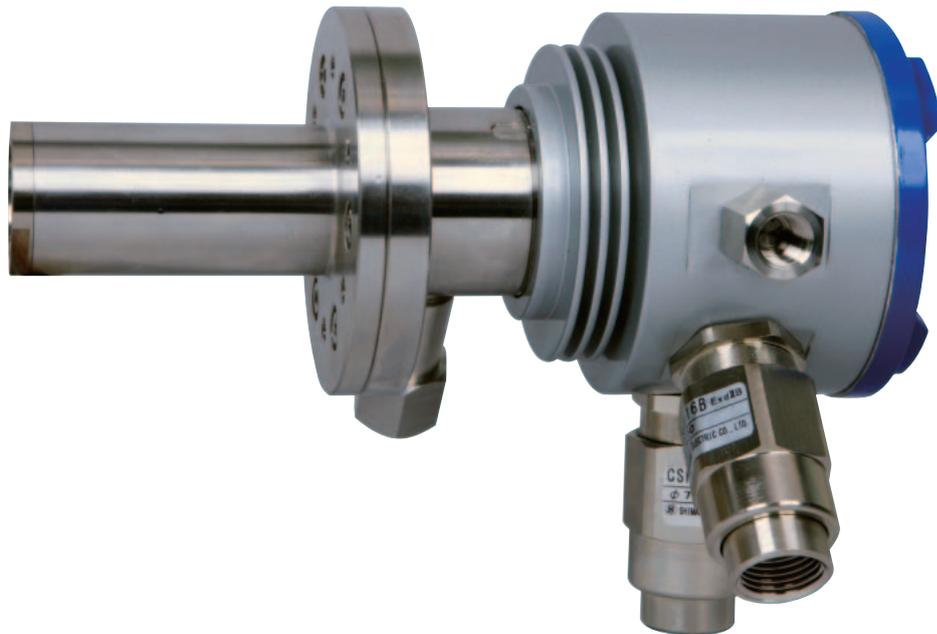




Instruction Manual

THE DIRECT INSERTION TYPE ZIRCONIA OXYGEN ANALYZER DETECTOR

TYPE: ZFKE



PREFACE

Thank you very much for your kind purchase of Fuji's explosion-proof zirconia oxygen analyzer detector (Type ZFKE).

- Read this instruction manual carefully to get a thorough understanding of how this zirconia oxygen analyzer works prior to installing, operating and maintaining the zirconia oxygen analyzer.
If abused, unnecessary troubles or failure could occur.
- The specification of this zirconia oxygen analyzer may be subject to change without previous notice for improvements of the product.
- Under no circumstances should this zirconia oxygen analyzer be modified without permission.
If any trouble should occur because of having been modified without permission, we won't be responsible for it anyway.
- This instruction manual should be kept in custody by a person who operates the zirconia oxygen analyzer actually.
- After reading this manual, it should always be kept in a place which allows the person who operates it to refer to any time as required.
- A due consideration should be given so that this instruction manual is delivered to a final user certainly.

Manufacturer : Fuji Electric Instrumentation Co., Ltd.
Type : Described in the nameplate put on the main body
Date of manufacture : Described in the nameplate put on the main body
Product nationality : Japan

Related instruction manuals

Direct insertion type explosion-proof zirconia oxygen analyzer detector (Type : ZKME)INZ-TN1ZKME-E

NOTE

- It is prohibited to transfer a part or all of the contents of this manual without permission.
- The contents of this manual may be subject to change in future without previous notice

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Issued in May, 2009

SAFETY PRECAUTIONS

Prior to operating the detector, read this “Safety precautions” carefully for correct use.

- In the precautions shown here, important contents on safety are included. So, be sure to observe them. The safety precautions have been ranked into “DANGER” and “CAUTION”.

 DANGER:	If this apparatus is abused, a dangerous condition could come about and it is supposed to die or get a serious injury.
 CAUTION:	If the apparatus is abused, a dangerous condition could arise and it is supposed to get medium injury or a minor injury and a physical damage is supposed to occur.
 PROHIBITION:	This indicates a prohibition (act which must not do).

Precautions in installing and wiring	
 DANGER:	<ul style="list-style-type: none"> • Although this is explosion-proof type, do not use it in the place where explosive gases always exist (zone 0) to prevent explosion, fire or otherserious accidents.
 CAUTION:	<ul style="list-style-type: none"> • Install this product in a place compatible with the conditions set forth in “instruction manual”. The use at a place not conforming to the installation conditions may result in an electric shock, a fire and a malfunction. • When this product is mounted on a furnace which is under operation, take utmost care with blow-out from the furnace. There is a risk of burn injury. • In the case of the wiring work, be careful not to drop foreign matters including wire chips into the product. Otherwise, a fire, failure or malfunction may result. • Connect a power source compatible with the specified rating. Connection of power source different from the rating might cause a fire. • Before doing the wriring work, be sure to turn off the main power. Otherwise, it results in getting an electric shock as the case may be. • Use proper wiring materials according to the rating of apparatus. If a wiring material which is not bearable to the rating is employed, it might cause a fire.
 PROHIBITION:	<ul style="list-style-type: none"> • Never do the work at a place where the product getsw wet with rain directly. A failure to observe this instruction may result in getting an electric shock or failure.

Precautions in operation, stop, maintenance and check



DANGER:

- In case where combustible gas is contained in the measured gas, check the gas composition and specifications carefully before using. Otherwise, the original performance is not displayed, and there is a fear of explosion.



CAUTION:

- Do the work in a condition where the main power has been turned off. If the work is done while current is flowing, there is a fear of getting an electric shock.
- The operating temperature of the detector (tip of ceramic heater) is about 800 °C and the surface temperature is also very high. So, never touch the detector by bare hand.
Otherwise, there is a fear of getting a burn.
- Before cleaning the flow guide tube, turn off the main power and cool the tube down fully.
There is a fear of getting a burn.
- Don't use any other renewal part than those designated by the maker. Otherwise, the original performance is not fully displayed and an accident or failure may result.
- Dispose of the renewal parts such as the maintenance parts as an incombustible article.



PROHIBITION:

- Never do the work at a place where rain water splashes the product directly. A failure to observe this instruction may result in getting an electric shock or failure.

Other precaution



CAUTION:

- For a failure which cannot be judged even if referring to the instruction manual, be sure to ask the nearest dealer or Fuji adjustment serviceman for repair. If disassembled carelessly, an accident or injury could result.

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1. INTRODUCTION

1.1 General description of zirconia oxygen analyzer

This zirconia oxygen analyzer makes use of the oxygen ion conductivity of solid electrolytes composed mainly of zirconia (ZrO_2) at high temperatures.

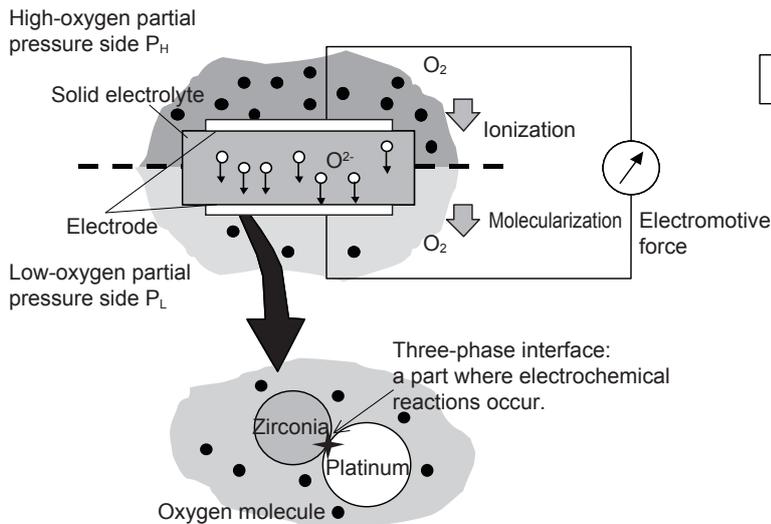
If electrodes of platinum or the like are attached to both faces of a solid electrolyte and the faces are on the conditions of different oxygen partial pressures, an electrochemical reaction causes an electromotive force between both the electrodes. This phenomenon is called concentration cell action.

Microscopically, it is assumed that electrochemical reactions occur at the interface (three-phase interface) among a solid electrolyte, electrode and oxygen.

High-oxygen partial pressure side: $O_2 + 4e^- \rightarrow 2O^{2-}$ (ionization)

Low-oxygen partial pressure side: $2O^{2-} \rightarrow O_2 + 4e^-$ (molecularization)

An electromotive force (E) generated is expressed as follows with Nernst's equation:



Nernst's equation

$$E = \frac{RT}{4F} \ln \frac{P_H(O_2)}{P_L(O_2)}$$

- E : Electromotive force
- $P_H(O_2)$: Oxygen partial pressure of a reference gas (atmosphere)
- $P_L(O_2)$: Oxygen partial pressure of a measured gas
- R : Gas constant $8.3144[J \cdot m \cdot ol^{-1} \cdot K^{-1}]$
- T : Absolute temperature[K]
- F : Faraday constant $9.649 \times 10^4 [c \cdot mol^{-1}]$

1.2 Description of flameproof

Flameproof is the unit that has passed the test conducted by the public institution as a flameproof-structured instrument.

A test certificate and a name plate including necessary specifications for the purpose of explosion-proof are attached to such an accepted unit.

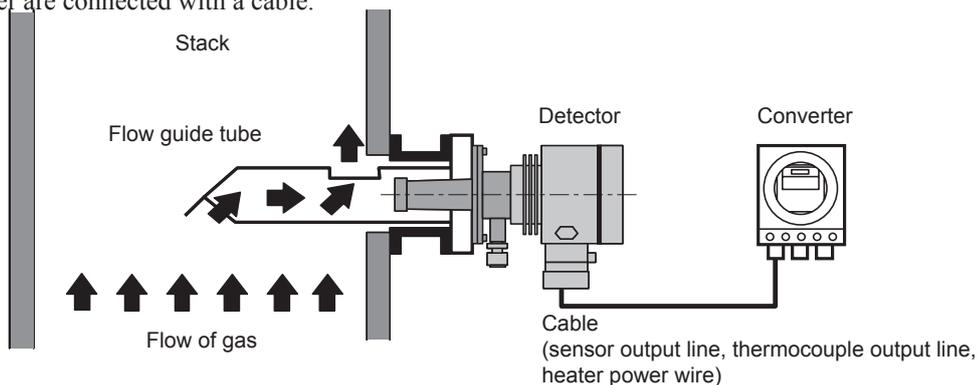
Confirm them and use the unit according to those contents.

On the name plate for instrument of flameproof, the 17th digit of type code, either with N for China or T for Japan, is stated.

The certification mark by public institution is also attached.

1.3 Device configuration of direct insertion type oxygen analyzer

The direct insertion type zirconia oxygen analyzer consists of the detector with a sensor unit, the flow guide tube that is directly inserted to the stack or the like in order to supply a gas to the detector, and the converter that performs sensor control, signal processing, output/display, and external transmission. The detector and converter are connected with a cable.



