



Oxygen Gas Detector Head

GD-F4A-SC-A

Operating Manual

(PT2-152)

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[OPERATING PRECAUTIONS]

This is a fixed type gas detector (head) and alarm instrument to detect oxygen gas in air. The gas alarm instrument is a safety instrument, not an analyzer nor measuring instrument to make quantitative and qualitative analysis or measurement.

Please understand following points and use this detector head correctly.

1. The indication on this detector has some changes against fluctuation of atmospheric pressure. Especially, take care about alarm action at the time of depression caused by typhoon.
It may also fluctuate against the environmental (temperature, humidity, etc.) change around detector head.
2. Alarm level for gas alarm instrument shall be set within the performance of the instrument.
Our standard alarm level is 18% by volume for the prevention of oxygen deficiency.
3. This is not control equipment, but a safety instrument.
Use the alarm contact from gas alarm instrument only for external alarm light or buzzer.
And the analog output signal shall be used only for external indicator or recorder.
We do not assume liability for any accident or damage caused by other control purpose than the above.
4. To maintain the performance of this gas detector, the regular maintenance service including the regular parts replacement and adjustment described in this manual shall be required.
Also every 6 months regular maintenance and gas calibration are required since this is a safety instrument.

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1. OUTLINE OF THE PRODUCT

1 — 1. Preface

Thank you for purchasing our fixed type Oxygen Detector Head GD-F4A-SC-A.
First of all, verify that the model number of this product is identical with specifications described in this manual. This manual is a guide to operation of the GD-F4A-SC-A. All persons who use this unit for the first time and who has ever used this unit are requested to read through the manual to understand the content before use.

1 — 2. Purpose of use

This is a suction(flow-through) type oxygen detector head applying the galvanic cell type oxygen sensor and is used in combination with indicator / alarm unit to show oxygen content. Read the operating manual for indicator / alarm unit as well as this manual.
This unit is designed as drip-proof construction for outdoor installation.
Also, it can be used as intrinsically safe system in combination with zener barrier (option) to be able to install in hazardous area.

1 — 3. Definition of DANGER, WARNING, CAUTION and NOTE

This manual contains the following headings to ensure the safe and effective operation.



This message indicates that improper handling may cause serious damage on life, health or assets.



This message indicates that improper handling may cause serious damage on health or assets.



This message indicates that improper handling may cause minor damage on health or assets.



This message indicates advice on handling.

2. IMPORTANT INSTRUCTIONS FOR THE SAFETY

2—1. Danger cases



DANGER

In case of non-explosion proof system, do not use this unit at the place where combustible gas may exist.

2—2. Warning cases



WARNING

- Do not cut the wire for protective ground both inside and outside of instrument. Or, do not disconnect the connection of the ground terminals.
- Before starting the operation, check if any defect is not found on the protective grounding.
- If there is any defect on the protective functions such as protective grounding, do not start the operation.
- It is very dangerous if the instrument gives oxygen deficiency alarm.
Take appropriate measures based on your judgment at that time.
- Perform gas calibration at proper interval.
- Do not change or remodel the circuit/structure of this unit.
- Do not disassemble the sensor since there is a electrolyte inside.
If your finger touches the electrolyte, wash your finger away with water immediately.

2—3. Caution cases



CAUTION

- Do not use a walky-talky around the instrument.
The indication might be affected by the electromagnetic wave generated by the walky-talky if it is used near the instrument. When the walky-talky is used, be away enough from the instrument not to affect.
- Do not control other equipment by using outputs of this detector.
This is not a control equipment. It is prohibited to control other equipment by using outputs of this detector.

2—4. Caution for explosion proof (In case of intrinsically safe design)

