



Service manual

Laser Gas Analyzer for EGCS

TYPE: ZQS-1

INTRODUCTION

This is a service manual for Laser Gas Analyzer for EGCS (model: ZQS).

This document describes maintenance and service by service person and how to deal with troubles.

- Read and understand this service manual carefully before installing, operating and maintaining the product. Incorrect handling may cause accidents or damage.
- Only our trained person should perform the work described in this service manual. We do not recommend work by untrained people.
- Read and understand the instruction manual of this product carefully. When reading this service manual, refer to the instruction manual.
- This product is a precision instrument. Do not inadvertently drop or impact the product. It may result in malfunction.
- The specifications of this product may be changed for improvement without prior notice.
- Any modification of the products without permission shall be strictly prohibited. We assume no responsibility for any accidents or defects caused by unauthorized modifications.

Manufacturer: Fuji Electric Co., Ltd.

Formula: Presented on the company nameplate.

Manufacturing date: Indicates on the main body company nameplate..

Manufacturing country: Japan

Note

- Transcription of a part or the whole of this manual without permission is prohibited.
- The contents of this manual are subject to change without prior notice.

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SAFETY INSTRUCTIONS




Before using the product, read this “Safety Precautions” carefully and use the product correctly.


The following items are important for safe operation and must be fully observed. These safety precautions are ranked in 2 levels; “**DANGER**”, “**CAUTION**” and “**PROHIBITION**”.

 DANGER	If operation is incorrect, a dangerous situation may occur, resulting in death or serious injury.
 CAUTION	If operation is incorrect, a dangerous situation may occur, resulting in minor to medium injuries or only physical damage to equipment.
 PROHIBITION	Items which must not be done are noted.

Installation and transportation	
 DANGER	<ul style="list-style-type: none"> ● When the analyzer (extraction unit) is installed on a flue, make sure the engine has stopped completely. Installing in the engine operation may cause high temperature exhaust gas blowing, resulting in burn. ● This analyzer is not explosion-proof. Do not use it in an atmosphere of explosive gas. This may result in serious accidents such as explosion, fire, etc.
 CAUTION	<ul style="list-style-type: none"> ● The analyzer should be installed in a place conforming to the installation requirements noted in this instruction manual, and where the weight of the analyzer can be endured. Otherwise, it may cause a tip-over, drop, electric shocks, fire or malfunction of the unit. ● Ask professional services or your dealer for installation, transportation, reinstallation, and associated piping and wiring work. Improper installation may result in a falling accident, electric shock, or injury. ● Check the installation site once every 6 months to make sure that the installation surface is free of rattling. If the instrument is used under insecure installation conditions, a falling accident may occur. ● During installation, make sure that the inside of the unit is free from cable chips and other foreign objects. Otherwise, it may cause fire, failure or malfunction. ● For lifting the gas analyzer, be sure to wear protective gloves. Bare hands may leave you prone to injury. If the temperature in the installation site is high, it is imperative to wear leather gloves to prevent burn. ● The analyzer is heavy. It should be transported carefully by two or more persons to prevent body harm or injury.
 PROHIBITION	<ul style="list-style-type: none"> ● Do not allow water to get into the equipment. It may result in electric shock or fire.

Wiring	
 CAUTION	<ul style="list-style-type: none"> ● Connect a grounding wire securely. Failure to ground equipment may result in electric shock or malfunction. ● If the power supply voltage exceeds the rating, electric shock or damage to the instrument may result. Be sure to use the instrument within the specified rating range. ● Be sure to turn off the power before performing wiring work. ● Use a ground wire with a diameter of 1.5 mm or larger. ● Select input/output wires of materials and diameter that satisfy the rating of each device. If a wire which cannot endure the rating is used, electric shock or fire may occur. ● Fasten the input/output wires to the floor or wall, and use a wire protection device.

Operation	
 DANGER	<ul style="list-style-type: none"> ● When handling the standard gas such as calibration gas, read the instruction manual of the standard gas carefully, and use the gas correctly. ● When toxic fumes, corrosive gas or inert gas is used as calibration gas, be sure that the position of the air ventilation or exhaust port is suitable. Otherwise you may inhale exhaust gas. Furthermore, suffocation, brain disorder, circulatory deficit, or contraction of the breathing system may occur, resulting in death.
 CAUTION	<ul style="list-style-type: none"> ● Do not touch the switch with a wet hand. Otherwise it may cause electric shock. ● Do not touch the detector during operation. It may get hot and cause burns. ● Do not operate the laser gas analyzer for long periods of time with the sampling unit or interface box front panel open. Atmospheric dust or dust may adhere to the insides, resulting in a fault. ● Do not touch the terminal block during operation. Otherwise, it may cause electric shock or injury. ● Before leaving the analyzer unused for a long time or restarting after left at such a status for an extended length of time, follow the instructions of instruction manual because they are different from normal starting or shutdown. Otherwise, adequate performance will not be provided. Furthermore, an accident or fault may be caused. ● Do not allow water to go into the gas analyzer. Otherwise, electric shock or fire in the instrument may be caused. ● Do not smoke nor use a flame near the gas analyzer. Otherwise, it may result in a fire.
 PROHIBITION	<ul style="list-style-type: none"> ● Do not put sticks or your fingers in the fan of the extraction unit because it may cause an injury. ● Do not touch the terminals in the interface box, the extraction unit, and the detection unit with your fingers or a piece of metal because it may cause an electric shock or injury. ● Do not smoke or use a flame near the gas analyzer. Otherwise, it may result in a fire. ● Do not allow water to go into the gas analyzer. Otherwise, it may result in an electric shock or a fire.

Precautions for Handling Laser Products	
 CAUTION	<p>Class 1 Laser Product</p> <p>This product is designated as a class 1 laser product according to IEC 60825-1 (2014). The detection unit employs two laser diodes, but they are fully shielded so that the laser beams cannot exit from the enclosure. The identification label is shown at the product.</p> <p>This product can be used as a Class 1 laser product, but the laser light is emitted from the transmission unit during power-on of this product. Be sure to observe the following precautions for safety.</p> <ol style="list-style-type: none"> (1) Do not remove part of the detector (transmission unit, receiving unit, or part of them) without our permission. Laser light may enter the eye and cause blindness. Laser light may also be applied to the skin, causing skin damage.

Maintenance and inspection



DANGER

- When the analyzer (receiver unit and transmitter unit) is installed on incineration facility, make sure the facility has stopped completely. Installing on the operating facility may cause high temperature gas injection, resulting in burn.
- If the analyzer is installed or removed from the location higher than operator's height, set up a fence to keep someone from approaching under or near the unit. If the analyzer inadvertently falls off and hits someone, serious injuries may occur, resulting in death.



CAUTION

- Be careful not to drop the analyzer on your foot. Otherwise, it may cause fracture of the bone.
- Do not touch the terminal block during operation. Otherwise, it may cause electric shock.
- Before working, take off a wrist watch, finger ring or other metallic accessories. Never touch the instrument with a wet hand to avoid electric shocks.
- If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before. Otherwise, it may cause electric shock or accident.
- Do not wash or splash water on the switch or electrical parts inside the device. Otherwise it may cause an electric shock, failure, or fire.
- Use only the parts that we specified for replacement. Otherwise, adequate performance will not be provided. Furthermore, an accident or fault may be caused.
- Dispose replacement parts as incombustibles in accordance with the laws and regulations of your country or areas.

Others



CAUTION

If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled, you may get an electric shock or injury.

1. SERVICE PREPARATION

Understand the configuration of each unit of the product when preparing for service. Prepare replacement parts and tools.

1.1. Configuration of the interface box

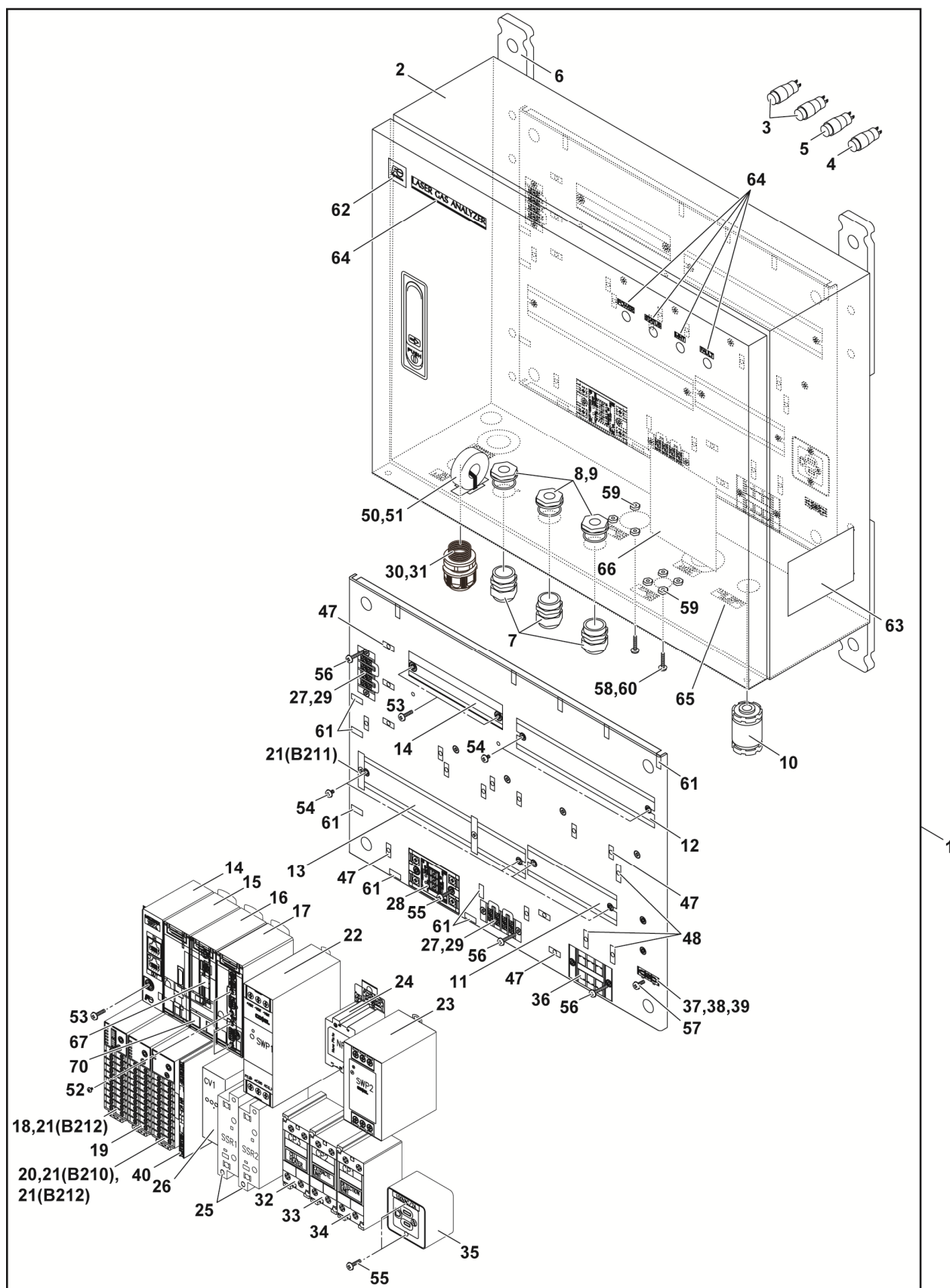
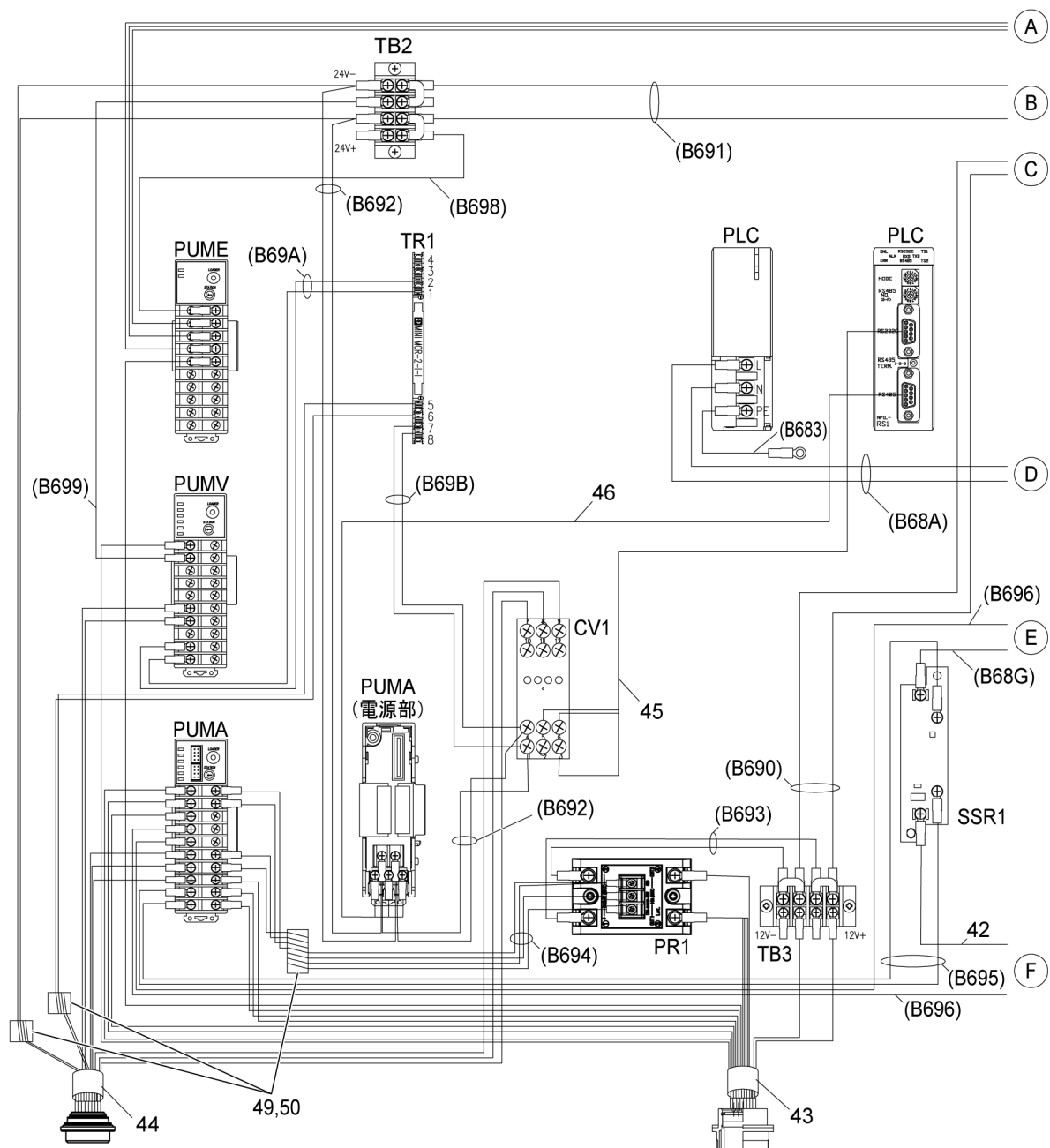


