibration Range”

To close “Setting of Calibration Range” or to cancel this mode midway, press the " ESC" key. A previous screen will return.

Example

Ch1 NOx	Range 1: 0 to 100 ppm Range 2: 0 to 2000 ppm	both
Ch2 SO_2	Range 1: 0 to 100 ppm Range 2: 0 to 2000 ppm	current

Ch1: Range 1 and Range 2 are calibrated together with zero and span calibration.
Ch2: Only currently displayed range is calibrated with zero and span calibration.

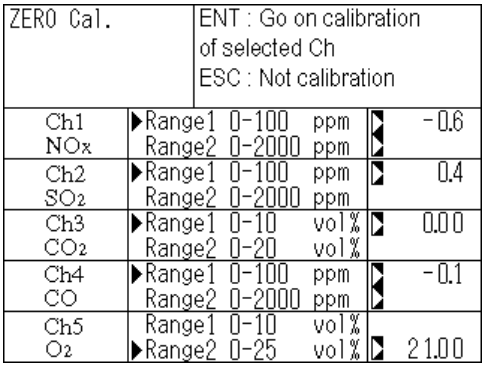
T9.1E.eps

Note

To perform calibration for “both,” set the same calibration gas concentration for both ranges.

Manual Calibration screen

When setting NOx and CO to both



F9.10E.eps

Two cursors will appear in both ranges (Ch1 and Ch4).

9.4.4 Setting of auto calibration component/range

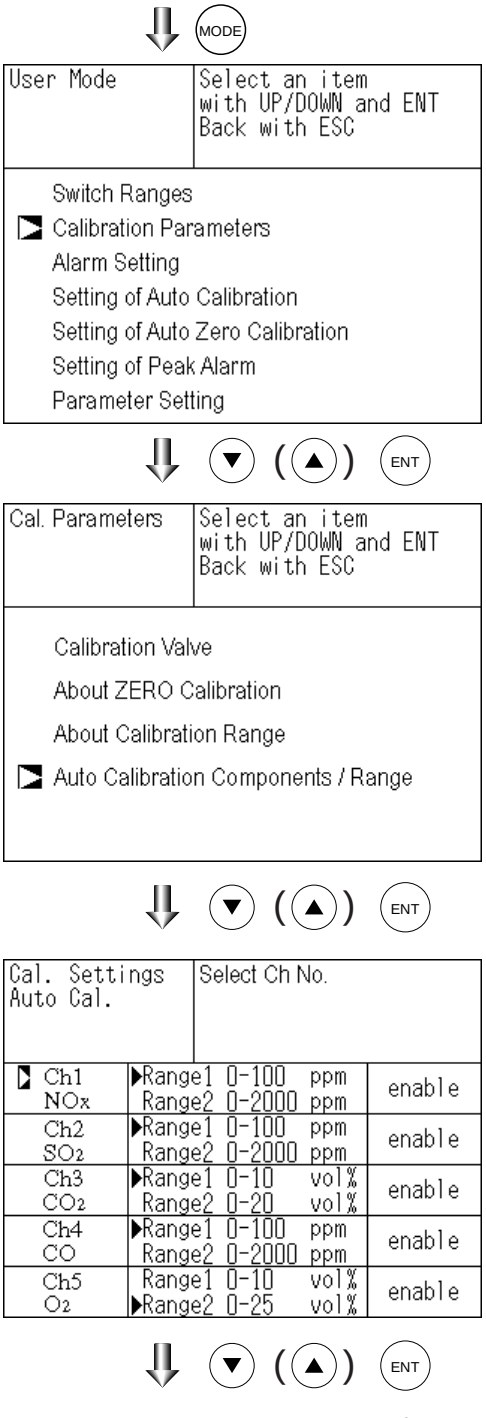
Select the Ch (component) and the range with which auto calibration is to be performed. The Ch for which “AR” has been selected as range switch mode is calibrated in the range set here even when auto calibration is performed.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Calibration Parameters” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Calibration Parameters” screen that appears, point the cursor to “Auto Calibration Components / Range” by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) In the “Auto Calibration Components / Range” selection screen that appears, point the cursor to the Ch you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.



F9.11E.eps

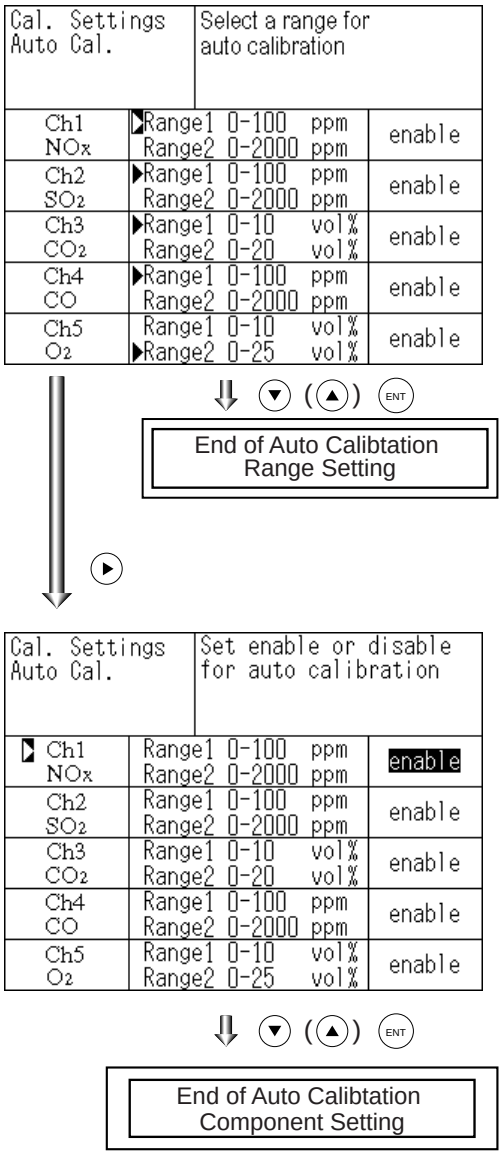
(5) The cursor next to the range of the selected Ch (component) is highlighted. Select the range to be calibrated mainly by pressing the ▲ or ▼ key.

(6) Then press the "ENT" key, and calibration is performed in the selected range.

Note

"Auto Calibration Component/range" setting

Auto calibration and the manual calibration of the component with which "AR" has been selected as range switch mode are performed in the range selected here. In this case, once the calibration is started, the range is automatically switched, and on completion of the calibration, the original range is resumed. The range identification contact is interlocked with the range after the switch. However, if the hold setting is set to "ON", the contact status before calibration is maintained.



F9.12E.eps

(7) Press the ▶ key in the state described in (5), and the highlight is switched between "enable" and "disable" auto calibration.

(8) Select "enable" of "disable" by pressing the ▲ or ▼ key.

(9) Then press the "ENT" key.

To close the setting

Press the "ESC" key to exit automatic calibration component/range setting, and the previous screen appears.

Operation by setting

Auto calibration is performed under the following rules.

1. Zero calibration is performed at the same time, for the Ch (component) with which "enable" is selected at the time of auto calibration and auto zero calibration.
2. Span calibration is performed in the order from smallest Ch No., for the Ch (component) with which "enable" is selected at the time of auto calibration.

Note

ZERO calibration on auto calibration and auto zero calibration of the component with which enable is selected are performed in batch irrespective of the description in 9.4.2 Setting of manual zero calibration.

9.5 Alarm Setting

9.5.1 Setting of alarm values

The High/Low limit alarm output setting for the measured concentration and power off alarm (alarm 6 only) setting can be made during measurement. Arbitrary 6 alarm contact outputs can be used.

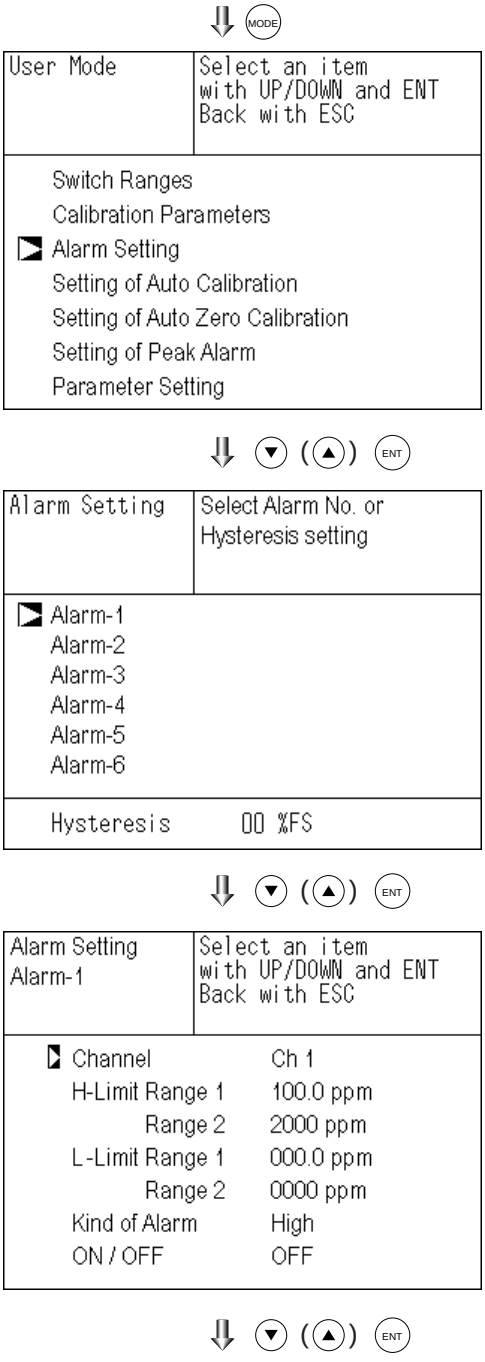
To change alarm setting, set the alarm ON/OFF setting to OFF, and then change the value.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Alarm Setting” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) After the alarm No. selection screen has appeared, point the cursor to the Alarm No. you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) After the alarm item selection screen has appeared, operate the ▲ or ▼ key until the cursor is aligned with a desired item and press the "ENT" key.

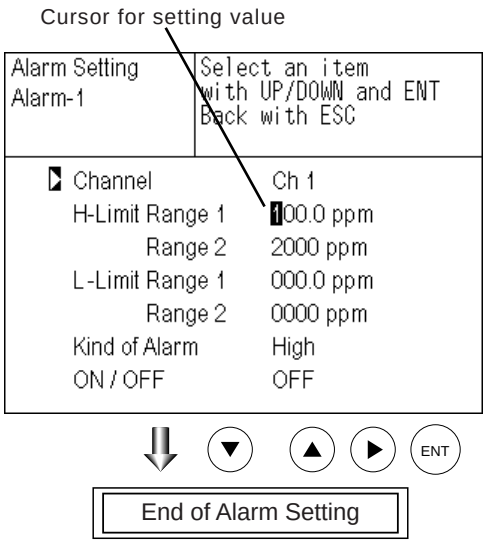


F9.13E.eps

Note

Set the values so that H-limit value > L-limit value and that (H-limit value − L-limit value) > hysteresis.

(5) After setting, the alarm setting is now completed by pressing the "ENT" key.



F9.14E.eps

To close the "Alarm Setting"

To close the "Alarm Setting" or to cancel this mode midway, press the "ESC" key. A previous screen will return.

Setting range

0 to 100% FS (Settable in each range).

Description of setting items

The alarm contact assigned the same number as the alarm is operated accordingly.

Channel: Channel setting targeted for issuance of alarm (Power off alarm can be selected for alarm 6.) One Ch No. can be selected for multiple alarms.

H-Limit value: Sets the high limit value (concentration) of alarm.

L-Limit value: Sets the low limit value (concentration) of alarm.

Kind of Alarm: Selects one of High limit alarm, Low limit alarm, and High limit or Low limit alarm, HH limit alarm, and LL limit alarm.

High, HH ... Alarm contact closes when above H-limit alarm.

Low, LL ... Alarm contact closes when below L-limit alarm.

High or Low ... Alarm contact closes when above H-limit value or below L-limit value.

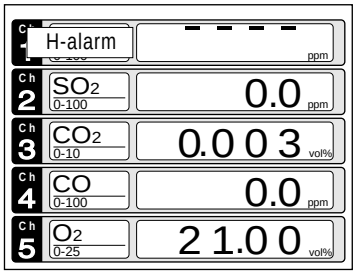
If "Power off" is selected for "Channel" displayed on LCD, the contact is closed at all times while the power is on irrespective of the setting mode here. (Alarm-6 only)

ON/OFF: Enables the alarm function if set at "ON", or disables the alarm function if set at "OFF".

* The H-limit value cannot be set below the L-limit value, and the L-limit value cannot be set above the H-limit value. If it is desired to set the H-limit value below the L-limit value already stored in the memory, reduce the L-limit value beforehand, and vice versa.

Typical on-screen display when an alarm occurs

When an H-limit alarm occurs, the H-alarm message comes on in the field of relevant Ch (component). (L-alarm for L-limit alarm, HH-alarm for HH limit alarm, and LL-alarm for LL limit alarm)



F9.15E.eps

Note

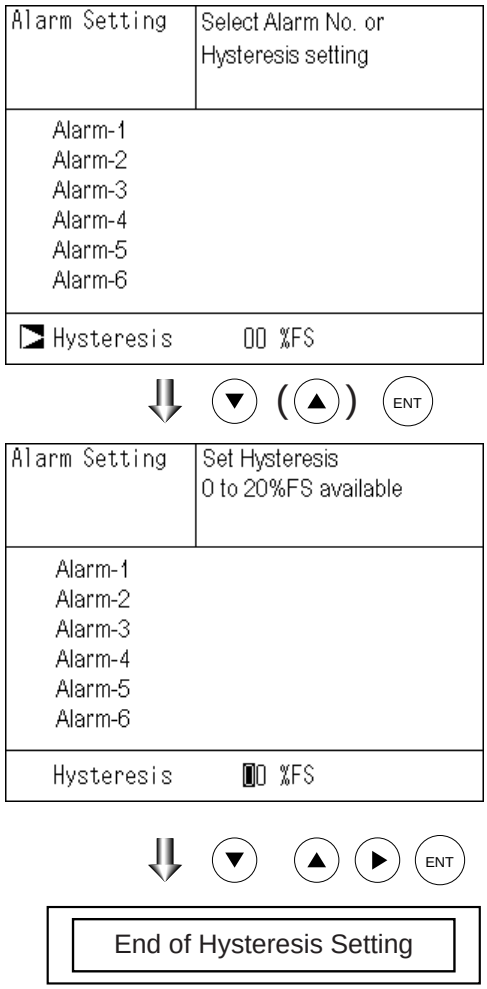
For 10 minutes after turning on power, the alarm judgment is inactive.

9.5.2 Hysteresis setting

To prevent chattering of an alarm output near the alarm setting values, set the value of hysteresis.

(1) In the “Alarm No. Selection” screen that appears, point the cursor to “Hysteresis” by pressing the ▲ or ▼ key. Press the "ENT" key.

(2) In the “Hysteresis Value Setting” screen that appears, enter hysteresis values. For the value entry, 1-digit value is increased or decreased by pressing the ▲ or ▼ key, and pressing the key ▶ moves the digit. After setting, press the "ENT" key.



F9.16E.eps

To close “Hysteresis Setting”

To close the “Hysteresis Setting” or cancel the mode midway, press the "ESC" key. A previous screen will return.

Setting range

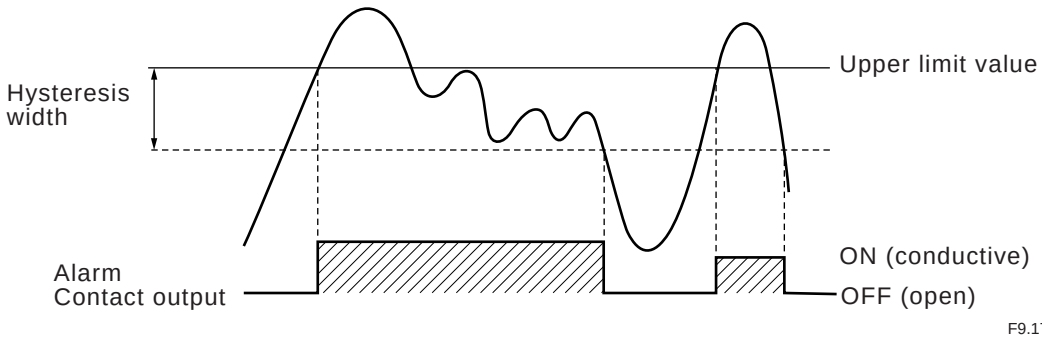
0 to 20% of full scale
[% full scale (FS)] represents the percentage with the width of the range of each component regarded as 100%.

Note

The hysteresis is common to all alarms (components).

Hysteresis (In case of upper limit alarm)

An alarm output is turned “ON” if measurement value exceeds the upper limit value as shown below. Once the alarm output has been turned “ON”, it is not turned “OFF” as long as the indication does not fall below the hysteresis width from the upper limit value.



F9.17E

9.6 Setting of Auto Calibration

9.6.1 Auto calibration

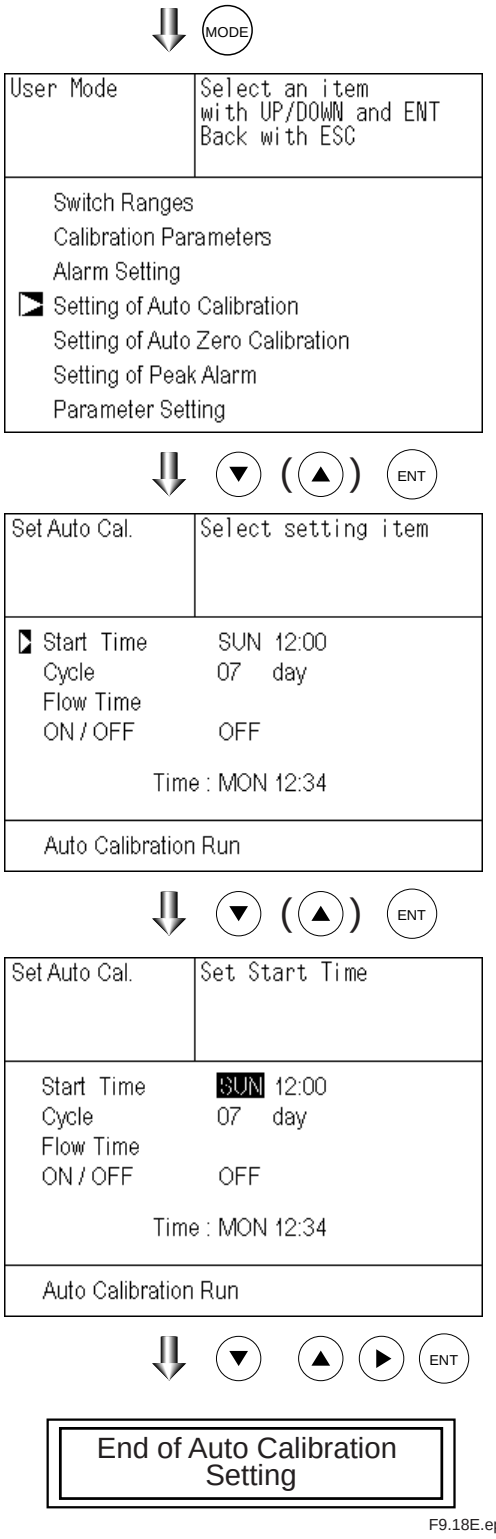
Auto calibration is automatically carried out at the time when zero calibration and span calibration are set.
Before changing the setting of auto calibration, set the ON/OFF to “OFF”.

1. During measurement, press the "MODE" key to display the User mode.

2. Point the cursor to “Setting of Auto Calibration” by pressing the ▲ or ▼ key. Press the "ENT" key.

3. In the “Setting of Auto Calibration” screen that appears, point the cursor to any item you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.

4. In the “Auto Calibration Parameter Setting” screen that appears, perform the value entry or the setting. For the value entry or setting change, use the ▲ or ▼ key. To change the setting, use the ▶ key to move the cursor to the right. After setting, press the "ENT" key, and setting of auto calibration is carried out .



F9.18E.eps

Description of setting items

- Start Time :
  Setting at the first calibration (day of the week, hour, minute)
- Cycle : A period between the start time of one calibration and another (unit : hour/day)
- Flow Time :
  The time required for replacement by calibration gas after the calibration is completed (Set by calibration gas. See the next page.)
- ON/OFF : ON/OFF of auto calibration

To close “Setting of Auto calibration”

To close the “Setting of Auto calibration” or cancel this mode midway, press the "ESC" key. A previous screen will return.

<Gas flow time setting>

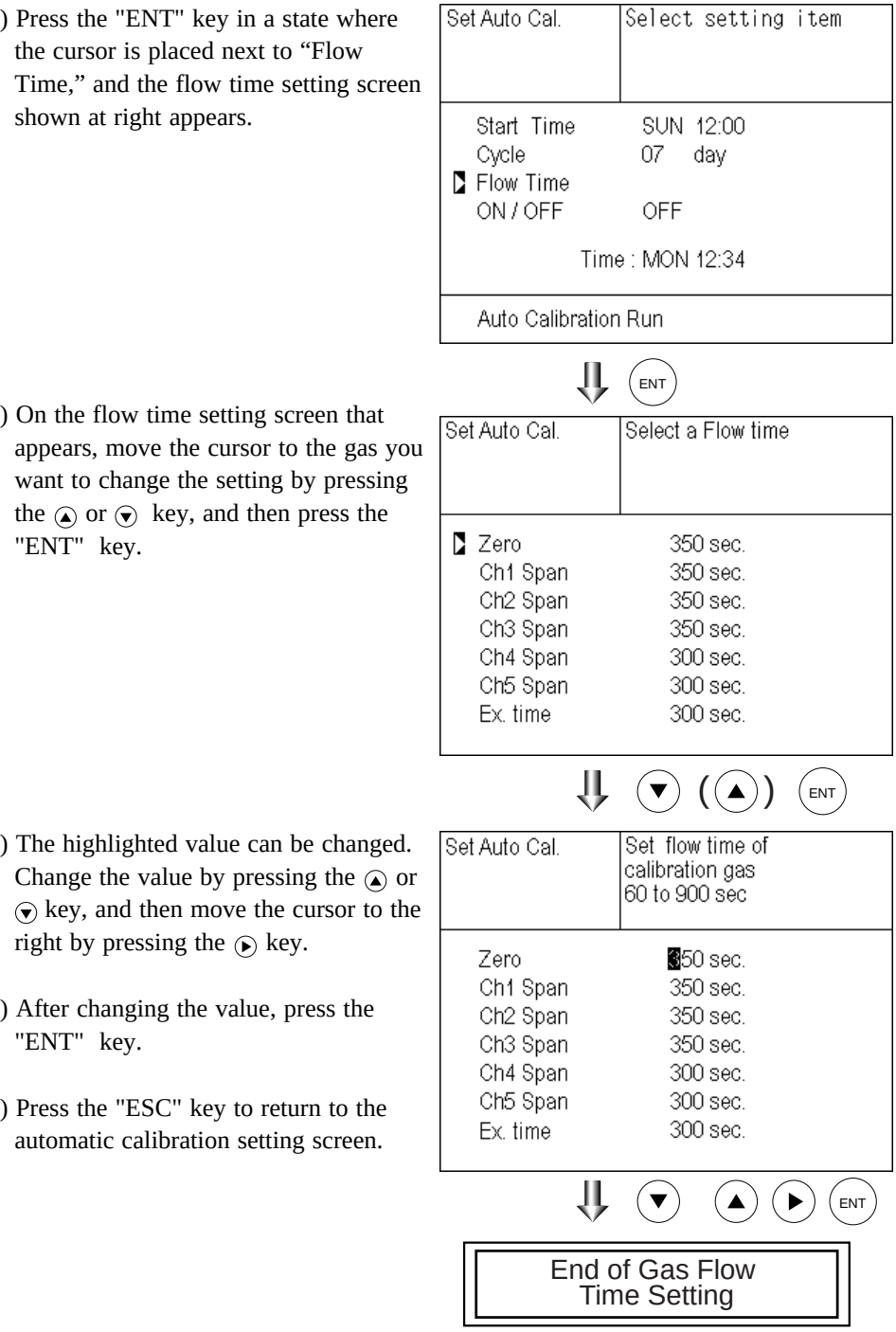
(1) Press the "ENT" key in a state where the cursor is placed next to “Flow Time,” and the flow time setting screen shown at right appears.