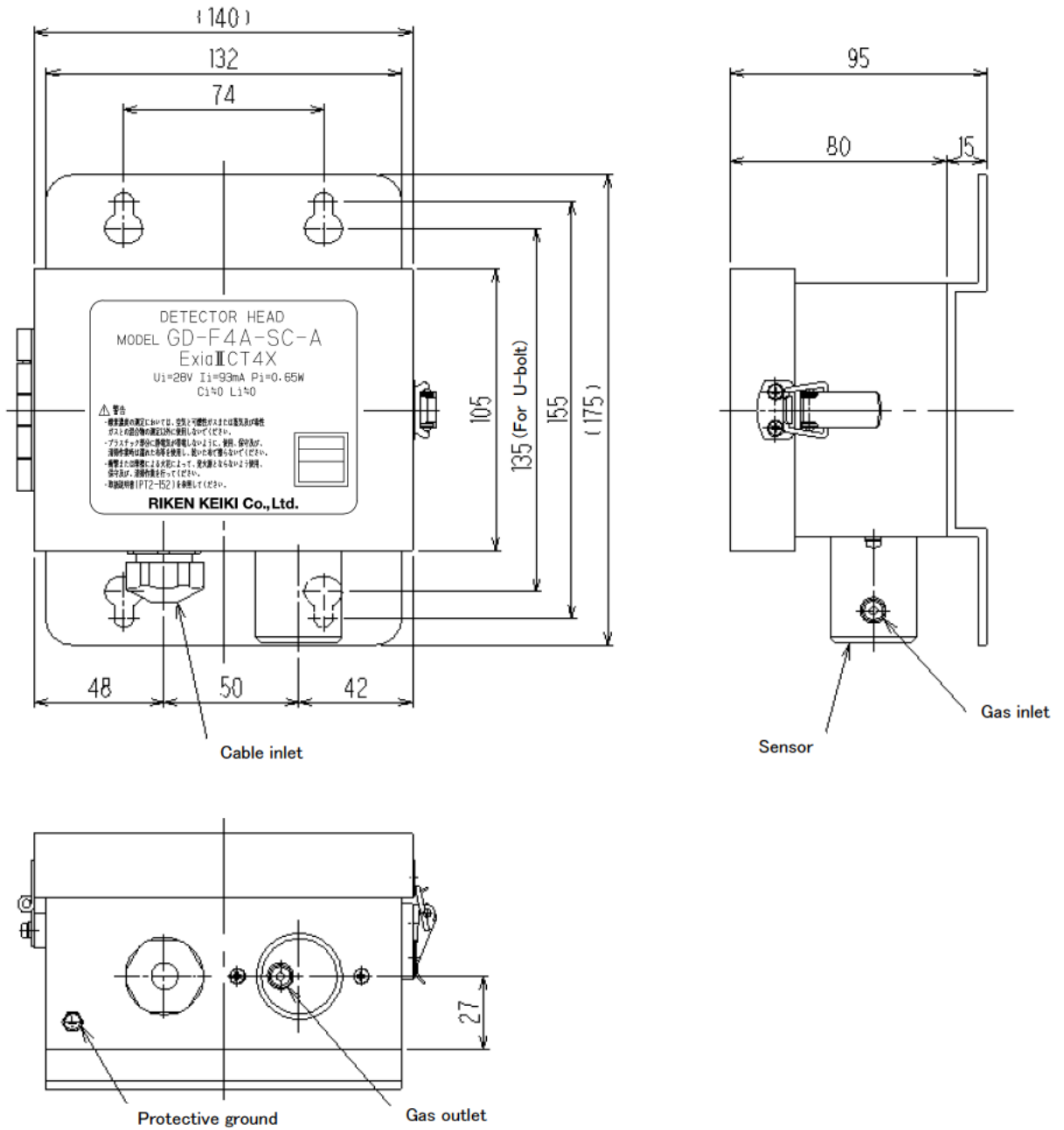


CAUTION

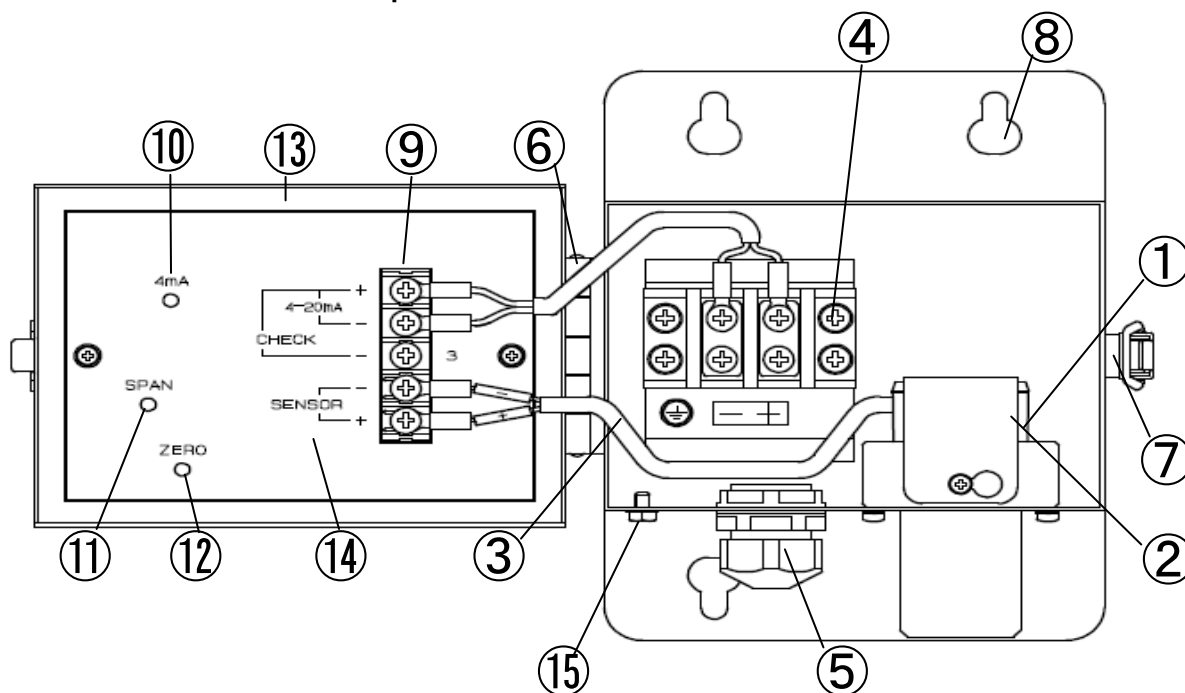
- Do not use this detector head expect for the measurement of oxygen content in a mixture of air and combustible gas or vapors, or a mixture of air and toxic gases.
- When cleaning this unit, do not use dry cloth but use the wet cloth not to change the static electricity on plastic part.