Fig. 1-1 Explodid view of the interface box



() Parts No. in parentheses

Fig. 1-2 Wiring diagram inside the interface box (continuing to the next page)

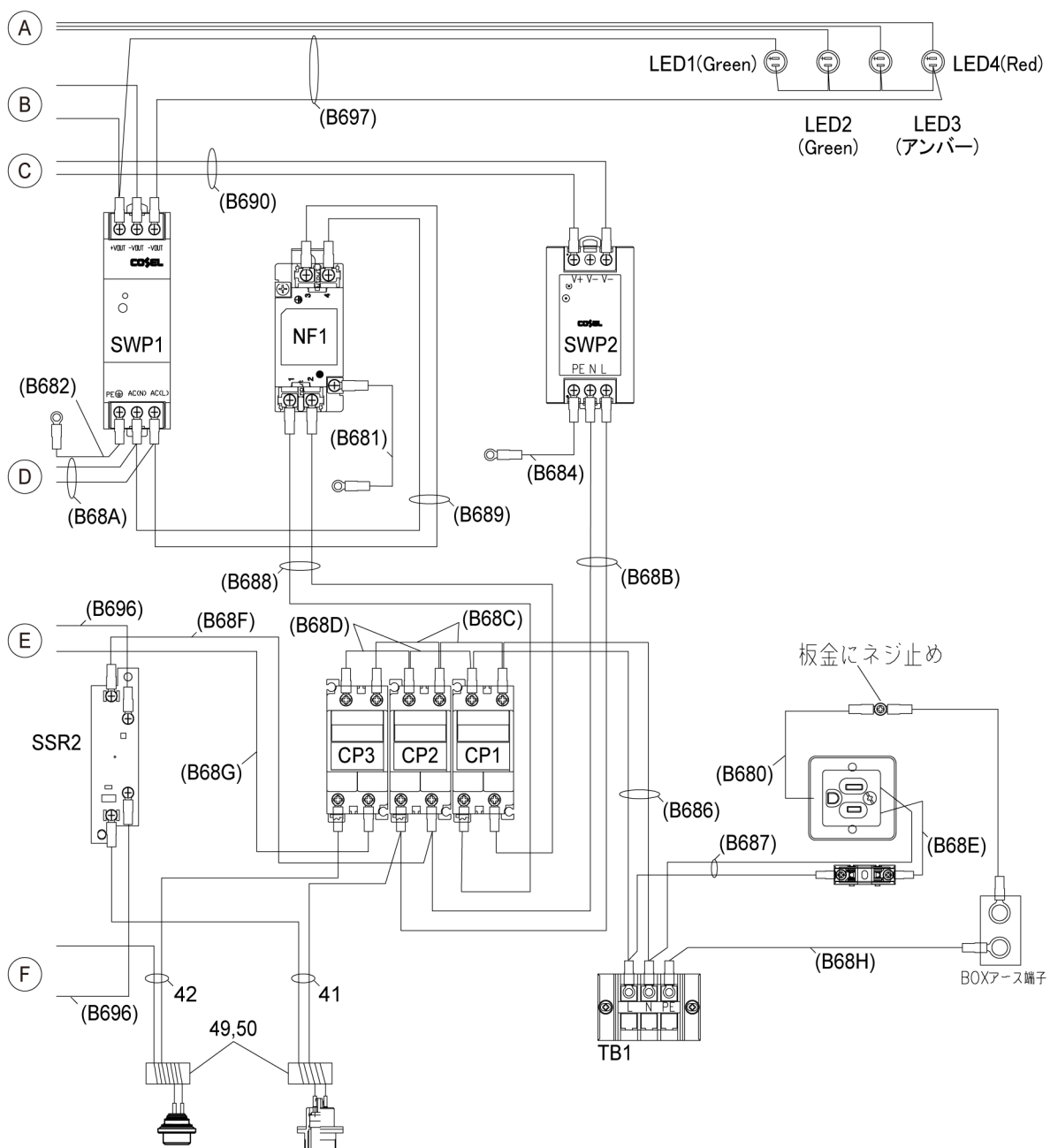


Fig. 1-2 Wiring diagram inside the Interface box (continued from the previous page)

Table 1-1 Parts list of the interface box

Item No.	Part Number	Parts name	Numbers	Remark
1	B010	Interface box	1	
2	B020	Interface box enclosure	1	
3	B030	Indicator light	2	LED green
4	B040	Indicator light	1	LED red
5	B050	Indicator light	1	LED amber
6	B060	Mounting bracket	1	
7	B070	Cable connector	3	
8	B080	Lock nut	3	M20 × 1.5
9	B090	Flat packing	3	M20
10	B100	Cable gland	1	Marine wire piercing fittings (CFBG 15)
11	B110	DIN rail	1	FDR-120
12	B120	DIN rail	1	FDR-186
13	B130	DIN rail	1	FDR-223
14	B140	Base board	1	Format: NP1BS-03
15	B150	Power-supply module	1	Format: NP1S-91
16	B160	CPU module	1	Format: NP1PM-48E
17	B170	Communication module	1	Format: NP1L-RS1
18	B180	4ch control module	1	Format: PUMATCC1
19	B190	Analog input/output module	1	Format: PUMVAEE1
20	B200	Event input/output module	1	Format: PUMERYYY1
21	B210	Accessory	1	
	B211	Accessory	2	
	B212	Accessory	1	
22	B220	Switching power supply	1	DC24
23	B230	Switching power supply	1	DC12
24	B240	Noise filter	1	
25	B250	Relay	2	
26	B260	Communication converter	1	AC/DC24
27	B270	Terminal block	2	
28	B280	Peltier relay	1	
29	B290	Shorting bar	4	
30	B300	Cable clamp	1	
31	B310	Rubber bushing	1	
32	B320	Low voltage circuit breakers	1	Format: CP30FM-2P007
33	B330	Circuit protector	1	Format: CP30FM-2P005
34	B340	Circuit protector	1	Format: CP30FM-2P003
35	B350	Outlet	1	
36	B360	Terminal block	1	
37	B370	Fuse-holder	1	
38	B380	Fuse carrier	1	
39	B390	Fuse	1	2A
40	B400	Signal converter	1	
41	B410	Cable	1	Cable for heater in sampling section
42	B420	Cable	1	Cable for cell heater
43	B430	Cable	1	Signal cable for sampling section
44	B440	Cable	1	Detector Signal Cable
45	B450	Cable	1	PLC-converter cable
46	B460	Cable	1	
47	B470	Cable clamp	15	
48	B480	Cable clamp	3	
49	B490	Ferrite bead	5	
50	B500	Mount base	6	

Item No.	Part Number	Parts name	Numbers	Remark
51	B510	Ferrite core	1	
52	B520	Screw	4	M2.6 × 4
53	B530	Screw	4	M5 × 10
54	B540	Screw	10	M4 × 8
55	B550	Screw	6	M4 × 12
56	B560	Screw	6	M4 × 16
57	B570	Screw	1	M3 × 8
58	B580	Screw	8	M3 × 10
59	B590	Nut	8	M3
60	B600	Washer	8	M3
61	B610	Cable clamp	11	
62	B620	Label	1	
63	B630	Label	1	Specification label
64	B640	Label	1	Model nameplate
65	B650	Label	1	Set name version
66	B660	Label	1	Terminal nameplate
67	B670	Label	1	History label
68	B680	Cable	1	AC cable
	B681	Cable	1	AC cable
	B682	Cable	1	AC cable
	B683	Cable	1	AC cable
	B684	Cable	1	AC cable
	B685	Cable	1	AC cable
	B686	Cable	1	AC cable
	B687	Cable	1	AC cable
	B688	Cable	1	AC cable
	B689	Cable	1	AC cable
	B68A	Cable	1	AC cable
	B68B	Cable	1	AC cable
	B68C	Cable	2	AC cable
	B68D	Cable	2	AC cable
	B68E	Cable	1	AC cable
	B68F	Cable	1	AC cable
	B68G	Cable	1	AC cable
	B68H	Cable	1	AC cable
69	B690	Cable	1	DC cable
	B691	Cable	1	DC cable
	B692	Cable	1	DC cable
	B693	Cable	1	DC cable
	B694	Cable	1	DC cable
	B695	Cable	1	DC cable
	B696	Cable	1	DC cable
	B697	Cable	1	DC cable
	B698	Cable	1	DC cable
	B699	Cable	1	DC cable
	B69A	Cable	1	DC cable
	B69B	Cable	1	DC cable
70	B700	Battery	1	