(2) On the flow time setting screen that appears, move the cursor to the gas you want to change the setting by pressing the ▲ or ▼ key, and then press the "ENT" key.

(3) The highlighted value can be changed. Change the value by pressing the ▲ or ▼ key, and then move the cursor to the right by pressing the ▶ key.

(4) After changing the value, press the "ENT" key.

(5) Press the "ESC" key to return to the automatic calibration setting screen.



F9.19E.eps

Note

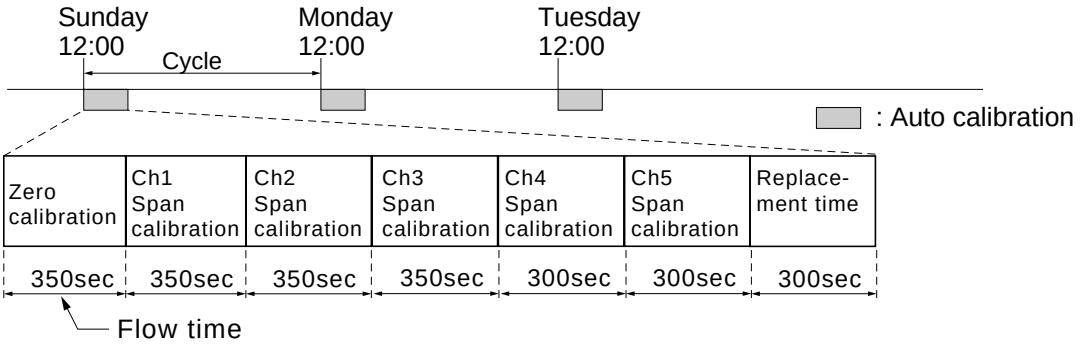
Only the Channels used are displayed on this screen. The Ex. time is the output signal hold extension time after the completion of calibration. It is valid only when the hold setting is set to “ON”. The Ex. time set here is also the hold extension time at the time of manual calibration.

Auto calibration status contact output is closed during auto calibration (including Ex. time), and is open in other cases.

Example

Start Time	SUN	12:00
Cycle	1	day
Flow Time	Zero	350 sec
	Ch1 Span	350 sec
	Ch2 Span	350 sec
	Ch3 Span	350 sec
	Ch4 Span	300 sec
	Ch5 Span	300 sec
	Ex. time	300 sec
ON/OFF	ON	

In case where auto calibration is carried out at the above setting.



(An example of Ch1: through Ch5: enable , as given in Item 9.4.4 Auto Calibration Components/Range)

F9.20E.eps

Setting range

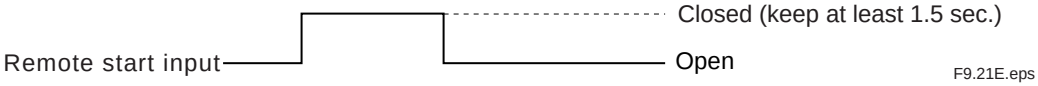
Cycle : 1 to 99 hours or 1 to 40 days (initial value 7 days)
Flow Time : 60 to 900 sec (initial value 300 sec)

CAUTION

- When an auto calibration starts, the measurement screen automatically appears.
- Any operation other than Stop Auto Calibration (see Item 9.6.2) is not permitted during auto calibration. Stop Auto Calibration cannot be performed with the key lock to “ON”. To cancel auto calibration forcedly, set the key lock to “OFF” and then execute Stop Auto Calibration .
- Turn on the power again after it is turned off (including the case of power failure) at the time set as the next start time in auto calibration, and then repeat it in the set cycle.

Remote start

Whether the auto calibration is set at “ON” or “OFF”, an auto calibration is available by keeping the remote start input closed for at least 1.5 seconds.



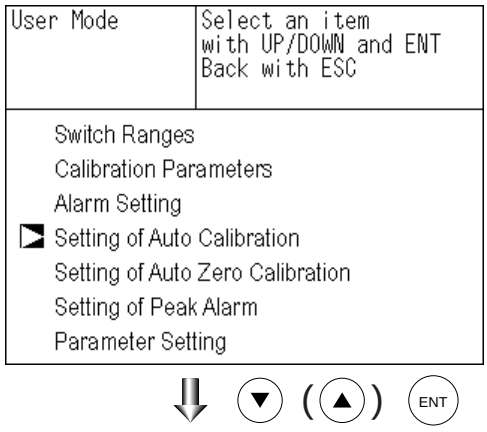
F9.21E.eps

9.6.2 Forced run/stop of auto calibration

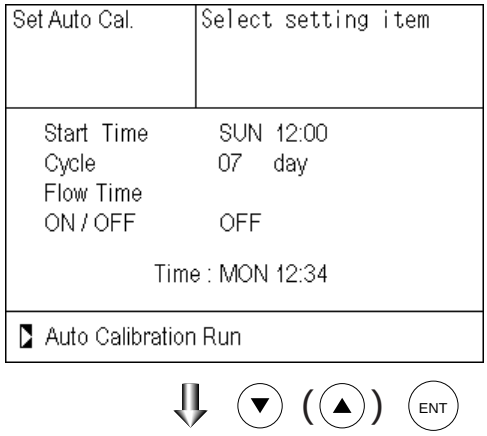
Auto calibration can be performed just once or forcibly stopped while the calibration is performed.

9.6.2.1 Execution of auto calibration (only once)

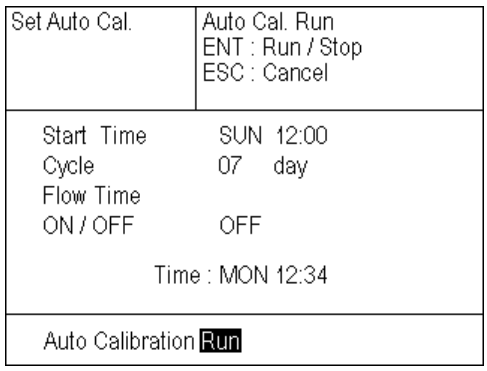
(1) Display the User mode screen. Move the cursor to “Setting of Auto Calibration” by pressing the ▲ or ▼ key, and then press the "ENT" key.



(2) In the “Setting of Auto Calibration” item selection screen that appears, point the cursor to “Auto Calibration Run” by pressing the ▲ or ▼ key. Press the "ENT" key.



(3) “Run” is highlighted, displaying a message to confirm the execution of auto calibration. Press the "ENT" key to execute the auto calibration, and press the "ESC" key to cancel.

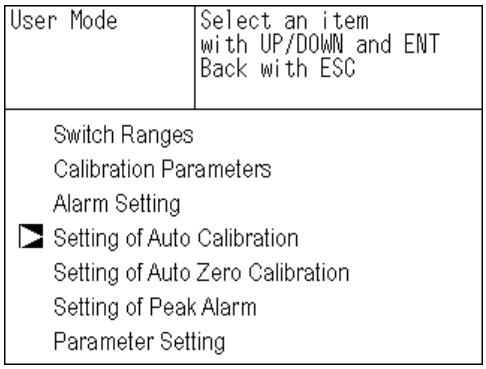


F9.22E.eps

9.6.2.2 Forced stop of auto calibration

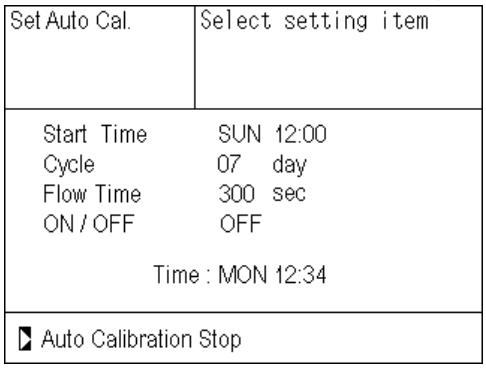
This mode is used to stop the auto calibration forcedly.

(1) In the User mode that is displayed, point the cursor to “Setting of Auto Calibration” by pressing the ▲ or ▼ key. Press the "ENT" key.



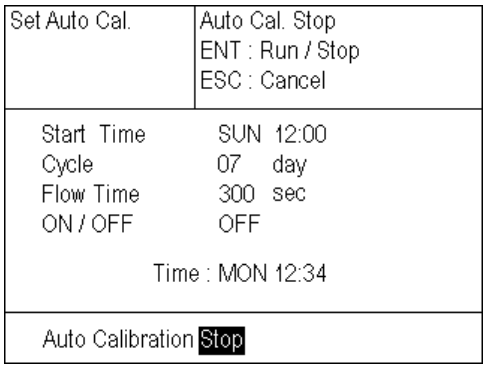
▼ (▲) ENT

(2) In the “Setting of Auto Calibration” item selection screen that appears, point the cursor to “Auto Calibration Stop” by pressing the ▲ or ▼ key. Press the "ENT" key. (“Auto Calibration Stop” appears when the screen is selected while auto calibration is performed.)



▼ (▲) ENT

(3) “Stop” is highlighted, displaying a message to confirm the stop of auto calibration. Press the "ENT" key to stop the auto calibration, and press the "ESC" key to cancel (not stopped).



F9.23E.eps

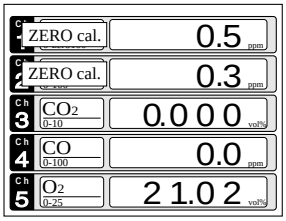
Auto Calibration screen

Example

In case where setting the auto calibration components (see Item 9.4.4) to Ch1: enable and Ch2: enable

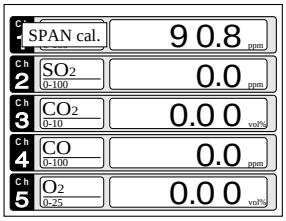
· Zero calibration

A message, Zero cal. blinks at Ch1 and Ch2.



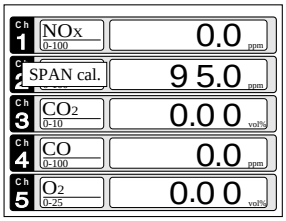
· Ch1 span calibration

A message, Span cal. blinks at Ch1.



· Ch2 span calibration

A message, Span cal. blinks at Ch2.



F9.24E.eps

CAUTION

During auto calibration, any key operation is not permitted other than operations such as key lock ON/OFF and Stop Auto Calibration. When the key lock is set at “ON”, even the Auto Calibration Stop cannot be used. To stop Auto Calibration forcedly, set the key lock to “OFF” and then execute Auto Calibration Stop.

9.7 Setting of Auto Zero Calibration

9.7.1 Auto zero calibration

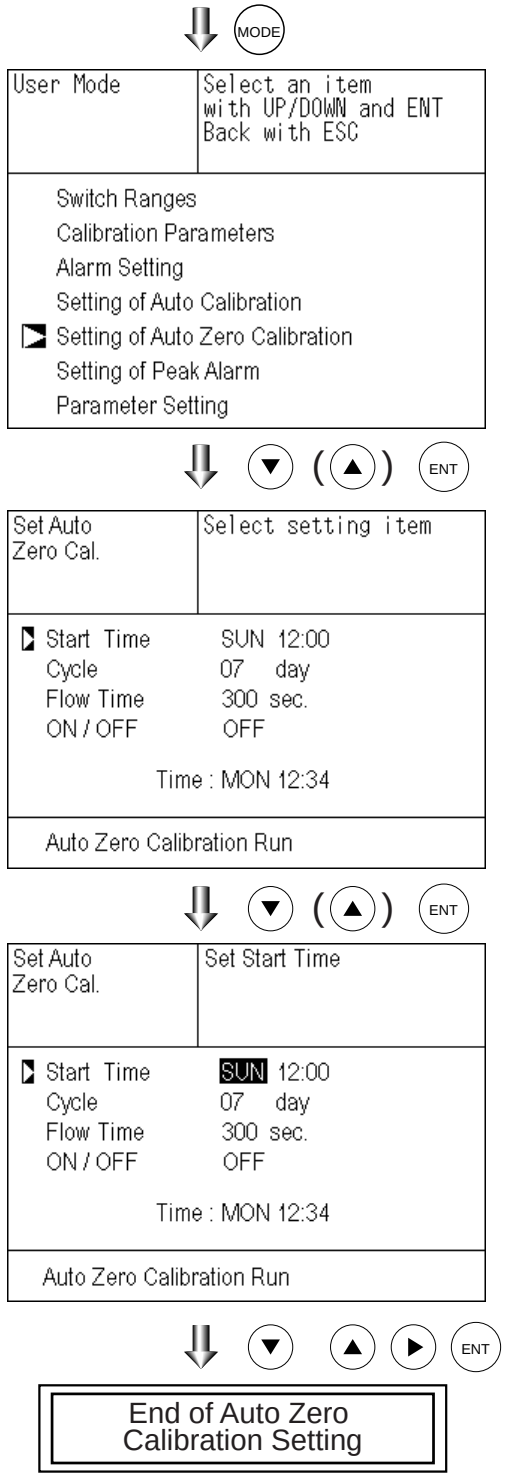
Auto zero calibration is automatically carried out at the time when zero calibration is set. Components for which a calibration is to be made are determined by setting of auto calibration component in Item 9.4.4. Before changing the setting of auto zero calibration, set the ON/OFF to “OFF”.

(1) During measurement, press the "MODE" key to display the User mode.

(2) Point the cursor to “Setting of Auto Zero Calibration” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Setting of Auto Zero Calibration” screen that appears, point the cursor to any item you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) In the “Auto Zero Calibration Parameter Setting” screen that appears, perform the value entry or the setting. For the value entry or setting change, use the ▲ or ▼ key. To change the setting, use the ▶ key to move the cursor to the right. After setting, press the "ENT" key, and auto zero calibration is carried out by the entered setting value.



F9.25E.eps

Description of setting items

- Start Time :
  Setting at the first calibration (day of the week, hour, minute)
- Cycle :
  A period between the start time of one calibration and another (unit : hour/day)
- Flow Time :
  The time required for the calibration gas to be replaced in the cell
- ON/OFF :
  ON/OFF of auto zero calibration

To close the “Setting of Auto Zero Calibration”

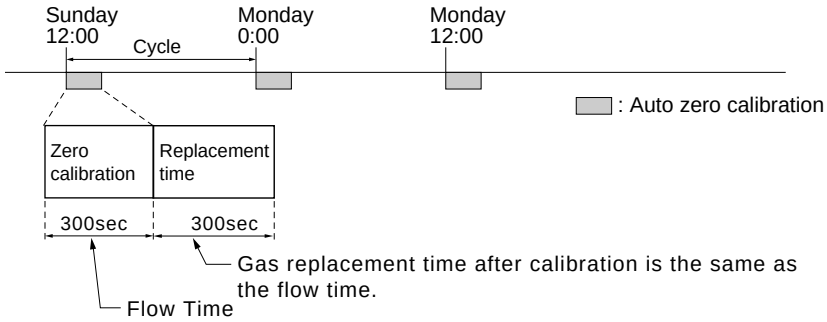
To close “setting of Auto Zero Calibration ” or cancel this mode midway, press the "ESC" key. A previous screen will return.

Auto calibration status contact output is closed durin auto zero calibration, and is open in other cases.

Example

Start Time	SUN	12:00
Cycle	12	hour
Flow Time	300	sec
ON/OFF	ON	

In case where auto zero calibration is carried out at the above setting.



(An example of Ch1: through Ch5: enable, as given in Item 9.4.4 Auto Calibration Components/Range)

F9.26E.eps

Setting range

Cycle : 1 to 99 hours or 1 to 40 days (initial value 7 days)
Flow Time : 60 to 900 sec (initial value 300 sec)

CAUTION

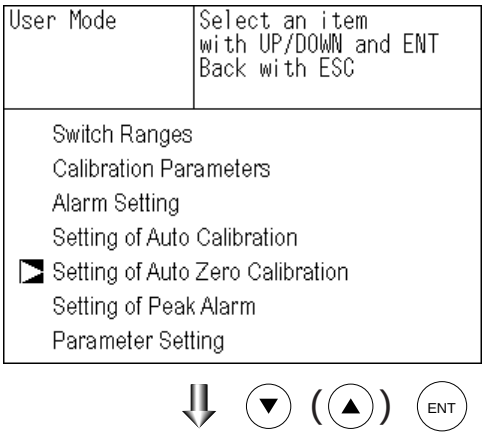
- When an auto zero calibration starts, the measurement screen automatically appears.
- Any operation other than “Stop Auto Zero Calibration” (see Item 9.7.2) is not permitted during auto zero calibration. "Stop Auto Zero Calibration" cannot be performed with the key lock to “ON”. To cancel auto zero calibration forcedly, set the key lock to “OFF” and then execute "Stop Auto Zero Calibration".
- If the auto calibration period and auto zero calibration period have overlapped, the auto calibration is retained, ignoring the auto zero calibration of that period.
- When the hold setting is set to “ON”, the hold time of auto calibration contact and measurement value output signal is extended after calibration for gas replacement time.

9.7.2 Forced run/stop of auto zero calibration

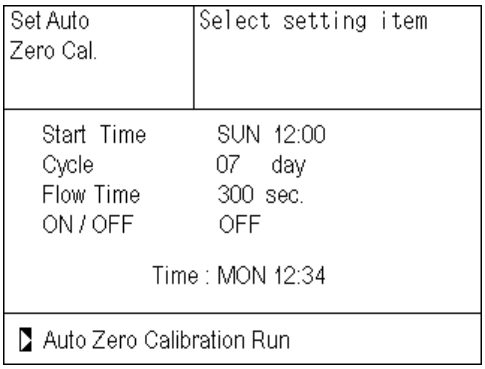
Auto zero calibration can be performed just once, or auto zero calibration can be forcibly stopped during calibration.

9.7.2.1 Execution of auto zero calibration (just once)

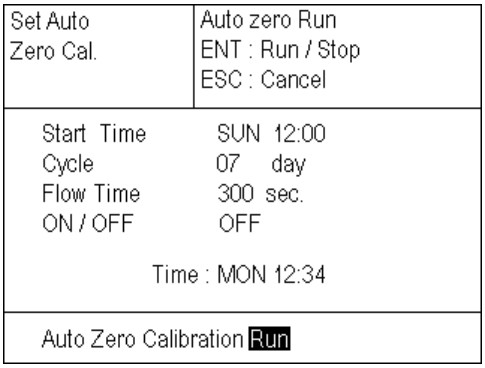
(1) Move the cursor to “Setting of Auto Zero Calibration” by pressing the ▲ or ▼ key on the user mode screen, and then press the "ENT" key.



(2) In the “Setting of Auto Zero Calibration” item selection screen that appears, point the cursor to “Auto Zero Calibration Run” by pressing the ▲ or ▼ key. Press the "ENT" key.



(3) “Run” is highlighted, displaying a message to confirm execution of auto zero calibration. Press the "ENT" key to execute the calibration, and press the "ESC" key to cancel.

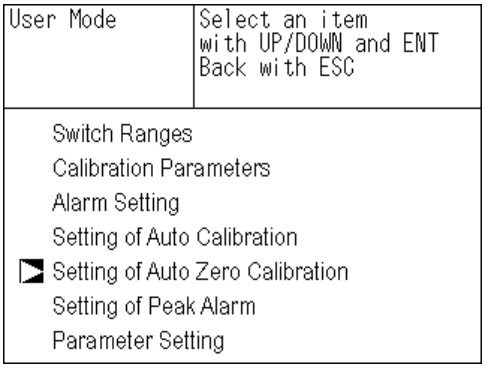


F9.27E.eps

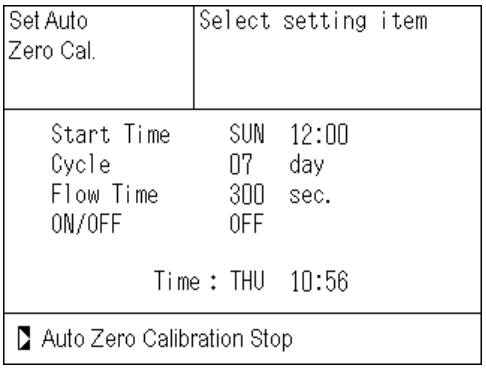
9.7.2.2 Forced stop of auto zero calibration

This mode is used to cancel the auto zero calibration forcedly.

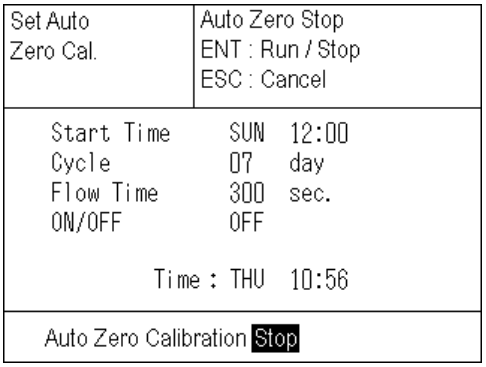
(1) In the User mode that is displayed, point the cursor to “Setting of Auto Zero Calibration” by pressing the ▲ or ▼ key. Press the "ENT" key.



(2) In the “Setting of Auto Zero Calibration” item selection screen that appears, point the cursor to “Auto Zero Calibration Stop” by pressing the ▲ or ▼ key. Press the "ENT" key. (“Auto Zero Calibration Stop” appears when the screen is selected while auto zero calibration is performed.)



(3) “Stop” is inverted. A message appears, prompting you to verify that you want to stop auto zero calibration. Press the "ENT" key to stop the auto zero calibration and the "ESC" key to cancel (not stopped).



F9.28E.eps

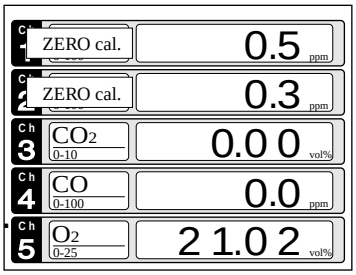
“Auto Zero Calibration” screen

Example

In case where setting the auto calibration components (see Item 9.4.4) to “Ch1: enable” and “Ch2: enable”

・Zero calibration

A message, “Zero cal.” blinks at Ch1 and Ch2.