3. PRODUCT COMPONENTS

3-1. External drawing



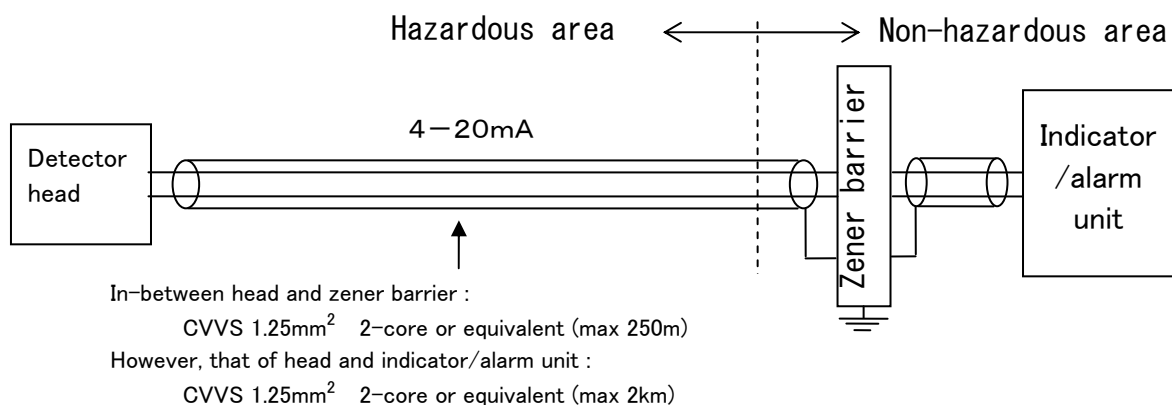
3-2. Name of each part and functions



- | | |
|-------------------------|--|
| ① Oxygen sensor | : Galvanic type sensor to detect oxygen content. |
| ② Sensor holder | : This is a retainer to hold the oxygen sensor (equipped filter inside). |
| ③ Sensor lead wires | : Lead wires for oxygen signal outputs. |
| ④ Terminal strip 1 | : Relayed terminal for sensor lead wires and external cable. |
| ⑤ Cable gland | : Entrance to lead the cable ($\phi 8 - \phi 11\text{mm}$) from outside. |
| ⑥ Hinge | : Hinge for front door. |
| ⑦ Lock | : Lock for front door. |
| ⑧ Mounting hole | : Mounting hole to fix this unit on the wall surface. |
| ⑨ Terminal strip 2 | : Relayed terminal for input/output signal use to the signal converter. |
| ⑩ 4mA adjusting hole | : VR hole to adjust 4 mA of 4-20mA output(factory set) |
| ⑪ SPAN adjusting hole | : VR hole to adjust SPAN |
| ⑫ ZERO adjusting hole | : VR hole to adjust ZERO |
| ⑬ Front door | : Front door for the unit |
| ⑭ Signal converter | : Circuit unit to convert the sensor output into 4-20mA |
| ⑮ Protective earth bolt | : Bolt for protective grounding. |

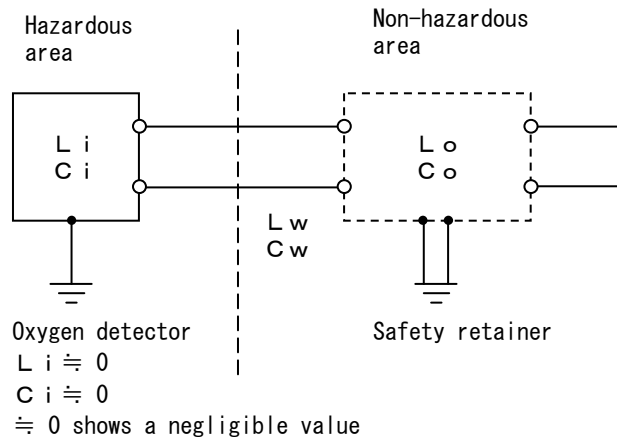
3-3. System composition

(1) Intrinsically safe system



! WARNING

1. The oxygen detector shall be used as following composition.



2. The safety retainer to be connected with oxygen detector shall have linear characteristics and be passed the type approval as it is.

Also it shall satisfy the following conditions.

(1) Rating of safety retainer

- Max voltage of intrinsic-safety circuit: Below 28V
- Max current of intrinsic-safety circuit: Below 93 mA
- Max power of intrinsic-safety circuit: Below 0.65W

(2) Performance division and group

- Performance division: ia
- Group : II C

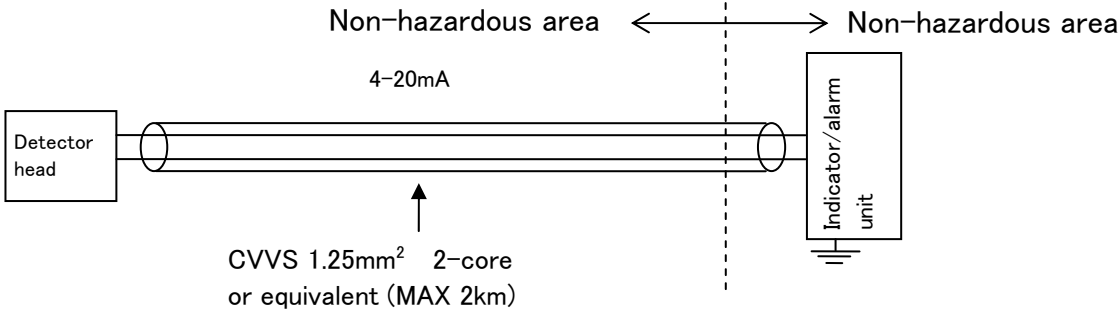
(3) Relations between allowable inductance (L_o) and allowable capacitance (C_o) of intrinsic-safety circuit, and external wiring inductance (L_w) and capacitance(C_w) of intrinsic-safety circuit.

$$L_o \geq L_i + L_w$$

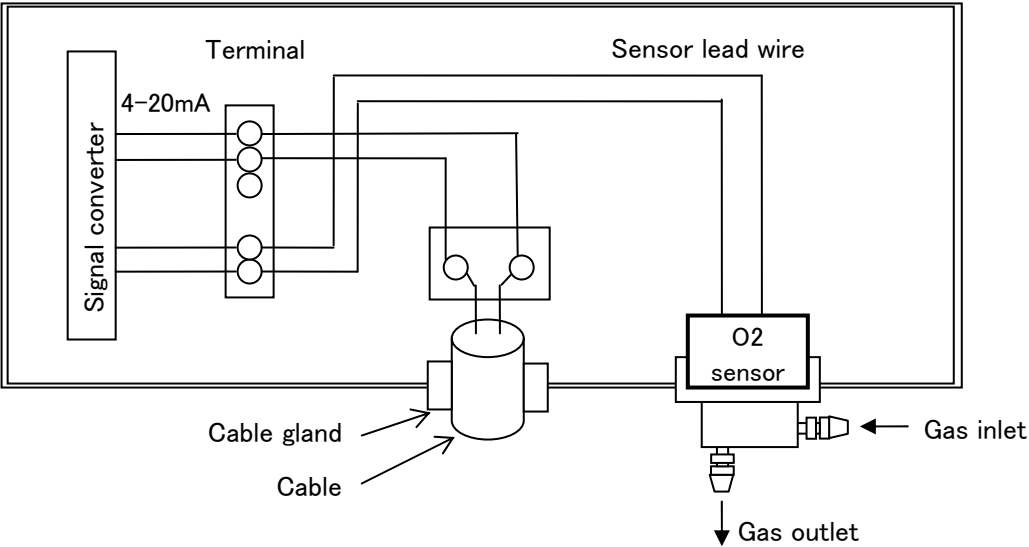
$$C_o \geq C_i + C_w$$

3. When making wiring connection for intrinsic-safety circuit, take care not to induce an electric current and voltage which will spoil the performance of intrinsically safe by the electromagnetic induction or electrostatic induction to the intrinsic-safety circuit.