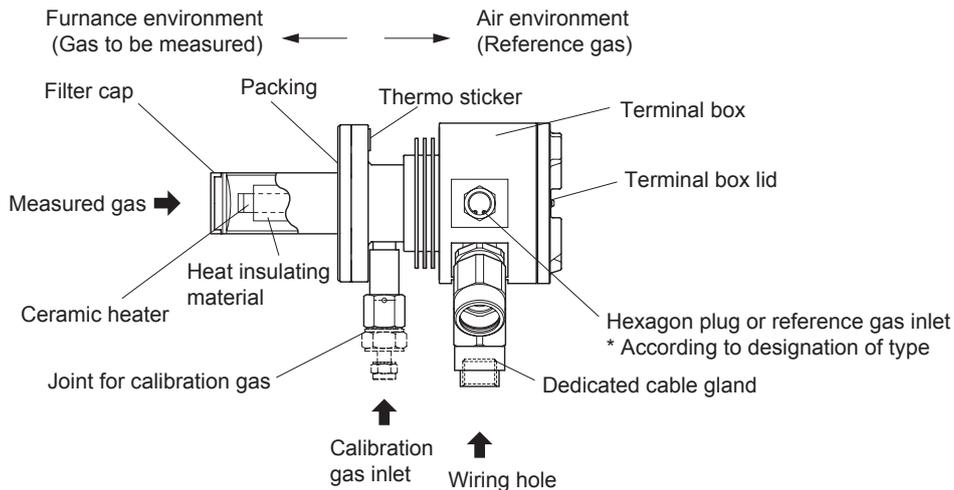
1.4 Description of each component



CAUTIONS

- The operating temperature of detector (tip of ceramic heater) is about 800°C and the surface temperature is also very high. So, never touch it by bare hand. Otherwise, there is a fear of getting a burn. Especially when a filter at the end of the detector is replaced, take utmost care.

(1) ZFKE



Caution in handling

- Since the detector is made of porcelain of zirconia, there is a case where it breaks due to drop or impact. So, be sufficiently careful.
- The detector is unusable for a plant in which water droplets might run down inside a sampling pipe.
- There is no need to remove M5-hexagon set screw of the terminal box unless otherwise a reference gas inlet is used. Don't loosen the screw without thought since a waterproofing effect becomes zero.

1.5 Check of type

The name of type has been put in the specification name-plate. Make sure it is as ordered.

Refer to Item 8.2 "Desingation of type".

1.6 Check of delivered articles

Make sure the following articles have been delivered without lack.

No.	Description	Classification	Q'ty	Remark
1	Detector		1 unit	Confirmed in Item 1.3
2	Instruction manual (this manual)		1 copy	INZ-TN5ZFKE-E
3	Packing	Accessories	1 sheet	See Item 2.2.1.
4	Mounting screw, plain & spring washer (M5)	Accessories	6 pcs each	See Item 2.2.1.
5	Thermo sticker	Specification goods	1 sh.	See Item 2.2.1.
6	Filter cap	Specification goods	1 piece	See Item 6.2.2
7	Spring	Specification goods	1 piece	See Item 6.2.2
8	Hexagonal wrench	Accessories	1 piece	See Item 2.2.1
9	Flow guide tube	Specification goods	As ordered	See Item 6.2.2 and 2.2.3.
10	Reference gas inlet	Specification goods	As ordered	See Item 3.2.

2. MOUNTING

2.1 Mounting location



DANGER

- Although this is explosion-proof type, do not use it in a place where explosive gases always exist (zone 0) to prevent explosion, fire or other serious accidents.



CAUTIONS

- Install this product at a place compatible with the following conditions. The use of it at a place not conforming the installation conditions specified in this manual could cause an electric shock, a fire or incorrect operation.

Mount the detector by selecting the places shown below:

- 1 Place where there is a space which allows doing daily check and wiring work
- 2 Place where there is little vibration (acceleration: 2 m/s^2 , frequency: within 5 to 100 Hz), dust and humidity (equivalent to IP65 or less)
- 3 Place where peripheral air environment is non-corrosive.
- 4 Place where there are no electric appliances producing noise trouble (For example : motor, transformer and appliances bringing about electromagnetic induction trouble and electrostatic induction trouble) nearby the detector.
- 5 Place where ambient temperature and humidity are -10 to $+60^\circ\text{C}$ and less than 95% RH .

2.2 Mounting method



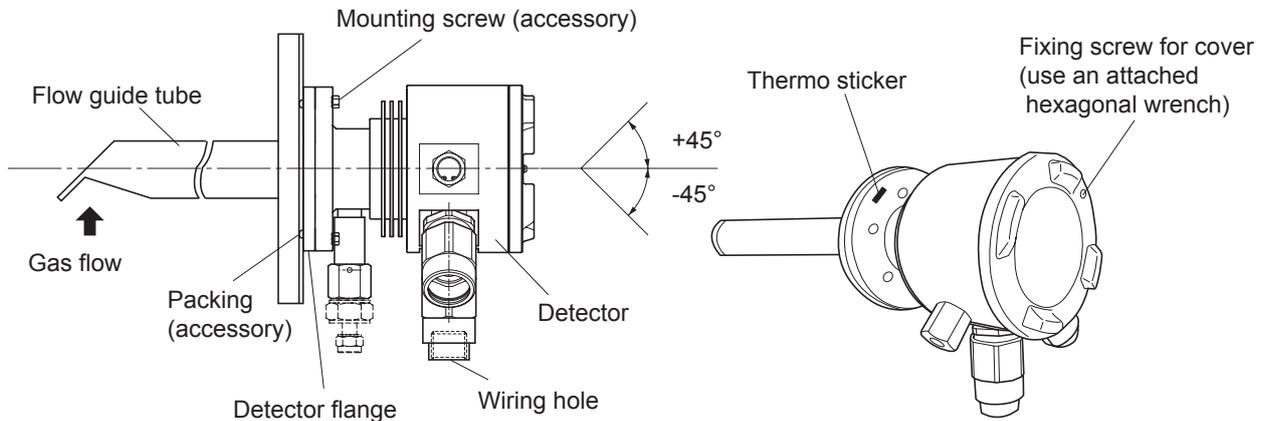
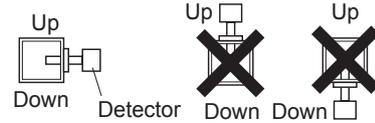
CAUTIONS

- When mounting the detector on a furnace which is under operation, take utmost care about the blowout from the furnace; otherwise, there is a fear of getting a burn.

2.2.1 Mounting method of detector

Caution in mounting

- Never mount the detector with the tip turned upward or downward. A failure of the detector may result.



- 1 Attach the packing (accessory, Viton P36) to the detector flange. Subsequently, attach the detector to the flange of the flow guide tube by fixing the mounting screws (accessory, M5) and the flat and spring washers (accessories) to the three locations (at the opposing corners of six mounting holes) (recommended tightening torque: 3.5 N · m).
- 2 Attach the detector so that it is within the range of $\pm 45^\circ$ to the horizontal plane.
- 3 Attach the detector so that the wiring hole is located at the bottom.
- 4 Set the temperature of the detector flange to 125°C or less regardless of the measured gas temperature.

<How to check>

- Complete the mounting, piping and wiring work of the detector completed, make sure the color of thermo sticker [125] put on the detector flange is not changing to red in the exhaust gas measuring condition (while current is flowing to the detector and the plant is under running). (Usually, the color of thermo sticker is light pink.)
- If the color has changed to red, it means that the temperature of detector flange has been over 125°C. So, take the following steps:
 - (a) Change the existing flange packing to a thicker one.
 - (b) Use a longer companion flange.
 - (c) Mount the flow guide tube according to Item “2.2.2”.

By taking the above steps, minimize heat transfer from the gas duct wall and lower the temperature.

The thermo sticker does not return to its original condition once it discolors. So, after taking the steps, re-put a thermo sticker available as an accessory on the detector flange and make certain that it does not turn red. (For the part No. for additional procurement of the thermo sticker, refer to Item “6.4”.

2.2.2 Mounting method of flow guide tube

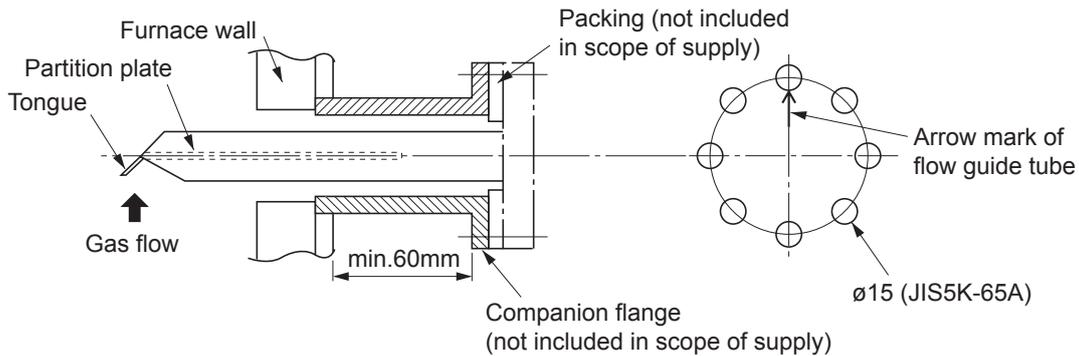
(Designation of type: When 9th to 11th digits are 5A□, 5B□ and 5C□)

The flange of flow tube has mounting holes at 8 locations. These holes are available for regulating an in-flow into the flow guide and mounting the tube correctly in the flowing direction of gas and it is enough if mounted at 4 locations.

(1) Direction of tongue and Partition plate of flow guide tube

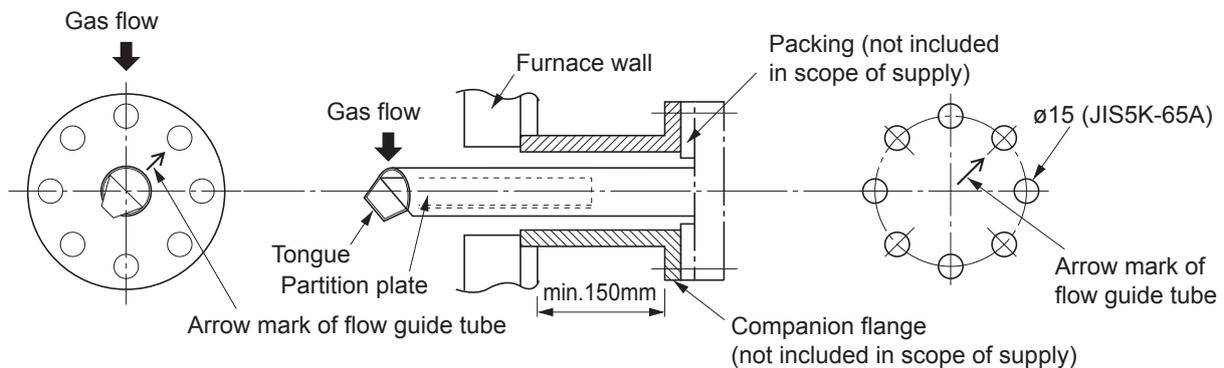
- 1 When exhaust gas temperature is under 200°C and gas flowing velocity is low

As illustrated below, set the partition plate inside the flow guide tube at a right angle to the gas flow and mount the tube so that the tongue turns to an upstream direction relative to the gas flow.



- 2 When exhaust gas temperature is 200°C or higher and gas flowing velocity is fast

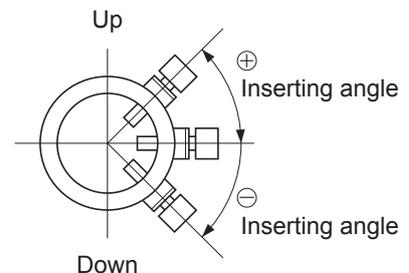
As illustrated below, tilt the partition plate inside the flow guide tube 45° to the gas flow and mount the tube so that the tongue turns to a down-stream direction relative to gas flow.



(2) Inserting angle of flow guide tube

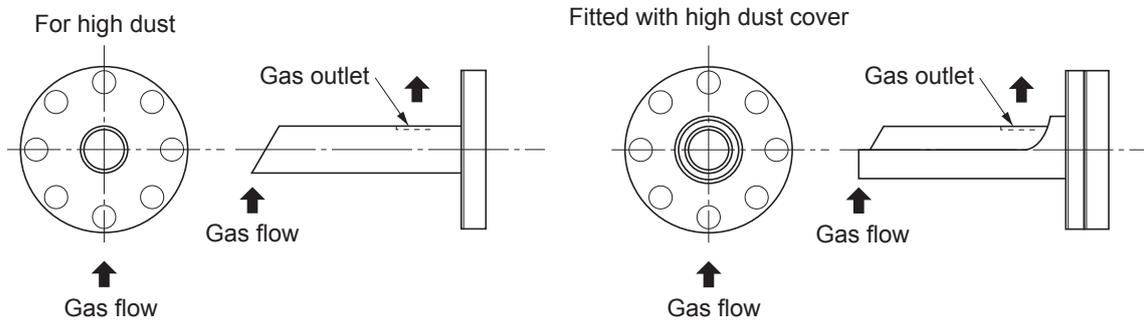
According to the temperature of exhaust gas and the amount of dust, the inserting angle of the flow guide tube differs. With reference to the following conditions, install a companion flange.