1.2. Configuration of the detection unit

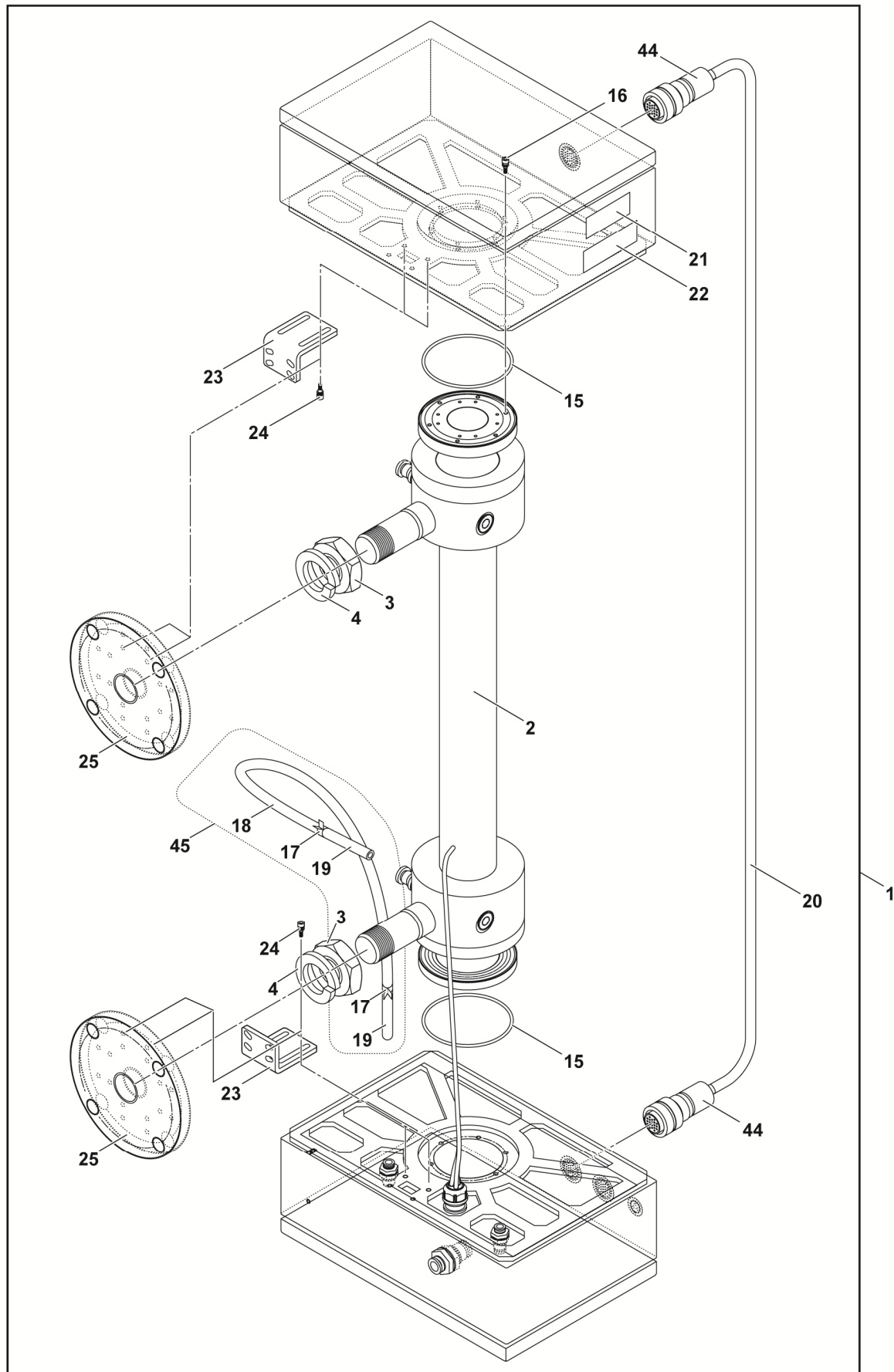


Fig. 1-3 Exploded view of the detection unit

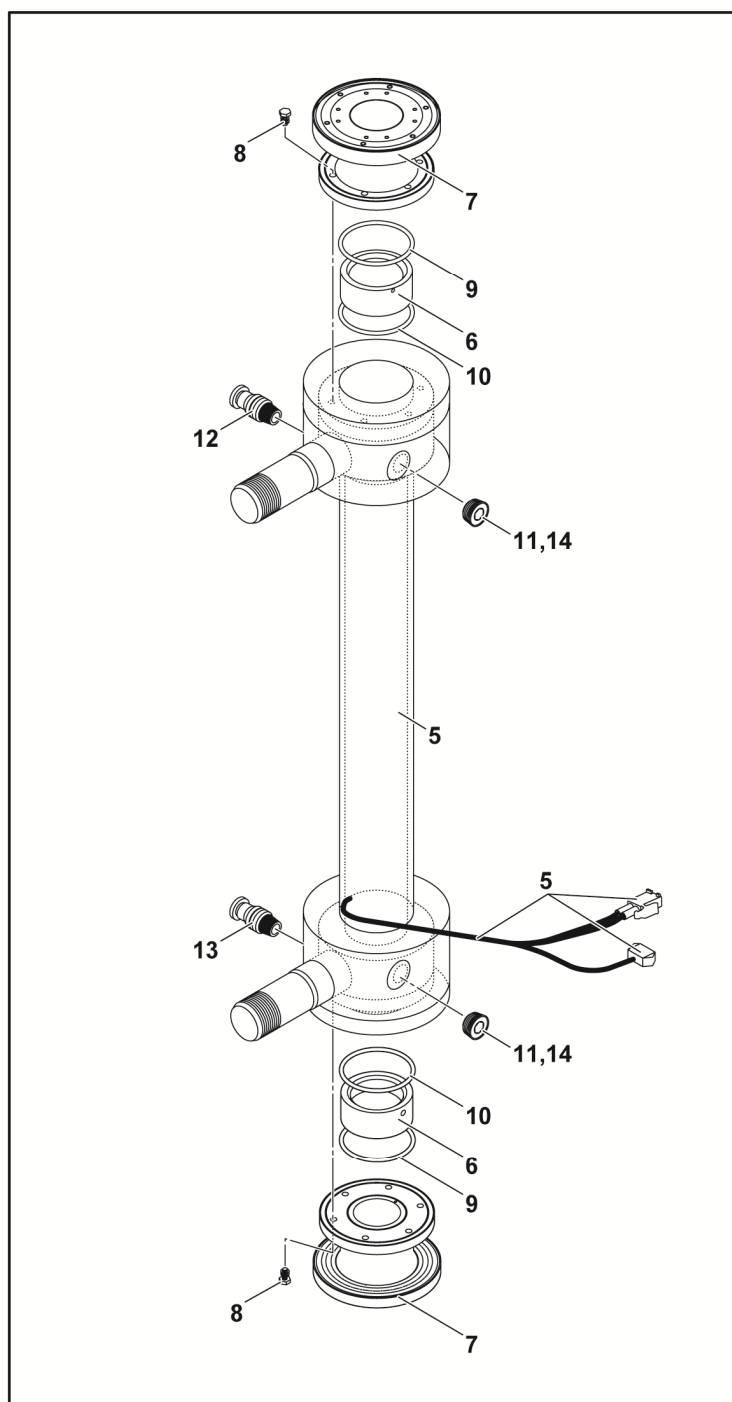


Fig. 1-4 Exploded view of the gas cell

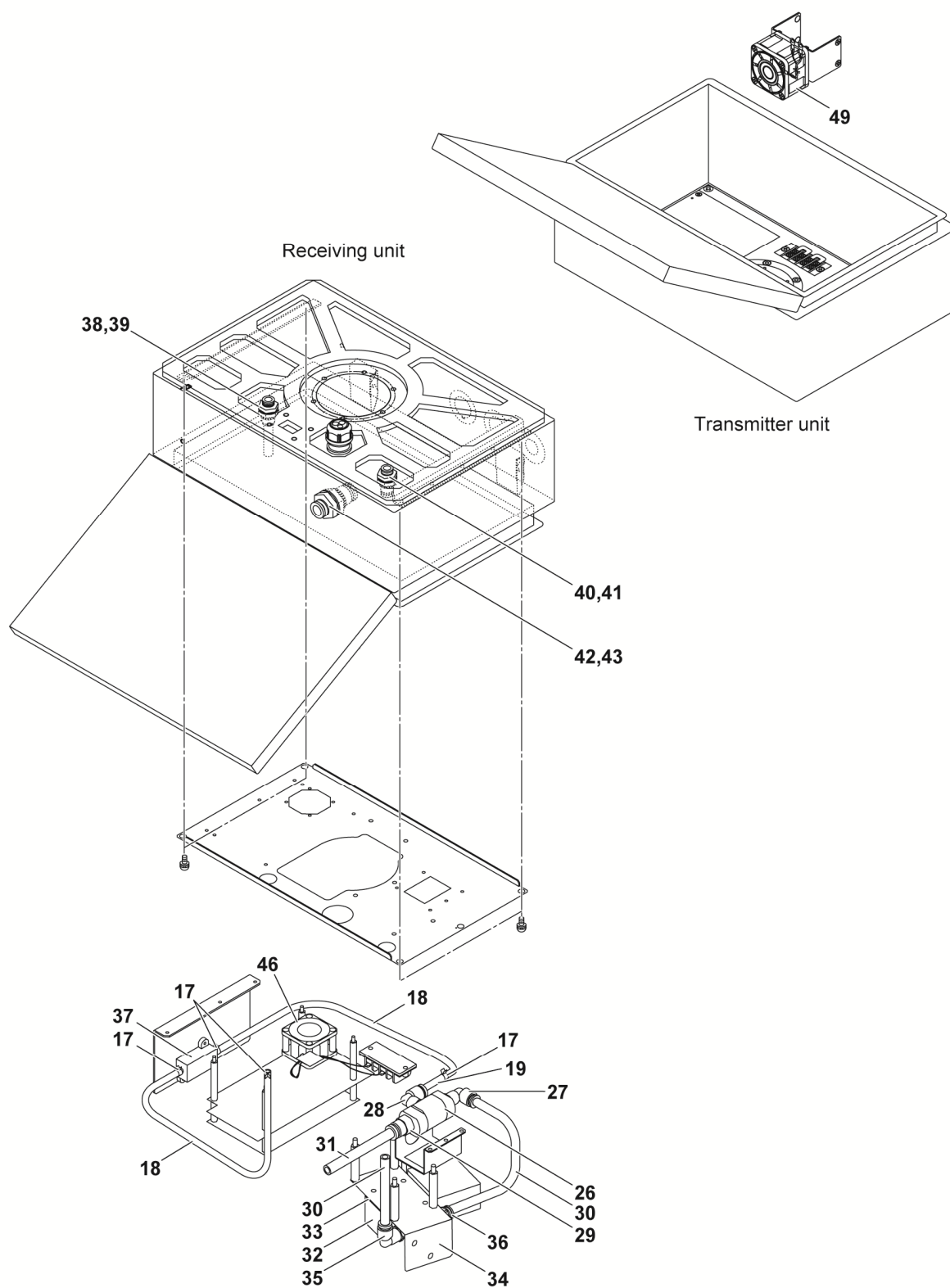


Fig. 1-5 Exploded view of the transmitter unit and the receiver unit

Table 1-2 Parts list of the detection unit

Item No.	Part Number	Parts name	Q'ty	Remark
1	A010	Detection unit	1	
2	A020	Cell unit ass'y	1	
3	A030	Nut	2	M33 SUS × M7
4	A040	Spring washer	2	M33 SUS × M7
5	A050	Gas cell ass'y	1	
6	A060	Window unit	2	
7	A070	Mounting	2	
8	A080	Cap screw	12	M5 × 18 SUS × M7
9	A090	O-ring	2	FKM-70 S50
10	A100	O-ring	2	FKM-70 S60
11	A110	Plug	2	
12	A120	Fitting	1	ø6mm
13	A130	Fitting	1	ø8mm
14	A140	Sealing tape	1	PTFE, 0.1mm × 13mm × 10m
15	A150	O-ring	2	FKM-70 G90
16	A160	Cap screw	12	M4 × 10 SUS × M7
17	A170	Hose clamp	2	
18	A180	PVC tube	2	ø7 × ø10, 200mm, 300mm
19	A190	PTFE tube	1	ø6 × ø8, 40mm
20	A200	Cable between the transmitter unit and the receiver unit	1	
21	A210	Label	1	Class1 laser product
22	A220	Label	1	Warning
23	A230	L-angle	2	
24	A240	Cap screw	16	M5×12 SUS × M7
25	A250	Flange	2	
26	A260	Ejector	1	
27	A270	Fitting	1	ø6mm
28	A280	Fitting	1	ø8mm
29	A290	Fitting	1	ø10mm
30	A300	PTFE tube	2	ø4 × ø6, 180mm, 60mm
31	A310	PTFE tube	1	ø8 × ø10, 70mm
32	A320	Solenoid valve	1	
33	A330	Sheet	1	
34	A340	Plate	1	
35	A350	Fitting	1	ø6mm
36	A360	Fitting	1	ø6mm
37	A370	Flow sensor	1	
38	A380	Fitting	1	ø6mm
39	A390	Washer	1	
40	A400	Fitting	1	ø8mm
41	A410	Washer	1	
42	A420	Fitting	1	ø10mm
43	A430	Washer	1	
44	A440	Ferrite core	2	
45	A450	Tube ass'y	1	
46	A460	Receiver unit fan ass'y	1	
47	A470	Ejector ass'y	1	
48	A480	Solenoid valve ass'y	1	
49	A490	Transmitter unit fan ass'y	1	