(2) Non-explosion proof system



(3) Component inside detector head



4. HOW TO USE

4—1. Before using the detector head

All persons who use this detector for the first time and who has even used the detector are requested to follow all the instructions for use carefully. If not, the instrument may be defective and correct gas detection may not be performed.

4—2. Precautions for installation points

When installing this detector, note the following points.

WARNING

Do not install the detector head and cable at the following points.

- Place to get direct rays of the sun.
- Places closed to high temperature and/or emission of electromagnetic wave.
- Place with vibration or shocks.
- Place where the mounting part is weak and it is easy to come out.
- Place where it is difficult to make maintenance and inspection.
- Place unable to secure grounding.
- Places where the temperature is drastically changed.
- Places exceeding operating temperature and humidity.

4—3. Maintenance space

A certain maintenance space must be secured around the detector head, so that the maintenance staff can perform the safe and correct maintenance work. Pay due attention to secure this space during work plan and execution.

4—4. How to install

(1) Mounting to the wall surface

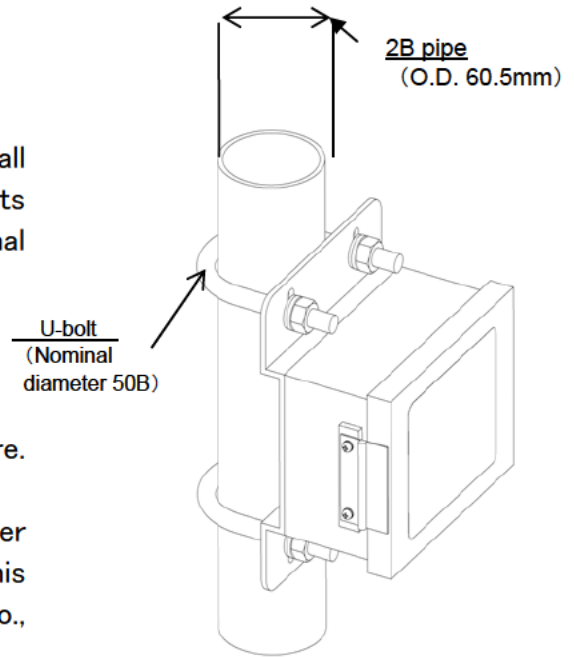
Mount the detector head to a flat surface (wall surface, etc) with either M6 bolts or M10 bolts through mounting holes. Refer to “3-1. External drawing” for mounting pitch.

(2) Mounting to the pole

The unit can be mounted to the pole (2B pipe) by using the optional U-bolts shown in right figure.

(3) Installation to the outdoors

For outdoor installation, optional drip-proof cover is required to keep reliable detection although this is a drip-proof design. Contact RIKEN KEIKI Co., Ltd.



Mounting to the pole

4—5. Caution at wiring construction

! CAUTION

- When make wiring construction, take care not to damage the internal electronics circuit.
- When handle the detector unit, put it at horizontal position. If put it vertically, it tends to fall and damage the detector.
- Power cable and signal cable shall not be laid down together with motive power cable such as motor, etc.
- When use twisted cable, take care not to contact a part of core cable with other core cable.

4—6. Applicable cable

Signal transmission : CVVS 1.25mm², 2-core or equivalent

Transmission distance : Within 2 km at full lengths

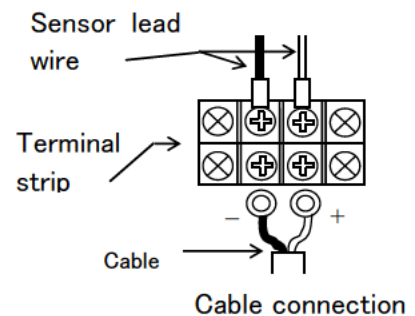
(Cable length: Max 250m between detector and zener barrier for the case of intrinsically safe enclosures)

Cable O.D. : $\phi 8$ – $\phi 11$ mm

4—7. Example of cable connection

(1) In case of non-explosion proof system

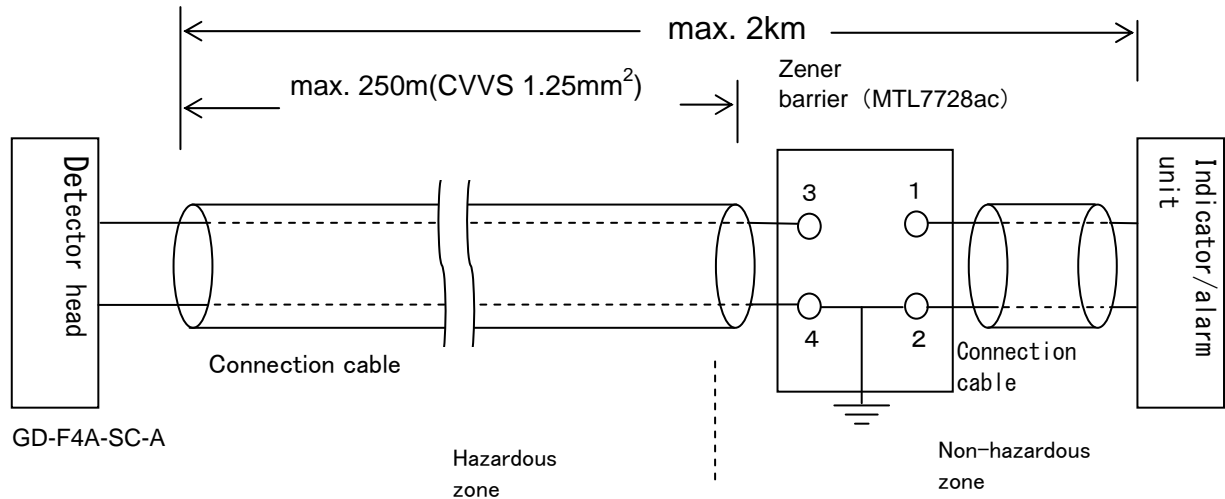
- ① Lead the applicable cable through cable inlet and connect to the terminal strip.
- ② Connect the other side of the cable to the indicator/alarm unit side.
- ③ Connect the shield's drain to ground on the indicator/alarm unit side.