- 1 When exhaust gas temperature is under 200°C and amount of dust is under $0.2\text{g}/\text{Nm}^3$
 - Inserting angle: within a range of -45 to $+45^\circ$
- 2 When exhaust gas temperature is 200°C or higher and amount of dust is under $0.2\text{g}/\text{Nm}^3$
 - Inserting angle: within a range of -20 to $+20^\circ$
- 3 When amount of dust is over $0.2\text{g}/\text{Nm}^3$
 - Inserting angle: within a range of 0 to $+45^\circ$



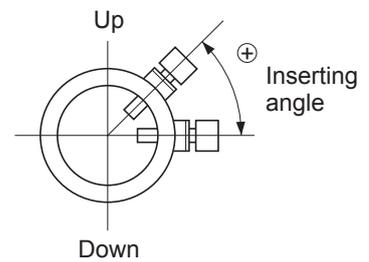
2.2.3 Mounting method of high dust-use flow guide tube
(Designation of type : When 10th digits are D, E, F, G, J, K)

Mount the tube so that the gas outlet turns downward relative to the gas flow as shown below.



Be careful not to block the gas outlet by the furnace wall or pipe and keep the periphery of the outlet widely.

Set the inserting angle within a range of 0 to +45°.



3. PIPING

3.1 Piping of calibration gas

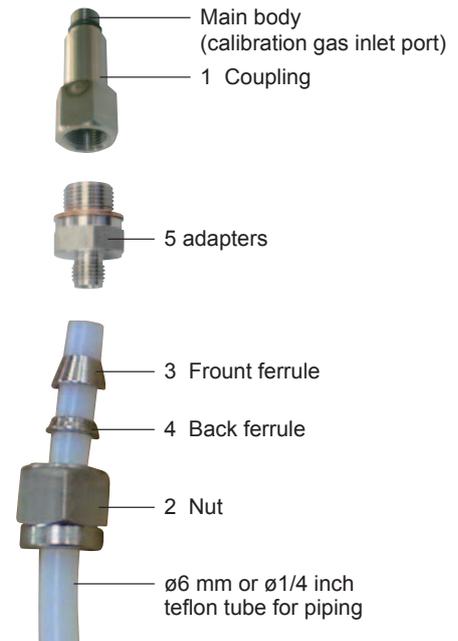
As the piping material, use a teflon-made $\phi 6$ mm or $\phi 1/4$ inch tube.

- From the coupling attached to the detector, remove 2 nut, 3 front ferrule and 4 back ferrule, put them through the $\phi 6$ mm or $\phi 1/4$ inch teflon tube for piping, and then attach it to coupling.
- For mounting 2 nut, tighten by making about 2 turns with a spanner after it cannot be turned any more by hand.

Joint for calibration gas:

The joint for calibration gas is a special joint with a built-in check valve.

If a malfunction occurs, order the joint for calibration gas and attach it.



3.2 Piping of reference gas inlet

If the atmosphere around the terminal box is significantly dirty or the humidity of the location is extremely high, install piping for reference gas.

If the 13th digit of the type is “A” or “B,” the piping for reference gas is delivered together with the detector body.



CAUTIONS

- When used at an ordinary place (oxygen concentration : 20.6 vol%), the reference gas is unnecessary. So, don't remove a hexagonal plug of the mounting port of reference gas inlet unnecessarily since a waterproofness becomes poor.

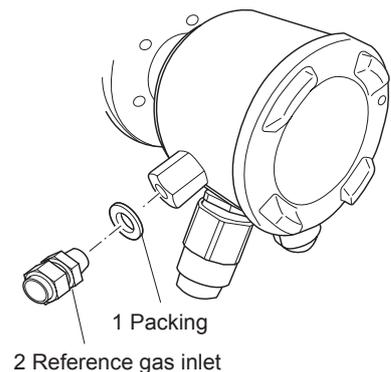
Refer to the previous section “3.1 Piping to calibration gas” for the installation method of piping.

Set one of the two reference gas ports as “inlet” and the other as “outlet.”

Install piping so that dust or water does not enter the “outlet.”

Attachment of joints for reference gas:

If you order the joints for reference gas additionally, remove the hexagonal plugs and attach the joints for reference gas (two locations) as shown in the figure on the right.



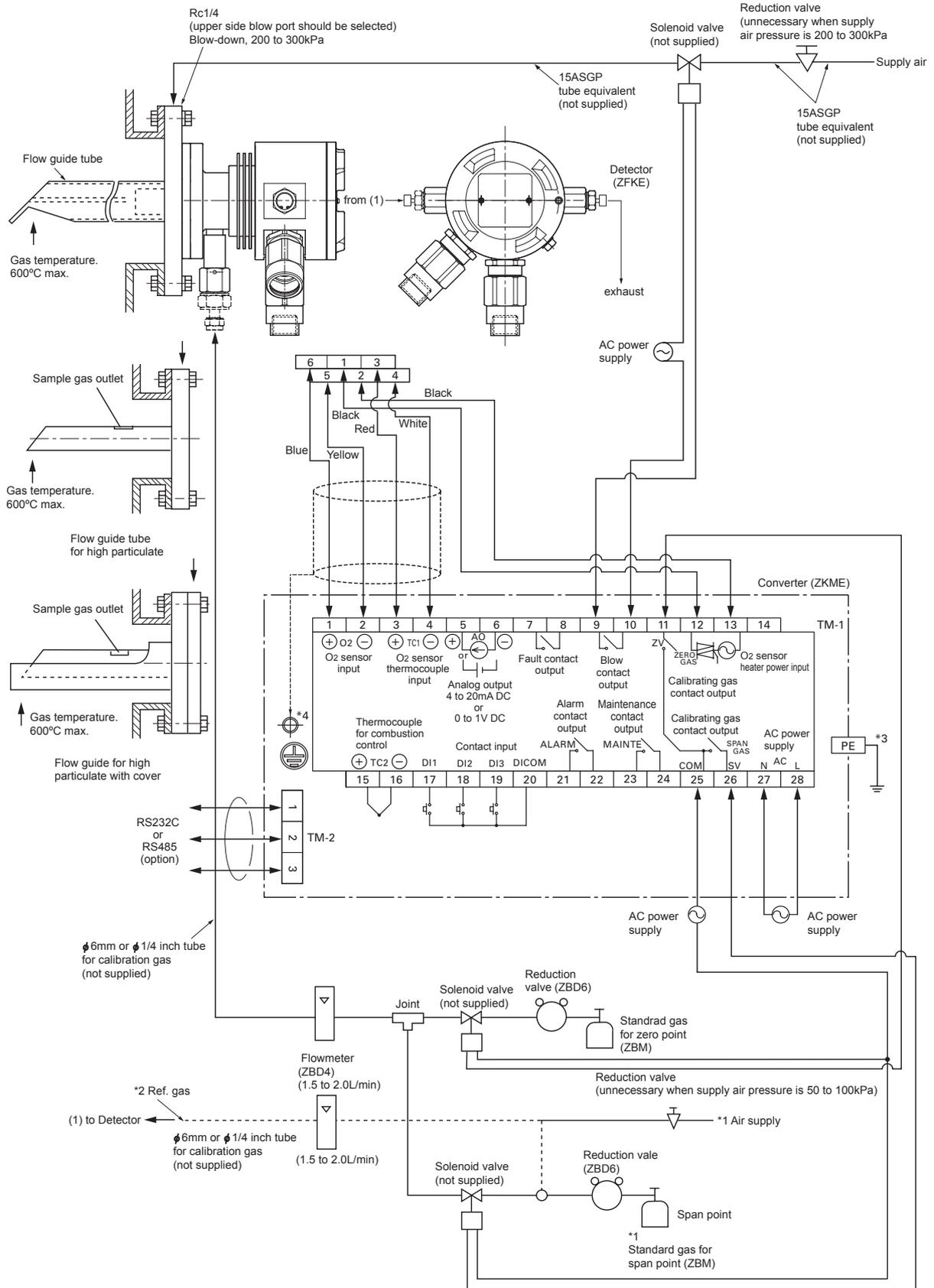
3.3 Piping for blow down air

Connect the blow air inlet (4 locations) of blowdown-fitted flow guide tube by detaching a plug of the upper-side blow port (1 location) so that drain does not accumulate.

For the blow piping, use a copper tube 15A SGP or larger (tube having larger inside diameter) or $\phi 10/\phi 8$ teflon tube. And, use L-shape joint or union without bending the pipe wherever possible and keep the piping length as short as possible.