F9.29E.eps

CAUTION

During auto zero calibration, any key operation is not permitted other than operations such as key lock ON/OFF and "Stop Auto Zero Calibration". When the key lock is set at “ON”, even the "Stop Auto Zero Calibration" cannot be used. To stop auto zero calibration forcedly, set the key lock to “OFF” and then execute "Auto Zero Calibration Stop."

9.8 Peak Alarm Setting

When the peak number of times CO concentration exceeds the upper limit value during measurement exceeds the set number, an alarm is provided.

The peak alarm and this setting screen appear only when an option is added.

(1) Press the "MODE" key in the Measurement mode, and the User mode appears.

(2) Point the cursor to “Setting of Peak Alarm” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Peak Alarm Setting” item selection screen that appears, point the cursor to any item you want to set by pressing the ▲ or ▼ key. Press the "ENT" key.

(4) Then, enter numeric values and perform the setting.

Entering the numeric values or setting the items should be carried out by using the ▲ or ▼ key. After setting, press the "ENT" key, and the set values are saved.

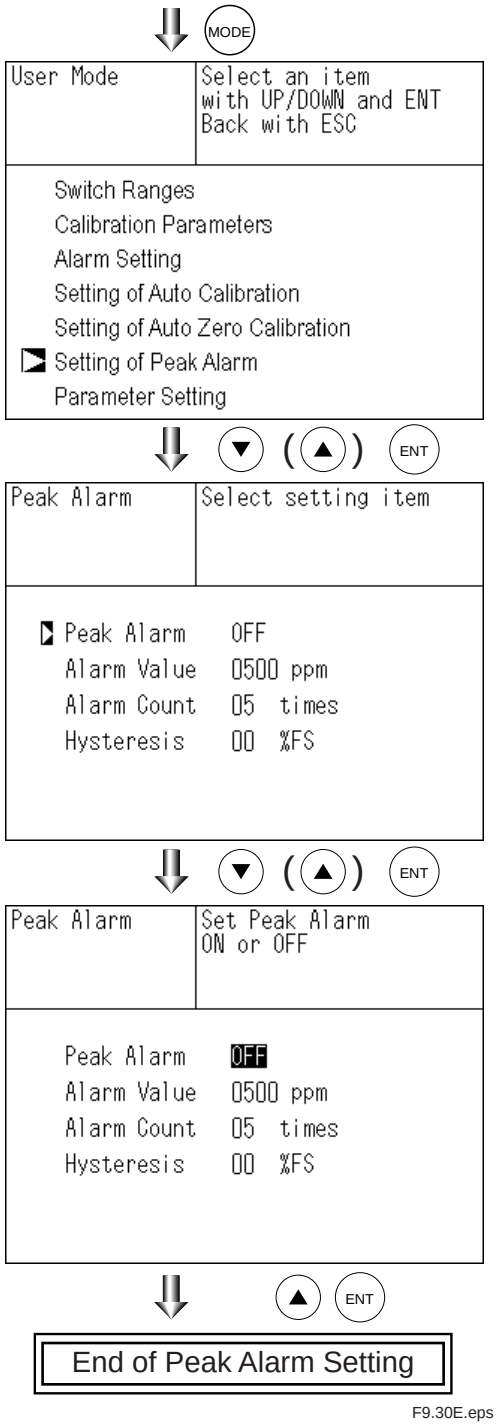
Description of setting items

・Peak Alarm : ON/OFF of peak alarm

・Alarm Value :
If measuring value exceeds the set alarm value, a peak counter counts 1 time.

・Alarm Count :
When a peak in excess of the setting time occurs, a peak count alarm output is provided.

・Hysteresis :
To prevent possible chattering when the measuring value may exceed the set peak concentration by only 1 time, the peak count has an allowance in the hysteresis width.



F9.30E.eps

Setting range

Alarm value : 10 to 1000 ppm, 5 ppm step → (initial value: 500 ppm)
Alarm count : 1 to 99 times → (initial value: 5 times)
Hysteresis : 0 to 20 % of full scale → (initial value: 0% of full scale)
[% full scale] represents the percentage with the CO range regarded as 100%.

Action of peak alarm

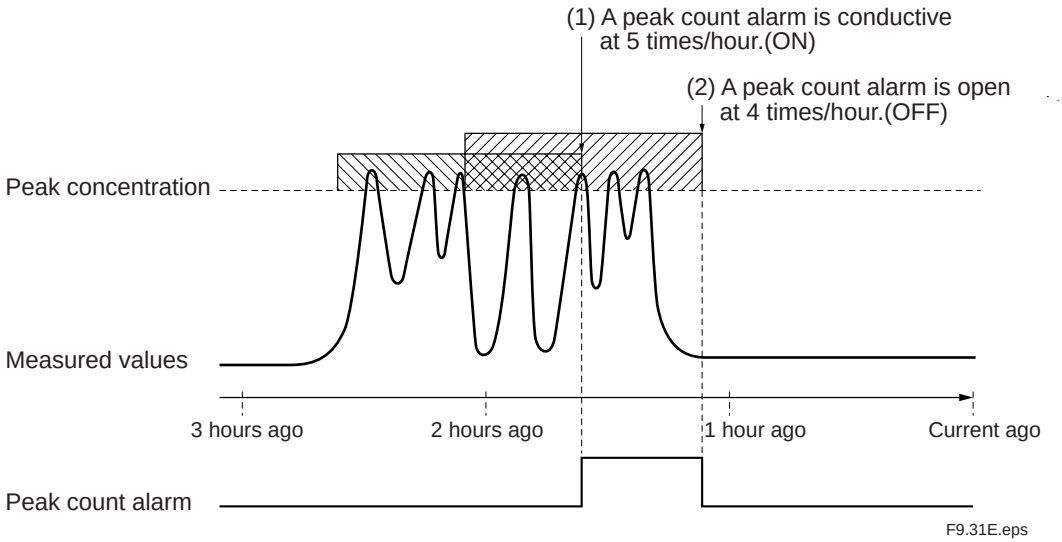


Figure 9. Example of peak alarm action

If CO concentration exceeds the alarm value, counting will begin. If the number of peaks is over the set times per hour, a peak alarm contact output becomes closed (ON). If it is less than the set times per hour, it is open (OFF). Since 5 times of peaks /hour is marked at (1) ▧ section from the above graph, the peak count alarm is turned “ON”. Since peaks of more than 5 times per hour occur at the interval between (1) and (2) ▨, the peak count alarm remains “ON”. Since at (2), peaks are reduced to 4 times per hour, it is turned “OFF”.

Like the hysteresis of the alarm setting , the hysteresis prevents possible chattering when measured gas is fluctuated near the alarm value.

* For 10 minutes after the power is turned “ON”, a peak alarm counting is not carried out.

Releasing peak count alarm

To release the peak count alarm, set the peak alarm to "OFF".

Turning on the peak alarm initiates counting from 0.

9.9 Parameter Setting

It allows you to carry out the parameter setting such as time, key lock, etc., as required. Items to be set are as follows:

・Current Time : Current year, month, date, day of the week, hour, and minute setting (The display appears in this order.)

Note

The clock backup time is 2 days. If power is turned on after it is kept off for 2 days or longer, make the time setting again.

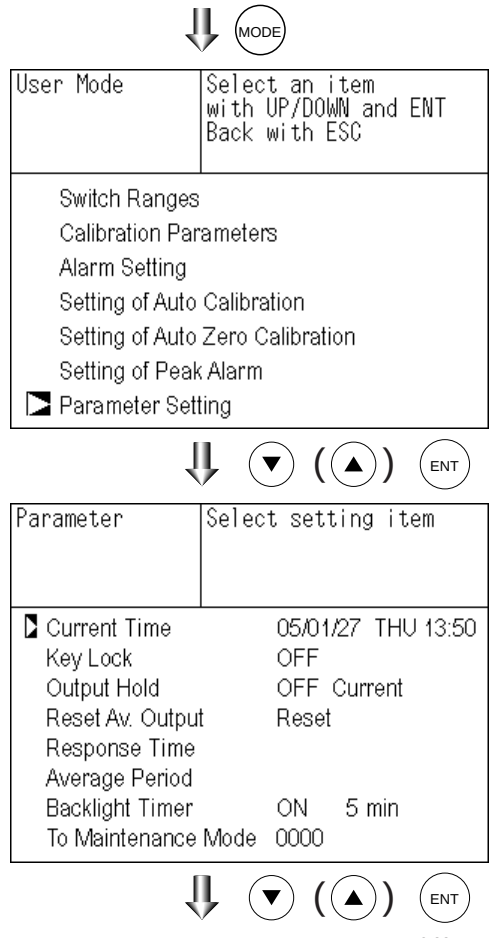
・Key Lock : Sets with ON/OFF so that any key operation except the key lock "OFF" cannot be performed.
・Output Hold : Sets whether Calibration Output is held or not, and the holding value setting.
・Reset Av. Output : Resets the average value.
・Response time : Sets the response time of electrical system.
・Average Period : Sets the moving average time.
・Backlight Timer : Sets automatic "OFF" of the backlight of display unit and the time until backlight out.
・Maintenance mode : Enters passwords to switch to the Maintenance mode.

* For the maintenance mode, see Item 9.10.

(1) To display the User mode, press the "MODE" key in the measurement mode.

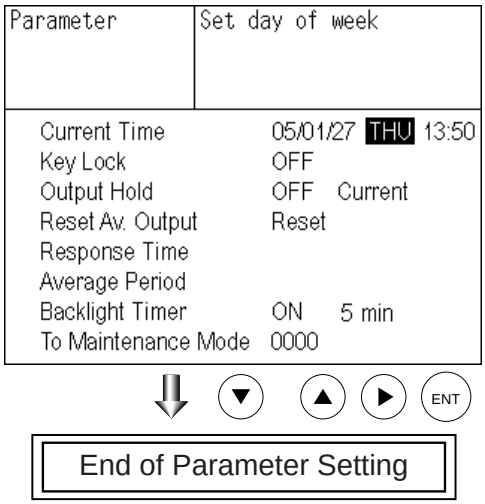
(2) Point the cursor to “Parameter Setting” by pressing the ▲ or ▼ key. Press the "ENT" key.

(3) In the “Parameter Setting” screen that appears, point the cursor to any item you want to set by pressing the ▲ or ▼ key. Press the ENT key.



F9.32E.eps

(4) In the "Parameter Setting" screen that appears, enter the numeric values and set the items. Entering the numeric values or setting the items should be carried out by using the ▲ or ▼ key. To move the cursor to the right, press the ▶ key. When the "ENT" key is pressed, the parameter setting is carried out with the value you set.



F9.33E.eps

To close Parameter Setting screen

To close the “Parameter Setting” screen or cancel this mode midway, press the "ESC" key. A previous screen will return.

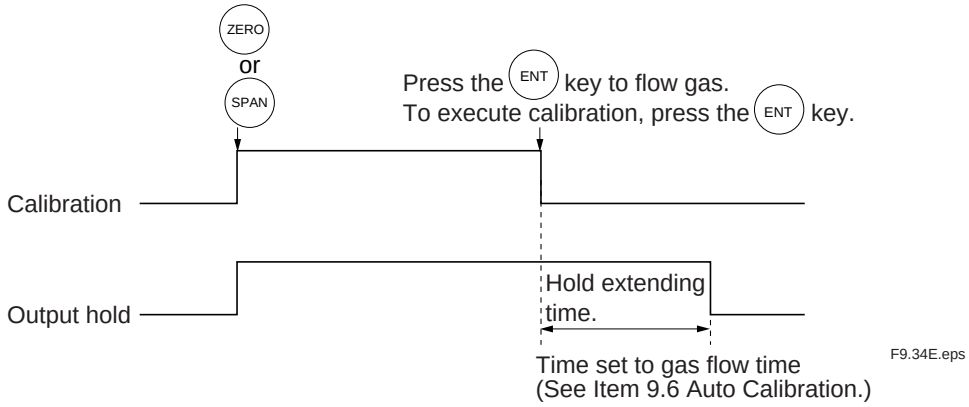
Setting Range

- Hold setting : 0 to 100% FS
- Response Time : 1 to 60 sec. (initial value: 15 sec)
- Average Period : 1 to 59 min or 1 to 4 hours (initial value: 1 hour)
  When setting the unit of 1 to 59 minutes is terms of minute or 1 to 4 hours with hour
- Backlight Timer : 1 to 60 min (initial value: OFF)
- Maintenance Mode : 0000 to 9999 (initial value: 0000)

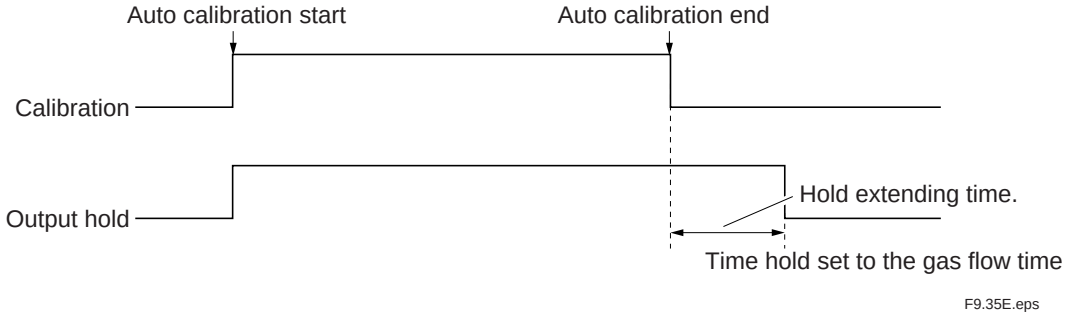
9.9.1 Output Hold

By setting an output hold to “ON”, an output signal of each channel are held during the calibration (manual calibration and auto calibration) and for the gas flow time (refer to Item 9.6, Setting of Auto Calibration). Regardless of Hold ON/OFF setting, an output signal can be held via an external input.

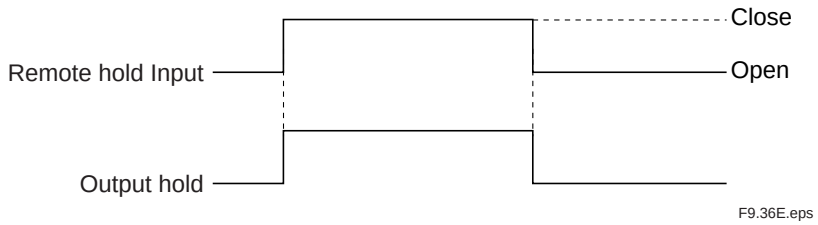
(1) Manual calibration



(2) Auto calibration



(3) External hold



(4) Screen display during Holding

The “on Hold” message blinks on the measuring screen. Since the screen displays the process of calibration is displayed during the manual calibration, “on Hold” is not displayed even if the output signal is held, but the screen is displayed with the hold extending time.

(5) If calibration is cancelled after the calibration gas is supplied regardless of during manual calibration or auto calibration, the holding extending time will be performed.

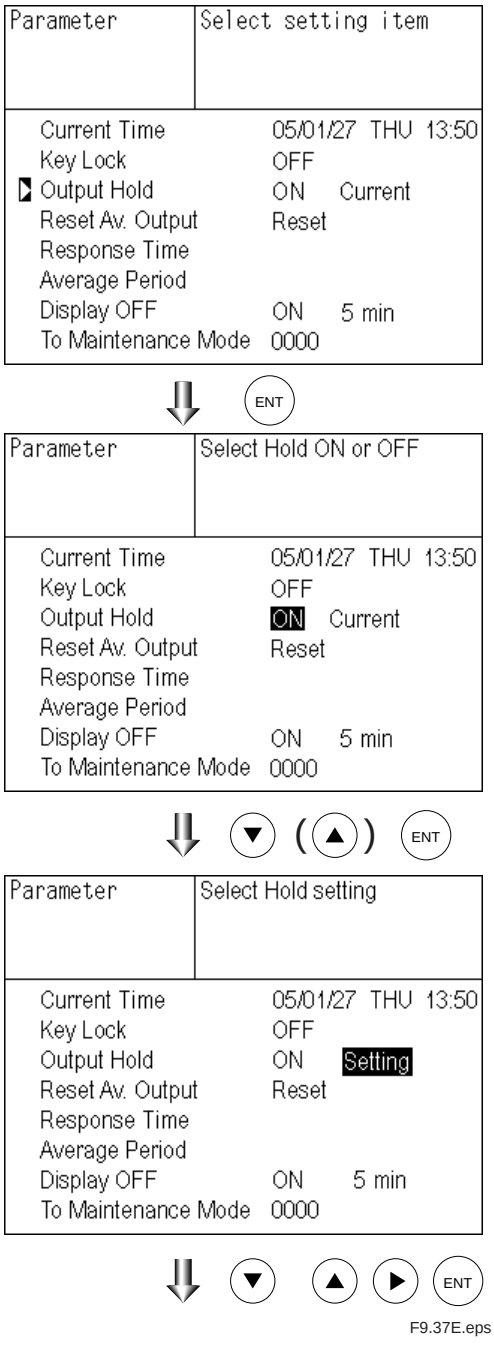
(6) You can select the value for hold from the value immediately before entering output hold, “Current,” and arbitrary value, “Setting.” Follow the procedures shown below to make the setting.

(a) Move the cursor to "Output Hold". Press the "ENT" key.

(b) “ON” or “OFF” is highlighted. Press the ▲ or ▼ key to select "ON" or "OFF". Press the "ENT" key to return to (1).

(c) Press the ▶ key in a state ON/OFF is highlighted, and “Current” or “Setting” is highlighted. Select “Current” or Setting” by pressing the ▲ or ▼ key.

(d) Press the "ENT" key while “Current” is selected to return to (1). Press the "ENT" key while “Setting” is selected to go to the setting entering screen.
“Current” : Holds the value immediately before the hold.
“Setting” : Holds the value arbitrarily set.



F9.37E.eps

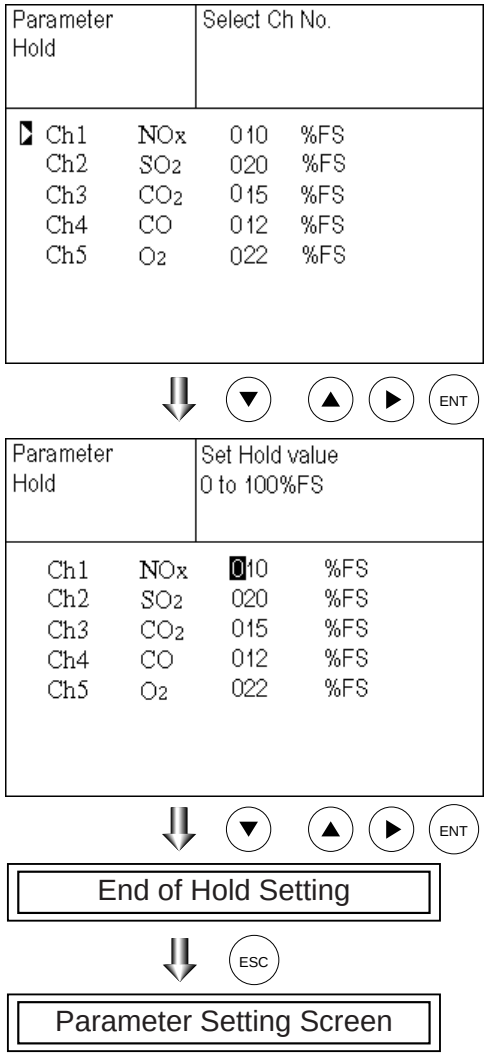
(e) On the "Parameter Hold" screen that appears, move the cursor next to the Ch (component) you want to make the setting by pressing the ▲ or ▼ key, and then press the "ENT" key.

(f) The value is highlighted, indicating that the value can be changed. Change the value by pressing the ▲ or ▼ key, and then move the cursor to the right by pressing the ▶ key.

(g) After the value is changed, press the "ENT" key.

Meaning of setting

The setting is expressed in % against the range for both ranges. When 0 to 1000 ppm is selected as the range, for example, if 10% FS is selected as hold setting, the output equivalent to 100 ppm is output and held irrespective of the measurement value at that time.



F9.38E.eps

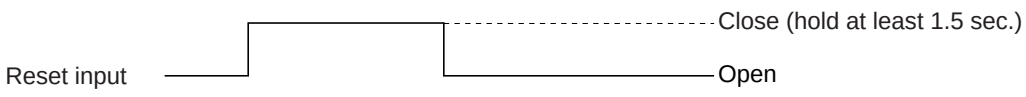
(h) Press the "ESC" key to return to the parameter setting screen.

Description of setting

- Instantaneous value display of the measurement cannot be held. (Output only can be held.)
- If set value is selected for hold, instantaneous O_2 correction value is calculated and held based on the set value.
- Range identification contact output cannot be switched even if the range is switched during the hold.

9.9.2 Average value reset

This mode is used to clear all average values O_2 correction average and O_2 average, and restarts averaging. All average values are reset at a time. The indication value and output value is 0 ppm, vol% or so at the time of the reset input (Refer to the average period).



F9.39E.eps

So long as close, resetting lasts.
At the edge of changing from closing to opening, the average action restarts.

9.9.3 Response time

The response time of the electrical system can be changed. Setting is available by components.

Note

It does not provide exact seconds for the setting time, but it gives a guide of the setting time. The setting value can be modified as requested by the customer.

Parameter Response Time		Select Ch No.	
▶ Ch1	NOx	10	sec.
Ch2	SO_2	20	sec.
Ch3	CO_2	15	sec.
Ch4	CO	12	sec.
Ch5	O_2	22	sec.

T9.40E.eps

9.9.4 Average period

It allows you to set an average period of the average value of O_2 correction and O_2 average. It enables you to set an average time of 1 to 59 minutes (1-minute step) or 1 to 4 hours (1-hour step).

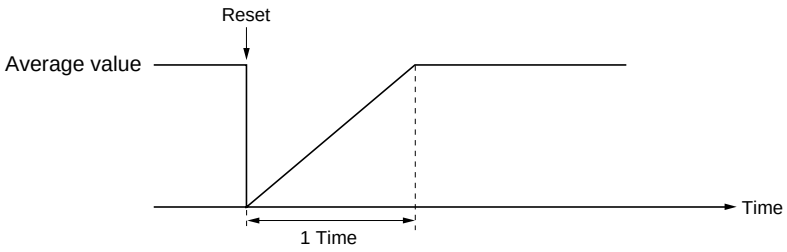
Changing the setting resets the average value of O_2 correction and O_2 average value. (Pressing the "ENT" validates the resetting only for components whose setting was changed.)

Parameter Average Period		Select Ch No.	
▶ Ch9	AV. CV NOx	01	hour
Ch10	AV. CV SO_2	01	hour
Ch11	AV. CV CO_2	01	hour
Ch12	AV. O_2	01	hour

T9.41E.eps

Example of average action

In case the average period was set to 1 hour.



・Sampling occurs every 30 seconds.
・Every 30 seconds, the average for last 1 hour (time setting) is output.
・At the instant of resetting, zero is assumed for all past values.
It means that the average value will not be correct for 1 hour after resetting.

F9.42E.eps

9.9.5 Backlight Timer

Automatic “OFF” setting of the backlight of the LCD unit can be made. When the specified time elapses from when the measurement screen is resumed, the backlight is automatically turned off. Press any key to reset backlight “OFF”.