(2) In case of intrinsically safe system

You can build the intrinsically safe system by adding optional zener barrier between detector head and indicator/alarm unit.

- ① Lead the applicable cable through cable inlet and connect to the terminal strip.
- ② Connect the optional zener barrier between this unit and indicator/alarm unit at non-hazardous area. (See below fig.)
- ③ Connect the other side of the cable to the indicator/alarm unit side.
- ④ Connect the shield's drain wire to ground on the indicator/alarm unit.



⚠ WARNING

- Ground the zener barrier separately corresponding to the A-class grounding with ground resistance of 10Ω or less.
- Use the specified cable.
- For system installation, operation and maintenance, take care not to damage the intrinsically safe design.
- The power of the indicator/alarm unit shall be turned on after completion of all wirings. If each wiring is carried out in the power on condition, short-circuit between terminals or an electrical shock may be occurred.

⚠ CAUTION

- Do not alter, nor remodel the parts, etc.
- Use the circuit breaker as for the power of indicator/alarm unit. Also it shall be mounted nearby indicator/alarm unit and be specified that it is for power interruption of indicator/alarm unit.

*** NOTE**

When wiring, read the operating manual for the connected indicator/alarm unit.

4—8. Cautions at piping works



WARNING

- This unit is designed to sample the gas in an atmospheric pressure. Do not give an excessive pressure to gas inlet and outlet of this unit.
- Connect the exhaust pipe to the gas outlet located at the bottom of this unit and exhaust the sampled gas to an area known to be non-hazardous.



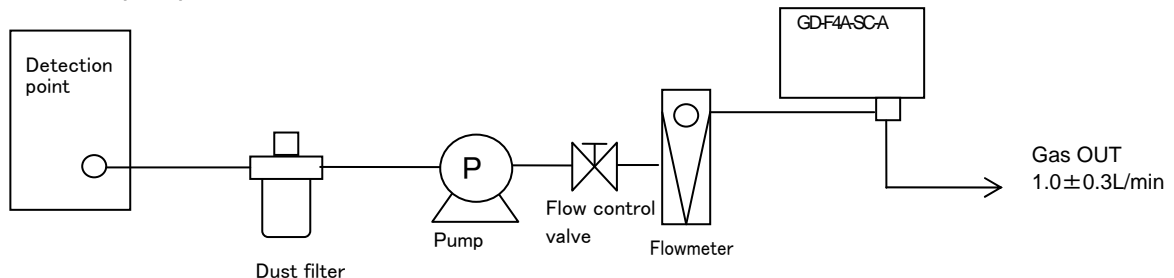
CAUTION

- Use $\phi 8$ (O.D)-1t copper pipe and so on for piping.
- Carry out piping works as straight as possible.
Excessively high load may cause burden on the suction pump, shortening the effective life of the pump.
When bending the pipe, secure R (radius of curvature) enough to avoid loading to the piping.
- Determine the suction side piping length while considering the response time. When the gas is sampled from the piping end (gas detection point), the response time of the gas detection sensor itself + delay time caused by the piping length becomes equivalent to the detector response time.
- Be sure to attach the gas suction port at the end of gas detection point.
- Be sure to put dust filter in front of gas detector. If sampled gas contains water and corrosive gases, removal device is required separately.

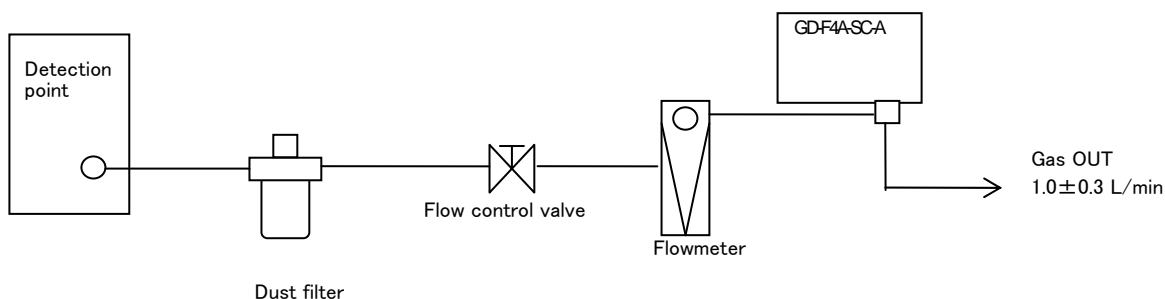
4—9. Example of piping connection

Gas inlet/outlet fitting of this unit is PT 1/8 female screw and provided with brass coupling. Applicable piping is $\phi 8$ (O.D)-1t copper pipe. Secure the piping connections not to leak. The piping material will be changed depending on corrosive gas contained in a sampled gas. In such case, contact RIKEN KEIKI Co., Ltd.