1.3. Configuration of the extraction unit

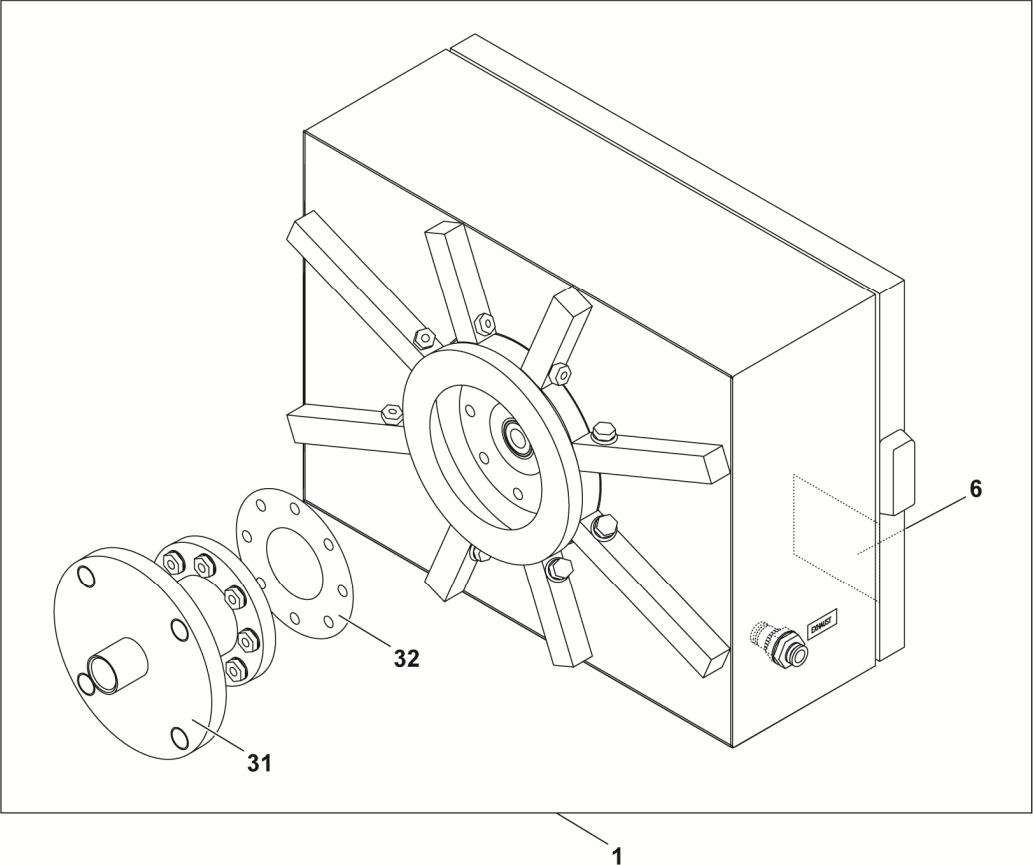


Fig. 1-6 Exploded view of the extraction unit

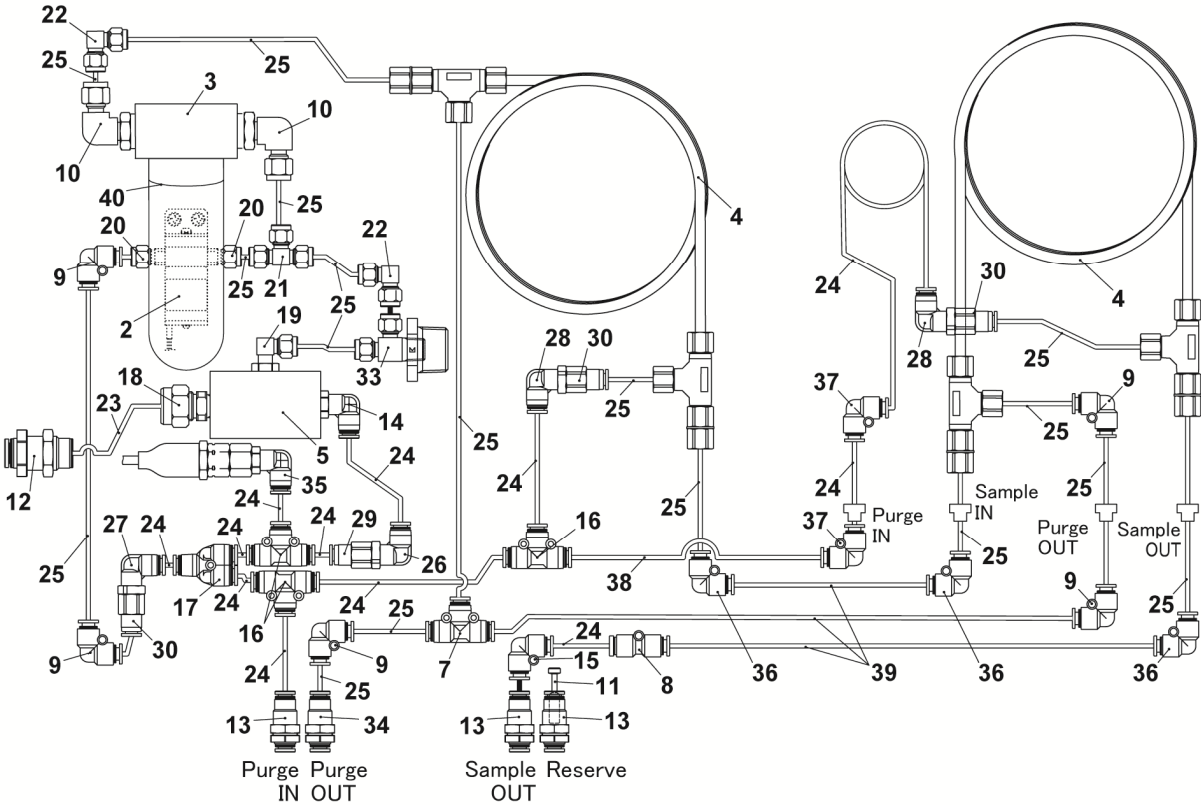


Fig. 1-7 Piping system diagram of the extraction unit

Table 1-3 Parts list of the extraction unit

Item No.	Part Number	Parts name	Q'ty	Remark
1	D010	Extraction unit	1	Mounting flanges standard JIS 5K65A
2	D020	Solenoid valve	1	
3	D030	Filter	1	
4	D040	Dryer	2	
5	D050	Ejector	1	
6	B630	Label	1	
7	D070	Fitting	1	
8	D080	Fitting	1	
9	D090	Fitting	5	
10	D100	Fitting	2	
11	D110	Tube cap (B)	1	
12	A420	Fitting	1	
13	A380	Fitting	3	
14	A270	Fitting	1	Sealing is required.
15	D150	Fitting	1	
16	D160	Fitting	3	
17	D170	Fitting	1	
18	D180	Fitting	1	Sealing is required.
19	D190	Fitting	1	Sealing is required.
20	D200	O-ring connector	2	
21	D210	Fitting	1	
22	D220	Fitting	2	
23	A310	PTFE tube	1	ø8 × 10, 2m
24	D240	PTFE tube	1	ø4 × 6, 2m blue
25	D250	PTFE tube	1	ø4.35 × 6.35, 2m yellow
26	D260	Fitting with orifice	1	
27	D270	Fitting with orifice	1	
28	D280	Fitting with orifice	2	
29	D290	Fitting	1	
30	D300	Fitting	3	
31	D310	Joint	1	Mounting flanges standard JIS 5K65A
32	D320	Flange packing	1	
33	D330	Fitting	1	Sealing is required.
34	D340	Fitting	1	
35	A350	Fitting	1	
36	D360	Fitting	3	
37	D370	Fitting	2	
38	D380	PTFE tube	1	6A, 2m
39	D390	PTFE tube	1	1/4B, 2m
40	D400	O-ring	1	

1.4. Lists of Preparations

Prepare replacement parts, jigs and tools described below.

Table 1-4 Regular replacement parts

Parts name	Q'ty	Part Number	Replacement cycle (years)
Filter element	12	E060	1/12
O-ring	2	A090	1
O-ring	2	A100	1
PVC tube	Several meters	A180	1
Tube ass'y	1	A450	1
Battery	1	B700	1
O-ring	1	D400	1
Bolt	4	E010	2
Spring washer	4	E020	2
Washer	4	E030	2
Nut	4	E040	2
Packing	1	E050	2
Gas sampling probe	1	F010 - F015 *1	2
Window unit	2	A060	5
Fitting	1	A120	5
Fitting	1	A130	5
Transmitter unit fan ass'y	1	A490	5
Receiver unit fan ass'y	1	A460	5
Solenoid valve ass'y	1	A480	5
Ejector ass'y	1	A470	5
Switching power supply	1	B220	5
Switching power supply	1	B230	5

*1 Select and prepare one with the same length as the part at the time of delivery.

Table 1-5 Spare parts

Parts name	Q'ty	Part Number
Sealing tape	1	A140
PTFE tube	Several meters	A190
Instruction manual	1	C020
Receiver/transmitter box key	1	C030
Interface box key	1	C040
Tube cap (B)	2	D110
PTFE tube	Several meters	D240
PTFE tube	Several meters	D250
PTFE tube	Several meters	D380
PTFE tube	Several meters	D390
Tube cap (A)	1	E080
Sample gas tube	Several meters	G011

Table 1-6 Jigs and tools

Name	Q'ty	Application and remarks
Zero gas (pure nitrogen)	1	For zero-calibration, impurity ≤ 1 ppm C, ≤ 1 ppm CO, ≤ 400 ppm CO of $_2$, ≤ 0.1 ppm NO
Span gas (pure nitrogen + SO ₂)	1	For span calibration, SO ₂ concentrations of 240 ppm or more and less than 300 ppm
Span gas (pure nitrogen + CO ₂)	1	For span calibration, CO ₂ concentrations of 8% or more and less than 10%
Pressure regulator	1	secondary pressures 0.1MPa or more
Flow meter	1	For calibration, 0.5 L/min or more
Notebook PC	1	For PC loaders
Pump	1	For leakage test, maximum vacuum reach-10 kPa or more
Flow meter	1	For leakage test with a detection limit of 2.5 mL/min or less
Set of tools	1	Set of general-purpose tools
Tube cutter	1	Cut the PTFE tube and PVC tubes vertically.
Monkey wrench (M12 or more)	2	Remove and attach the bolts and nuts of the sampling and detection sections.
Pipe wrench (ø28 or more, total length 500mm or more)	1	Removing and installing the sampling tube in the sampling section
Metal rods (about 3mm in diameter and 10cm or more in length)	1	For removing the window unit. A positive driver or a negative driver can be substituted.
Blank flange (JIS 5 K 65 A)	1	Inspection and replacement of the sampling tube for temporary holding
Cloth	1	Inspection and cleaning of sampling and detection sections
Brush	1	Inspection and cleaning of the sampling section
Blower	1	Cleaning of the detection unit window unit
Rulers	1	For checking the mounting of the detection unit window unit
Flashlight (handy light)	1	Inspection of the inside of the gas cell
Digital multi-meter	1	For checking the power supply voltage
Hexagon wrench 2 mm	1	Removing and mounting the light emitting module
Hexagon wrench 4 mm	1	Removing and attaching the joint (with hexagon socket socket) for the gas cell (light emitting part side)
Hexagonal wrench with ratchet 4mm	1	Remove and attach the light emitting unit and light receiving unit.
Hex wrench 6 mm	1	Removing and attaching the joint (with hexagon socket socket) for the gas cell (light receiving side)
Digital-camera	1	For preserving the current state of the inside of the light-receiving unit
Nut driver 6 mm	1	Remove and install the printed circuit board (PD Digital) of the light receiving unit.
Silicone grease	1	For lubrication of O-rings. (e.g., Shin-Etsu Chemical G-501)
Plier	1	Remove and attach the clamp connecting the tube of the light receiving unit.

1.5. Installing and Configuring the PC Loader

The PC loader is used for some of the services. Prepare a PC that meets the following requirements and install the PC loader.

PC requirements

OS: Windows 8 or later

Screen resolution: 1024 × 768 or higher

Interface: LAN connector

[Procedure]

- Copy the folder containing the set of files associated with the PC loader to the appropriate directory (e.g., desktop).
- Open the initialization file ZqsLsAnalyzer.ini with an application such as notepad to set the language.
(Language = 001 ※ Select and set this value from the following values: 001:English, 081: Japanese, 086: Chinese)
- Turn on the ZQS power supply and wait for at least one minute (CPU module startup wait time).
- Run ZqsLsAnalyzer.exe

Note: The PC loader does not start normally because communication is not possible if the ZQS is turned off.