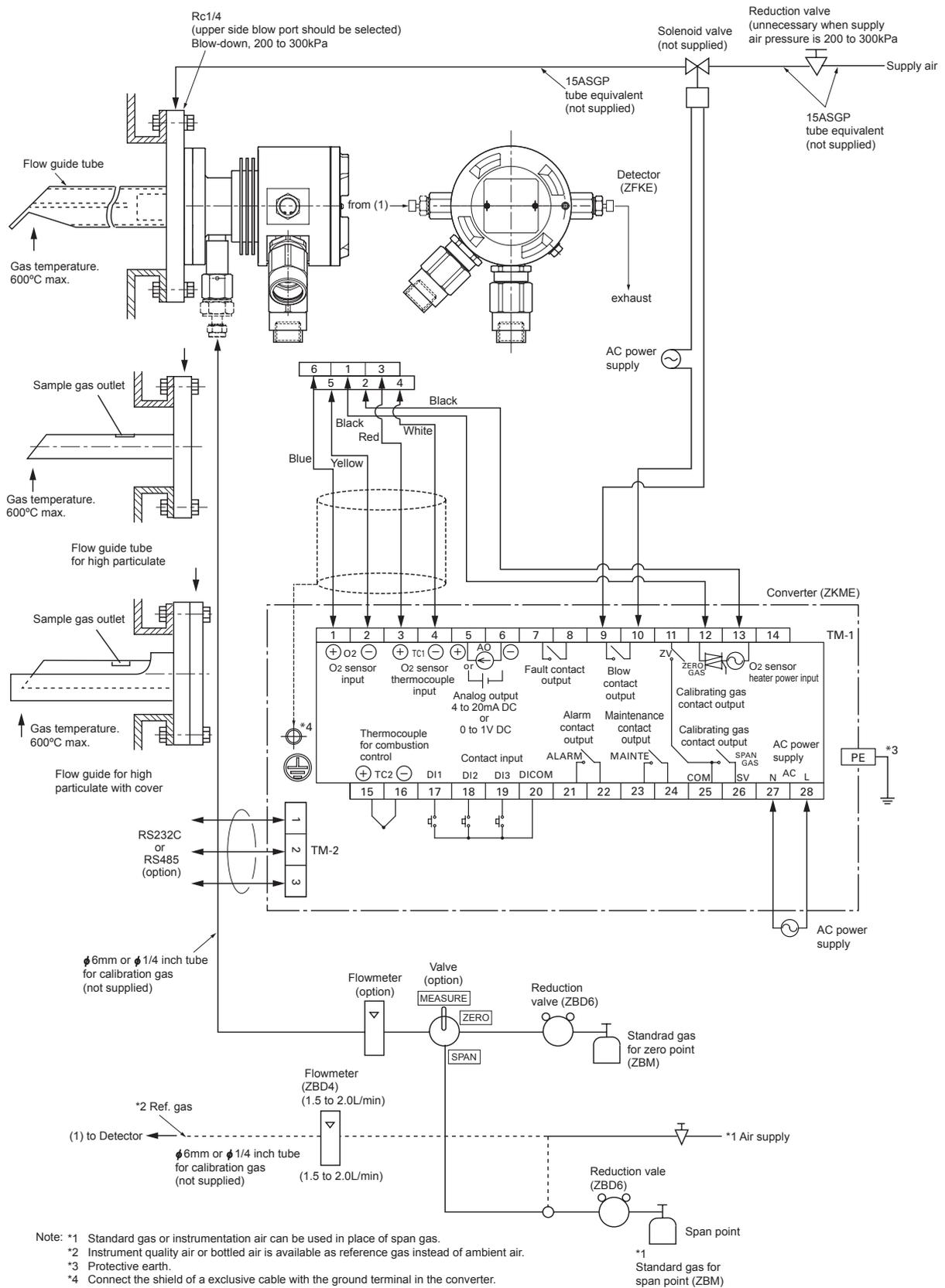
3.4 Piping drawing

(1) Flow guide tube system

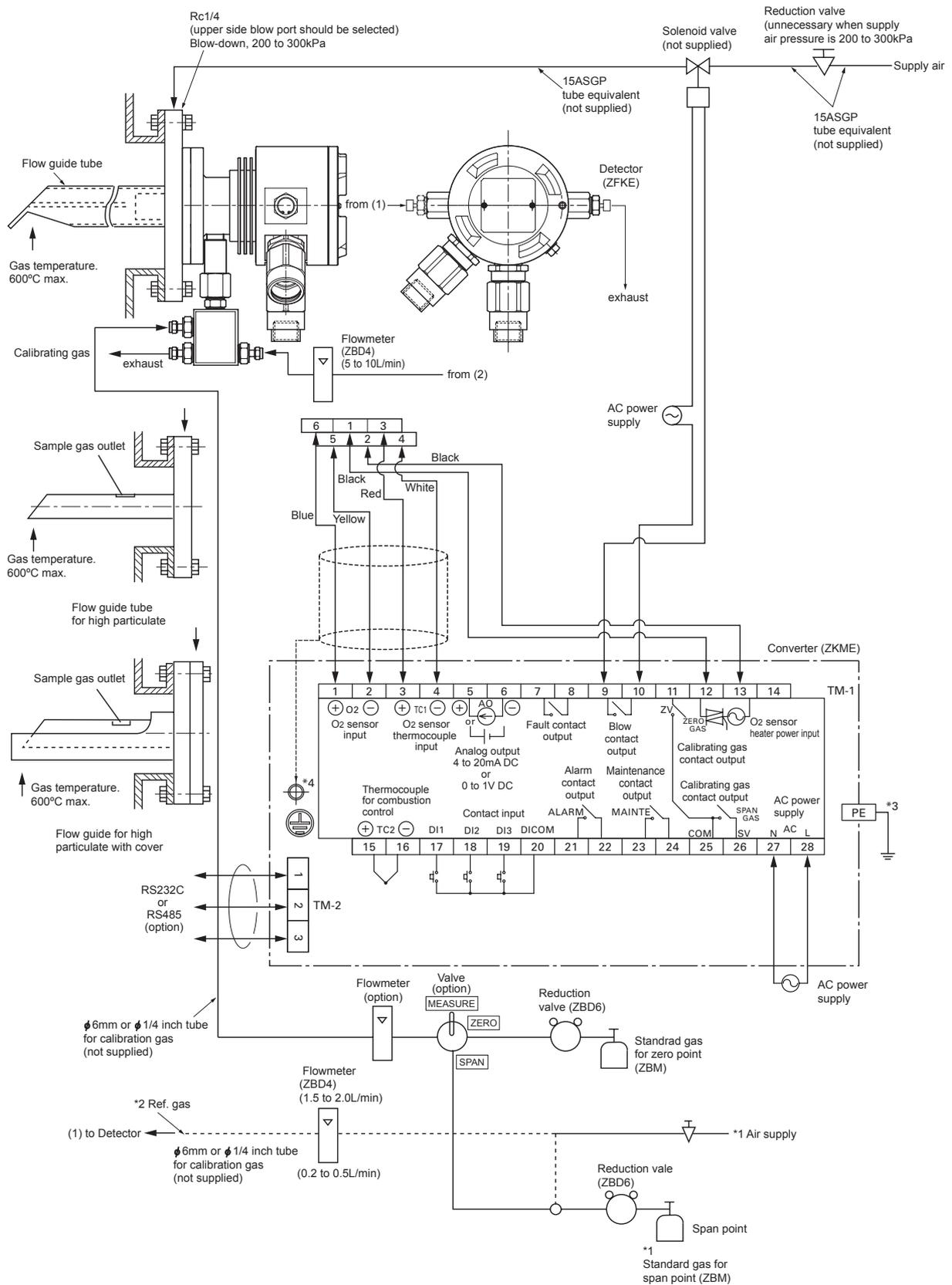


- Note: *1 Standard gas or instrumentation air can be used in place of span gas.
 *2 Instrument quality air or bottled air is available as reference gas instead of ambient air.
 *3 Protective earth.
 *4 Connect the shield of an exclusive cable with the ground terminal in the converter.

(2) Flow guide tube system (with valve)



(4) Flow guide tube system (with ejector+valve)



- Note: *1 Standard gas or instrumentation air can be used in place of span gas.
 *2 Instrument quality air or bottled air is available as reference gas instead of ambient air.
 *3 Protective earth.
 *4 Connect the shield of an exclusive cable with the ground terminal in the converter.

4. WIRING



CAUTIONS

- In the case of the wiring work, be careful not to drop foreign matters including wire chips inside the product. Otherwise, this might cause a fire, failure or malfunction.
 - Connect a power source compatible with the rating. Connection of a power source not conforming to the rating may cause a fire.
 - Before proceeding with the wiring work, be sure to turn off the main power supply. Otherwise, there is a fear of getting an electric shock.
 - As the wiring material, use a proper one conforming to the rating of apparatus. The use of a wiring material which is not bearable to the rating could cause a fire.
- ⊕ : Make sure to ground (D-class grounding). Take care so that the converter and the detector is the same electric potential.



PROHIBITION

- Never do the work at a place where the product gets wet with water, such as the rain. Otherwise, an electric shock or failure may result.

4.1 Before wiring

Put the cables for R thermocouple and element output away from the power cable to take a noise preventive step.

Use a dedicated cable.

When an exclusive cable is not used, use the following wire rods:

- For heater (2 pcs.) 3A or more in rating
- For R thermocouple Specified in JIS C1610-1995 (equivalent to RCA-2-G-0.75mm²-S2).
- Recommended wire rod (at 20 °C)

For wiring of the detector, be sure to use a solderless terminal (for M3).

- Recommended solderless terminal Solderless terminal prescribed in JIS C 2805 (Nominal designation: R1.25-3)

		For heater	Element output compensation conductor
Composition	Nominal sectional area (mm ²)	0.75	
	Number of composed element wires/ diameter of element wire (mm)	30/0.18	
	Outside dia. (mm)	1.1	1.14
	Thickness of vinyl insulating material (mm)	0.6	
	Thickness of vinyl sheath (mm)	1.0	1.5
Max. conductor resistance per unit length (Ω/m)		24.4	—
Test voltage (V)		1000	1500
Insulation resistance per unit length (MΩ•km)		5	40
Rating (A)		7	—
External diameter of sheath (mm)		7 to 10	



CAUTIONS

- When you do not use a dedicated cable, make sure to use a cable with the same external diameter as a sheath which is applicable to a cable gland.

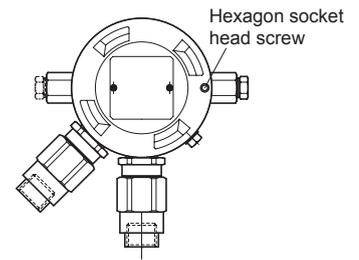
For the reason of protection against injury, install the cable sheathing an appropriate protection equipment, such as a protection tube of a steel conduit as needed.

In the case of wiring work at the zone 1, take an appropriate prevention countermeasure against gas flow to prevent explosive gas being flown into the zone 2 or unclassified area through a kind of duct or protection tube.

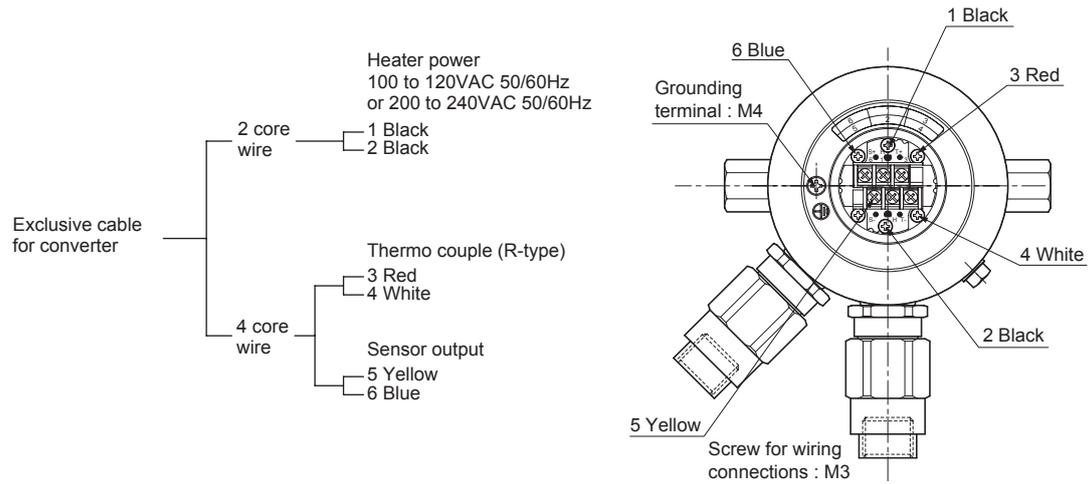
When connecting 2 cables, and connecting a cable and a cable covered with metal tube for flameproof, use a flameproof-structured box.

4.2 How to open the cover

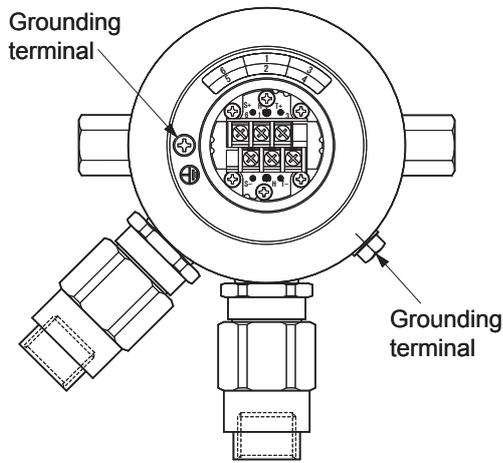
Loosen the hexagon socket head screw, and open the cover. (use an attached hexagonal wrench)



4.3 Wiring to each terminal



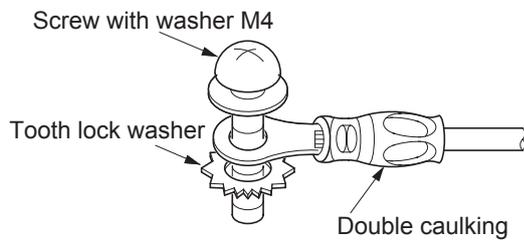
Connect the protective grounding to one of the two terminals in the figure below. (Class D (Class 3) grounding, grounding resistance: 100 Ω or less)



Wiring of grounding terminal

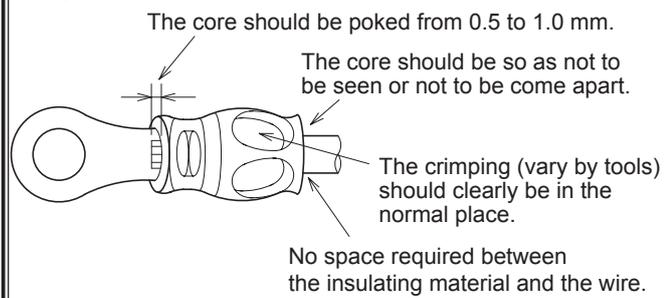
Attach the solderless terminals to the grounding terminals with them between the tooth lock washer and screw with washer.