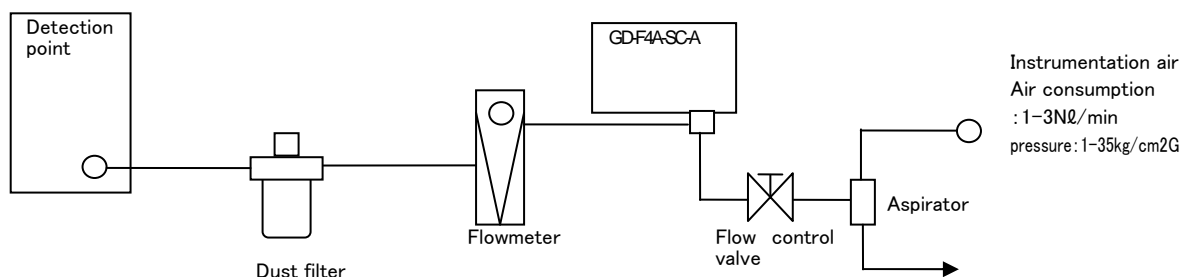
(1) In case of pump suction



(2) In case of pressurized sample gas



(3) In case of aspirator suction



! CAUTION

- It is also possible to apply air aspirator unit to sample the gas by utilizing instrumentation air. In this method, pressure to the sensor must be kept as small as possible and make it to -20mmHg at a maximum. As the load to oxygen sensor is high on this method, aspirator suction method shall be used only when the pump cannot be used.
- If the sample gas pressure would fluctuate, use the constant flow rate control valve to keep the constant flow rate.
- Exhaust the sampled gas to open air in principle. When make piping to exhaust side necessarily, choose the piping diameter to keep the pressure loss due to the length of piping within 10mmHg .

5. HOW TO OPERATE

5—1. Preparation for start up

Before making power on, take care of the following. If do not keep this, there is the danger of electrical shock and damage of instrument.



WARNING

- Make protective grounding.
- Check that the wiring with outer unit is made correctly.
- Check that the supply voltage is within the rating.
- Check that the rated fuse is used.

5—2. How to start the detector head

- ① This detector head does not equip a power switch. Analog outputs of oxygen sensor are converted to 4–20mA and transmitted to the indicator/alarm unit directory through the connected cable. As far as the cable has been connected correctly, this system starts operation by putting on the power switch in indicator/alarm unit.
- ② Let the gas flow be sampled to this unit by turning on the pump switch etc.
- ③ Adjust the flowrate to lead sampled gas to $1.0L \pm 0.3mL/min$.
- ④ Be sure to perform gas calibration at the time of new installation. Correct reading may not be obtained before gas calibration.



CAUTION

- At the new installation, adjust the reading in indicator/alarm unit according to “6-2. Calibration”.

5—3. How to exit

- ① Stop the sample gas supply to this unit by turning off the pump switch, etc.
- ② This system stops operation by putting off the power in indicator/alarm unit, since this unit has no power switch.

6. MAINTENANCE

Gas detection and alarm instrument is kept in continuous operation over a long time and must perform a vital role as a safety device. For this purpose, periodical inspection must be made. The High-pressure Gas Safety Act in Japan sets forth the obligation of periodical inspection of the gas detection and alarm instrument.

– Maintenance Contract –

Be sure to perform the regular maintenance since this is an instrument for security and safety. If this detector head founds defective, contact RIKEN KEIKI immediately.

6—1. Maintenance intervals and items

The maintenance includes a daily maintenance which a person in charge of control and operation of the gas detection instrument performs maintenance before work once a day, and a monthly maintenance carried out once a month, and periodical maintenance conducted by the service personnel designated by manufacturer. The maintenance items are confirmation of lights, concentration indication and alarm function on the indicator/alarm unit side. It is also necessary to carry out gas calibration at least every 6 months. The law in Japan sets forth that the unit must issue an alarm during the circuit maintenance related to alarm while providing normal operation, at least, once a month.

To maintain the safety operation of the gas detection instrument, it is recommended to keep the maintenance contract with our authorized distributor for regular maintenance, adjustment and overhaul etc including the gas sensitivity adjustment (gas calibration).

For the detail of maintenance contract, contact RIKEN KEIKI.



WARNING

- This is a safety instrument and the maintenance every 6 months or more is mandatory to ensure the safety. If the unit is used by continuously without maintenance, the sensor sensitivity may change, resulting in failure of correct detection.

* NOTE

- Be sure to inform sections concerned beforehand when performing alarm test or gas calibration. For the equipment connected with output signal from indicator/alarm unit, perform them after disconnecting the output signal.
- Special trained engineer for gas detection instrument can perform maintenance work accurately and efficiently.
- Then, it is recommended to contact RIKEN KEIKI for maintenance.

6—2. Calibration

Perform gas calibration at new installation, 6 months maintenance and sensor replacement.

6—2—1. Required kit and tools for calibration

Prepare following jigs and tools to perform zero and span adjustments.

- Calibration gas (standard gas for zero and span)
- Gas sampling bag for calibration gas
- Gas sampling bag for exhaust gas.
- Suction pump to lead calibration gas
- Flowmeter with flow control valve (enable to control 1.0L/min)
- Ammeter (For 4–20mA adjustment)

6—2—2. Performing a zero adjustment

- ① Plug the ammeter to terminal no 3(-) and 5(+) of terminal strip 2.
- ② Pack the zero gas (Nitrogen more than 99.9 vol %) into gas sampling bag.
- ③ Disconnect piping for both gas inlet and gas outlet of this unit.
- ④ Connect flowmeter (with flow control valve) and suction pump to the detector head. Turn on the pump and adjust the reading of flowmeter to 1.0 ± 0.3 L/min.
- ⑤ Connect gas sampling bag for calibration to the IN side of the pump and gas sampling bag for exhaust gas to the outlet of this unit respectively.
- ⑥ After reading by ammeter gets stable, adjust the reading to 4mA with ZERO potentiometer.
- ⑦ Stop the supply of zero gas, disconnect gas sampling bag for calibration and confirm that the oxygen reading returns to 20.9vol %.
- ⑧ Return disconnected piping to where they were (completion of zero adjustment).