Note: To connect the CPU module and the notebook PC with LAN cable, disconnect the existing LAN cable.
Modbus communication with the host system (e.g., EGCS control panel) is cut off during this period.

1.6. How to handle one-touch fitting

During maintenance, you frequently remove and attach tubes from fittings. Many "one-touch fittings" are used for the joints. The following explains how to handle them.

1. As shown in Photo 1-1, a tube is connected to a one-touch fitting. The one-touch fitting have a ring.

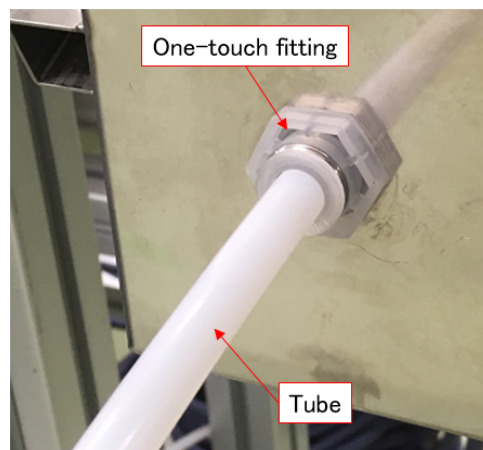


Photo 1-1 The tube is connected to the one-touch fitting.

2. To remove the tube from the one-touch fitting, pull it out while pushing the ring uniformly, as shown in Photo 1-2. The force required to pull out is 5 to 15N. Unless the ring is pushed in, it will not come out because it is locked.

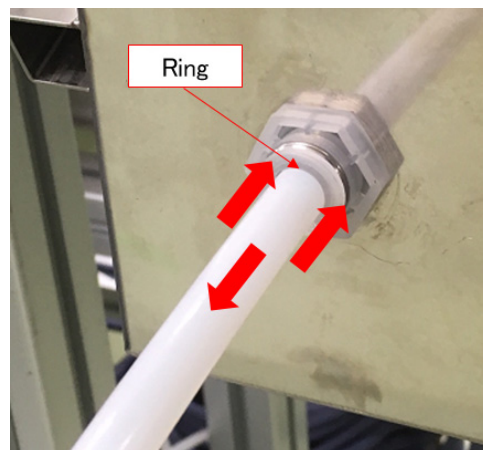


Photo 1-2 Pull out the tube while pushing the ring uniformly.

3. Before attaching the tube to the one-touch fitting, check the following conditions.
The cross section of the tube tip shall be perpendicular to the longitudinal direction.
No scratches, dirt, or collapse at the tip of the tube inserted into the fitting.
No dirt or damage to the joint.
If these are not met, leakage from the fitting will occur. Also, since one-touch fittings and tubes are consumables, they may leakage due to invisible degradation if they are attached and detached many times. Please satisfy the above conditions by replacing the product with a new product or cutting the leading edge of the pipe as necessary.
4. When attaching the tube to the one-touch fitting, insert the tube back into the fitting as shown in Photo 1-3 and push it until it stops.
There is no need to touch the ring.



Photo 1-3 Insert the tube into the fitting and push it until it stops.

5. Pull the tube with a force of 5 to 15N, as shown in Photo 1-4, to confirm that the tube has been securely attached.
Do not touch the ring of the one-touch fitting.
If it is not pulled out, it is complete.
If it is missing, start again from step (3).
Replace the one-touch fitting with a new one if it comes off after many trials because it is suspected that the one-touch fitting will fail.
Replacement procedures are described in of this manual.
Refer to "3. MAINTENANCE".



Photo 1-4 Pull the tube with a force of 5 to 15N to confirm that it does not come off.

2. INSTALLATION AND COMMISSIONING

For installation, piping, wiring, and commissioning, refer to the instruction manual. See the chapters of “4. INSTALLATION” and “5. OPERATION”.

3. MAINTENANCE

The following table lists regular maintenance by service personnel. Confirm the maintenance interval before performing maintenance.

Table 3-1 Maintenance items

Name	Maintenance interval	Maintenance details	Description
Maintenance of the extraction unit	Once per year	Inspection of Gas sampling probes Replacing the O-ring of the filter	3.1 of this service manual
	Once every two years	Replacement of Gas sampling probe Replace the bolts, nuts, and washers for fixing the flange. Replacement of sample gas tube	
Maintenance of the detection unit	Once per year	Replacement of O-ring Cleaning the window unit Cleaning the gas cell Replacement of gas cell tube assembly Replacing the tube inside the receiver unit	3.2 of this service manual
Maintenance of the interface box	Once per year	Replacing the battery of the CPU module	3.3 of this service manual
Calibration	Once per year	Zero calibration and span calibration	"7.1 Calibration" in the Operation Manual
Leakage test	Once per year	Leakage test	"7.2 Leakage Test" in the Operation Manual
Overhaul	Once every five years	Disassembly, inspection, and replacement of parts	3.4 of this service manual

Perform annual maintenance in the following order;

Maintenance of the extraction unit, maintenance of the detection section, calibration, leakage test, and replacement of the battery of the CPU module.


Maintenance should be performed once every two years in the following order;


Maintenance of the extraction unit, maintenance of the detection section, calibration, and leakage test.

Maintenance should be performed once every five years in the following order;

Overhaul, calibration, and leakage test.

3.1. Maintenance of the extraction unit

 DANGER	<ul style="list-style-type: none">• Make sure that the engine is completely stopped when removing the sampling section from the flue. If the product is removed while the engine is running, the exhaust gas may blow out and cause serious injury or even death.• Before removing the sampling section from the flue, secure a scaffold for work. Also, install a fence on the scaffold or attach a safety belt to prevent falling. People who fall may be seriously injured or may die.• Provide fences to prevent people from entering under or around the sampling section when it is removed. If the unit falls inadvertently and hits a person, serious injury or even death may result.
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 CAUTION	<ul style="list-style-type: none">• Be careful not to drop the device onto your feet. Fractures may occur.• The work environment may become hot. Take measures to prevent heat stroke, such as breaking the work time, replenishing water, or moving to a cool place.• After use, the collection tube contains acids and dust in the exhaust gas. Wear acid-resistant gloves, protective glasses, and dust masks during operation.• Replace only the components specified by the manufacturer. This may cause an accident or failure as well as insufficient performance.• Replaced used parts must be discarded in accordance with the rules stipulated for each ship.
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Inspection and replacement of the gas sampling probe, replacement of the O-ring of the filter, and replacement of the bolts, nuts, and washers for fixing the flange. Perform the following procedure.

Note: The gas sampling probe in the sampling unit is contaminated with exhaust gas from the scrubber. Since the exhaust gas contains sulfuric acid, the gas sampling probe may corrode and break and fall. Therefore, make sure to perform an inspection once a year. If it is corroded, replace it. Be sure to replace it at least once every two years.

Be sure to replace the bolts, nuts, and washers used to fasten the flanges once every two years as there is a danger of corrosion or sticking.

[Procedure]

1. Turn off the power switches (three places) of the main unit.
2. If the wiring interferes with the work, remove the wiring. For wiring, refer to "4.6.1 Connecting the units" in the instruction manual.
3. After confirming that the engine is stopped, remove the tube connected to the exhaust port of the sampling section from the sampling unit.
Refer to "4.5.3 Exhaust gas tube" in the instruction manual for the exhaust port and piping.
Pull out the tube while pushing the ring of the one-touch joint with the tube inserted (Photo 3-1).

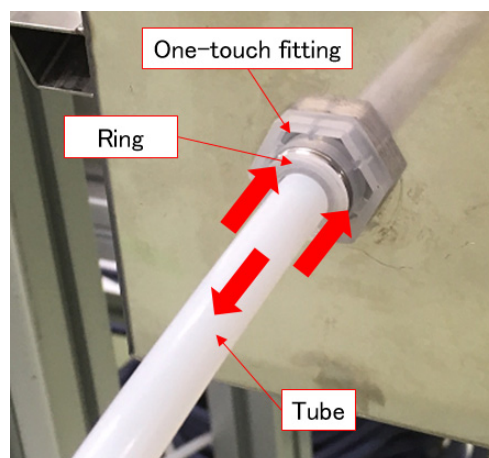


Photo 3-1 Remove the tube connected to the outlet of the sampling section from the sampling section.

4. Remove the sampling unit from the flue flange.
Refer to "4.4.2 Installation" in the operation manual for the mounting of the sampling unit.
Keep instrumentation air flowing and remove the sampling unit.
If the bolts and nuts are fixed, apply a torque equal to or higher than the tightening torque (70N·m) and remove them.
Replace the installation bolts, nuts, and washers with a new ones once every two years.
5. Keep the gas sampling probe in a horizontal or downward position, and place the removed sampling unit on a safe floor.
Do not incline the gas sampling probe above horizontal (Photo 3-2).
If dirt such as sludge accumulates in the gas sampling probe, it will be difficult to recover from the dirt if it enters the extraction unit, and the entire extraction unit must be replaced.

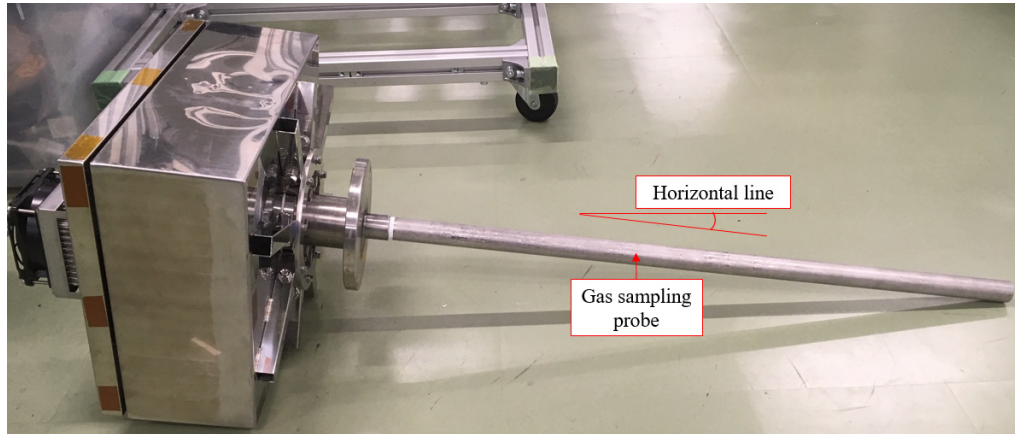
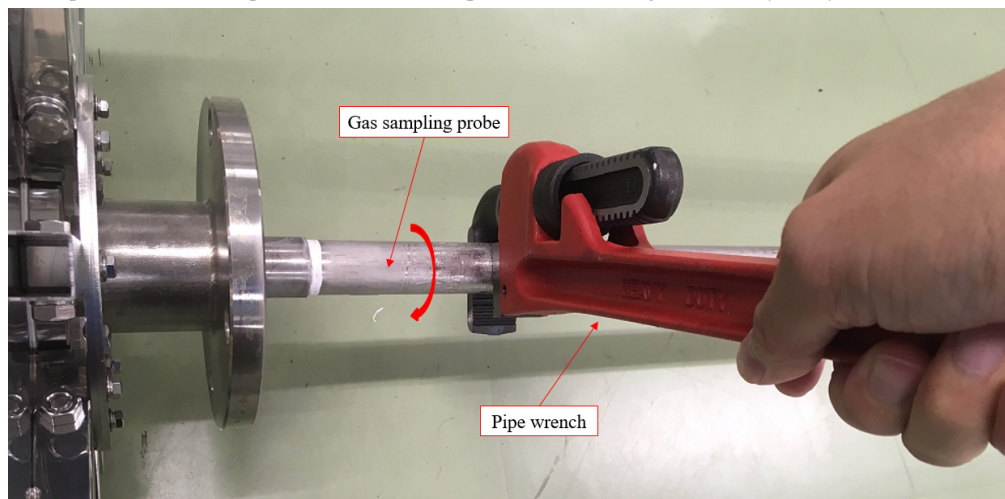


Photo 3-2 The gas sampling probe is always oriented below horizontal.