(recommended tightening torque: 1.8 N·m)

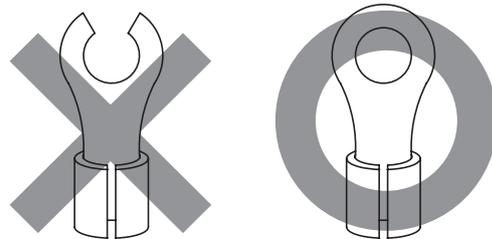


Note

- Use the cable more than 0.75mm² for main ground (earth) line.
- For solderless terminal, doubly caulk the core and the sheath separately.



- Use “◎” type of solderless terminal.



5. OPERATION AND STOP



DANGER

- In case where combustible gas is contained in the measured gas, make sure of the gas composition and specifications carefully before using this product. Otherwise, the original performance is not displayed and there is a fear of explosion.
- Turn on electricity before closing the cover.

5.1 Start of operation

- When electricity is turned on after completion of wiring and piping work, the detector starts its operation.
- After warm-up at least 10 minutes, start the operation of the furnace.
- After zero calibration and span calibration have finished, get to work on the measurement.
- For the method of calibration, refer to each instruction manual of converters (ZKME).
- When the converters (ZKME) are not used, run the zero and span calibration gases and calibrate by converting the output in a stabilized state into oxygen concentration according to the standard output table of converter in Item. "6.3".

If using the reference gas, supply it before the calibration. (flow rate: 0.2 to 0.5 L/min)

5.2 Stop of operation

If the power is turned on in a state of dew condensation it leads to the failure of detector. Stop the operation following the procedures described below.

(1) In case of short-term shutdown (about 1 week) of furnace

- Keep the power supply of the detector (converter) turned "ON". This can prevent the detector from getting dewed.

Also, note that if "ON-OFF" is repeated in a condition where the detector has dewed (according to the furnace and ambient conditions), the detector might fail.

- When the ejector is in use, stop the air supply to the ejector.

(2) In case of long-term shutdown of furnace

- Turn off the power of the detector (converter) after the peripheral air of the detector inside the furnace (especially, temperature and humidity) has become an air environment. Or, turn off the power after taking the detector out of the furnace and leaving it as it is for 15 minutes or more.
- When the ejector is in use, stop the air supply to the ejector.

6. MAINTENANCE AND CHECK



CAUTIONS

- Do the work in a condition where the main power supply has been turned off. If the work is done while current is flowing, there is a fear of getting an electric shock.
- The operation temperature of the detector (tip of the ceramic heater) is about 800°C and the surface temperature is also very high. So, never touch it by bare hand. Otherwise, there is a fear of getting a burn.
- Before proceeding with the cleaning of the flow guide tube, turn off the main power and cool the tube down fully and then, do the work. Otherwise, there is a fear of getting a burn.
- Don't use other renewal parts than those designated by the maker. Otherwise, the original performance is not displayed fully and an accident or failure could come about.
- Dispose of the renewal parts including the maintenance parts as an incombustible.



DANGER

- Open the cover 30 minutes after turning the power off. There is a fear of ignition of ambient flammable gases by heater's heat.



PROHIBITION

- Never do the work at a place where the product gets wet with water, such as the rain. Otherwise, an electric shock or failure may result.

6.1 Check

Perform the check periodically for using the product always in good condition. Especially, perform the checks shown in table below. Moreover, perform the periodic check at a time of checking the furnace or every 6 months.

	Check items	Details of checking work
Daily check	Execution of zero & span calibration	<ul style="list-style-type: none"> • When the converters (ZKME) are in use: With reference to the instruction manuals of the converters (ZKME), check once a week as a rough standard. (calibration gas flow rate : 1.5 to 2.0 L/min) • When the converters (ZKME) are not used: Running the zero and span calibration gases, make calibration once a week as a rough standard by converting the output in a stabilized state into oxygen concentration according to the standard output table of converter in Item "6.3".
	Check for looseness of cable gland.	Retighten the cable gland or if the packing is found deteriorated, replace.
	Check of residue in calibration gas cylinder	Check it by a primary pressure gauge.
	Check of blowdown (when blowdown nozzle is fitted)	Referring to each instruction manual of the converters (ZKME), check at 200 to 300 kPa.
Periodic check	Check for leak from packing fitted between flow guide tube and companion flange and O-ring of detector.	If either of the packing and O-ring or both of them are found deteriorated, replace with new O-ring (refer to the part No. for procurement in Item "6.4") and replace the packing (not included in scope of supply).
	Removing detector, check for clogging of ceramic filter of detector.	When it is necessary to replace the ceramic filter, refer to Item "6.2.2".
	Check by disconnecting for clogging or corrosion of flow guide tube.	Check following the procedure in Item "6.2.3".
	Remove and check if there is not clog in the lead-in port of the air outlet of ejector.	Clean the air outlet and lead-in port.

6.2 Maintenance

The replacing intervals of sensor unit, ceramic filter and packing, and the maintenance periods of flow guide tube and sampling probe differ depending on the working conditions including the components of measured gas and the amount of dust.

The replacing intervals in a general conditions are shown below. Determine the replacing intervals in the individual working condition with a period till a first replacement after delivery and operation as a rough standard.

- Sensor unit..... Yearly
- Filter cap..... At 6 month interval
- Flow guide tube..... At 3 to 4 year interval
- Packing..... Yearly

Please note the followings.

- (1) For the flameproof type, 3 factors of mechanical strength of detector case, gap, and depth of gap are very important. Therefore, take care not to scratch on the joint area or screw connection part, or to make an impact on the case.
- (2) If the necessary parts for conservation of flameproof (terminal box, screw part of terminal box cover, joint area, connection between terminal box and flange, cable gland, joint for reference gas, etc.) damaged or corroded, contact us. It is very danger to fix up them carelessly because change of gap or the like possibly occurs.
- (3) When use them again after repair or mend, check the necessary parts for conservation of flameproof adequately and confirm that screws have been tighten firmly.

Make sure to tighten the cover completely. Do not open the terminal box cover unnecessarily at the site.

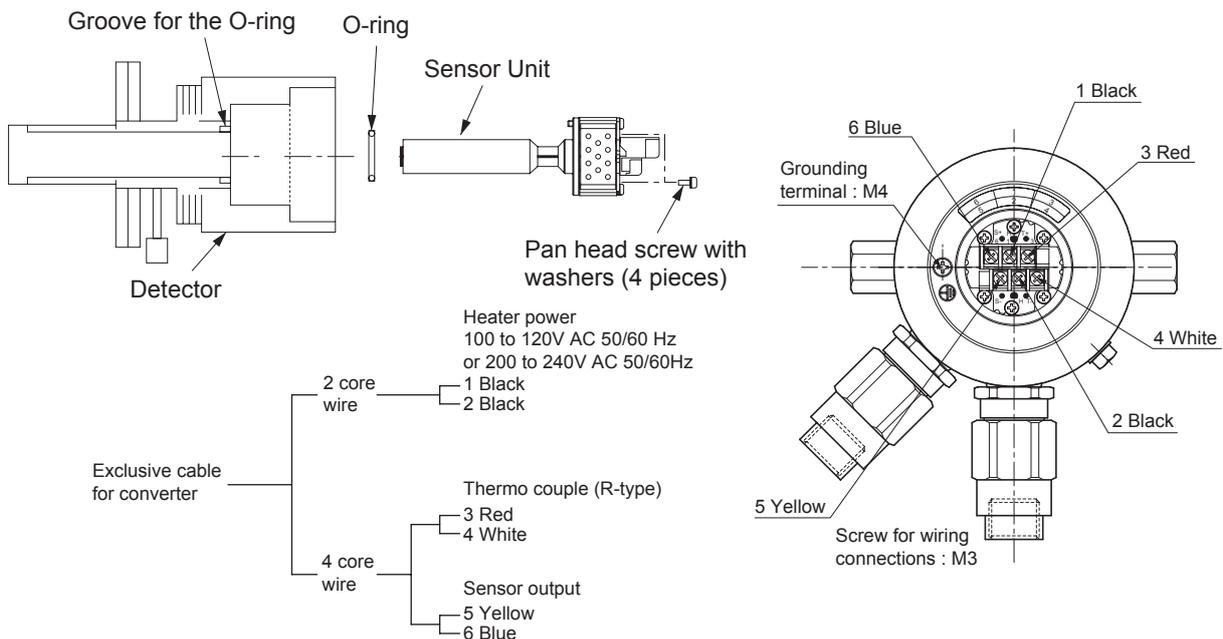
Tighten the hexagon socket head screw of the terminal box cover to prevent the cover being opened or closed unnecessarily at the site. Use the attached hexagonal wrench.

6.2.1 Replacement of Sensor unit

Caution about the replacement of the sensor unit:

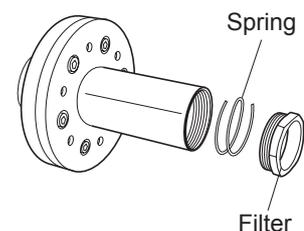
- Check that the sensor unit complies with the specifications of the power supply you use.
- Avoid replacing the sensor unit while the current is applied.
- The temperature of the detector becomes high. Replace the sensor unit after the temperature is reduced sufficiently.

- (1) Turn off the power for the detector. (Set the switch of the converter or the main power supply to “OFF”.)
- (2) Check that the surface temperature of the detector is reduced sufficiently.
- (3) Remove the hexagon socket head screw for fixing attached on the terminal box cover (by using the attached wrench).
- (4) Remove the six wires connected the terminal block of the sensor unit (M3 screws, six locations).
- (5) Remove the ring screws (M3 screws, four locations) fastening the sensor unit .
- (6) Remove the sensor unit and o-ring from the detector.
- (7) Attach the supplied O-ring of the replacement sensor unit to the groove for the O-ring at the detector.
- (8) Attach the replacement sensor unit to the detector.
(Attach the sensor unit so that the rotational direction is as shown in the figure below.)
- (9) Fasten the sensor unit with the supplied ring pan-head machine screws (M3 screws, four locations).
(recommended tightening torque: 0.7 N·m)
- (10) Connect six wires to the terminal block of the sensor unit and attach the terminal block cover.
- (11) Attach the terminal box cover.



6.2.2 Replacement of Filter cap

- After turning “OFF” the power of the detector, lower the surface temperature of the tip (at the Filter cap side) by cooling down fully with the air.
- After the detector cooled adequately, remove the filter cap from the detector and then remove the spring.
- Attach a filter and a new spring to the detector, and then tighten the cap completely.



6.2.3 Maintenance of flow guide tube

- After removing the flow guide tube from the furnace wall and then, from the detector, cool the tube down fully in the air.
- Remove dust sticking to the outside of the flow guide tube by water-washing with the use of a scrubbing brush.
- Remove dust sticking to the inside of the flow guide tube by using a metallic rod or screwdriver. (Clean so that tube is through at least about 3/4 part of the whole interior.)
- For the flow guide tube for high dust, remove together dust sticking around the gas outlet.

6.3 Standard output of detector

For the output voltage of the detector, refer to the standard output table below.