6—2—3. Performing a span adjustment

- ① Plug the ammeter to terminal no 3(-) and 5(+) of terminal strip 2.
- ② Pack the span gas (fresh air for oxygen deficiency alarm instrument and their concentration is around preset alarm level for other purpose) into gas sampling bag. For simple calibration, you may be possible to use an ambient air as span gas containing 20.9vol% O₂ providing that the ambient pressure is 1 atm (1000 ± 50 hPa) and contamination in air is negligible against span gas concentration.
- ③ Disconnect piping for both gas inlet and gas outlet of this unit.
- ④ Connect flow meter (with flow control valve) and suction pump to the detector head. Turn on the pump and adjust the reading of flow meter to 1.0 ± 0.3 L/min.
- ⑤ Connect gas sampling bag for calibration to the IN side of the pump and gas sampling bag for exhaust gas to the outlet of this unit respectively.
- ⑥ After reading by ammeter gets stable, adjust the reading to the equivalent current of span gas concentration with SPAN potentiometer.
- ⑦ Stop the supply of span gas, disconnect gas sampling bag for calibration and confirm that the oxygen reading by indicator/alarm unit is 20.9vol %.
- ⑧ Return disconnected piping to where they were (Completion of span adjustment).

*** NOTE**

• Output current corresponding to gas concentration is a linear and obtained by following equation.

$$\text{Output current (mA)} = 4 + 16 \times \frac{\text{Oxygen concentration (vol\%)}}{\text{Full scale concentration (vol\%)}}$$

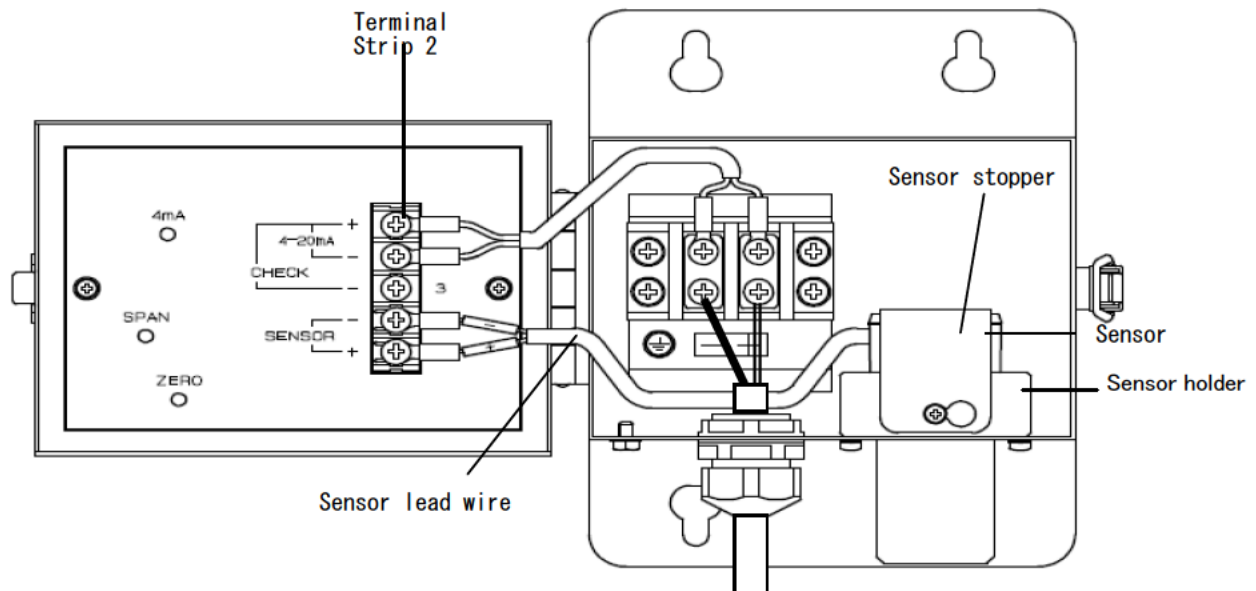
6—3. Replacing the sensor

6—3—1. Replacement intervals of the sensor

To maintain the reliability of the measurement, it is recommendable to replace the sensor periodically. Our oxygen sensor has an enough life span. However, the actual life is depending on the operating conditions. Then, replace the sensor once a year as the tentative deadline for the replacement cycle.

6-3-2. How to replace the sensor

- ① Verify that the indicator/alarm unit is off. If the sensor is disconnected, the indicator/alarm unit issues an alarm.
- ② Turn a lock of detector head and open the front door.
- ③ Loosen two screws at the top of terminal strip and disconnect two lead (black and white) wires.
- ④ Loosen the screw for sensor stopper and take off the sensor stopper. Pull out the sensor upward from the holder.
- ⑤ Insert new sensor into the holder and push the sensor until it comes to the end. Mount the sensor stopper and fix it with screw.
- ⑥ Connect black and white sensor lead wires to the terminal strip. Connect white wire to positive (+) terminal and black wire to negative (-) terminal respectively.
- ⑦ Close the front door of the detector head and fasten a lock.



CAUTION

•Be sure to carry out gas calibration after sensor replacement. If not, correct gas detection may not be performed.

6—4. Storage or treatment when not in use for a long period

Oxygen sensor is a kind of cell and will continue to consume its life even though it is not used. When detector head is not used for a long period, take out the sensor from detector head and store it at following environment to make lower the consumption of sensor.

- Environment of low temperature (5 – 10°C)
- Environment of low oxygen content
(Put a sensor into the container and seal off the container.)

6—5. List of recommendable spare parts for regular replacement

No.	Name of parts	Inspection frequency	Replacement interval	Q' ty/unit
1	O-ring(sensor side in the holder)	1 year	3-6 years	1
2	Packing(Housing side in the holder)	1 year	3-6 years	1

* NOTE

- The replacement interval will change depending on operating condition and it does not mean the warranty period.
Replacement interval changes according to the result of regular maintenance.

7. STORAGE, RELOCATION AND DISPOSAL

7 — 1. Procedures to store the detector head or leave it for a long time

The detector head must be stored under the following environmental conditions.

- In a dark place under the normal temperature and humidity away from direct sunlight
- In a place where gases, solvents or vapors are not present

7 — 2. Procedures to relocate the detector head or use it again

When the detector head is relocated, select a new place in accordance with “4-2. Precautions for installation points” and “4-4. How to install”.