Only when “ON” is selected, the time until auto OFF is displayed. Press the ▶ key in this state, and the time setting can be changed by pressing the ▲ or ▼ key.

Press the "ENT" key to confirm the selection. If “OFF” is selected, the backlight is not turned off.

Parameter	Select ON or OFF

Current Time	05/01/27 THU 13:50	
Key Lock	OFF	
Output Hold	ON	Previous value
Reset Av. Output	Reset	
Response Time		
Average Period		
Backlight Timer	**ON**	5 min
To Maintenance Mode	0000	

F9.43E.eps

9.9.6 Password setting for Maintenance mode

Enter the password and then press the "ENT" key to enter the maintenance mode. The password can be set by the password setting in maintenance mode. Default password setting at the time of delivery from the factory is “0000.”

You can enter the maintenance mode with the value before it is changed.

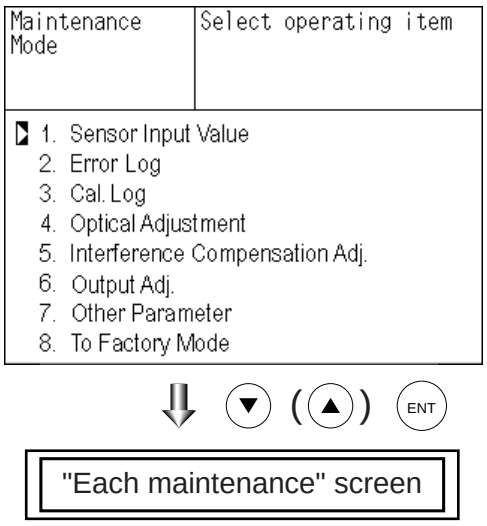
9.10 Maintenance Mode

This mode is used for check of sensor input values, display of error log files or setting of passwords, etc. First, enter a password and then use it from the next operation. This mode is displayed by selecting the Maintenance Mode from “Item 9.9 Parameter Setting”. Each “Maintenance Mode” screen

(1) Select the "To Maintenance Mode" from the "Parameter Setting" screen to display the Password Setting screen.

(2) Enter the password, and the Maintenance Mode item selection screen will be displayed. Point the cursor to the item you want to set by pressing the ▲ or ▼ key and press the "ENT" key.

(3) Next, each Maintenance screen is displayed.



F9.44E.eps

Note

"To Factory Mode” is used for our service engineers only. Refrain from using this mode.

(4) Press the "ESC" key to return to the Maintenance Mode item selection screen from each screen.

9.10.1 Sensor Input Value

Description of Sensor Input Value screen

- NOx M :
  NOx sensor input value
- NOx C :
  NOx interference compensation sensor input value
- SO_2 M :
  SO_2 sensor input value
- SO_2 C :
  SO_2 interference compensation sensor input value
- CO_2 M :CO_2 sensor input value
- CO_2 C :CO_2 interference compensation sensor input value
- CO M :CO sensor input value
- CO C :CO interference compensation sensor input value
- Temperature: temperature sensor input value
- O_2 : O_2 sensor input value

Maintenance Sensor Input

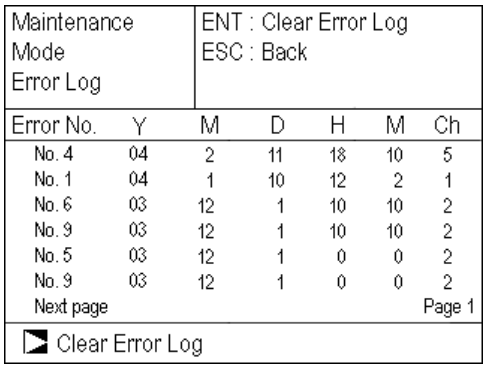
Sensor		input	sensor	input
NOx	M	648	O_2	20785
	C	499	TEMP	15785
SO_2	M	1518		
	C	425		
CO_2	M	1120		
	C	80		
CO	M	39		
	C	80		

F9.45E.eps

9.10.2 Error Log screen

Description of Error Log screen

In this error history, fourteen newest errors are logged. For error number, date and time (year, month, day, period) of occurrence, channel and other details of error, refer to Item 12.2 Error message. Select Clear Error Log and press the "ENT" key, and the error log is cleared completely.



9.10.3 Calibration Log screen

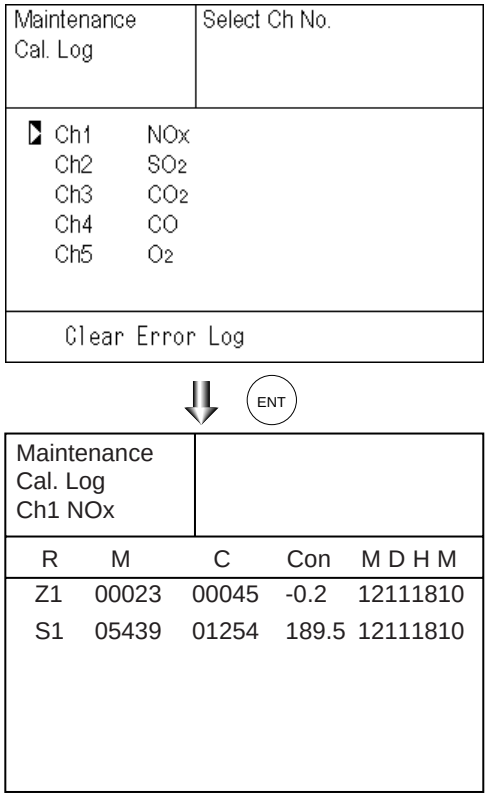
Description of Calibration Log screen

Past calibration history is shown. Sensor input value, concentration value, and the date when zero/span calibration is performed are logged. The 10 newest calibration data are logged by each component.

Operation

Move the cursor to Clear Calibration Log and press the key, and the calibration log is cleared completely.

Z1 : Zero calibration (Z) of Range 1
S1 : Span calibration (S) of Range 1
M : Value of measuring detector at the time of calibration
C : Value of the interference compensation detector at the time of calibration
Con : Concentration value displayed before calibration



F9.47E.eps

CAUTION

If the following operation is maladjusted, the measurement may be adversely and excessively affected. Carry out the operation with utmost attention.

9.10.4 Optical adjustment screen

For details of this item, refer to “Item 10.3.4(3) Optical zero adjustment method”. Press "ENT" key and turn “ON” the solenoid valve signal for each calibration gas by using the ▲ or ▼ key.

Maintenance Optical Adj.		ENT : Selectable flow gas	
1−1	9	2−1	24
	3		1
1−2	21	2−2	40
	27		80
GAS Sample			

9.10.5 Moisture interference compensation adjustment screen

For details of this item, refer to “Item 4. Moisture interference compensation adjustment method” of section 10.3.4.

Description of moisture interference compensation adjustment screen

In values on the left side of screen, the moisture interference for each component is already offset. The figures at right are interference compensation coefficients.

Operation

Move the ▶ cursor to a desired Ch (component) by pressing the ▲ or ▼ key, and then press the "ENT" key, and the selected value at right is highlighted.

Check that the gas for moisture interference compensation is flowing, change the moisture interference compensation coefficient using the ▲ or ▼ key, adjust the value at left so that it becomes near zero, and then press the "ENT" key to log moisture interference compensation value.

CAUTION

Since an interference compensation detector is not provided if the 1st range is beyond 0 to 10 vol%, no interference adjustment can be performed (no need).

Maintenance		Select Ch No. with UP / DOWN and ENT Back with ESC	
▶ Ch1	NOx	10	1.252
Ch2	SO_2	-33	0.983
Ch3	CO_2	13	0.000
Ch4	CO	20	1.922
ALL			
Valve OFF			

⇩ ▼ (▲) ENT

Maintenance		Adjust with UP / DOWN ENT : Memorized ESC : Back	
Ch1	NOx	0	1.263
Ch2	SO_2	-33	0.983
Ch3	CO_2	13	0.000
Ch4	CO	20	1.922
ALL			
Valve OFF			

F9.49E.eps

9.10.6 Output adjustment screen

Description of output adjustment screen

Analog output adjustment screen. Connect the digital multi meter to the output terminal corresponding to the number of OUT to be adjusted, and adjust the value so that 4 mA or 0V is output at zero and 20 mA or 1 V is output at span.

Operation

Move the cursor using the ▲, ▼ or the ▶ key to the output (OUT No. and Zero / Span) to be adjusted, and then press the "ENT" key. The selected value is high-lighted. Adjust the value, while watching the output, by pressing the ▲ or ▼ key. Press the ▶ key to select the next digit. On completion of the adjustment, press the "ENT" key.

Maintenance Mode Output Adj.			Adjust OUTPUT ZERO and SPAN		
OUT	Zero	Span	OUT	Zero	Span
1	01245	11845	7	01900	12500
2	01245	11845	8	01900	12500
3	01245	11845	9	01900	12500
4	01245	11845	10	01900	12500
5	01245	11845	11	01900	12500
6	01245	11845	12	01900	12500

Maintenance Mode Output Adj.			Zero / Span adjustment		
OUT	Zero	Span	OUT	Zero	Span
1	01245	11845	7	01900	12500
2	01245	11845	8	01900	12500
3	01245	11845	9	01900	12500
4	01245	11845	10	01900	12500
5	01245	11845	11	01900	12500
6	01245	11845	12	01900	12500

F9.50E.eps

9.10.7 Other parameter

Description of each setting screen

Password Set : Set the password used to move from the parameter setting screen to the maintenance mode. Arbitrary 4-digit number can be selected.

O_2 ref. Value : Set the oxygen concentration reference value at the time of oxygen correction calculation. Settable in the range from 00 to 19%.

Limit : Set the oxygen concentration limit at the time of oxygen correction calculation. Settable in the range from 01 to 20%.

* Refer to the O_2 correction concentration value in 8.3 Outline of display screen for oxygen correction calculation procedure.

Range setting : Moves to the screen on which measuring range is changed.

Operation

Press the ▲ or ▼ key to move the cursor to the item whose setting is to be changed. The values for password, oxygen correction, limit, and station No. are highlighted. Press the ▲ or ▼ key to change the value to desired one, and then press the "ENT" key.

Maintenance Mode setting	Select an item
Password Set 2465 O_2 ref. Value 12% O_2 limit 20% O_2 Station No. 01 Range setting	

Note

Pay attention not to forget the password. Otherwise you cannot enter the maintenance mode.

<How to set/change the range>

The measuring range can be arbitrarily selected in the minimum and the maximum range specified at the time of purchase. The range to be used can be selected 1 or 2.

Settable range

The value for range 1 and range 2 must fall within the range from the MIN and the MAX range (including the MIN and the MAX range), and at the same time range 1 must be smaller than range 2. The number of ranges is 1 or 2.

Operation

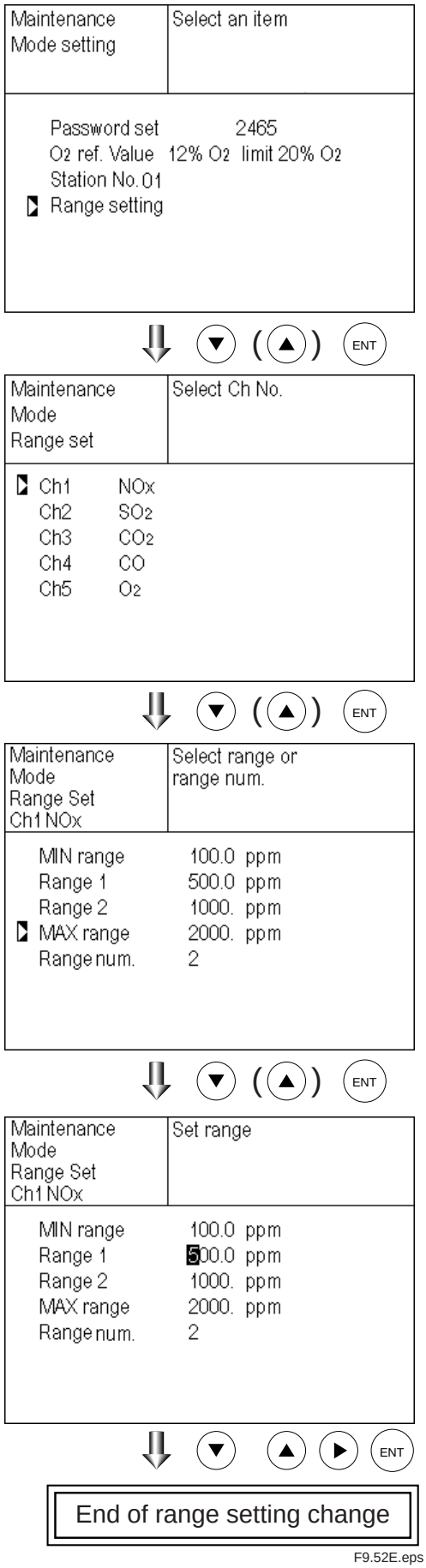
(1) Move the cursor to the item to be set by pressing the or the key, and then press the "ENT" key.

(2) Move the cursor to the Ch (component) whose setting is to be changed by pressing the ▲ or ▼ key, and then press the "ENT" key.

(3) Move the cursor to the item whose setting is to be changed by pressing the ▲ or ▼ key, and then press the "ENT" key.

(4) Press the ▲ or ▼ key to change the value. Press the ▶ key to select the next digit. In a state where the decimal point is highlighted, press the ▲ or ▼ key, and the decimal point position can be changed.

(5) When necessary change is made, press the "ENT" key.



F9.52E.eps

9.11 Calibration

9.11.1 Zero calibration

It is used for zero point adjustment. For zero calibration gas, suited for an application should be used according to “Standard gas in Item 2.3.”

(1) Press the "ZERO" key on the Measurement screen to display the Manual Zero Calibration screen.

(2) Select he Ch (component) to be calibrated by pressing the ▲ or ▼ key. After selection, press the ENT key, and zero gas will be supplied.

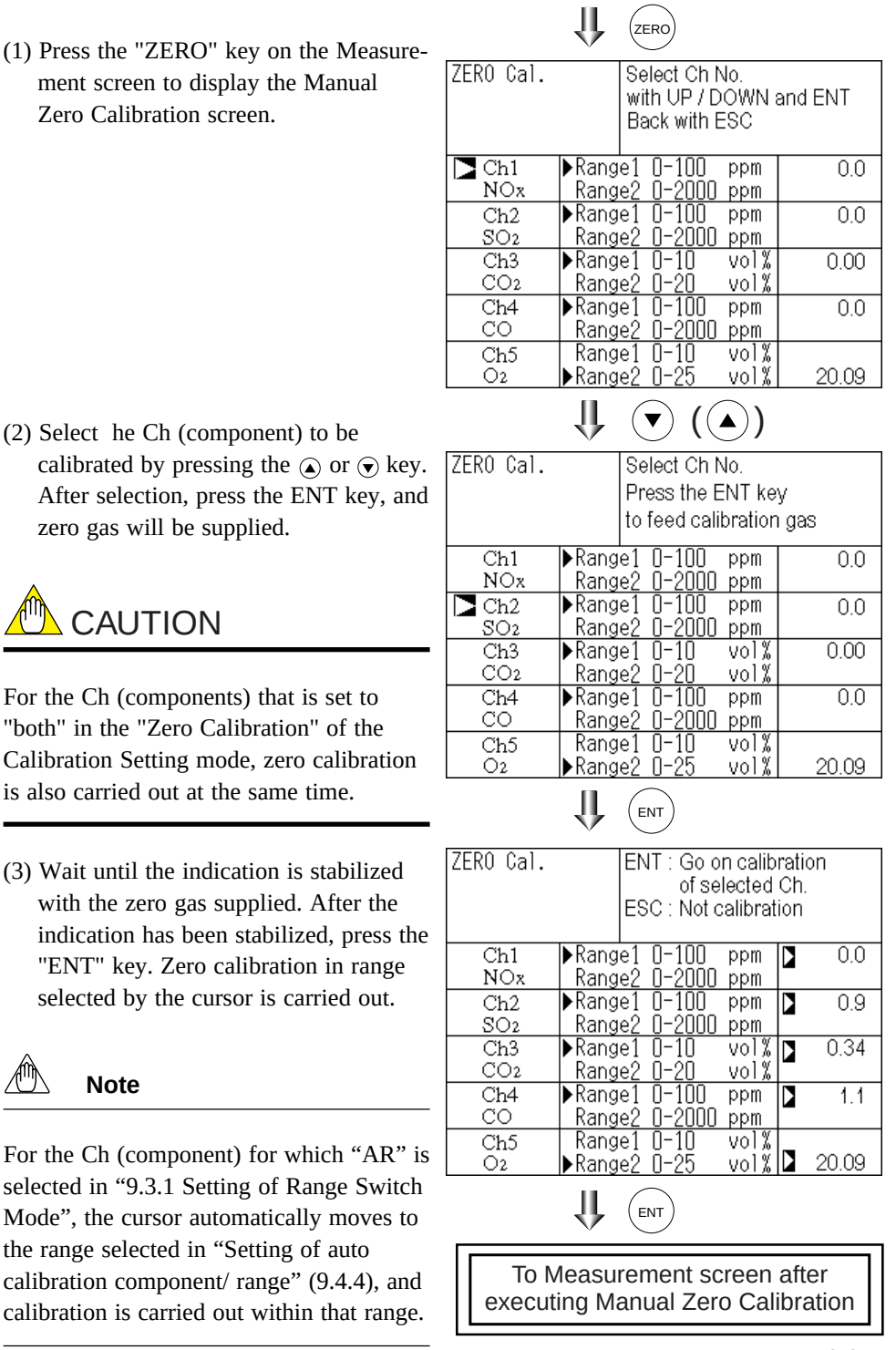
CAUTION

For the Ch (components) that is set to "both" in the "Zero Calibration" of the Calibration Setting mode, zero calibration is also carried out at the same time.

(3) Wait until the indication is stabilized with the zero gas supplied. After the indication has been stabilized, press the "ENT" key. Zero calibration in range selected by the cursor is carried out.

Note

For the Ch (component) for which “AR” is selected in “9.3.1 Setting of Range Switch Mode”, the cursor automatically moves to the range selected in “Setting of auto calibration component/ range” (9.4.4), and calibration is carried out within that range.



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To close “Zero Calibration”

To close the “Zero Calibration” or cancel this mode midway, press the "ESC" key. A previous screen will return.

9.11.2 Span calibration

It is used to perform a span point adjustment. Supply calibration gas with concentration set to the span value to perform the span calibration. For the span calibration gas for the NO_X, SO_2, CO_2, CO measurement, use the standard gas with a concentration of 90% or more of the range value. For the span calibration gas for the O_2 measurement, use the standard gas with a concentration of 90% or more of the range value when measuring with the built-in O_2 sensor, and use the standard gas of 1 to 2 vol% when measuring with an external zirconia O_2 sensor.

(1) Press the "SPAN" key on the Measurement screen to display the Manual Span Calibration screen.

(2) Select Ch (component) to be calibrated by pressing the ▲ or ▼ key and press the "ENT" key. The calibration gas is supplied.

CAUTION

When “both” from " Calibration Range” of the Calibration Setting mode is set, span calibration is performed together with 2 Ranges.

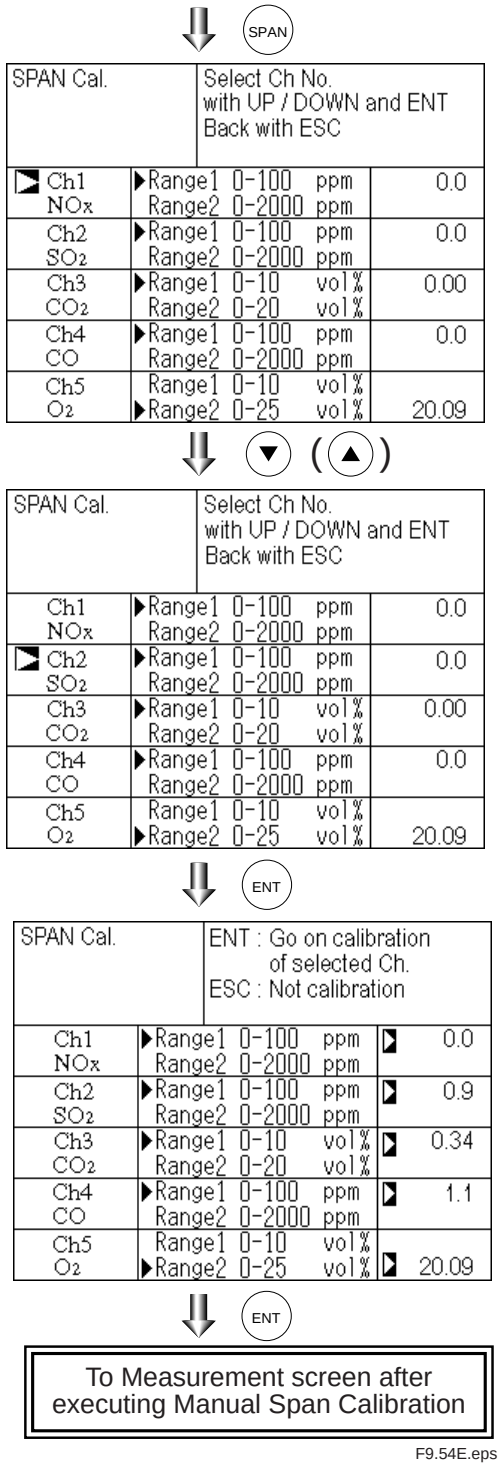
(3) Wait until the indication is stabilized in the state where the calibration gas is supplied. After the indication has been stabilized, press the "ENT" key. Span calibration of Range selected by the cursor is performed.

Note

For the Ch (component) for which “AR” is selected in " 9.3.1 Setting of Range Switch Mode”, the cursor automatically moves to the range selected in “Setting of auto calibration component/range” (9.4.4), and calibration is carried out within that range.

To close “Span Calibration”

To close the “Span Calibration” or cancel this mode midway, press the "ESC" key. A previous screen will return.



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10. INSPECTION

Note

Be sure to enter the confirmed data on check sheets in Section 10.3.6 later in this manual.

10.1 Routine Inspection

For analyzer maintenance and inspection, open the instrument's front door to gain access to the toggle switch in the top right part of the front panel. Then place the switch in the maintenance position as required. When the switch is in this position, analog output signals (corresponding to all components) remain in memory. The digital displays (measured values) on the operation panel are updated. To place the equipment in measurement status, turn the switch to the measurement position.

Note

If the toggle switch remains in the maintenance position, the analog output will remain in memory. So, after completing maintenance, be sure to return the switch to measurement mode.

10.1.1 Zero and Span Calibration

Conduct zero and span calibrations once a week as required. Consult Section 9.11, "Calibration".

Note

The calibration adjustment should be conducted while the analyzer indicates it is in a stable state. Under cold weather conditions, if the analyzer is installed outdoors and its front door open, the temperature inside the analyzer will change rapidly, which may result in an unstable indication.

10.1.2 Flow Inspection

(1) Set the sample gas flow, standard gas flow, and purge gas flow as follows:

Sample gas and standard gas flow : 0.5 ± 0.2 L/min.