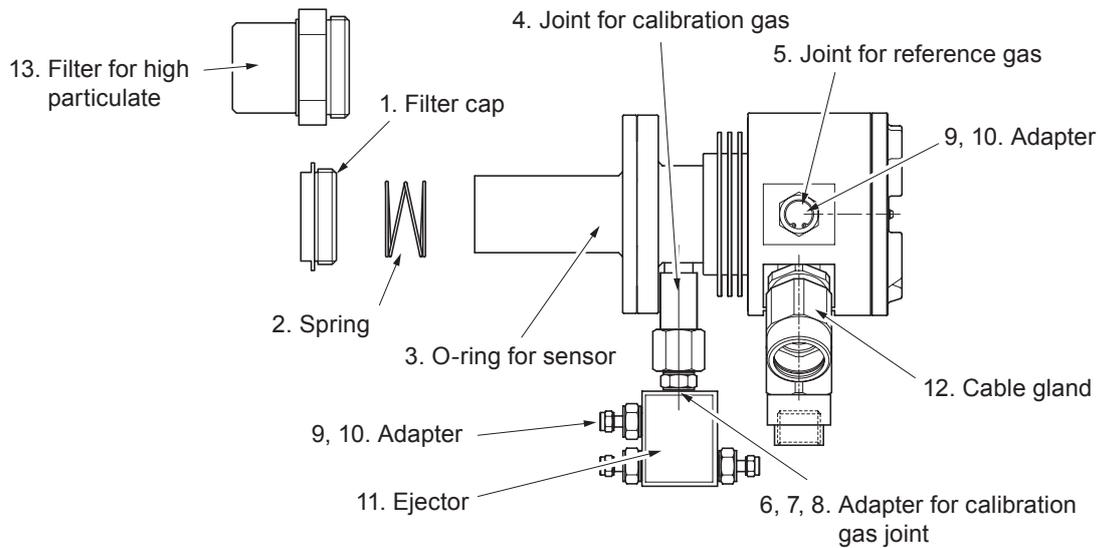
Standard output table (Reference)

Oxygen concentration (vol%)	Detector output (mV)
0.01	168.15
0.05	132.68
0.1	117.41
0.5	81.94
1.0	66.67
1.2	62.65
1.4	59.25
1.5	57.73
1.6	56.31
1.8	53.71
2.0	51.39
2.2	49.29
2.4	47.37
2.5	46.47
2.6	45.61
2.8	43.98
3.0	42.46
3.5	39.06
4.0	36.12
4.5	33.52
5.0	31.20
5.5	29.10
6.0	27.18
6.5	25.42
7.0	23.79
7.5	22.26

Oxygen concentration (vol%)	Detector output (mV)
8.0	20.84
8.5	19.51
9.0	18.25
9.5	17.06
10.0	15.92
11.0	13.82
12.0	11.91
13.0	10.14
14.0	8.51
15.0	6.99
16.0	5.57
17.0	4.23
18.0	2.97
19.0	1.78
20.0	0.65
20.6	0.00
21.0	-0.43
22.0	-1.45
23.0	-2.43
24.0	-3.37
25.0	-4.27
30.0	-8.29
35.0	-11.68
40.0	-14.62
45.0	-17.22
50.0	-19.54

6.4 Arrangement

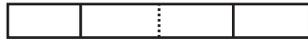
No.	Description	Part No. for procurement (Procured type)	Remark
1	Filter cap	*ZZPZFKE-TK7N7179C1	
2	Spring	*ZZPZFKE-TK7N9327P1	
3	O-ring for sensor	*ZZPZFKE-8552836	
4	Joint for calibration gas	*ZZPZFKE-TK4J4660C1	
		*ZZPZFKE-TK7N8173P34	
5	Joint for reference gas	*ZZPZFKE-TK4J5565C1	
6	Adapter for calibration gas joint	*ZZPZFKE-TK7N8173P25	For ejector
7	Adapter for calibration gas joint	*ZZPZFKE-TK7N8173P1	For \varnothing 6 mm tube
		*ZZPZFKE-TK7N8173P3	(Packing)
8	Adapter for calibration gas joint	*ZZPZFKE-TK7N8173P2	For \varnothing 1/4 inch tube
		*ZZPZFKE-TK7N8173P3	(Packing)
9	Adapter	*ZZPZFKE-TK7K1652P9	For \varnothing 6 mm tube
		*ZZPZFKE-TK7J0987P2	(Packing)
10	Adapter	*ZZPZFKE-TK7K1652P10	For \varnothing 1/4 inch tube
		*ZZPZFKE-TK7J0987P2	(Packing)
11	Ejector	*ZZPZFKE-TK7P0738C1	
12	Cable gland	*ZZPZFKE-TK7N7181P2	
13	Filter for high particulate	*ZZPZFKE-TK7P0524C1	
14	Flow guide tube	According to the following table "Drawing No. for flow guide"	



Part No. for procurement of flow guide

Drawing No. for flow guide

*ZZP-TK7P0526C



Flange size	Digit of type specification 9th digit	Code for flange combination
JIS 5K 65A	7	01
JIS 5K 80A	8	02
JIS 5K 100A	9	03
JIS 10K 65A	A	04
JIS 10K 80A	B	05
JIS 10K 100A	C	06
ANSI 150LB 2B	D	07
ANSI 150LB 3B	E	08
ANSI 150LB 4B	F	09
DIN DN50 PN10	G	10
DIN DN80 PN10	H	11

Purpose/Material	Digit of type specification 10th digit	Code for purpose combination
For general explosion-proof/SUS316	F	1
With blowdown nosle/SUS316	G	2
For high particulate/SUS316	H	3
With cover for high particulate/SUS316	J	4
For high particulate/SUS310S	K	5
With cover for high particulate/SUS310S	L	6
For high particulate/Titanium	M	7
With cover for high particulate/Titanium	N	8

Insertion length	Digit of type specification 11th digit	Code for insertion length combination
300	3	1
500	5	2
750	7	3
1000	1	4

7. TROUBLESHOOTING



CAUTIONS

- If a failure should occur which cannot be judged even if referring to the operation manual, be sure to ask the nearest dealer or Fuji adjustment serviceman for repair. If disassembled carelessly, there is a fear of an accident or injury.

Troubles	Probable causes	Check procedures (normal values)	Remedies	
<ul style="list-style-type: none"> • Indication is fixed. • Indication response is slow. 	<ul style="list-style-type: none"> • Clogging of ceramic filter of detector and flow guide tube interior 	<ul style="list-style-type: none"> • Check visually for fouling of ceramic filter of detector and clogging of flow guide tube interior with dust. 	<ul style="list-style-type: none"> • Clean or exchange ceramic filter, if need be. 	
	<ul style="list-style-type: none"> • Leak from joint and airtightness of mounted part. 	<ul style="list-style-type: none"> • Check for looseness of each joint and airtightness of mounted part. 	<ul style="list-style-type: none"> • Retighten and replace joint(s), if need be. 	
	<ul style="list-style-type: none"> • Deterioration of detector 	<ul style="list-style-type: none"> • Check by changing zero calibration gas over to span calibration gas and vice versa if it takes more than 5 minutes for 90% response. 	<ul style="list-style-type: none"> • Replace detector. 	
	<ul style="list-style-type: none"> • Decrease of exhaust gas flowing velocity 	<ul style="list-style-type: none"> • Check exhaust gas responding time after stop of calibration gas supply. 	<ul style="list-style-type: none"> • Increase amount of exhaust gas inside flow guide tube to be taken in. • Clean flow guide tube. 	
<ul style="list-style-type: none"> • Temperature alarm continues coming on despite 20 minutes having elapsed after turning on power. 	<ul style="list-style-type: none"> • Disconnection of cable 	<ul style="list-style-type: none"> • Check continuity. 	<ul style="list-style-type: none"> • Replace cable. 	
	<ul style="list-style-type: none"> • Error in wiring 	<ul style="list-style-type: none"> • Check wiring. 	<ul style="list-style-type: none"> • Wire correctly. 	
	<ul style="list-style-type: none"> • Low supply voltage 	<ul style="list-style-type: none"> • Check if supply power is as specified. 	<ul style="list-style-type: none"> • Supply correct power. 	
	<ul style="list-style-type: none"> • Disconnection of thermocouple 	<ul style="list-style-type: none"> • Check continuity. • Check if resistance across terminals No. 3 and No. 4 is 2 to 3 Ω. 	<ul style="list-style-type: none"> • Replace detector. 	
	<ul style="list-style-type: none"> • Blow out of fuse of converters (ZKME) 	<ul style="list-style-type: none"> • Check continuity of fuse. 	<ul style="list-style-type: none"> • Exchange fuse(s). (Refer to each instruction manual of converters) (ZKME). 	
<ul style="list-style-type: none"> • Indication is too high or too low. 	<ul style="list-style-type: none"> • Looseness of flange mounted part or defects of O-ring or packing (not included in scope of supply). 	<ul style="list-style-type: none"> • Check airtightness of detection unit, flow guide tube and flange mounted part. 	<ul style="list-style-type: none"> • Retighten mounting screw. • Exchange O-ring. • Exchange packing (not included in scope of supply) 	
		<ul style="list-style-type: none"> • Check for leak in from periphery. 	<ul style="list-style-type: none"> • Shield 	
	<ul style="list-style-type: none"> • Deterioration of detector 	<ul style="list-style-type: none"> • Check airtightness of calibration gas supply port. • Check at a time of running zero and span calibration gases if detector output (mV) is higher or lower than others. (Refer to Table in Item "6.3"). 	<ul style="list-style-type: none"> • Retighten calibration gas joint. • Replace detector. 	
	<ul style="list-style-type: none"> • Abnormality of detector temperature 	<ul style="list-style-type: none"> • Check indicated temperature of converter. 		
	<ul style="list-style-type: none"> • Change of ambient air oxygen concentration of a terminal box or very high humidity 	<ul style="list-style-type: none"> • Check ambient air oxygen concentration of a terminal box is 20.6 vol%. 	<ul style="list-style-type: none"> • Use reference gas inlet. 	

8. APPENDIX

8.1 Specification

8.1.1 General Specifications

- **Measuring object:** Oxygen in noncombustible gas
- **Measuring method:** Directly insert type zirconia system
- **Measuring range:** 0 to 2 ... 0 to 50 vol% O₂
2 ranges available in 1 vol% O₂ steps
- **Repeatability:** Within ±0.5 %FS
- **Linearity:** Within ±2 %FS
- **Response time:** Within 4 to 7 sec, for 90% (from calibration gas inlet)
- **Warmup time:** approx. 10 min
- **Analog output:** 4 to 20 mA DC (allowable load resistance less than 500Ω) or 0 to 1 V DC (output resistance more than 100 Ω)
- **Power supply:** Rated voltage;
100 to 120 V AC (operating voltage 90 to 132 V AC)
200 to 240 V AC (operating voltage 190 to 264 V AC)
Rated frequency; 50/60 Hz
- **Power consumption:** Maximum 240 VA (Detector: approx. 200 VA, Converter: approx. 40 VA)
Normal 70 VA (Detector: approx. 50 VA, Converter: approx. 20 VA)

8.1.2 Detector Specifications (ZFKE)

- **Measured gas temperature:**
Flow guide tube system; -10 to +600°C (for general-use, corrosive gas)
- **Measured gas pressure:**
-3 to +3 kPa (-306 to +306 mm H₂O)
- **Flow guide tube:** With or without blow-down nozzle
Flange; JIS5K 65A FF
(JIS5K-80AFF for high particulate gas)
Insertion length; 0.3, 0.5, 0.75, 1 m
Other: See. Code Symbols
- **Ejector (general-use):**
Probe for vacuuming up measured gas to detector (option)
- **Operating temperature:**
-10 to +60°C for Primary detecting element
125°C or less at detector flange surface with power applied
- **Storage temperature:**
Sensing element: -20 to +70°C
- **Structure:** Dust/rain-proof structure (IEC IP66 equivalent)
- **Flame proof:** See Table 1.
- **Filter:** SUS316 (filtering accuracy 60 μm)
- **Main materials of gas-contacting parts:**
Detector; Zirconia, SUS316, platinum
Flow guide tube; SUS316
- **Calibration gas inlet:**
ø6 mm tube join or ø1/4-inch tube join (as specified)
- **Reference gas inlet (option):**
ø6 mm tube join or ø1/4-inch tube join (as specified)
- **Detector mounting:** Horizontal plane ±45°, ambient surrounding air should be clean.