For information on wiring work, see “4-5. Caution at wiring construction”. The unpowered time must be minimized when the detector head is relocated.



CAUTION

- When using a relocated or stopped/stored detector again, never fail to perform a calibration. For information on readjustment including calibration, please contact RIKEN KEIKI.

7 — 3. Disposal of products

When the detector head is disposed of, it must be treated properly as an industrial waste in accordance with the local regulations.

8. MEASURES AT ABNORMAL CASE

8—1. Responding to trouble alarm

If this detector founds defective, contact our authorized agent or RIKEN KEIKI.

8—2. Before it is thought to be a trouble

It may be caused by cable disconnection, short circuit, etc.

- Check the wirings around the related instruments as well as this detector head.

It may be caused by improper operation.

- Re-check the detection system and contact RIKEN KEIKI.

9. PRODUCT SPECIFICATIONS

9 — 1. Standard specifications

Model	GD-F4A-SC-A
Detection principle	Galvanic cell method
Detectable gas	O ₂
Detection method	Suction method (with flow passage)
Suction flow	1.0±0.3L/min
Transmission method	Analog transmission
Transmission specification	4-20mADC
Transmission cable	CVVS 1.25mm ² ·2-core or equivalent
Transmission distance	Up to 2km with CVVS 1.25mm ² (up to 250m between the detector head and Zener barrier)
Power supply	24VDC (supplied from indicator/alarm unit)
Zener barrier	MTL7728ac/MTL7728+/MTL7728- ZB-1A/ZB-1A+/ZB-1A- ZB-4A/ZB-4A+/ZB-4A-
Cabling port	Cable gland (Applicable cable O.D. φ 8 - φ 11mm)
Piping port	Rc1/8 (with half union for O.D φ 8-1t)
Operating temperature	-10 - +40°C (non-rapidly-vary)
Operating humidity	Less than 90%RH (non-condensing)
Structure	Wall mounting type/mountable to pipe size 2B<50A>
Explosion-proof structure	Intrinsically safe structure(by using zener barrier)
Explosion-proof grade	Ex ia II C T4 X
Outer dimension	Approx. 140(W) × 175(H) × 95(D)mm
Weight	General spec.: approx.1.7kg Stainless steel spec.: approx.2.0kg
Color	Munsel 2.5Y9/2 half tone

9 — 2. Standard accessories

- Operating manual
- Sensor

9 — 3. Optional accessories

- U-bolt (for nominal diameter 2B)
- Zener barrier (MTL7728ac)

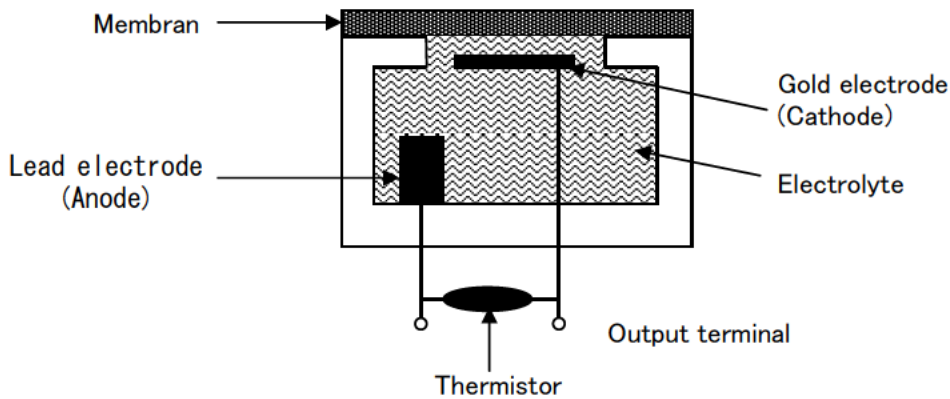
9—4. Detection principle

(1) Structure

In a resin container, there are noble metal electrode as cathode and lead electrode as anode immersed in an electrolyte.

A part of container is opened and put a membrane over there. A lead wire from each electrode (anode and cathode) is led to take out an electrical output across a temperature compensation thermistor network.

Structure of galvanic cell type oxygen sensor is shown below.

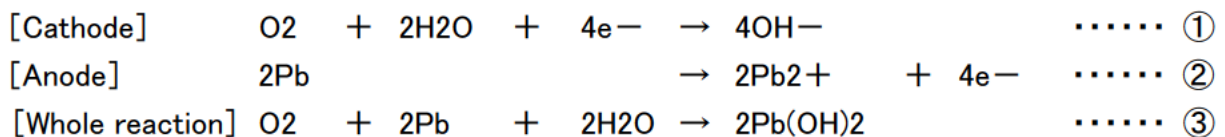


Structure of galvanic cell type oxygen sensor

(2) Working principle

By connecting a noble metal and base metal electrodes immersed in an electrolyte with a lead wire, an electrochemical cell is formed. A membrane covers the cell and allows oxygen to diffuse into the electrolyte at a rate proportional to the partial pressure to oxygen where reduction on the noble electrode and oxidation on the lead electrode occur respectively as shown in the following chemical equations and produce a current between electrodes.

Oxygen concentration can be determined by measuring this current, since it is proportional to the oxygen content diffusing the membrane.



10. DEFINITION OF TERMS

Galvanic cell

Galvanic cell type oxygen sensor that produces a current proportional to the oxygen content permeated through the membrane. Refer to “9-4. Detection principle” for details.

Zener barrier

Safety retainer for explosion protection by limiting the energy of electric current within a non-ignition level.

CVVS

This is a kind of connecting cable between indicator/alarm unit and oxygen detector head. CVVS means a “Polyethylene insulated and vinyl sheathed control cable with shield”.

Calibration

By using standard (calibration) gas, adjust gas reading in indicator/alarm unit to match the calibration gas concentration.

Manual Log

Rev.	Amendment	Issue data
0	First issue	2018/2/9