F10.1E.EPS

CAUTION

To control the flow rate of the analyzer with the standard specifications, the needle valve should be used. The needle valve of the flowmeter is fully open and needs no adjustment. When the pressure regulator is provided in accordance with the specifications, adjustment should be made by the needle valve of the flowmeter, not by the pressure regulator.

Purge gas flow:

If the /SO1 option (specification for high concentrations of sulfur dioxide) is selected, set the purge-gas (instrument air) for gas dryer at approximately 1± 0.2 L/min.

(2) Inspection and maintenance service should be conducted once a day as required.

10.2 Inspection

Make routine and periodic inspections referring to Section 10.3.1, “Routine Maintenance and Inspection,” as well as the routine inspection requirements sheet in Section 10 later in this manual.

Table 10.1

Check requirements	Inspection point	Problem	Probable cause	Corrective action	References
Check every day	Analyzer and Recorder indication	Indicates extremely high or extremely low level.	1) Dust in sample cell 2) Air being drawn into sample pipe	1) Clean sample cell and check sample unit, especially gas filter. 2) Check sampling line for leaks. Remove leaky line.	10.3.4
	Sample-gas flow (Purge-gas flow where gas is being purged)	Reference flow beyond the specified flow of 0.5 ±0.2 L/min.	Sample line clogged (drain or mist-dust attached, or filter clogged)	Check and clean sampling unit and pipe. Check for gas conditioner drawing level.	10.1.2 10.3.1 10.3.3
	Membrane filter	Dirty filter	Faulty primary filter (Filtering probe, External primary filter, mist filter	1) Replace primary filter. 2) Replace filter paper.	10.3.3
Check every week.	Analyzer zero point	Incorrect zero point		Make zero adjustment.	10.1.1
	Analyzer maximum point	Incorrect maximum (span) point		Make span adjustment.	
	Membrane filter	(Checking required even if no problem indicated.)		Replace filter paper.	10.3.3
Check every three months.	Sample cell (cleaning)	(Checking required even if no problem indicated.)		Clean sample cell. (Use sample cloth supplied for cleaning.)	10.3.3
Check every four months.	SO_3 mist catcher	(Checking required even if no problem indicated.)		Change SO_3 mist catcher a new one if necessary	In case of /SO1
Check every year.	Analyzer	(Checking required even if no problem indicated.)		Overhaul analyzer.	10.3.6
	Analyzer output	(Analyzer output checking required after overhauling.)		Check instrument errors.	

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Note

In order to adjust the flow rate of a sample gas,

(1) Do not use the needle valve of the flowmeter when the stack gas analyzing system is of the standard specification .

(2) Do not use the pressure regulator when the pressure regulator is provided in accor dance with the specifications. The pressure regulator has been adjusted so that it absorbs the pressure fluctuation and keeps the flow rate of the sample gas constant. If it is adjusted unnecessarily, drain or water may be sucked into the flow.

10.3 Maintenance

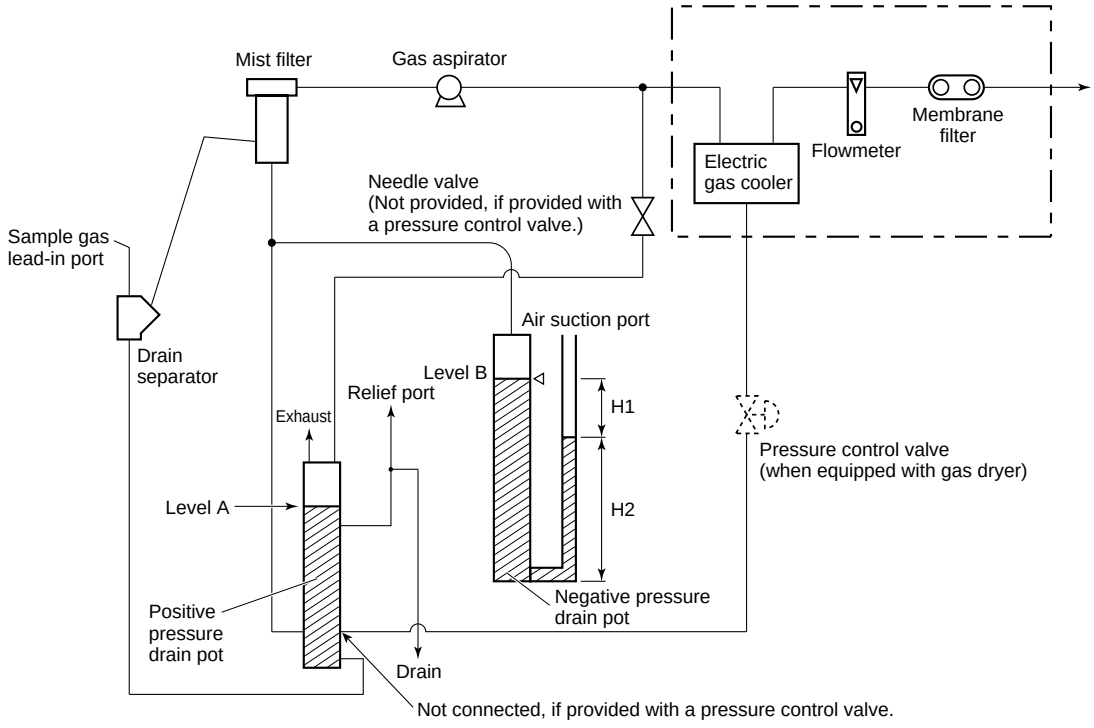
10.3.1 Routine Maintenance and Inspection

Table 10.2

Maintenance/inspection item	Procedure
Sample-flow monitoring	Check the flowmeter for the specified flow. If the meter indicates a flow value beyond the specified limits, check the sampling line. Clean the line whenever required. Also, check the conditioner air-intake level. Replace the filter as required. (*1)
Conditioner air intake level	Good if the level is at least 50 mm under the water surface in the upper chamber (H1 ≦ 50 mm in Figure 10.1). If this is not the level, a pressure loss may result in the previous stage of the conditioner filter. Check the probe filter (see Section 10.3.3). Also check the gas piping for clogging.
Membrane filter	If the membrane filter is dirty, replace the filter paper (see Section 10.3.3).
Electric gas cooler	Check the fan for rotation. Check that the lamp flashes.
Temperature controller for nitrogen dioxide to nitrogen monoxide converter	Check that the temperature controller indicates about 220 °C.

*1 Do not adjust the pressure regulator. If it must be adjusted, contact YOKOGAWA

T10.2E.EPS



H1: Sample negative pressure degree

(1) It is satisfactory if H2 is 50 mm or higher.
(2) Inspection of the extractor filter piping is required, if H2 is less than 50 mm.

There is a possibility where atmosphere is sucked through the air suction port, if the gas pressure exceeds the limit.

F10.2E.eps

Figure 10.1 Drain pot

● Routine Check Table for Model SG700 Series of Stack Gas Analyzer

Checkpoint		Check and maintenance items	Procedure and criteria	Recommended check and maintenance periods: Routine check	Once a week	Once a month	Every three months	Every four months	Every six months	Once a year	Every two years	Every five years
Sampling unit	1	Flowmeter sample flow	See Section 10.3.1. Check that the flowmeter ball is at the normal flow rate of 0.5 ±0.2 L/min.	○								
	2	Drain pot level	Water level must be above 50 mm in height from the bottom.	○								
			Supply water if water level is under drain pot A and B.			○						
			Replace water.						○			
	3	Membrane filter	Replace the black filter. Before replacement, stop the pump. See Section	○								
			10.3.3. Coat vaccum grease on the O-ring.						○	★		
	4	Mist filter and O-ring	Check for dirty element. If the flow does not increase because of dust that sticks, replace the dirty element. See Section 10.3.3.						○			
	5	Drain separator (installed externally)	Check water level. Check water for sealing.	○								
	6	/SO1 option for gas dryer specifications	Clean whether the dryer has become dirty or clogged. Set up a cleaning period according to the drain adhering conditions of the dryer.	○								
	7	/SO1 option for SO_3 mist catcher	Replace SO_3 mist catcher every four months.					○				
	8	Nitrogen dioxide to nitrogen monoxide converter	Replace catalyst material. Set up an appropriate replacement period (by referring to the check results). (Replace every eight months whenever the nitrogen dioxide gas is less than 10 ppm.)									
	9	External primary filter	Clean or replace filter element. Set up an appropriate replacement period (by refering to the check results).									
	10	Standard gas	Check filling pressure.		○							
			Also, check the effective date of gas as required.						○			
	11	Pressure regulator for cylinder	Use soapy water to check for pressure leaks. Replace packing as required.						○			
	12	Pump valve and diaphragm	Replace diaphragm (for details, see Section 10.3.3). Use valve by turning it 90 degrees.						○			
	13	Analyzer calibration	Make zero and span calibrations with reference gas.		○							
	14	Fixed restriction	If the restriction is clogged, the sample gas may drop. Replace clogged restriction.									
	15	Filter element in filter probe and O-ring	Clean or replace filter element. Set up an appropriate replacement period (by refering to the check results).							★		
	16	Pressure regulator	Replace diaphragm and disc once a year.							★		
	17	Three-way solenoid valve	Replace leaky valve.(Option code "/R" is specified)						○			
	18	Overhaul	Check the pipe for dirt. Also, check it for leaks.							○		

T10.3E.EPS

* In the check and maintenance columns, place a check mark (○) for check and confirmation work, a dark star (★) for replacement, and a white star (☆) for parts preparation for preventive maintenance.

● Routine Check Table for Infrared Gas Analyzer

Checkpoint		Check and maintenance items	Procedure and criteria	Recommended check and maintenance periods: Routine check	Once a week	Once a month	Every three months	Every six months	Once a year	Every two years	Every five years
Infrared gas analyzer	1	Optical zero-point adjustment and moisture interference correction	Adjust every six months.					○			
	2	Selector motor	Recommended replacement period: Every two years							★	
	3	Detector	Recommended replacement periods: Every two years for low concentrations of no more than 100 ppm;							★	
			every five years for general concentrations exceeding 100 ppm.								★
	4	Light source	Recommended replacement period: Every five years								★
	5	Sample cell	Set up an appropriate maintenance period (by refering to the check results)				○				
	6	Reference cell	Prepare one set of cells for about every 20 analyzers as spare parts five years after manufacture of analyzer.								☆
	7	Distribution cell	Prepare one set of cells for about every 20 analyzers as spare parts five years after manufacture of analyzer.								☆

* In the check and maintenance columns, place a check mark (○) for check and confirmation work, a dark star (★) for replacement, and a white star (☆) for parts preparation for preventive maintenance.

T10.4E.EPS

● **Limited service-life components**

The analyzer uses limited-life components. The recommended replacement periods are listed in the previous table.

(1) Limited service-life components are those which wear out or for which failure is presumed within five years under normal operating or storage conditions. Components with more than five years of service life are the exception.
(2) The previous table only involves the recommended periods for conducting preventive maintenance for limited service-life components; these periods do not guarantee that accidental failures will not occur.
(3) The recommended replacement periods are tentative and depend on operating conditions.
(4) The recommended replacement periods may vary depending on the field data.

● **Precautions to be taken while checking**

(1) When handling standard gas (during calibration), carefully read the standard gas instruction manual to use the gas correctly. In particular, special attention must be taken in handling carbon monoxide gases; otherwise, you may suffer from gas poisoning.
(2) During maintenance checks, be sure to keep the analyzer fan on. If any gas leaks, you may suffer from gas poisoning.
(3) When replacing the analyzer gas filter or conducting maintenance service of the washer, completely shut the calibration-gas valve. Otherwise, you may suffer from gas poisoning.
(4) The nitrogen dioxide to nitrogen monoxide gas converter is heated to about 220 ° C. So when you attempt to replace the catalyst, first turn off the converter power and wait at least about 30 minutes. Then use heat-resistant gloves for catalyst replacement. If you do not wear these gloves, you may get burned.
(5) If the power fuse blows, remove the source of the cause. Then replace the blown fuse with a new one having the same type and rating. Otherwise, you may suffer from electrical shock.
(6) In the case where a leakage current breaker is installed in the analyzing system, be sure to press the test button and then start the maintenance servicing. Otherwise, you may suffer from electrical shock.
(7) Be sure to lock the door. Permit only related personnel to maintain the door key.
(8) Remove the watch and other metallic objects before work
(9) Do not touch the instrument with a wet-handed.

10.3.2 Other Maintenance and Inspection Items

(1) Space heater and ventilating fan

If the ambient temperature drops below 5 ° C in cold districts, then turn on the space heater. The ventilating fan should always be left on.

(2) Blowback (a customized order)

Turn off the aspirator and close the measured gas-flow line. Then conduct a blowback procedure. Use the blowback procedure on the probe when necessary.

(Frequent use of the blowback procedure will cause the temperature of the gas sampler to drop and result in corrosion, so it should be kept to a minimum.)

(3) Valid term of verification for standard gas cylinder (for NOx, SO_2, CO, and O_2 analyzer)

Table 10.3

Gas	Concentration range	Period of validity
NO/N_2	0.4 ppm up to 250 ppm non-inclusive	For six months
NO/N_2	250 ppm up to 5% non-inclusive	For one year
SO_2/N_2	0.4 ppm up to 250 ppm non-inclusive	For six months
SO_2/N_2	250 ppm up to 1% non-inclusive	For one year
CO/N_2	2.4 ppm up to 100 ppm non-inclusive	For six months
CO/N_2	100 ppm up to 15% non-inclusive	For one year
O_2/N_2	0.9% up to 25% non-inclusive	For one year
N_2	——	None *1
Air	——	None

T10.5E.EPS

*1: It is recommended that a period of use of one year or so be planned under appropriate control.

Note

The standard gas concentration may be within the range specified above even after six months or one year; however, replace the standard gas cylinder within the period of validity if system traceability is important.

10.3.3 Maintenance of sampling device

● **Replacement of filter element of sample gas extractor (probe)**

(1) Remove and pull out the filtering probe from the stack.
(2) After the probe temperature has dropped, remove the filter element from the pipe head and attach a new filter element.
(3) Install the filtering probe to the stack.
(4) How to clean the filter element
  (a) Apply compressed air to the inside of the filter element to blow off dust.
  (b) Apply steam to the inside of the filter element to blow off dust.
  (c) Ultrasonically clean the filter element using trichloroethylene or perchloroethylene. If the above three cleaning procedures cannot clear the clog, do not reuse the filter element.

● **How to replace mist filter**

(1) Loosen the butterfly bolt and extract the head from the container.
(2) Then loosen the clamping nut and remove the contaminated mist filter.
(3) Carry out reassembly, using a new mist filter and new O-ring, in the sequence that is opposite to what is described above.

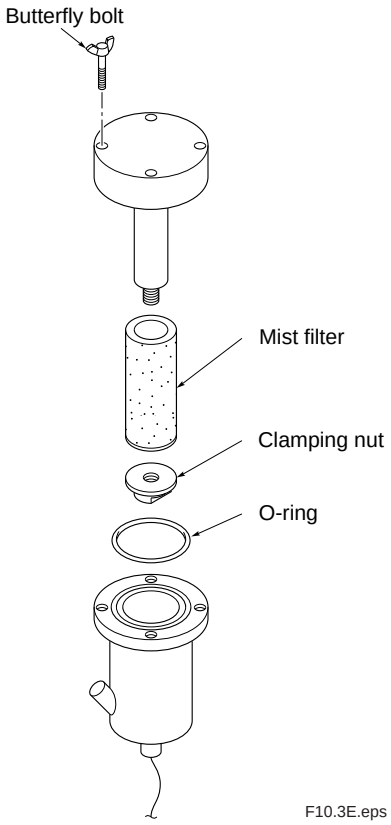


Figure 10.2 Mist filter and its related components

● **How to replace membrane filter for sampling module**

(1) Turn "OFF" the "Pump" switch on the interface module.
(2) Loosen 4 membrane filter screws fastened to the front of sampling module.
(3) Detach the cover and replace the filter by removing internal O-ring (P49 : 2pieces).
* The membrane filter is available into 2 types:

(a) Standard specifications
Glass paper filter : Filter pore diameter 0.5 μm. 2 filters used.
(b) SO_2 specifications
Teflon filter : Filter pore diameter 0.1 μm. 2 filters used.

(4) Wipe off dust deposited in the case by clean cloth. Use care to prevent dust from sucking in the inlet by gas.
(5) For assembly after filter replacement, reverse the above procedures. Mount smaller O-ring (P3) without fail.
(6) Apply vacuum grease to the O-ring every 6 months.

CAUTION

By flat head screwdriver, etc., sufficiently tighten the membrane filter setscrews. Poor tightening may cause a leakage.

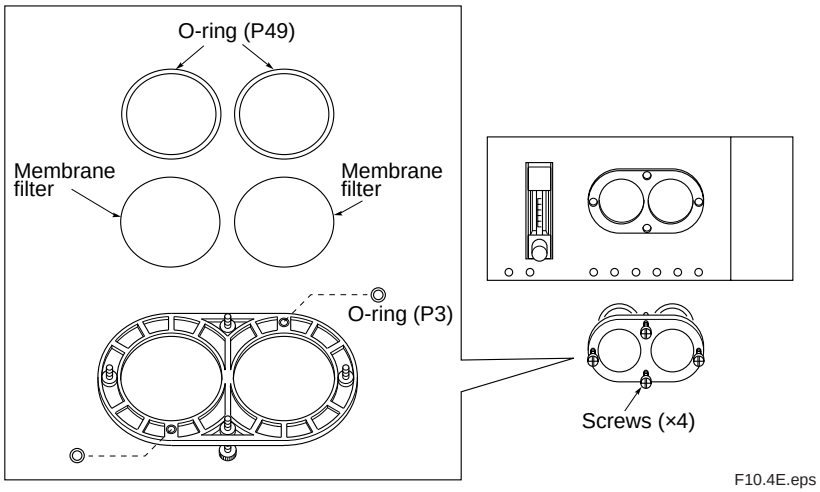


Figure 10.3 membrane filters and their related components

● **How to replace valve and diaphragm of diaphragm type gas aspirator**

(1) Turn “OFF” the power to the "Pump" switch on the interface module. Detach the pipes from the inlet and outlet connected to the aspirator.
(2) Remove 4 screws to separate cap A and cap B from the valve.
(3) Turn the diaphragm counterclockwise with hands and remove it.
(4) Install new diaphragm by allowing it to turn clockwise until it stops.

CAUTION

Confirm that new diaphragm is fully engaged with the thread of arm lot. Otherwise it will lead to the cause of trouble.

(5) Fit the valve to cap B while turning it by 90˚. Confirm that cap A is aligned with cap B with matching mark. Then, tighten 4 screws.

CAUTION

Use of multiple valve sheets allows changing from the hole in which the pin under the valve is first inserted to another one.

(6) Turn "ON" the power to the "Pump" switch for the interface module to energize the aspirator. Check that no abnormal noise is heard and valve is normally actuating by touching with hands (Air is sucked in the IN side and discharged from the OUT side).
If anything is wrong, repeat the same steps again.
(7) After checking that the aspirator is properly operated, turn "OFF" the "Pump" switch and return the pipe to the original place. Now, the work is completed.

CAUTION

When returning the pipe in position, use care to avoid applying excessive force to Rc1/8 screws.

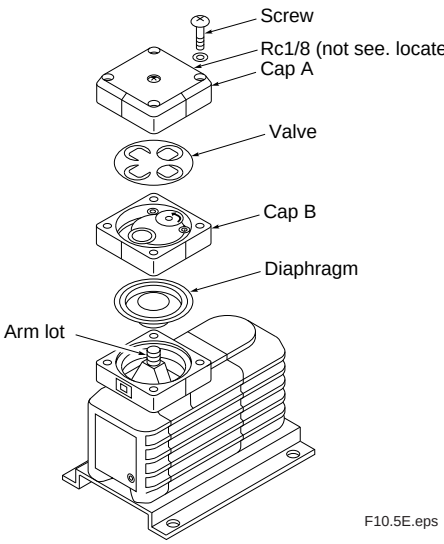


Figure 10.4 Diaphragm type pump

● **In case of option code /SO1 (Replacement of valve and diaphragm of diaphragm type aspirator)**

The seat valve should be rotated 90º after six months, and replaced after one year. The diaphragm should be replaced at one-year intervals. Replace these as follows:

(1) Valve replacement (Refer to Figure 10.5)

Turn "OFF" the power to the "Pump" switch, and detach the pipe.

(i) Remove the base fixing crew (10) and the base B (1) can be detached.
(ii) Replacement valves (n) and (p) are attached to the seat valve (2). (A pair of valves are attached to a single seat valve.)
(iii) The letter A is inscribed on part (a) of seat valve (2). Pin (b) is provided on the back of this part, and is inserted in hole (c) of base A (3). Turn seat valve to the right by 90° can be replaced with a new one by inserting pin(b) and hole(d).

Note

When pin (b) is inserted in hole (d) at valve replacement, then the furnished valve is no longer usable. Replace the seat valve with a new one, then insert pin (b) in hold (c).

(iv) Set base B (1) on seat valve (2). (At this time, the V notch (f) for positioning base A (3) should be aligned with the V notch (e) for positioning bese B (1).) Then tighten the base fixing screw (10) and the replacement is finished.

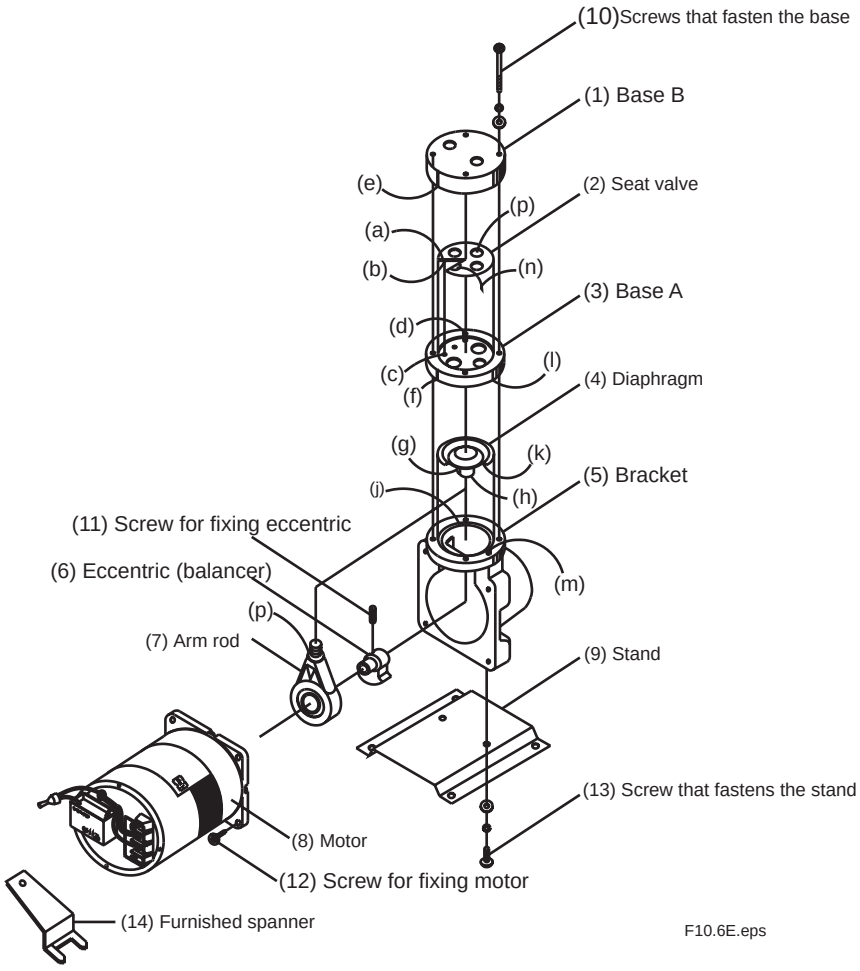


Figure 10.5 Exploded View of Diaphragm-type Aspirator

Note

After finishing the assembly, make sure that air is aspirated from INLET and discharged from OUTLET.