6. Remove sludge, soot, etc. from the flue flanges and branch pipes.
7. Remove dirt from the phase flange packing. If there is a scratch or damage of the flange. Replace it with a new one.
Also, replace it once every two years.
8. Temporarily attach the blank flange to the flue flange. With inserting a flange packing.
Even if the engine is stopped, it is dangerous if exhaust gas accumulated in the flue gas leakages.
9. Use a pipe wrench (ø28mm or more, total length 500mm or more) to remove the gas sampling probe from the sampling unit (Photo 3-3).
Proceed to step 10 for annual inspection. Proceed to step 12 for an exchange once every two years.



Picture 3-3 Turn off the gas sampling probe with the pipe wrench.

10. Clean the removed tube with a cloth or brush to make the surface of the tube visible.

11. Visually check the surfaces of the removed probe, particularly the thread (R3/4) (Photo 3-4). If there is any corrosion, replace it with a new product.

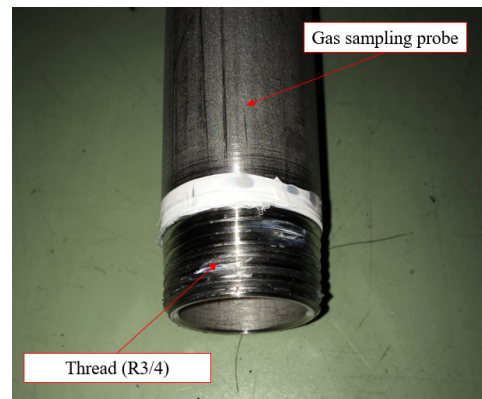


Photo 3-4 Check the thread (R3/4) for corrosions.

12. Clean and visually check the screw (R_C3/4) on the sampling unit (Photo 3-5). Replace it if there is any corrosion. Please contact us.

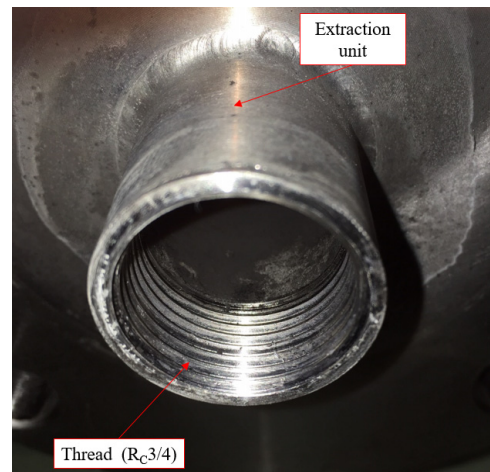
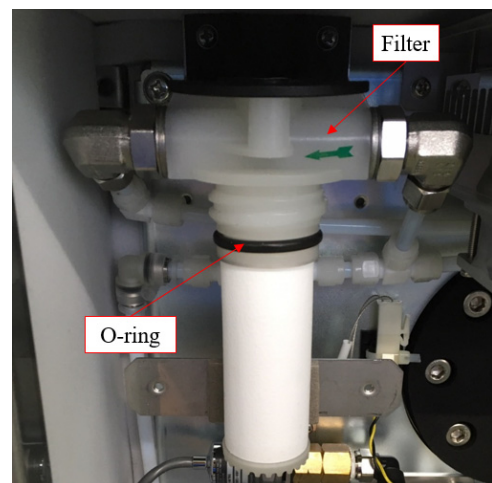


Photo 3-5 Check the thread (R_C3/4) for corrosions.




13. Attach a corrosion-free gas sampling probe to the corrosion-free sampling unit. Refer to "4.4.2 Installation" in the instruction manual, wind the seal tape, and tighten it using a pipe wrench (ø28mm or more, full length 500mm or more).
14. Replace the O-ring of the filter. Remove the glass according to "8.1.2 Replacing the Filter Element" in the instruction manual to expose the O-ring (Photo 3-6). Remove the O-ring and replace it with a new one.



Replace Photo 3-6 O-ring

15. Remove the blank flange from the flue and attach the sampling unit to the flue flange with inserting a flange packing. Even annual maintenance, replace the bolts, nuts, and washers with new ones if they are fixed at the time of removal. Be sure to replace them when maintenance once every two years.
16. Replace the sample gas tube with a new one.
17. Restore piping and wiring.
This is the end the maintenance work of the sampling unit.

3.2. Maintenance of the detection unit

Precautions for Handling Laser Products	
 CAUTION	<p>Laser elements that emit infrared laser light that is invisible to the 3B are mounted on the transmission section of this product. Be sure to observe the following precautions for safety.</p> <ul style="list-style-type: none">• Before working, make sure that the power switch of the unit is off.• Turn off not only the power switch but also the source switch.• Remove the cable between the transmission unit and receiving unit. <p>Remove the transmission unit and receiving unit after performing the above steps.</p> <p>Please never turn on the power supply until the installation of the light-emission unit and the receiving unit is completed. If the power is turned on with the transmission unit or the receiving unit removed, the laser light emitted from the transmission unit may enter the eye and blink may be lost. Laser light may also be applied to the skin, causing skin damage.</p>
 DANGER	<ul style="list-style-type: none">• Before removing the detector, make sure that there is a floor or scaffold below it.• If the unit falls inadvertently and hits a person, serious injury or even death may result.
 CAUTION	<ul style="list-style-type: none">• Be careful not to drop the device onto your feet. Fractures may occur.• The detector is made of metal. If the ambient room temperature is high, do not touch it with bare hands because it may cause burns. Wear heat-resistant gloves.• The surface and interior of the device are hot during operation. Turn off your power supply before working and do not touch it until the temperature falls. It may cause burns.• Replace only the components specified by the manufacturer. This may cause an accident or failure as well as insufficient performance.• Replaced used parts must be discarded in accordance with the rules stipulated for each ship.

Replace the O-ring, clean (replace) the window unit, clean the gas cell, replace the tube assembly of the gas cell, and replace the tube inside the receiving unit.

Be sure to perform the following steps once a year. Otherwise, correct measurement may not be possible or the product may fail.

[Procedure]

1. Be sure to turn off the power switches (three places) of the interface box. Turn off the power supply.
2. The temperature of the gas cell is 70°C during operation. After turning off the power switches, wait until the temperature drops.
The standard waiting time is about 30 minutes.
3. When the temperature of the gas cell drops, remove the transmitter unit, with keeping the gas cell mounted on a wall.
4. Disconnect the cable between the receiving and transmitter unit (Photo 3-7).
If this cable is disconnected, electric current cannot flow through the laser, and the laser does not emit light and irradiate it.

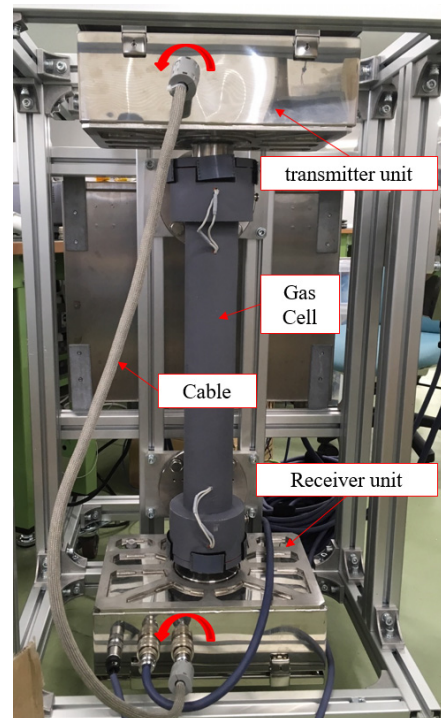


Photo 3-7 Disconnect the cable between the receiving unit and transmission unit.

5. First, start with the transmitter unit.
Remove the L angle between the transmitter unit and the wall-hanging flange.
Eight M5 hexagon socket head cap screws are tightened.
Remove this with a hexagon wrench (Photo 3-8).
Use a ratchet wrench to remove it quickly.

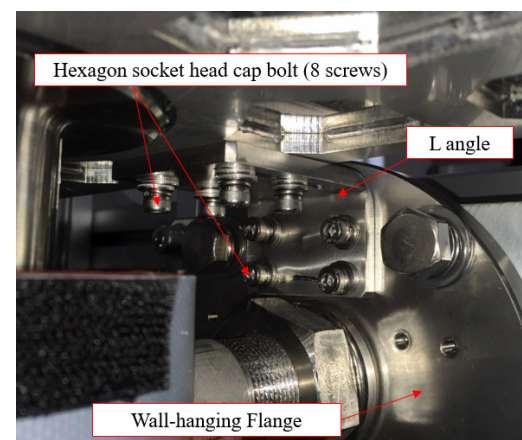


Photo 3-8 Remove the hexagonal socket head bolt (M5, 8) fastening the L angle.

6. Remove the heater cover of the gas cell on the transmitter unit side (Photo 3-9). Remove the three hook tapes to remove the heater cover. Re-use something removed (Photo 3-10).

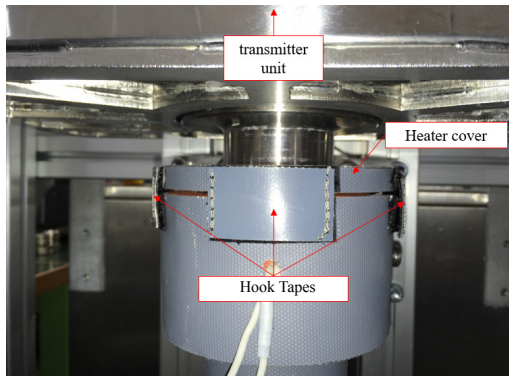


Photo 3-9 Remove three hook tapes and remove the heater cover.

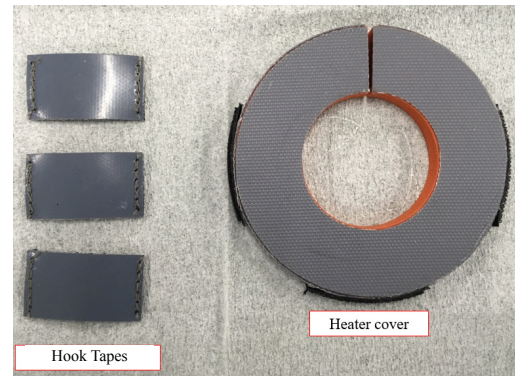


Photo 3-10 Hook tapes and heater cover removed

7. The gas cell and the transmitter unit are fastened with six M5 hexagonal socket bolts. Remove this with a 4mm hexagon wrench (Photo 3-11). Use the ratchet wrench to remove it quickly.

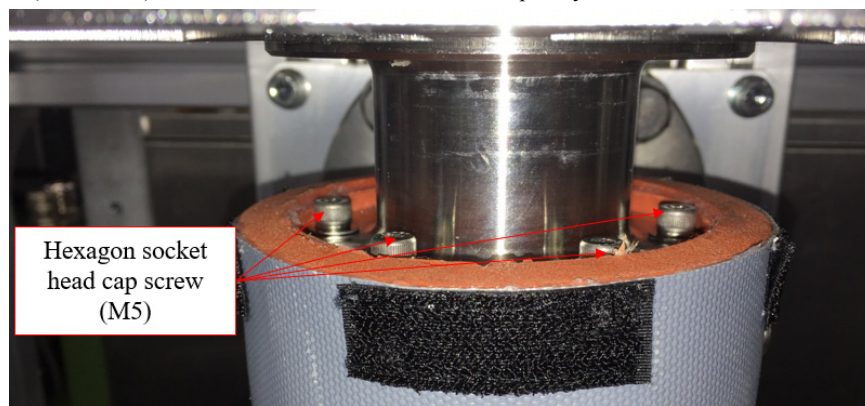


Photo 3-11 Remove the hexagon socket head cap screws (M5, 6) with a 4mm hexagon wrench.

8. When the transmitter unit is pulled up directly, the gas cell and the transmitter unit are separated from each other (Photo 3-12).