- **Outer dimensions:** (L × max. dia.) 215 mm × 164 mm (detector)
- **Mass (approx.) {weight}:**
Detector; 3.0 kg
Flow guide tube (for corrosive gas, 1 m); 6 kg
- **Finish color:** Case: Silver and SUS metallic color
Cover: Blue
- **Ejector air inlet flow rate:**
5 to 10 L/min
- **Calibration gas flow:**
1.5 to 2 L/min
- **Blowdown air inlet pressure:**
200 to 300 kPa {2 to 3 kgf/cm²}

Table 1

	Detector
TIIS (pending)	Exd IIB T4
NEPSI	EExd IIC T5 Ex II2G

8.1.3 Converter specification (ZKME)

- **Concentration value indication:**
Digital indication in 4 digits
- **Contact output signal:**
(1) Contact specification; 6 points, 1a 250 V AC/3A or 30 V DC/3 A
(2) Contact function;
 - Under maintenance
 - Under blowdown Note3)
 - Span calibrating gas
 - Zero calibration gas
 - Instrument anomalies Note1)
 - Alarm Note2)
- Note1) The following Instrument errors (1) Thermocouples break (2) Sensor break (3) Temperature fault (4) Calibration fault (5) Zero/span adjustment fault (6) Output error turn the contact-ON
- Note2) Alarm selects just one as mentioned below (1) High (2) Low (3) Upper and Lower (4) High-high (5) Low-low, it turns ON while operating.
- Note3) Under blow down is available in case of option, and it turns ON while operating.
- **Contact input signal:**
(1) Contact specification; 3points (the following option)
ON; 0 V (10 mA or less), OFF; 5 V
(2) Contact function;
 - External hold
 - Calculation reset
 - Heater OFF
 - Blow down (option)
 - Inhibition of calibration
 - Calibration start
 - Range changee
- **Calibration method:**
 - (a) Manual calibration with key operation
 - (b) Auto. calibration (option)
Calibration cycle; 00 day 00 hour to 99 days 23 hours
 - (c) All calibration

- **Calibration gas:**
 - Range settings
Zero gas; 0.010 to 25.00 % O₂
Span gas; 0.010 to 50.00 % O₂
 - Recommended calibration gas concentration
Zero gas; 0.25 to 2.0 % O₂
Span gas; 20.6 to 21.0 % O₂
(oxygen concentration in the air)
- **Blowdown : (option)** A function for blowing out with compressed air dust that has deposited in the flow guide tube. Blowdown can be performed for a predetermined time and at predetermined intervals.
Blowdown cycle; 00 hour 00 minute to 99 hours 59 minutes
Blowdown time; 0 minute 00 second to 0 minutes 999 seconds
- **Output signal hold:** Output signal is held during calibration, processing recoverable sensor, processing diagnosis of sensor, warm-up, PID auto tuning, under set up maintenance mode "available" and blowdown. The hold function can also be released.
- **Valve and flow meter (option):** Selects zero or span gas during manual zero or span calibration.
- **Communication function:**
RS232C (MODBUS) standard specification
RS485 (MODBUS) (option)
- **Combustion efficiency display (option):**
When you select this display, "rich mode display" will be an simultaneous display. This function calculates and displays combustion efficiency from oxygen concentration and measured gas temperature. Thermocouple (R) is required for temperature measurement.
- **Operating temperature:** -20 to +55°C
- **Operating humidity:** 95% RH or less, non condensing
- **Storage temperature:** -30 to +70°C
- **Storage humidity:** 95% RH or less, non condensing
- **Construction:** Dust-proof, rainproof construction (corresponding to IP65)
- **Explosion proof:** See Table 2
- **Material:** Aluminum case
- **Outer dimensions (H x W x D):** 470 X 326 X 211 mm (IP65)
- **Mass {weight}:** IP65: Approx.22 kg (excluding cable and detector)
- **Finish color:** Case: Silver
Cover: blue
- **Mounting method:** Mounted flush on panel

Electrical Safety:



Overvoltage category
; II power supply input
; I relay interfaces
(IEC1010-1)
External overcurrent protective device
; 10A
Equipment interfaces are safety separated (SELV)

ZFKE, ZKME

Table 2

	Converter
TIIS (pending)	Exd IIB T6
NEPSI	EExd IIC T6 Ex II2G

8.2.3 Converter

1 2 3 4 5 6 7 8 9 10 11 12 13 14														Description		
Z	K	M	E				1	1	-				1	-		Output signal 4 to 20mA DC 0 to 1V DC
																Communication function RS-232C RS-485
																Optional Functions None Combustion efficiency display function Note1) Blowdown Auto calibration Combustion efficiency indication + Blowdown Note1) Combustion efficiency indication + Auto calibration Note1) Blowdown + Auto calibration Combustion efficiency indication + Blowdown + Auto calibration Note1)
																Instruction manual language Japanese English Chinese
																Mounting Option None (Mounting on panel surface) With valve With valve + flowmeter
																Specification name plate Standard
																Number of Cable Gland 3 4 5 6 7
																Ex Standard NEPSI TIIS (pending)

Note1) When you select this display, rich mode will be a simultaneous display.

8.2.4 Exclusive-special cable

1 2 3 4 5 6 7 8 9									Description	
Z	R	Z	E	R			1	-		Connectable devices For ZKME
										Types For R thermocouple
										Cable length YA 6m YB 10m YC 15m YD 20m YE 30m YF 40m YG 50m YH 60m YJ 70m YK 80m YL 90m YM 100m
										Cable end treatment 0 None 1 One side (detector side) 2 Both sides

8.3 DEVICE CONFIGURATION

The device to be combined differ according to the conditions of the gas to be measured. Select the devices to be combined with reference to the following table.

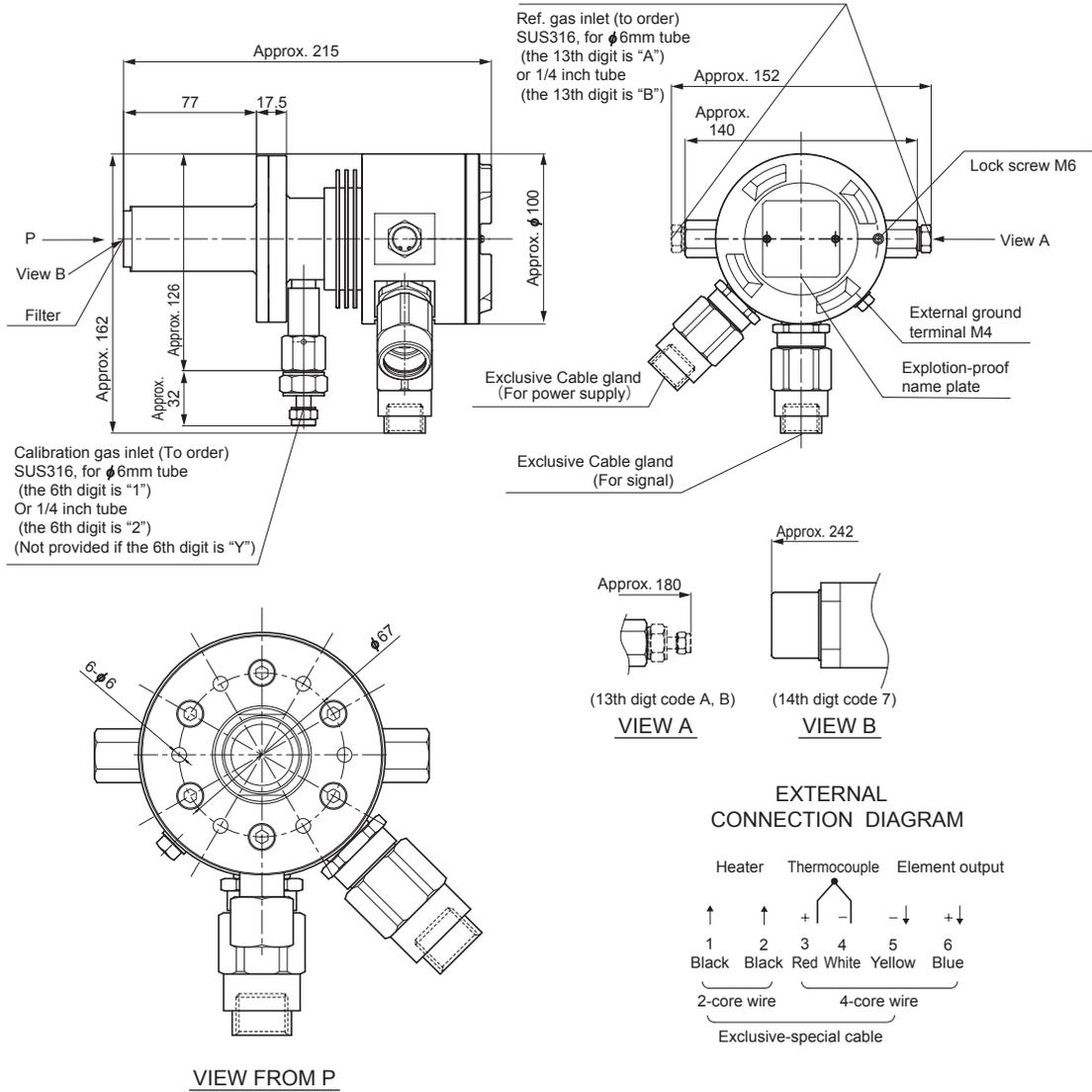
Measured gas					Device configuration	
Application	Temperature	Gas Flow	DUST	Note	Detector type	Converter type
General-use (boiler)	600°C or less	5 to 20 m/s	Less than 0.2 g/Nm ³	Fuel: gas, oil	ZFKER□□5-□F□Y□-□□	ZKME
			Less than 10 g/Nm ³	Fuel: coal with blow down	ZFKER□□5-□G□Y□-□□	ZKME
For corrosive gas (refuse incinerator)	600°C or less	5 to 20 m/s	Less than 1 g/Nm ³	Included low moisture	ZFKER□□5-□F□Y□-□□	ZKME
			Less than 10 g/Nm ³	Included low moisture with blow down	ZFKER□□5-□G□Y□-□□	ZKME
			Less than 25 g/Nm ³	Included low moisture with blow down	H ZFKER□□5-□K□Y□-□□ M	ZKME
			Less than 25 g/Nm ³	Included high moisture with blow down	J ZFKER□□5-□L□Y□-□□ N	ZKME

Note (1) Dust volume is approximate value.

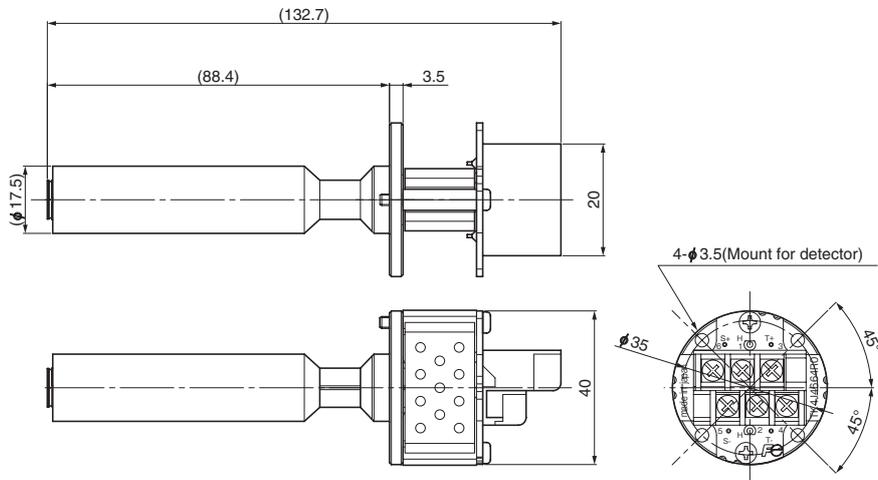
(2) Instrument quality air or bottled air is available as reference air by selecting detector with reference air inlet.