(2) Diaphragm replacement (Refer to Figure 10.5)

Turn "OFF" the power to the "Pump" switch, and detach the pipe.

(i) Remove base fixing crew (10) and then base B (1), seat valve (2) and base A (3) can be removed together.
(ii) Diaphragm (4) is fastened to arm rod (7) by a screw. Turn up the edge of diaphragm (4), loosen bracket (g) by turning leftward with the furnished spanner (15), and then the diaphragm can be removed by turning it by hand.
(iii) Attach a new diaphragm by reversing the above steps. Screw in until the bottom surface (h) of bracket (2) fits closely to surface (p) or arm rod (7), and finally tighten its surface.
(iv) Algin the arc-shaped park (k) of the diaphragm (4) rear surface with the arc-shaped groove (j) of bracket (5).
(v) A hole (l) is provided in the rear surface of base A (3). Fit hole (l) onto the pin (m) of bracket (5).

Note

Make sure that V notches (f) and (e) used for positioning come to the opposite side (shown in the exploded diagram) of motor (8).

(vi) Reassemble the valve, then tighten the base fixing screw (10) and the replacement is finished.

Note

Operate the pump and make sure is no abnormal sound.

● Maintenance of Gas Dryer

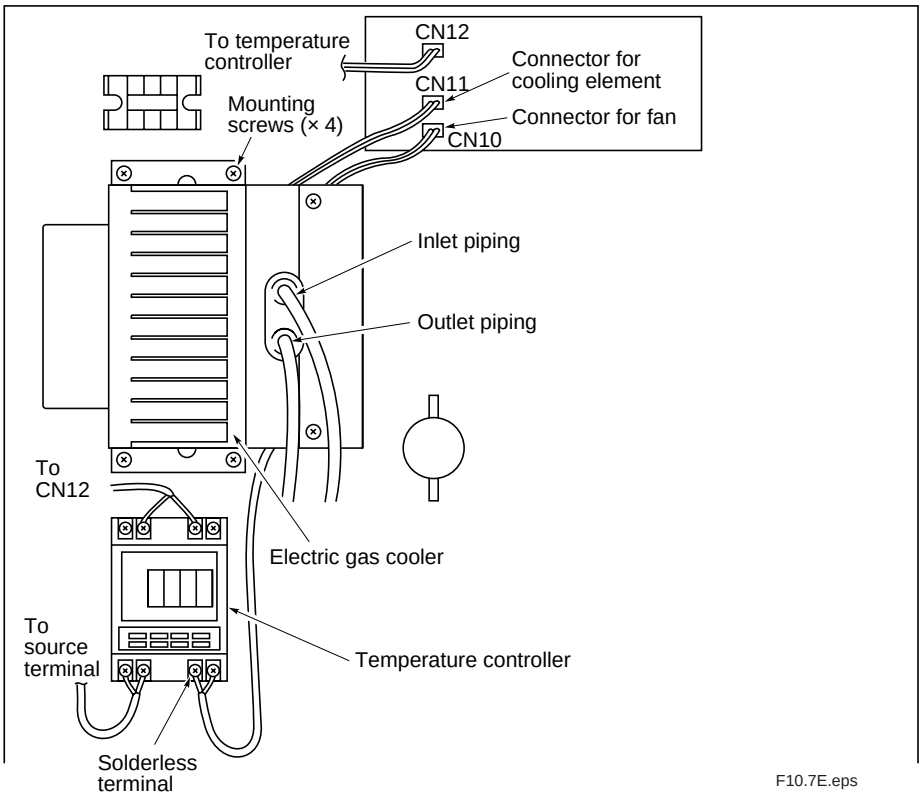
The gas dryer is used for SO_2 measurement (first range of 500 ppm or higher) or measurement in sludge incineration or boiler exhaust gases.

Since the gas dryer is free of moving parts and no consumption occurs, it can normally be run without maintenance if the precautions for its use are carefully observed.

(1) Check, at least once every month, if purge gas is flowing at an appropriate flow rate. Check the flow rate by the purge flowmeter, in case of instrumentation air purge. Check the flow rate by the flowmeter in the sampling module, in case of return gas purge.
(2) Completely release the internal compressed air at the time of removal.
(3) Be careful not to allow entry of foreign matters at the time of removal and mounting.
(4) Never attempt to disassemble the gas dryer. (The gas dryer cannot be disassembled.)
(5) Be careful not to apply pressure of over 0.05 MPa to purge gas inlet/outlet.
(6) If the purge gas inlet/outlet taper tightening joint is twisted by one turn or more, plugging may result due to wrenching of the internal hollow film.
(7) Use tap water or acid fluid for washing the interior of the gas dryer. Use of detergent or alkali fluid is banned. (The dehumidifying performance drastically drops, if alkali fluid is used.)

● **How to replace electric gas cooler**

(1) Turn “OFF” the "Pump" switch on the interface module.
(2) Turn “OFF” the "Sampling Module" switch on the interface module.
(3) Remove mounting screws (4 pieces) fastened to the front of the sampling module and draw out the sampling module.
(4) Detach the electric gas cooler connectors (3 pieces) and solderless terminal.
(5) Remove the electric gas cooler tube, the gas inlet/outlet tube (ϕ 6/ϕ 3 Toalon tube) and drain tubes below the sampling module.
(6) Remove mounting screws (4 pieces) and then remove the electric gas cooler.
(7) For mounting the electric gas cooler, reverse the above steps.
Be careful not to reverse the connection of the gas inlet/outlet piping and the connectors for the fan and the cooling element.
(8) Replace the electric gas cooler and the temperature controller as a set.



* At a normal action, the temperature controller reads between 1 °C and 5 °C.

Figure 10.6 Structure of Electric Gas Cooler

● Maintenance procedure for NO_2 / NO converter

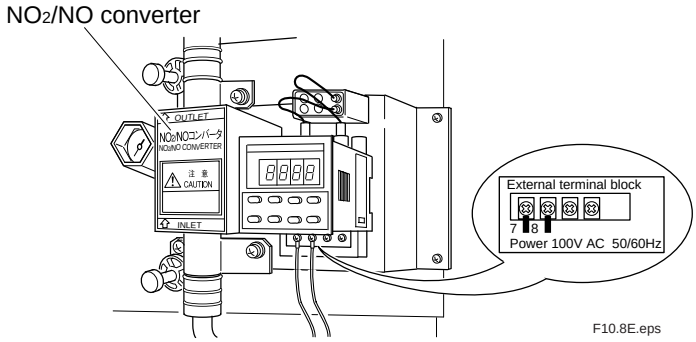


Figure 10.7 Location of NO_2 / NO converter

How to replace the catalyst

CAUTION

To reduce the risk of personal injury from hot converter, take care when replacing catalyst to avoid touching the converter unit.

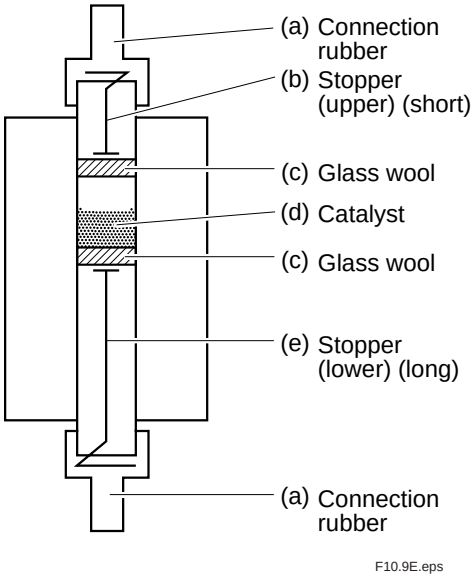


Figure 10.8 Structure of NO/NO_2 converter.

(1) Turn “OFF” the power to the Sampling Module switch.
(2) Prepare a catalyst receiver underneath the converter.
(3) After half an hour, remove (a), (b) and (c), and pull (e) downward. Take care not to burn your hands. Using a blade-edged driver, remove (a) while moving gradually from the clearance. If it does not fall, use a long bar to remove components from the pipe. Remove (e), and (c) and (d) will fall simultaneously.
(4) Attach (c) to the tip of (e) and insert it together with (a) from under the ceramic pipe. Inject one pack of new catalyst from the top. Install (b) and (c) at top of the pipe.
(5) Connect the tubing, turn “ON” the power to the Sampling Module switch, and assure that the temperature becomes stable at 220˚C.

● Maintenance Check for SO_3 Mist Catcher (K9350XV)

For high SO_2 concentration ranges of 500 to 1000 ppm (option code [/SO1]), an SO_3 Mist Catcher is added after the electric gas cooler.

The SO_3 Mist Catcher specifications are as follows:

Application	:	Removes SO_3 mist from combustion exhaust gas.
Filter material	:	Ceramic
Gas connection material	:	PVC
Operating temperature	:	0-45 ° C
Withstanding pressure	:	0.1 MPa
Connection	:	6 mm dia. hose
Weight	:	Approx. 0.3 kg
Mounting	:	Panel mounting, direct mounting (gas inlet is lower side)
Pressure loss	:	Approx. 4 kPa
Filter life	:	Recommended to replace every 4 months (depends on sampled gas)

External dimensions, etc. are shown below.

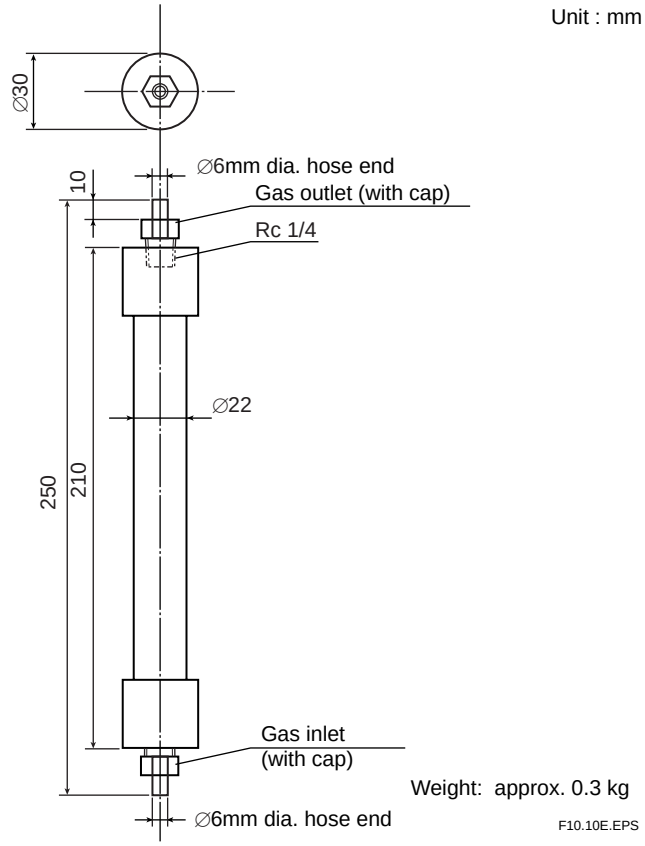


Figure 10.9 SO_3 Mist Catcher (K9350XV)

● SO_3 mist catcher replacement procedure

Prepare replacement mist catcher and two tie wraps Refer to Sec. 1.2.1, and Sec. 6.1.1, and check the position of the electric gas cooler outlet, Gas Drier and SO_3 mist catcher.

CAUTION

There may be poisonous gas remaining in the pipes, so be sure to flush with air. Residual acid in the mist catcher is dangerous. Use protective gloves, protective clothing, protective glasses, mask and the like to prevent contact with it. If you get this acid on your body or clothes, use lots of water to wash it off. If you get it in your eyes, wash eyes with water and visit a medical clinic or hospital for a check up.
The mist catcher cannot be recycled. It may contain dangerous acid, so dispose of it carefully.

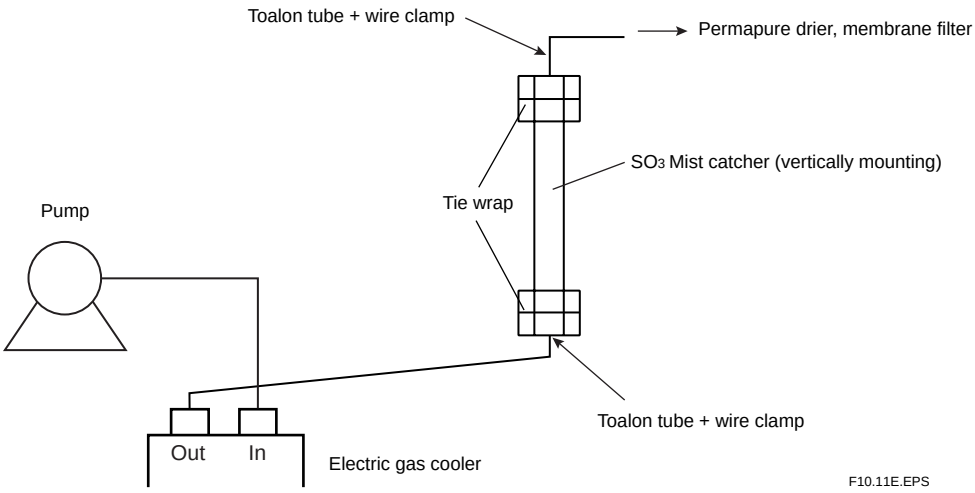


Figure 10.10 Connection of SO_3 Mist Catcher to other devices

(1) Switch toggle switch at top of front panel switchboard to Under Maintenance, and turn "Pump" switch on top of switchboard "OFF". You may leave other devices turned "ON" .
(2) Fix mist catcher and cut off excess tie wrap.
(3) Loosen wire clamp and remove mist catcher piping.
(4) Replace mist catcher with a new one, and tighten wire clamp so test gas won't escape from pipe.
(5) Check that piping from mist catcher outlet to sampling device is not damaged.
(6) Check that pipelines are normal, then turn pump power "ON".
(7) Fix mist catcher body (mount vertically) with tie wrap.
(8) Turn (suction) pump switch "ON", and check that test gas flow is correct (0.5 L/min).
(9) After measurement gas stabilizes, move toggle switch at top of switchboard to Measure mode.

10.3.4 Maintenance of analyzer unit

1. Cleaning method for sample cell (pipe cell)

This section is strictly factory adjusted. Handle it with utmost attention.

If it is absolutely required, contact us.

(1) Turn off the power switch, stop the sample gas, and allow the zero gas to flow for several minutes to purge the cell interior.
Loosen the setscrew (2 pieces) from the top cover and remove it.(See Figure 10.11)

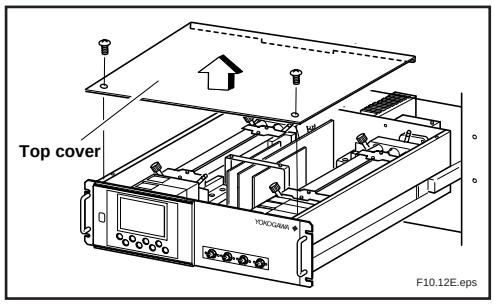


Figure 10.11 analyzer Unit

(2) Remove the internal gas inlet tube.
(3) Loosen both right and left screws for cell holding plate.
・Remove the sample cell only.

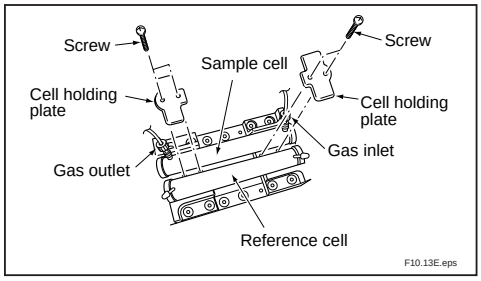


Figure 10.12 Sampling cell and its related parts

(4) Turn to the left the sample cell window and remove it from the sample cell (see Figure 10.13).
(5) For cleaning the window and cell inside surface, first eliminate coarse dust by soft brush or the like and then wipe them by soft rag.
The window is easy to get scratched. Pay utmost attention so as not to damage it.
(6) After the end of sample cell cleaning, mount the cell in place and proceed to running.
After cleaning sample cell, be sure to perform optical zero adjustment and moisture interference compensation adjustment.

CAUTION

If the window or the cell interior is very dirty, use a soft cloth moistened with absolute alcohol. A slightly corroded infrared transmission window or sample cell can be remedied by gently rubbing with chromium oxide powder on cleaning cloth but an excessively corroded one must be replaced. When cleaning, do not exert an excessive stress.

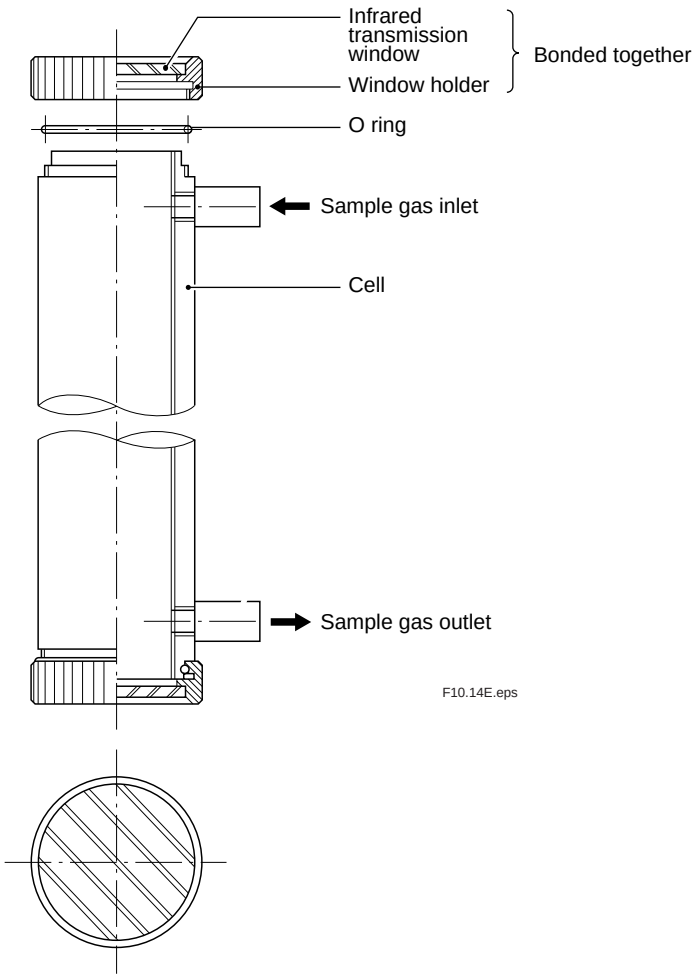


Fig. 10.13 Structure of sample cell (pipe cell)

2. Cleaning method for sample cell (block cell)

(1) Turn off the power switch, stop the sample gas, and allow the zero gas to flow for several minutes to purge the cell interior.
Loosen the setscrew (2 pieces) from the top cover and remove it.

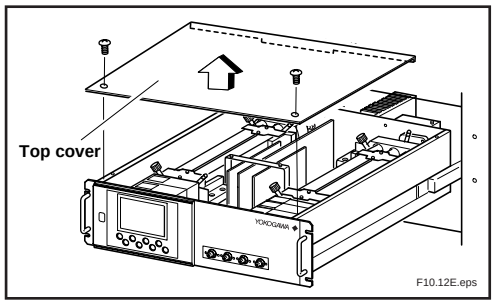


Figure 10.14

(2) Remove the internal gas inlet tube.

(3) Loosen the 2 detector set bolts.

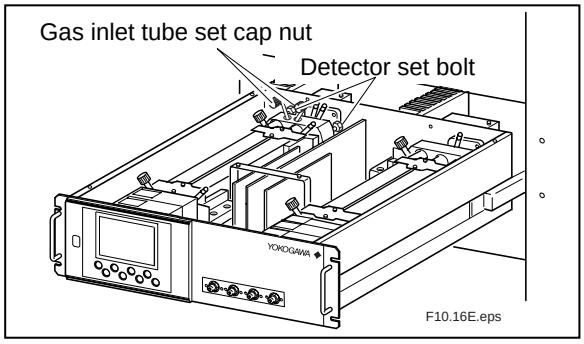


Figure 10.15

CAUTION

The distribution cell, block cell and detector are fastened by the same bolts.

(4) Using the furnished cell mounting tool, turn the window fixture to the left and remove it from the cell. (See the structure of sample cell (block cell) in Figure 10.17.)

(5) For cleaning the infrared transmission window and cell inside surface, first eliminate coarse dust by soft brush or the like and then wipe them by soft rag.
The window is easy to get scratched. Pay utmost attention so as not to damage it.

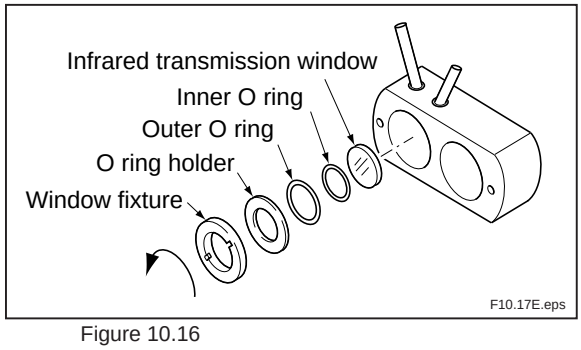
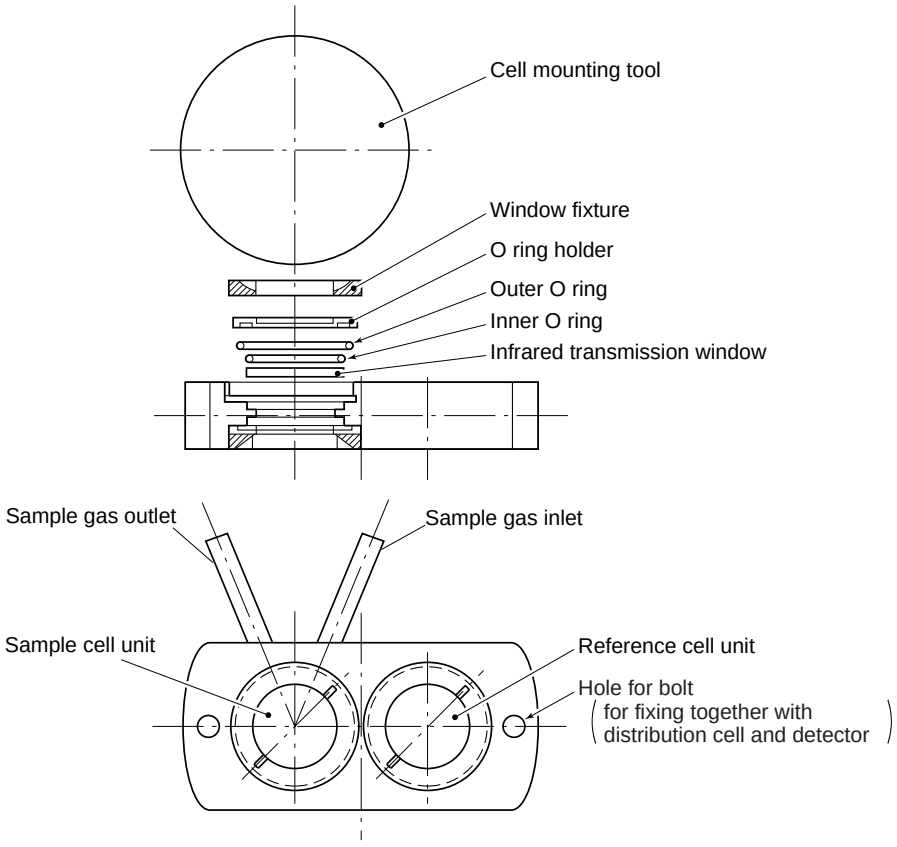


Figure 10.16

(6) After the end of sample cell cleaning, mount the cell in place and proceed to running. After cleaning sample cell, be sure to perform optical zero adjustment (see Item 10.3.4.3) and moisture interference compensation adjustment (see Item 10.3.4.4) .