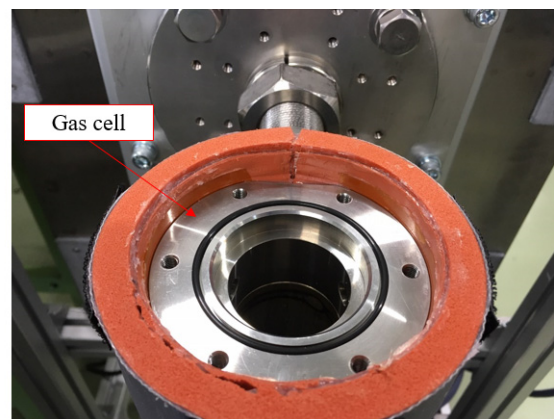
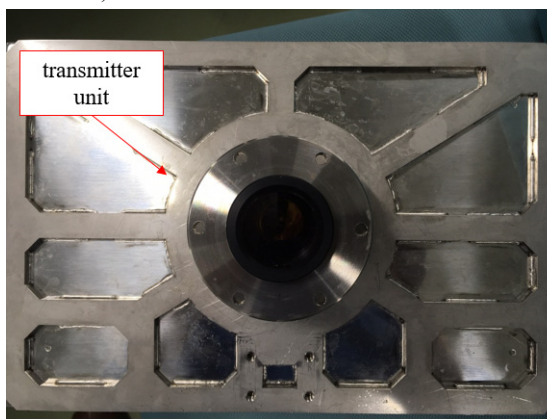


Photo 3-12 Separated Transmitter Unit and Gas Cell

9. Hook the O-ring (face seal type) on the gas cell side with a pointed tool and remove it (Photo 3-13). Attach a new one.
Note: Do not make a scratch when you remove the O-ring.
This may cause leakage.

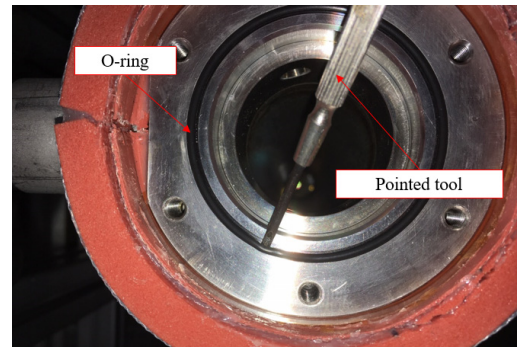


Photo 3-13 O-ring (face seal type) is hooked off with a pointed tool.

Remove the window unit on the transmitter unit side.

Two through holes with a diameter of 4 mm are opened on the side of the window unit. Pull it upwardly through the metal bar to remove the window unit (Photo 3-14).

Note: The window unit is fixed by the transmitter unit side and the positioning pin, so it does not rotate in the diametrical direction. It is easier to pick up by pulling it up alternately in the direction of the two arrows shown in the upper right corner of Photo 3-14.

- 10.

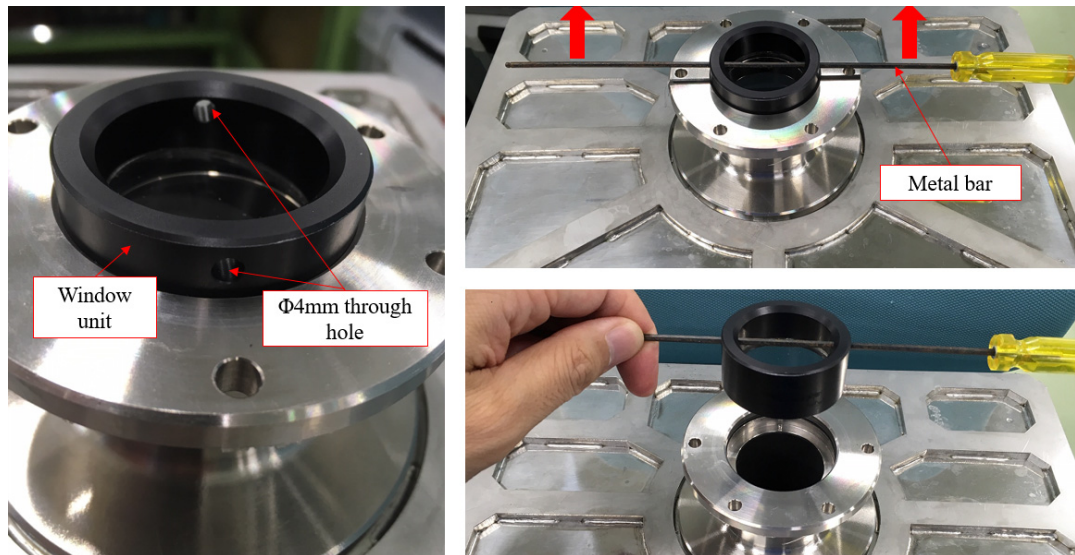


Photo 3-14 Remove the window unit from the transmitter unit.

11. Hook the O-ring (shaft seal type) on the transmitter unit side with a pointed tool and remove it (Photo 3-15). Apply silicone grease to a new O-ring and attach it to the transmitter unit.

Note1: Be sure to apply silicone grease (e.g., Shin-Etsu Chemical G-501) to the O-ring.

If you try to reassemble without grease, the O-ring may be damaged due to poor slip. This may cause leakage.

Note2: Do not make a scratch when you remove the O-ring.

This may cause leakage.

Note3: Do not put any foreign substance on the sealing plane.

This may cause leakage.

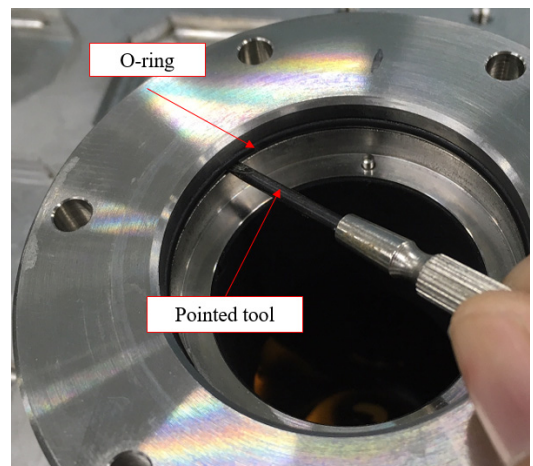


Photo 3-15 O-ring (shaft seal type) is removed by hooking it with a pointed tool.

12. Check the window unit for contamination. If it is dirty, blow off the solids with a blower (Photo 3-16). If there is no blower, it can be blown off using clean instrumentation air.
- Note: Don't blow your breath. The window may become dirty, or the window may rapidly cool and break due to saliva. Also, do not blow air containing oil or dust. The window may become dirty.

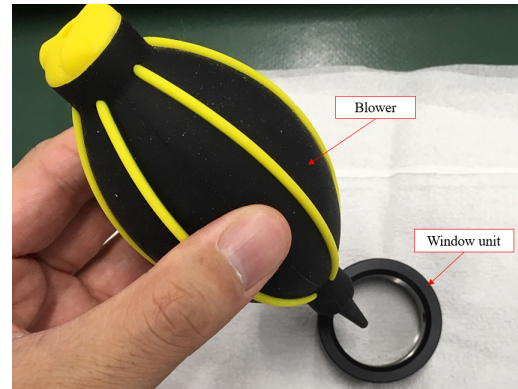


Photo 3-16 Blow off solids on the window unit by a blower.

13. Observe the window carefully after blowing off solids. If the surface of the window is dirty, or if it is cracked or broken, please replace the window unit with a new one.
14. Mount the window unit to the transmitter unit. A positioning pin (protrusion) is located on the side of the transmitter unit, and a positioning hole is located in the window unit (Photo 3-17). Push them in so that they fit. When assembled normally, the steps between the window unit and the transmitter unit are 9mm (Photo 3-18). If the step is longer than that, the product is not properly assembled. The protrusion may not fit into the hole. Repeat the procedure.

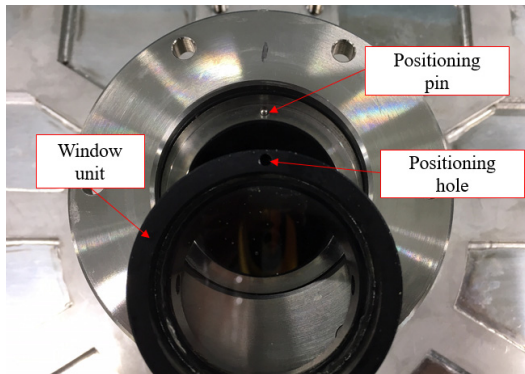


Photo 3-17 Positioning pins (protrusions) of the transmitter unit and positioning holes of the window unit. Assemble so that they fit

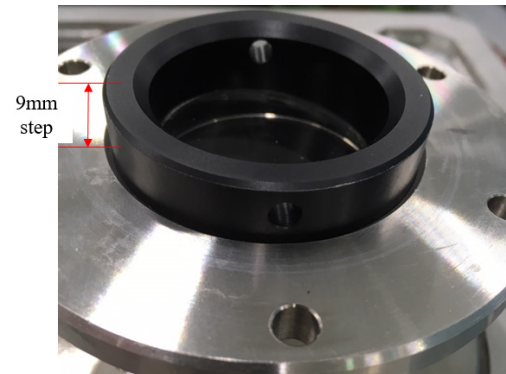


Photo 3-18 When assembled normally, the step between the window unit and the transmitter unit is 9mm.

15. Next, perform the work on the receiver unit side. It is recommended to remove the detection unit from the wall surface and temporarily fix the detector upside down to the wall surface because the receiver unit is located on the lower side and it is difficult to remove it.

16. A heater cable for the gas cell is connected between the receiving unit and the gas cell. Remove it. Unlock and open the panel of the receiving unit using the receiver/transmitter unit box key (Photo 3-19). There are two heater cable connectors inside the receiving unit (Photo 3-20). Remove these connectors. Loosen the cable ground on the outside of the receiving unit and pull out the heater cable from the receiving unit (Photo 3-21). Close the lid of the photodetector.

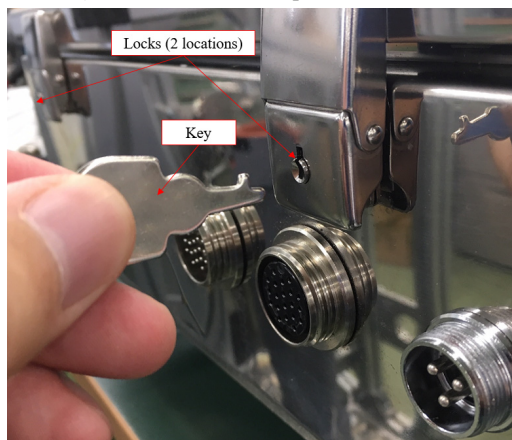


Photo 3-19 Unlock the panel of the receiver unit

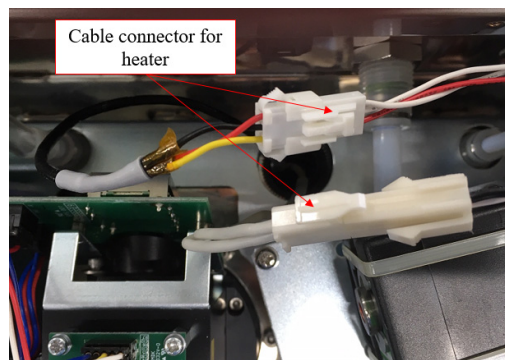


Photo 3-20 Cable connector for heater inside the receiver unit (2 locations)

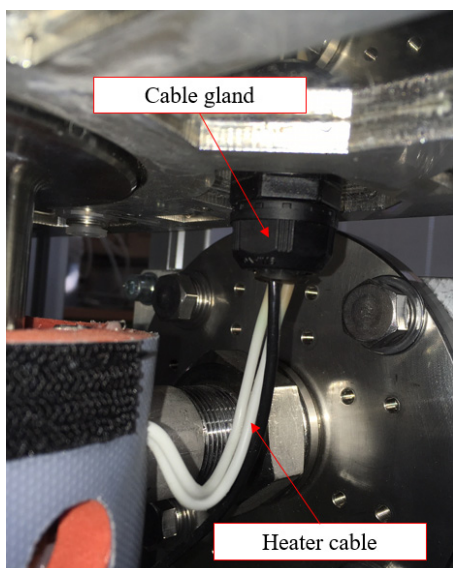


Photo 3-21 Cable ground outside the receiver unit (left). Disconnect the cable gland and pull out the heater cable (right)

17. Pull out the tube assembly (Photo 3-22) connected between the gas cell and the receiver unit from the two one-touch fittings. Pull out the end of the tube while pushing the rings of the fittings uniformly. Please replace this pipe assembly with a new product at the time of reassembly.