8.4 OUTLINE DIAGRAM (Unit:mm)

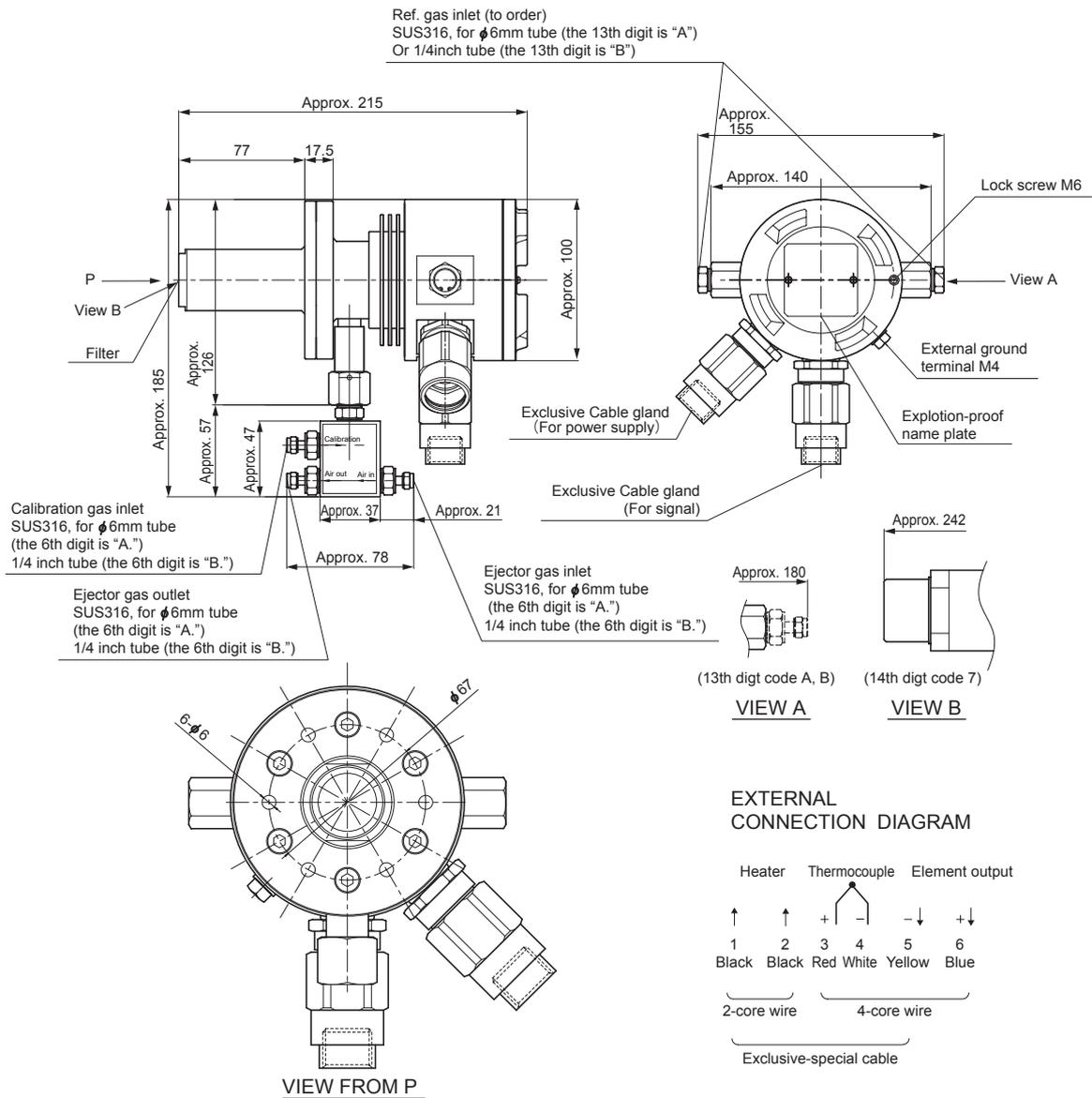
(1) Detector (ZFKER: 6th digit code. Y, 1, 2)



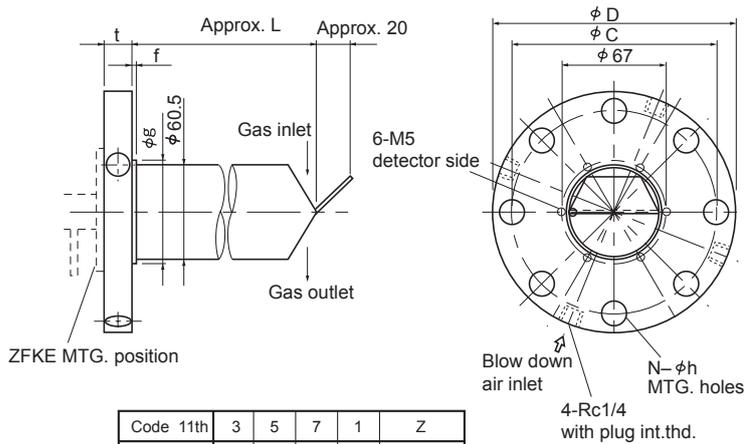
(2) Sensor unit (ZFK8YY)



(3) Detector (ZFKER: 6th digit code. A, B)



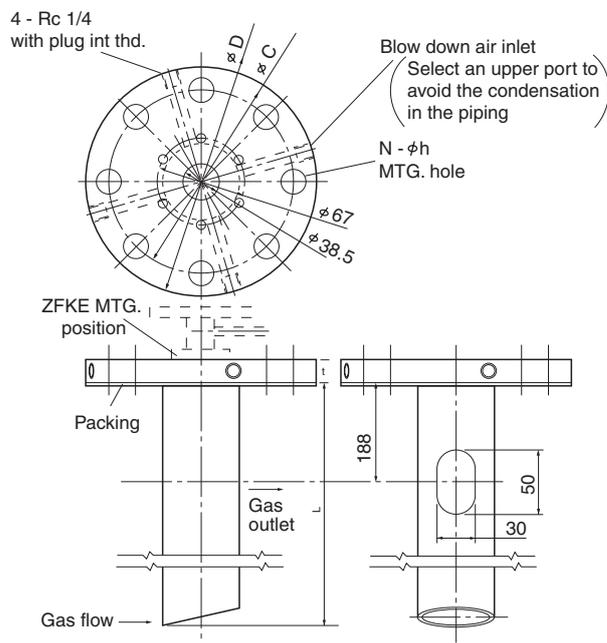
(4) Flow guide tube (for high particulate) (ZFKE: 10th digit code. H, K, M)s



Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
Mass Approx.(kg)	3.0	3.8	4.8	5.7	

Flange size	Code 9th	D	C	t	f	g	N	h
JIS 5K 65A	7	155	130	14	2	110	4	15
JIS 5K 80A	8	180	145	14	2	121	4	19
JIS 5K 100A	9	200	165	16	2	141	8	19
JIS 10K 65A	A	175	140	18	2	116	4	19
JIS 10K 80A	B	185	150	18	2	126	8	19
JIS 10K 100A	C	210	175	18	2	151	8	19
ANSI 150LB 2B	D	150	120.7	17.5	2	92.1	4	19.1
ANSI 150LB 3B	E	190	152.4	22.3	2	127	4	19.1
ANSI 150LB 4B	F	230	190.5	22.3	2	157.2	8	19.1
DIN DN50 PN10	G	165	125	18	0	0	4	18
DIN DN80 PN10	H	200	160	20	0	0	4	18

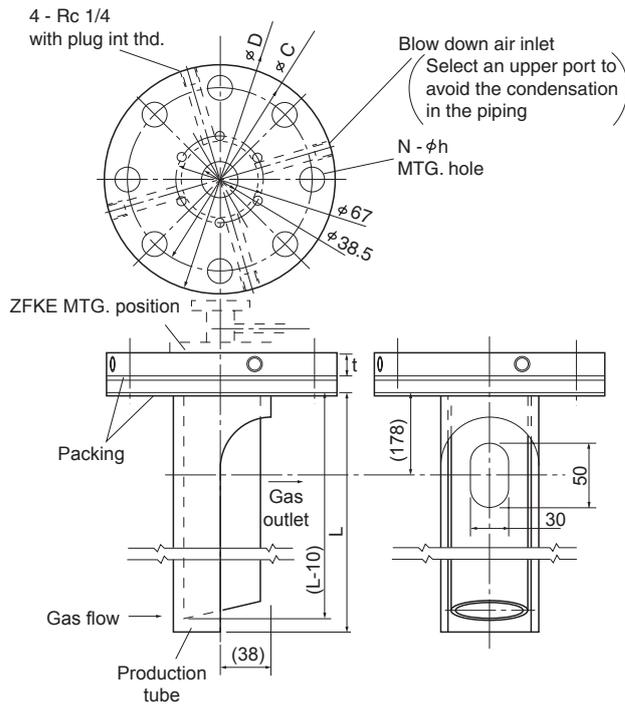
(5) Flow guide tube (for high particulate) (ZFKE: 10th digit code. H, K, M)



Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
Mass Approx.(kg)	4.5	5.6	7.0	8.3	

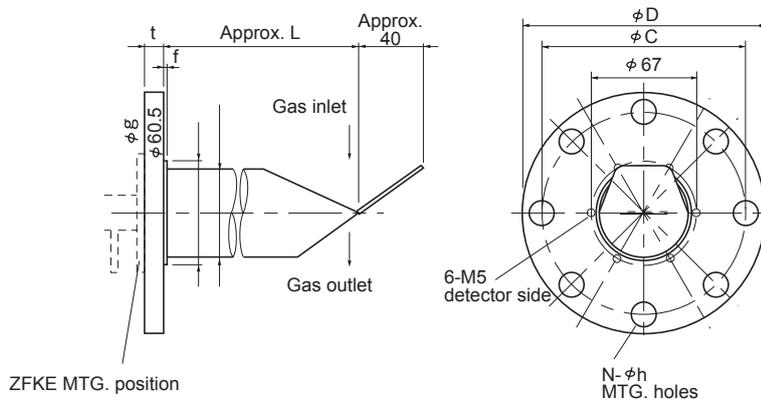
Flange size	Code 9th	D	C	t	f	g	N	h
JIS 5K 65A	7	155	130	14	2	110	4	15
JIS 5K 80A	8	180	145	14	2	121	4	19
JIS 5K 100A	9	200	165	16	2	141	8	19
JIS 10K 65A	A	175	140	18	2	116	4	19
JIS 10K 80A	B	185	150	18	2	126	8	19
JIS 10K 100A	C	210	175	18	2	151	8	19
ANSI 150LB 2B	D	150	120.7	17.5	2	92.1	4	19.1
ANSI 150LB 3B	E	190	152.4	22.3	2	127	4	19.1
ANSI 150LB 4B	F	230	190.5	22.3	2	157.2	8	19.1
DIN DN50 PN10	G	165	125	18	0	0	4	18
DIN DN80 PN10	H	200	160	20	0	0	4	18

(6) Flow guide tube (for high particulate with cover) (ZFKE: 10th digit code. J, L, N)



Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
Mass Approx.(kg)	7.1	9.0	11.4	13.6	

(7) Flow guide tube (ZFKE: 10th digit code. F)



Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
MASS Approx.(kg)	3.3	4.5	6.1	7.6	

Flange size	Code 9th	D	C	t	f	g	N	h
JIS 5K 65A	7	155	130	14	2	110	4	15
JIS 5K 80A	8	180	145	14	2	121	4	19
JIS 5K 100A	9	200	165	16	2	141	8	19
JIS 10K 65A	A	175	140	18	2	116	4	19
JIS 10K 80A	B	185	150	18	2	126	8	19
JIS 10K 100A	C	210	175	18	2	151	8	19
ANSI 150LB 2B	D	150	120.7	17.5	2	92.1	4	19.1
ANSI 150LB 3B	E	190	152.4	22.3	2	127	4	19.1
ANSI 150LB 4B	F	230	190.5	22.3	2	157.2	8	19.1
DIN DN50 PN10	G	165	125	18	0	0	4	18
DIN DN80 PN10	H	200	160	20	0	0	4	18

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