CAUTION

If the window or the cell interior is very dirty, use a soft cloth moistened with absolute alcohol. A slightly corroded infrared transmission window or sample cell can be remedied by gently rubbing with chromium oxide powder on cleaning cloth but an excessively corroded one must be replaced. When cleaning, do not exert an excessive stress.



Structure of sample cell (of 32, 16, 8, 4, 2 mm long)
(sample cell and reference cell are integrated)

Note) Use the dedicated cell mounting tool (furnished).

Figure10.17 Structure of sample cell (block cell)

3. Optical zero adjustment method (optical balance adjustment)

CAUTION

If the following operation is maladjusted, the measurement may adversely be affected. If you are not trained for adjustment, do not carry out this operation but contact the distributor or our serviceman.

The adjustment is performed at reassembly after removing the sample cell, etc. for cleaning, etc.

(1) Remove the top cover. Allow dry N_2 or air to flow through the analyzer unit sample gas inlet until the reading stabilizes. The sample gas is introduced directly to the INLET of analyzer unit through the gas cylinder.

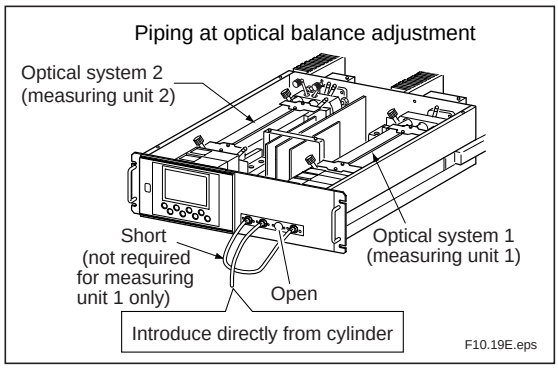


Figure 10.18

(2) Proceed to an optical adjustment in the Maintenance mode. The display on the operation panel of the main unit is as illustrated on the right. Balance adjust-ment is not required if the display falls within ±100.

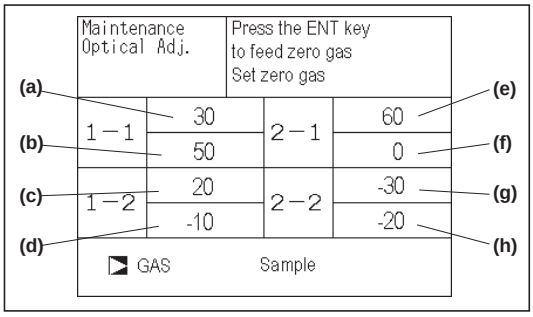


Figure 10.19

Table 10.4 Correspondence between measurement detector and indicated position

No. of components to be measured		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1-component meter		Main	Comp	—	—	—	—	—	—
2-component meter	NO-SO_2	NO Main	NO Comp	SO_2 Main	SO_2 Comp	—	—	—	—
	CO_2-CO	CO_2 Main	CO_2 Comp	CO Main	CO Comp	—	—	—	—
	NO-CO	NO Main	NO Comp	—	—	CO Main	CO Comp	—	—
3-component meter NO-SO_2-CO		NO Main	NO Comp	SO_2 Main	SO_2 Comp	CO Main	CO Comp	—	—
4-component meter NO-SO_2-CO_2-CO		NO Main	NO Comp	SO_2 Main	SO_2 Comp	CO_2 Main	—	CO Main	CO Comp

* O_2 is excluded from the number of components.
* Main is signal input value from the main detector of each component.
Comp is signal input value from interference compensation detector of each componen
If low range exceeds the range of 0 to 10vol%, detector signal of comp is not usable.

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(3) Carry out the adjustment in the procedure in (4) and subsequent.

・Adjust on the primary side of the optical system so that the values for **(a)** to **(d)** in 1-1 and 1-2 become as close to 0 as possible within ±100 range.

・Adjust on the secondary side of the optical system so that the values for **(e)** to **(h)** in 2-1 and 2-2 become as close to 0 as possible within ±100 range.

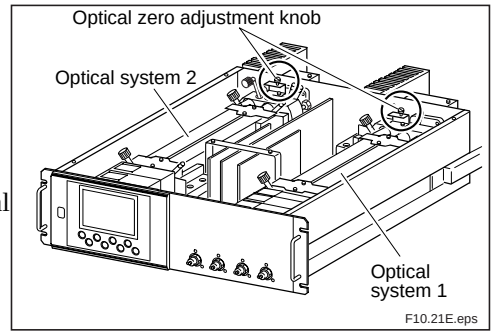

Figure 10.20

(4) Operate the optical zero adjustment knob to change the value displayed at **(a)** (or **(e)**).

(5) Move the dimmer plate sideview to change the value displayed at **(b)** (or **(f)**).

(6) Move the dimmer plate sidewise to change the value displayed at **(c)** (or **(g)**).

(7) Move the dimmer plate sidewise to change the value displayed at **(d)** (or **(h)**).

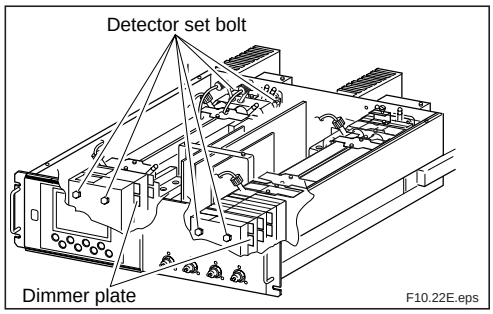

Figure 10.21

(8) Repeat the procedures in (4) to (7) to make all the displayed values come close to 0 as possible within ±100 range.

* Adjust the dimmer plate which is the nearest to the zero adjustment knob first, and sequentially.

(9) After the optical balance adjustment, mount the top cover of the analyzer unit, then carry out a moisture interference compensation adjustment, and perform zero and span calibrations.

* Before moving the dimmer plate, loosen the detector set bolts (just enough to make the plate movable for snug adjustment).

4. Moisture interference compensation adjustment method

CAUTION

If the following operation is maladjusted, the measurement may adversely be affected. If you are not trained for adjustment, do not carry out this operation but contact the distributor or our serviceman.

Proceed to an adjustment if excessively (beyond ± 2% FS) affected by moisture inteference.
After the end of optical balance adjustment, be sure to carry out moisture inteference compensation adjustment.

(1) After warm-up, select the low range, allow dry gas (N_2, air) to flow at 0.5 L/min and carry out zero calibration.
(2) Display the moisture interference compensation screen of the analyzer unit (see "9.10 Maintenance mode"). Set the dew point to 2° C by using an electric gas cooler, and introduce bubbled N_2 or air gas to the analyzer (shown on the figure).
(3) On the screen, select a desired Ch (component) by pressing the "ENT" key, adjust the value at right by pressing the ▲ or the ▼ key so that the value at left falls within ±10 (make it as close to 0 as possible), and then press the "ENT" key to memorize the value. (Exiting by "ESC" cancels the adjustment.)
Or, by selecting the “ALL” and pressing the "ENT" key, all components are adjusted to be zero.
(First, adjust all components by selecting ALL and then perform fine adjustment for components one by one using ▲ and ▼ keys.)
* If any components exceed the range of 0 to 10vol%, no adjustment can be performed (No interference compensation is required).
(4) After adjustment for all components and connection of tubes, make zero and span calibration.

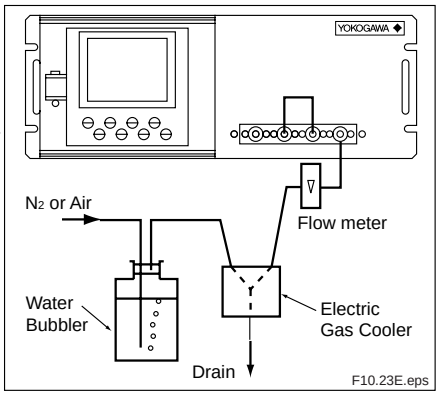

Figure 10.22

Moisture interference Compensation Adj.		Select Ch No. with UP / DOWN and ENT Back with ESC	
Ch1	NOx	10	1.252
Ch2	SO_2	-33	0.983
Ch3	CO_2	13	0.000
Ch4	CO	20	1.922
ALL			
Valve OFF			

⇩ ▼ (▲) ENT

Moisture interference Compensation Adj.		Adjust with UP / DOWN ENT : Memorized ESC : Back	
Ch1	NOx	10	1.252
Ch2	SO_2	-33	0.983
Ch3	CO_2	13	0.000
Ch4	CO	20	1.922
ALL			
Valve OFF			

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10.3.5 Maintenance of Oxygen Analyzer

(1) How to replace zirconia O_2 sensor

Routine maintenance

No parts require periodic maintenance. Check that sensor temperature is 800 ± 5° C, when the SO_2 concentration in sample gas is higher than 500 ppm, you should check occasionally if the outlet pipe is clogged by the precipitation of crystal.

WARNING

The zirconia oxygen analyzer sampling line remains at a high temperature. If you attempt to access that line, first turn off the power and wait for at least one hour. Otherwise, you may get burned.

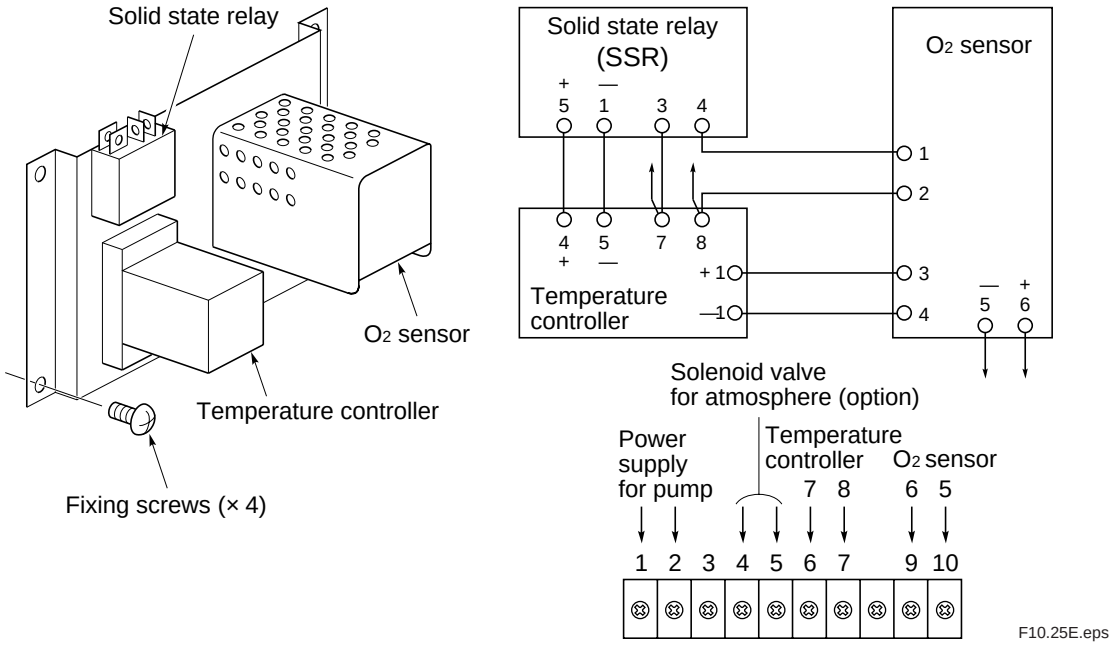

Figure 10.23

(a) Turn “OFF” the power to "Pump" switch on the interface module.
(b) Turn “OFF” the power to O_2 sensor switch on the interface module.
(c) Remove O_2 sensor tube and terminals from terminal blocks 6 & 7 (power supply) and 9 & 10 (signal +, -) below the pump.
(d) Remove the four mounting screws, and then remove the unit of O_2 sensor, temperature controller, solid state relay (SSR).
(e) For assembly, reverse the work above.
Use care about wiring installation.

(2)Replacement of magnetic O_2 sensor

Only fully trained persons can execute the work of this replacement. If such replacement is required, therefore, please contact our adjustment engineer.

10.3.6 Check sheet for SG700 Stack Gas Analyzing System

Enter the operation and calibration data into the following check sheet for the convenience of resetting those data.

Model Code			
Mesuring component	Ch1 :	TAG No.	
	Ch2 :	Measuring Object	
	Ch3 :	Serial No.	
	Ch4 :	Manufacturing Date	
	Ch5 :	Check Date	

Approve	Design

Setting Items

No.	Item			Set Value			
1	Measurement range Calibration setting	Switch of range		Measurement range	Zero gas	Span gas	Unit
		Ch1 ☐ MR ☐ AR ☐ RR	1st range				☐ vol% · ☐ ppm
			2nd range				☐ vol% · ☐ ppm
		Ch2 ☐ MR ☐ AR ☐ RR	1st range				☐ vol% · ☐ ppm
			2nd range				☐ vol% · ☐ ppm
		Ch3 ☐ MR ☐ AR ☐ RR	1st range				☐ vol% · ☐ ppm
			2nd range				☐ vol% · ☐ ppm
		Ch4 ☐ MR ☐ AR ☐ RR	1st range				☐ vol% · ☐ ppm
			2nd range				☐ vol% · ☐ ppm
		Ch5 ☐ MR ☐ AR ☐ RR	1st range				☐ vol% · ☐ ppm
			2nd range				☐ vol% · ☐ ppm

Zero calibration is fixed at 0 except to Zirconia Oxgen Analyzer.
Zero gas is 5-25 vol% O_2 and span gas is 0.01-5 vol% O_2 for Zirconia Oxgen Analyzer.

Manual Calibration	Ch1	☐ at once · ☐ each	— —
	Ch2	☐ at once · ☐ each	— —
	Ch3	☐ at once · ☐ each	— —
	Ch4	☐ at once · ☐ each	— —
	Ch5	☐ at once · ☐ each	— —
Calibration Range	Ch1	☐ both · ☐ current	— —
	Ch2	☐ both · ☐ current	— —
	Ch3	☐ both · ☐ current	— —
	Ch4	☐ both · ☐ current	— —
	Ch5	☐ both · ☐ current	— —
Auto Calibration component	Ch1	☐ 1st range · ☐ 2nd range	☐ enable · ☐ disable
	Ch2	☐ 1st range · ☐ 2nd range	☐ enable · ☐ disable
	Ch3	☐ 1st range · ☐ 2nd range	☐ enable · ☐ disable
	Ch4	☐ 1st range · ☐ 2nd range	☐ enable · ☐ disable
	Ch5	☐ 1st range · ☐ 2nd range	☐ enable · ☐ disable

Zero calibration and Auto zero calibration of the component (ch) with which "enable" is selected are performed.

2	Alarm setting	channel	Range	Upper limit	Lower limit	Unit	Contact actior	ON/OFF
	Alarm 1		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Alarm 2		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Alarm 3		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Alarm 4		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Alarm 5		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Alarm 6		1st Range			☐% ☐ppm		ON (effective) OFF (ineffective)
			2nd Range			☐% ☐ppm		
	Hysterisis		(Hysterisis is common for all alarms)			%F.S		

The alarm contact assigned the same number as the alarm is operated accordingly.
One Ch No. can be selected for multiple alarms. (Power off alarm can be selected for alarm6.)
Contact action: (1) Upper limit (2)Lower limit (3)Upper limit or Lower limit (4)HH limit (5)LL limit

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No.	Item		Set Value			Unit
3	Auto calibration	Start time	D H M			— —
		Cycle	( )			☐ Day・☐ Hour
		Flow time	Zero	( )		sec.
			Ch1 Span	( )		
			Ch2 Span	( )		
			Ch3 Span	( )		
			Ch4 Span	( )		
			Ch5 Span	( )		
			Replacement time	( )		
		Auto calibration action	☐ ON・☐ OFF			— —
		(Before changing the setting of auto calibration, set the ON/OFF to OFF.)				
4	Auto zero calibration	Start time	D H M			— —
		Cycle	( )			☐ Day・☐ Hour
		Flow time	( )			sec.
		Auto Zero calibration action	☐ ON・☐ OFF			— —
		(Before changing the setting of auto calibration, set the ON/OFF to OFF.)				
5	Peak alarm (Option) ∗Only for CO	ON-OFF	☐ ON・☐ OFF			— —
		Alarm value	( )			ppm
		Alarm count	( )			time
		Hysterisis	( )			%FS
6	Parameter	Current time	/ / ( )			— —
		Key Lock	☐ ON・☐ OFF			— —
		Output hold	☐ ON・☐ OFF ☐ Current・☐ Setting			%FS
			Setting	Ch1	( )	%FS
				Ch2	( )	%FS
				Ch3	( )	%FS
				Ch4	( )	%FS
				Ch5	( )	%FS
		Average value reset (at the time of the reset input, all average values are reset .)				— —
		Response time (1-60 sec)	Ch1	( )		sec.
			Ch2	( )		sec.
			Ch3	( )		sec.
			Ch4	( )		sec.
			Ch5	( )		sec.
		Average period (1-59 min or 1-4 hour)	☐ None	Average value of O2 correction ( )		☐ Hour・☐ min.
				Average value of O2 correction ( )		☐ Hour・☐ min.
				Average value of O2 correction ( )		☐ Hour・☐ min.
				O2 average ( )		☐ Hour・☐ min.
		Backlight timer(Automatic OFF the backlight)	☐ ON・☐ OFF ( )			min.
7	Maintenance mode	Sensor input value (confirm by using zero gas)	Sensor	Input	Sensor	Input	— —
			NO_x M		O_2		— —
			NO_x C		TEMP.		— —
			SO_2 M				— —
			SO_2 C				— —
			CO_2 M				— —
			CO_2 C				— —
			CO M				— —
			CO C				— —

Error Log (Total 14 newewst errors)	Error No.	Y	M	D	H	M	CH	Error No.	Y	M	D	H	M	CH

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7	Maintenance mode	Calibration log (Total 10 calibration data) Z1:Range 1 Zero Z2:Range 2 Zero S1:Range 1 Span S2:Range 2 Span M:Value of measuring detector at the time of calibration C:Value of the interference compensation detector at the time of calibration Con:Concentration value displayed before calibration	R	M	C	Con	MDHM	Remark

Optical adjustment (Confirmed with zero gas)	Select the solenoid valve for calibration gases by using the ▲ or ▼ key					— —
	1 - 1		2 - 1			— —
						— —
	1 - 2		2 - 2			— —
						— —
Moisture interference adjustment	Adjustment by flowing the gas for moisture interference compensation					— —
		Value after adjustment	Moisture interference compensation coefficient			— —
	Ch1					— —
	Ch2					— —
	Ch3					— —
	Ch4					— —
	ALL: All adjustment at a time					— —
Output adjustment	(Output adjustment of the output terminal corresponding to OUT No.) Adjust the value so that 4-20mA(0-1V)					— —
Other parameter	Password (To enter the maintenance mode) ( )					— —
	O_2 reference value (00-19) ( )					Vol% O_2
	Limit (O_2 limit at O_2 ref. 01-20) ( )					Vol% O_2
	Station No. (00-32) ( )					— —
	Range setting (Measuring range is settable within limited range)					

Range setting

	MIN range	1st Range	2nd Range	Max range	Unit	Number of range	Remark
Ch1					□% · □ ppm		
Ch2					□% · □ ppm		
Ch3					□% · □ ppm		
Ch4					□% · □ ppm		
CH5					□% · □ ppm		

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11. ACCESSORIES AND SPARES

11.1 Standard Accessories (supplied with the instrument at delivery time)

	No.	Name	Part number (*5)	Quantity				Remark
				SG700-A	SG700-C SG700-H SG700-J	SG700-B SG700-G	SG700-D SG700-E SG700-F	
Maintenance parts	1	Filter paper for membrane filter	K9350MD			1pack	1pack	25 papers per pack, 0.5 μm
	2	Filter paper for membrane filter	K9219BA	5, 10(*1)	5, 10(*1)			(*1) PTFE 0.1 μm
	3	Filter for gas conditioner	K9350MH	1	1	1	1	
	4	O-ring for gas conditioner	K9350MF	1	1	1	1	G65 chloroprene
	5	Fuse (for device SW)	K9350VN	2	2	2	2	2 A
	6	Fuse (for device SW)	K9350VP	2	2	2	2	3.2 A
	7	Fuse (spare for infrared analyzer)	K9218SB	2	2	2	2	3 A for analyzer
	8	Catalyst for NO_2/NO converter	K9350LP	1(*2)	1	1		For NO_x analyzer or (*2)
	9	Glass wool for NO_2/NO converter	K9350LQ	1(*2)	1	1		For NO_x analyzer or (*2)
	10	SO_3 mist catcher	K9350XV	2(*1)	2(*1)			(*1) change every four months
	11	Diaphragm for pump	K9350GE	1(*1)	1(*1)			With spanner
Accessories	12	Standard gas joint	K9219LA	(*3)	(*3)	(*3)	(*3)	(*3) For pressure regulator Rc 1/4- ϕ6
	13	Hose band for fixing standard gas cylinder	K9219LB	(*4)	(*4)	(*4)	(*4)	(*4) For pressure regulator
	14	Toaron tube for standard gas connection	K9641KA	1	1	1	1	1 m ϕ9/ ϕ5
	15	Polyethylene tube for standard gas connection	K9641KB	1	1	1	1	6 m ϕ6/ ϕ4
	16	Anchor bolt for cubicle installation	K9350ZA	4	4	4	4	
	17	Water bottle for injection	K9219BG	1	1	1	1	For refilling water of gas conditioner
	18	Water bubbler bottle	K9350XR	1	1	1	1	For correction of moisture interference
	19	Cell assembling tool	K9358UA		1(*6)		1(*6)	For block cell

T11.1E.EPS

(*1) When option code /SO1 is selected.
(*2) When option code /NO1 is selected.
(*3) [The number of measuring components + 1] fittings are included. For external gas cylinders, the quantity is doubled.
(*4) 4×[The number of measuring components + 1] hose bands are included.
(*5) A part number contains one piece of part.
(*6) Supplied when CO_2 measurement is performed.

11.2 One-Year-Usage Spare Parts (Optional)

No.	Name	Part number (*3)	Quantity				Remark
			SG700-A	SG700-C SG700-H SG700-J	SG700-B SG700-G	SG700-D SG700-E SG700-F	
1	Catalyst for NO_2/NO converter	K9350LP	2(*2)	2	2	—	For NO_x analyzer or (*2)
2	Glass wool for NO_2/NO converter	K9350LQ	2(*2)	2	2	—	For NO_x analyzer or (*2)
3	Fitting for NO_2/NO converter	K9350LV	4(*2)	4	4	—	For NO_x analyzer or (*2)
4	Filter for gas conditioner	K9350MH	2	2	2	2	
5	O-ring for gas conditioner	K9350MF	2	2	2	2	G65 chloroprene
6	Filter paper for membrane filter	K9350MD	—	—	1	1	25 papers per pack, 0.5 μm
7	Filter paper for membrane filter	K9219BA	12	12	—	—	PTFE 0.1 μm
8	O-ring for membrane filter	K9350MG	2	2	2	2	P49 chloroprene
9	O-ring for membrane filter	K9219BK	2	2	2	2	P3 chloroprene
10	Fuse (for device SW)	K9350VN	3	3	3	3	2 A
11	Fuse (for device SW)	K9350VP	4	4	4	4	3.2 A
12	Fixed diaphragm	K9641KC	1(*1)	1(*1)	—	—	50 kPa/0.6 L (*1)
13	Diaphragm for pump	K9350GE	1	1	1	1	
14	Valve for pump	K9350GF	1	1	1	1	
15	SO_3 mist catcher	K9350XW	1(*1)	1(*1)	—	—	Change every four months (*1)
16	Spare parts set for 1 year (*4)	K9641JA	1	—	—	—	For SG700-A (with /SO1 and /NO1)
17	Spare parts set for 1 year (*2), (*5)	K9641JB	1(*2)	1	—	—	For SG700-A (with /SO1 and /NO1) For SG700-C, -H, -J (with /SO1)
18	Spare parts set for 1 year (*6)	K9641JC	—	—	1	—	For SG700-B, -G
19	Spare parts set for 1 year (*7)	K9641JD	—	—	—	1	For SG700-D, -E, -F
20	Spare parts set for 1 year (*1), (*8)	K9641JE	1(*1)	—	—	—	For SG700-A (with /SO1 and /NO1)
21	Spare parts set for 1 year (*1), (*2), (*9)	K9641JF	1(*1)(*2)	1(*1)	—	—	For SG700-A (with /SO1 and /NO1) For SG700-C, -H, -J (with /SO1)

(*1) When option code "/SO1" is selected.
(*2) When option code "/NO1" is selected.
T11.2E.EPS
(*3) A part number contains one piece of part or one set of parts.
(*4) K9641JA consists of No.4, 5, No.7–11 and No.13, 14.
(*5) K9641JB consists of No.1–5, No.7–11 and No.13, 14.
(*6) K9641JC consists of No.1–6, No.8–11 and No.13, 14.
(*7) K9641JD consists of No.4–6, No.8–11 and No.13, 14.
(*8) K9641JE consists of No.4, 5 and No.7–15.
(*9) K9641JF consists of No.1–5 and No.7–15.

11.3 Recommended Spare Parts (Optional)

NO.	Name	Part number (*1)	Quantity per replacement	Recommended quantity
1	Filter element for type F filtering probe	K9718RS	1	2
2	Filter element for type M1E filtering probe	K9718RX	1	2
3	Filter element for type M2E filtering probe	K9718VF	1	2
4	O-ring for type M2E filtering probe	Y9144XB	2	8
5	Filter element for type M1E external primary filter	K9718RX	1	2
6	Filter element for type MS external primary filter	K9718US	1	2

(*1) Part numbers refer to each one piece. When separately ordering more than one of a part, specify the required quantity of the parts as well as the part number.
T11.3E.EPS
Note: Order more spare parts at parts replacement time, to maintain the recommended quantity of spare parts.

12. TROUBLESHOOTING

CAUTION

In case you find it difficult to judge what happened to the instrument, avoid disassembling the instrument without consulting our sales agent or service engineers. Otherwise, it may result in electrical shock or personal injury.

12.1 Troubleshooting

Table 12.1

Phenomena	Items	Check	Remedy
Sample gas flow rate is low	Filter (Gas sampler, Mist, Membrane filter)	Check if filter is clogged.	Clean or replace.
	Diaphragm gas aspirator	Check if aspirator is operating normally.	Clean aspirator or replace diaphragm or valve.
		Check for abnormal sound or vibration.	Retighten screws or replace aspirator.
	Electric gas cooler	Check if cooler is operating normally. Check the cooler temperature, and check if gas flow path is clogged.	Replace.
	Drain pot	Check if the water level of positive pressure drain pot is lowered.	Check the water supply and capillary.
	Gas leaks	Check if there are gas leaks somewhere in tube connecting to aspirator or joints.	Retighten or replace parts.
	Flowmeter	Check if drain or dust is attached to the flowmeter. Check the needle valve.	Adjust.
	Tube, capillary	Check the tube for breakage, or clogging.	Replace.
Indication value varies considerably.	Gas leak	Check the mist filter, tube, joints connecting to aspirator for gas leaks.	Retighten or replace parts.
	Diaphragm aspirator	Check if the aspirator is operated normally. Check if sample gas flow is supplied as set.	・Clean the aspirator or replace diaphragm or valve. ・Adjust the sample gas flow.
	Drain pot	Check that water level is as specified.	Supply water.
		Check that air is sucked in.	Check the filter in the gas extractor.
	Dissolution of gas	Check if drain remains in tube.	Clean or tilt tube.
Indication differs from the anticipated one.	Gas leak	Check if there is gas leak anywhere before the aspirator.	Retighten or replace parts.
	Measuring range	Check if correct range is selected.	Switch to correct range.
	Zero, span	Check zero and span using the standard gas.	Adjust zero and span correctly.
	Cell window	Check if it is cloudy.	Clean.
Indication is not deflected.	Power supply and fuse	Check power supply voltage and fuse.	Replace fuse.
Freeze-up	Drain tubing, water drain tube, sampling tube	Check for freeze-up in the tubing.	Implement heat insulation for preventing freeze-up.

T12.1E.eps

12.2 Troubleshooting for analyzer unit

Error message

If errors occur, the following contents are displayed.

Table 12.2 Error Message

Error display	Error contents	Probable causes
Error No.1	Motor rotation detection signal faulty	・Motor rotation is faulty or stopped. ・Motor rotation detector circuit is faulty.
Error No.4	Zero calibration is not within the allowable range.	・Zero gas is not supplied. ・Zero is deflected much due to dirty cell. ・Detector is faulty. ・Optical balance is maladjusted.
Error No.5	Amount of zero calibration (indication value) is over 50% of full scale.	
Error No.6	Span calibration is not within the allowable range.	・Span gas is not supplied. ・Calibrated concentration setting does not match cylinder concentration. ・Zero calibration is not performed normally. ・Span is deflected much due to dirty cell. ・Detector sensitivity has deteriorated.
Error No.7	Amount of span calibration (difference between indication value and calibrated concentration) is over 50% of full scale.	
Error No.8	Measured values fluctuate too much during zero and span calibration.	・Calibration gas is not supplied. ・Time for flowing calibration gas is short.
Error No.9	Calibration is abnormal during auto calibration.	・Error corresponding to No. 4 to No. 8 occurred during auto calibration.
Error No.10	Output cable connection is improper.	・Wiring is detached between analyzer and interface module. ・Wiring is disconnected between analyzer and interface module

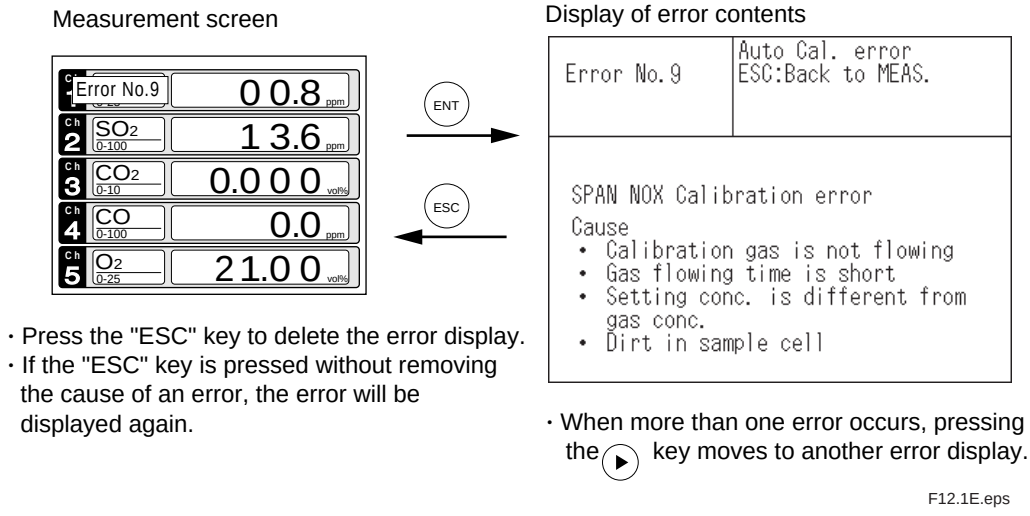
T12.2E.eps

When error No. 1 or No. 10 occurs, analyzing block error contact output is closed.

When an error from No. 4 to No. 9 occurs, calibration error contact output is closed.

Screen display and operation at the occurrence of error

In case of Error No. 1 to No. 4, No. 6, No. 8 to No. 10



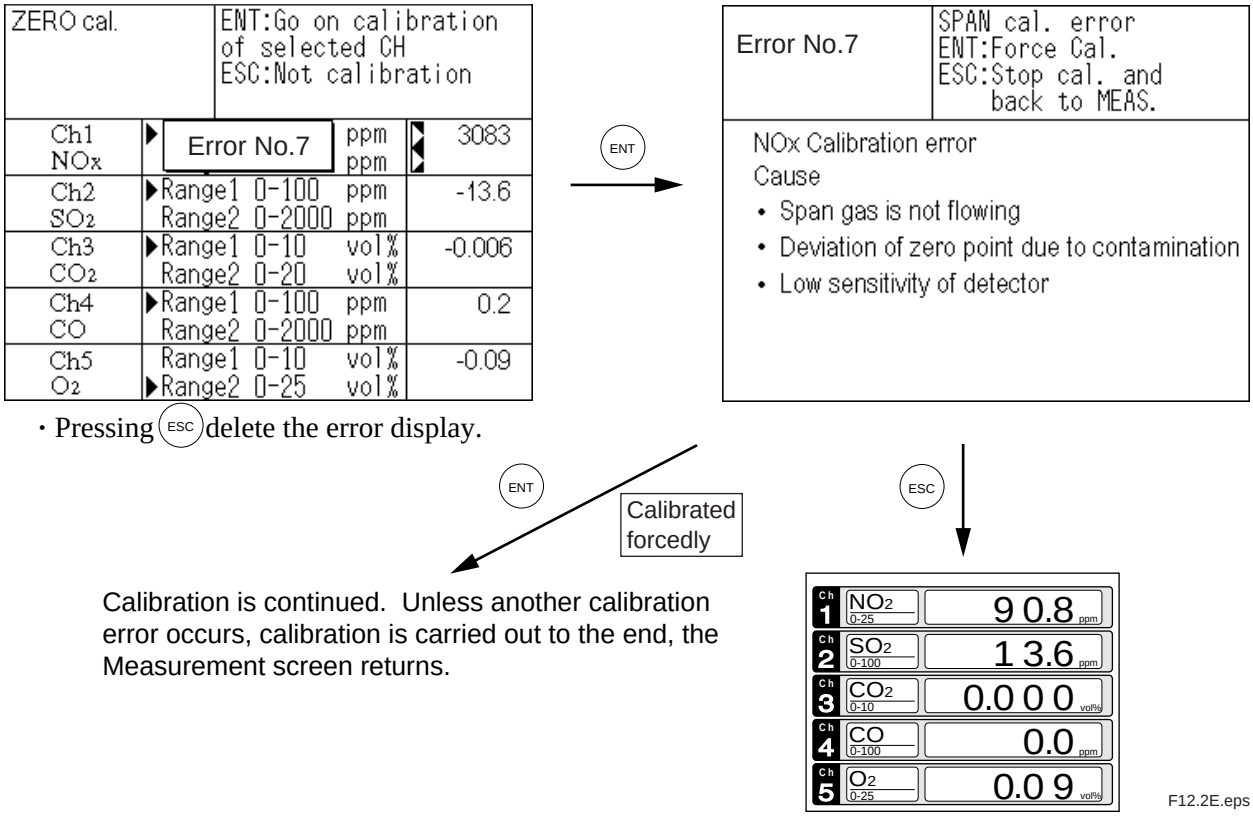
・Press the "ESC" key to delete the error display.
・If the "ESC" key is pressed without removing the cause of an error, the error will be displayed again.

・When more than one error occurs, pressing the ▶ key moves to another error display.

F12.1E.eps

Figure 12.1

In case of Error No. 7



・Pressing (ESC) delete the error display.

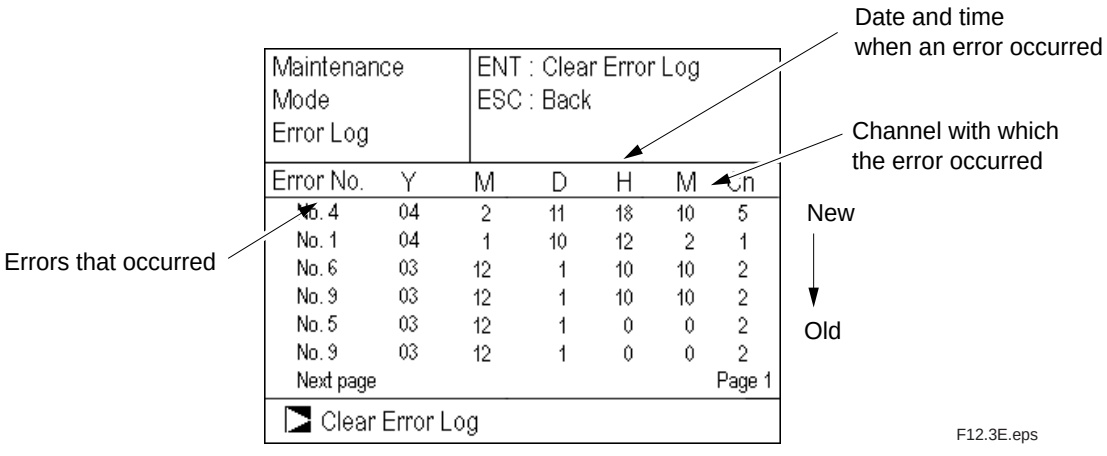
F12.2E.eps

Figure 12.2

Error log file

If error occurs, the history is saved in an error log file. The error log file exists in the maintenance mode.

Error log screen



F12.3E.eps

Figure 12.3

*Up to 14 errors can be saved in the error history; the oldest error will be deleted one by one every time a new occurs.

*If the power supply is turned "OFF", the contents in the error log file will not be lost.

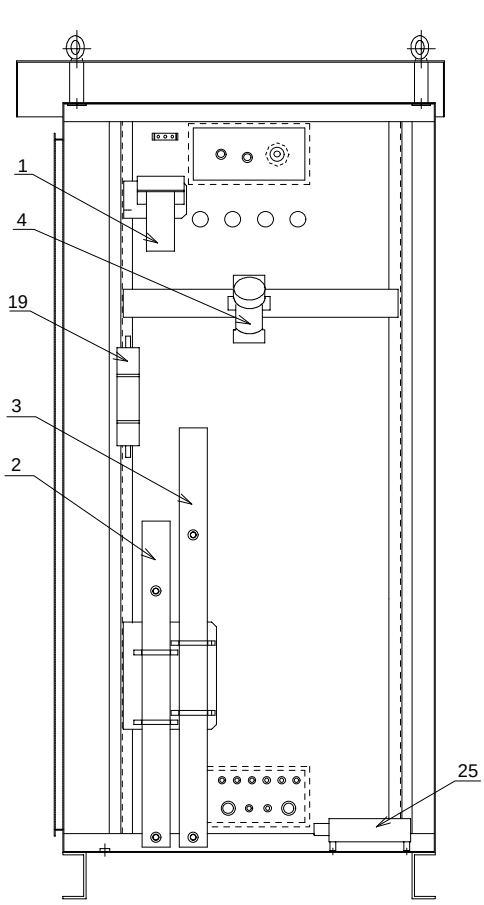
Deletion of error history

Press the "ENT" key on the above screen, and the “Error Log Clear” will be inverted. Further pressing the "ENT" key will clear the error history.

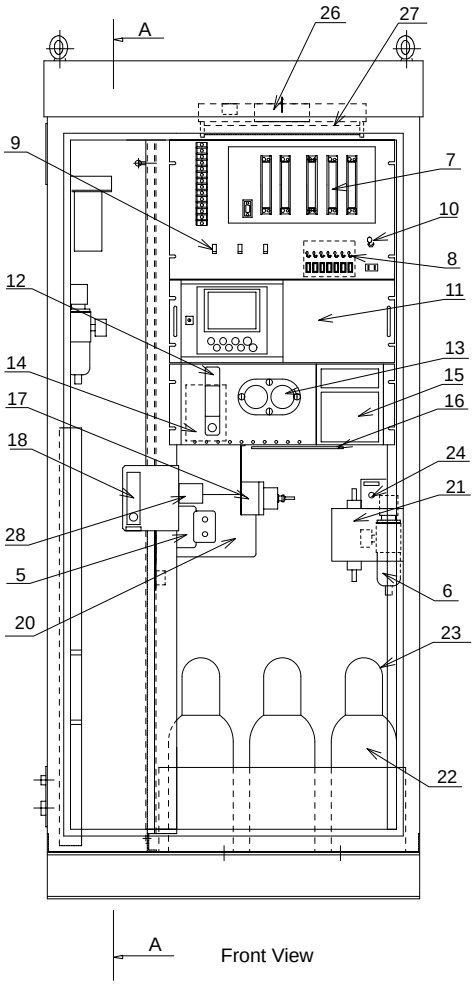
Customer Maintenance Parts List

Model SG700
Stack Gas Analyzing Systems

EXA IR



A-A View



Front View

Item	Part No.	Qty	Description
1	K9350EA	1	Mist filter
2	K9641LA	1	Positive pressure drain pot
3	K9641LB	1	Negative pressure drain pot
4	K9641LC	1	Drain sparator
5	K9219JV	1	Pump
	K9350GA	1	Pump (option cord /SO1)
6	K9350SB	1	Filter regulator
7	K9218SC	1	Terminal block
8	K9219FF	1	Switch box
9	K9350XN	1	Breaker (5A)
	K9350XP	1	Breaker (15A)
	K9350XQ	1	Breaker (20A)
10	K9219FK	1	Toggle switch

Item	Part No.	Qty	Description
11	—	1	IR400 Infrared gas analyzer
12	K9219LC	1	Flow meter
13	K9641LN	1	Membrane filter (glass)
	K9641LP	1	Membrane filter (teflon)
14	K9219GT	1	Electric gas cooler
15	—	1	Recorder (μR10000)
16	K9350JB	1	Gas dryer (option code /SO1)
17	K9350SD	1	Pressure regulating valve (option code /SO1)
18	K9350NE	1	Flow meter (option code /SO1)
19	K9350XV	1	Mist catcher (option code /SO1)
20	K9219GU	1	Zirconia oxygen analyzer
21	K9350LE	1	NO_2/NO converter

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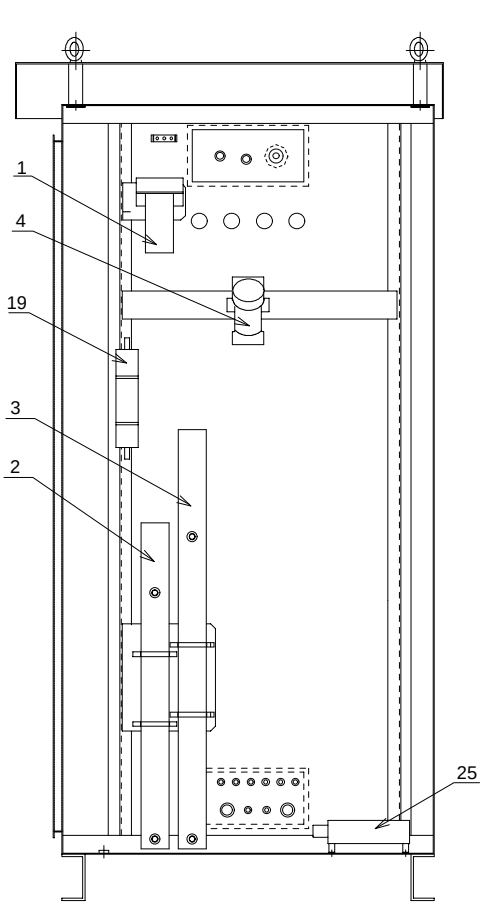
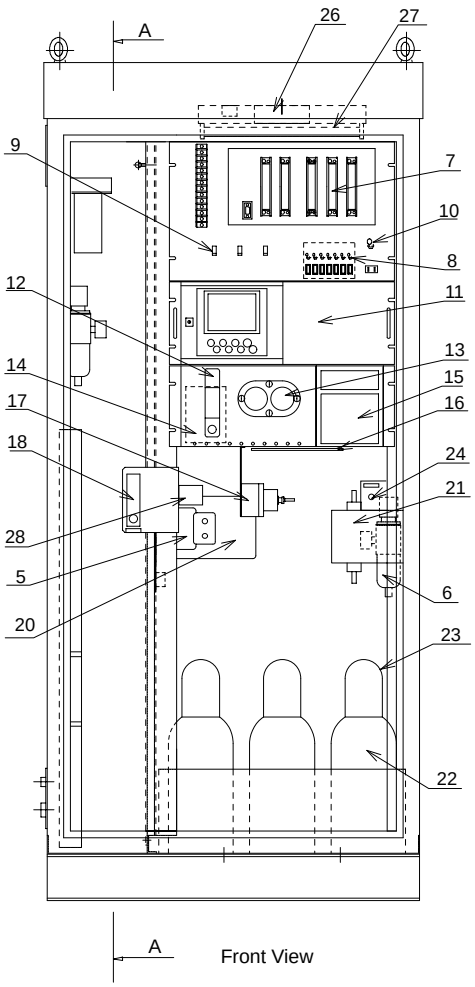


A-A View



Front View

Item	Part No.	Qty	Description
22	—		Standard gas cylinder (3.4 L)
23	—		Pressure regulator
24	K9641LD	1	Needle valve
25	K9350VB	1	Space heater
26	K9350VK	1	Ventilation fan
27	K9350VL	1	Fluorescent light (50Hz)
	K9350WL	1	Fluorescent light (60Hz)
28	K9350QV	1	Solenoid valve (option code /R)

(NOTE) For spare parts set, see chapter 11 of IM 11G0406-01E

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