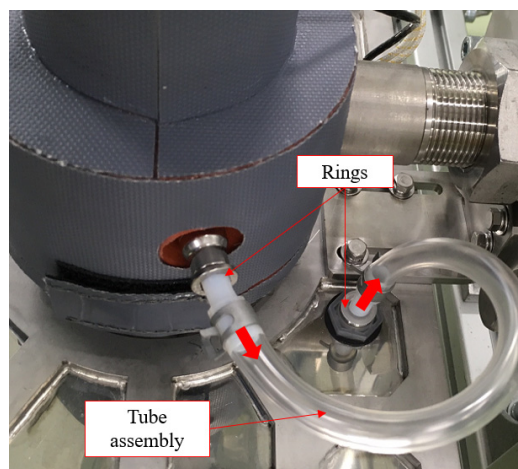


Photo 3-22 Tube assembly between the gas cell and the receiver unit

18. Disconnect the two cables between the receiver unit and the Interface box from the connectors.

19. Remove the heater cover of the gas cell on the receiver unit side (see Photographs 3-9 and 3-10).
20. The gas cell and the receiver unit are fastened with six M5 hexagonal socket bolts. Remove this with a 4mm hex wrench (as in Photo 3-11).
21. Pull the receiver unit directly upward to separate the gas cell from the receiver unit (see Photo 5-12).
22. Hook the O-ring (face seal type) on the gas cell side with a pointed tool and remove it (see Photo 3-13). Attach a new one.
Note: Do not make a scratch when you remove the O-ring. This may cause leakage.
23. Remove the window unit on the receiver unit side. Two through holes is formed in the side surface of the window frame. If you pull it through the metal bar, the window unit will come off (see Photo 3-14).
24. Hook the O-ring (shaft seal type) on the receiver unit with a pointed tool and remove it (see Photo 3-15). Apply silicone grease to a new O-ring and attach it to the receiver unit.
Note1: Be sure to apply silicone grease (e.g., Shin-Etsu Chemical G-501) to the O-ring. If you try to reassemble without grease, the O-ring may be damaged due to poor slip. This may cause leakage.
Note2: Do not make a scratch when you remove the O-ring.
This may cause leakage.
25. Check the window unit for contamination. If it is dirty, blow off the solids with a blower (see Photo 3-16). If there is no blower, it can be blown off using clean instrumentation air.
Don't blow your breath. Otherwise, the window may become dirty, or the window may rapidly cool and crack due to saliva. Do not blow air containing oil. Oil may contaminate the window.
Visually check the window after blowing off the solid content. If the surface of the window is dirty, or if it is cracked or broken, please replace the window unit with a new one.
26. Mount the window unit to the receiver unit. A positioning pin (protrusion) is located on the side of the receiver unit, and positioning hole is located in the window unit (see Photo 3-17). Push them in so that they fit. When assembled properly, the height difference between the window unit and the receiving unit is 9mm (see Photo 3-18). If the step is longer than that, the product is not properly assembled. The protrusion may not fit into the hole. Repeat the procedure.
27. Continue to clean the gas cell. Blow off the solids with a blower. If there is no blower, it can be blown off using clean instrumentation air.
Don't blow your breath. Otherwise, it may become dirty. Do not blow air containing oil. Oil may contaminate the gas cell. Wipe the inside of the gas cell with a clean cloth. Illuminate the inside with a flashlight to check the dirty state. If there is significant contamination, replace the gas cell. Please contact us.
28. Next, replace the tube inside the receiver unit. When the panel of the receiver unit is opened, the flow sensor and the tubes (b) and (c) connected to the flow sensor can be seen as shown in Photo 3-23. Replace tube (b) with tube (c).

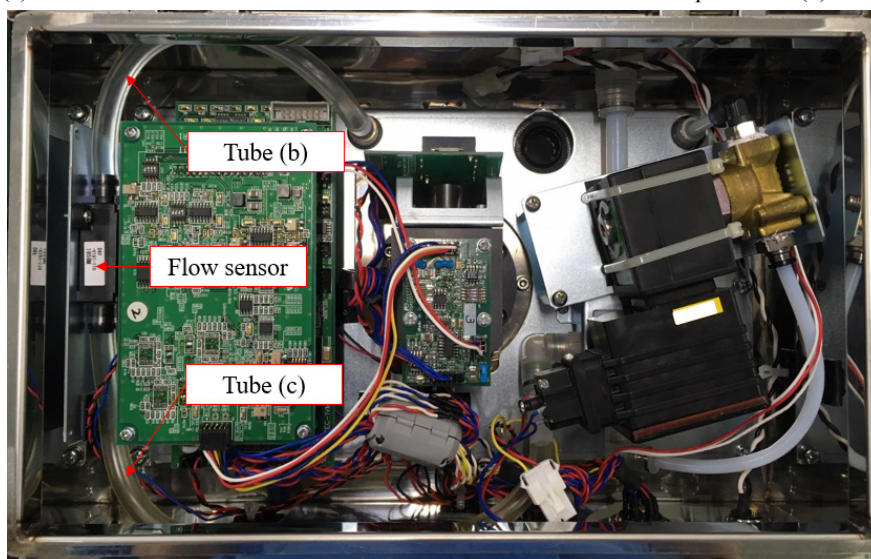


Photo 3-23 Flow sensor, tube (b) and tube (c), which are visible when the panel of the receiving unit is opened.

29. As shown in Photo 3-24, the flow sensor and tube are clamped together. When the clamps are grasped by the pliers and closed, the clamps expand and loosen. Loosen and shift the clamp to the tube side. The tube will be pulled out of the flow sensor. Pull out tube (b) and tube (c) from the flow sensor.

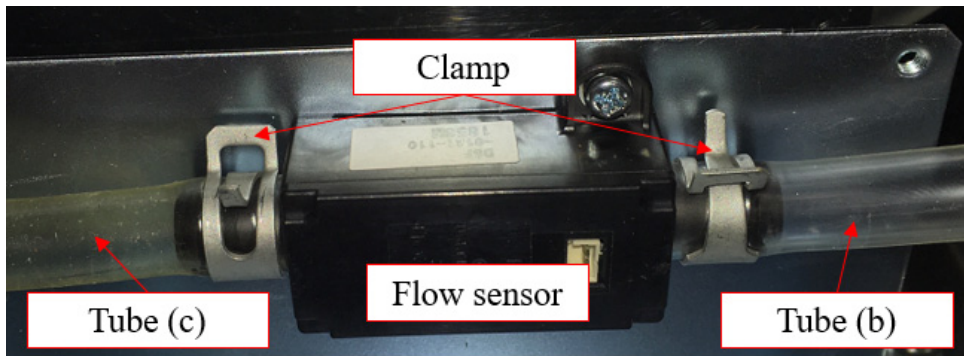


Photo 3-24 Clamps for fixing the flow sensor and tube (2 points)

30. The other ends of tube (b) and tube (c) are connected to the one-touch fitting shown in Photo 3-25. Remove the tube from the fitting. Pull out the tube while pushing the ring of the fitting uniformly.

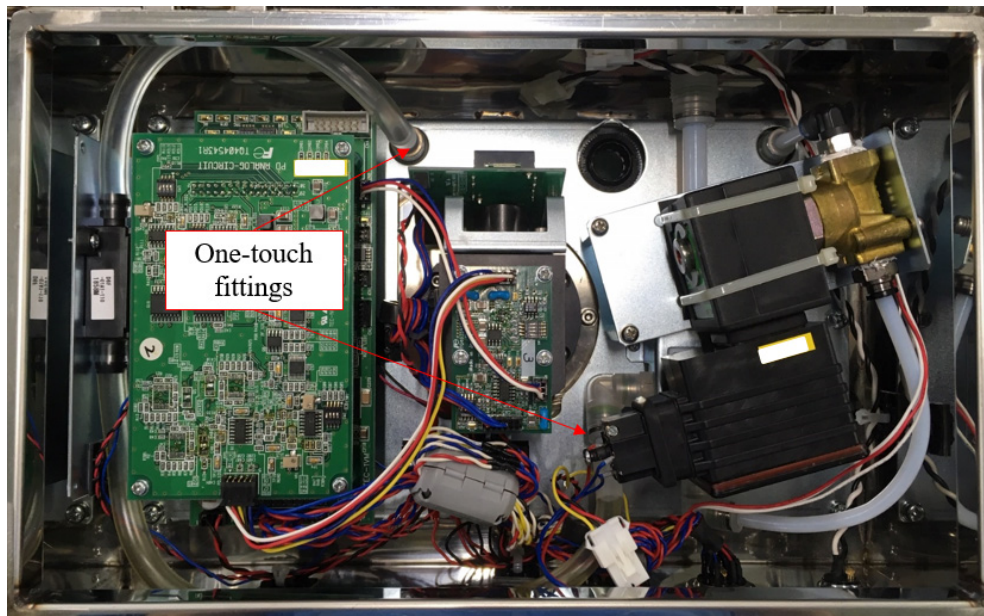


Photo 3-25 Joint with tube connected

31. Please replace the removed two tubes with new ones. Install the tube according to the reverse of the above procedure.
32. Reassemble the gas cell in the order of the transmitter unit and receiver unit. Each assembly procedure should be performed in the reverse order of this procedure. Keep in mind the mounting direction. The correct orientation is that the connector of the receiver and transmitter cables face directly opposite the wall surface.
33. Assemble the tube connected between the gas cell and the receiver unit using a new tube. Refer to Photo 3-22 for piping so that the tube does not break or collapse.
34. Install two cables between the receiver unit and the transmitter unit, and between the receiver unit and the Interface box. This is the end of the maintenance work of the detection unit.

3.3. Maintenance of the Interface box

Replace the battery in the CPU module once a year.

Open the cover at the bottom of the CPU module to expose the battery and connector. Pull out the connector. Mount a new battery (part number: B700) with connectors to the CPU module (Photo 3-26).

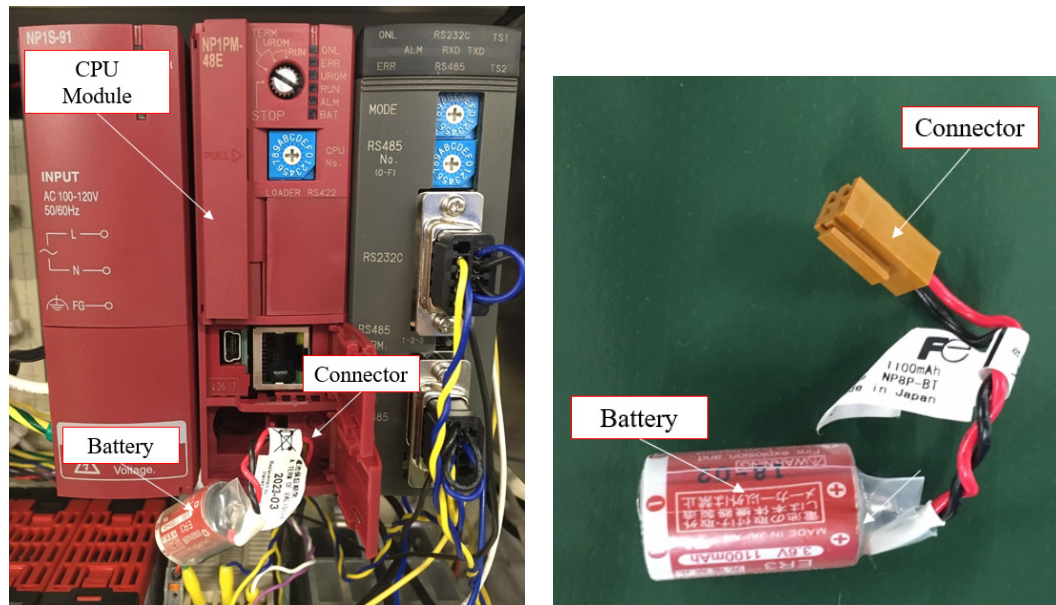


Photo 3-26 CPU module (left) and built-in battery (right) in the Interface box

3.4. Overhaul

In the case of overhaul, decomposition, inspect, and replace the extraction unit, the detection unit, and the Interface box once every five years. In doing so, perform the maintenance of the detection unit and the interface box once a year as described above.

3.4.1. Replacement of gas cell fittings

Replace the fittings of the gas cell (two parts on the transmitter unit side and receiver unit side) according to the following procedure.

It is recommended that this work be performed with the transmitter unit and the receiver unit removed. (after doing the procedure from 1 to 7 and from 15 to 21 in clause 3.2)

Note: The hexagon wrench used in this procedure should have been subjected to rust removal and degreasing treatment to prevent contamination of the gas cell.

1. Insert a 4mm hexagon wrench into the fitting (Photo 3-27) on the transmitter unit side of the gas cell, and rotate it counterclockwise to remove it.
Note: The hexagon socket head socket of the fitting is inside. Pass the hexagon wrench through the inside of the gas cell.

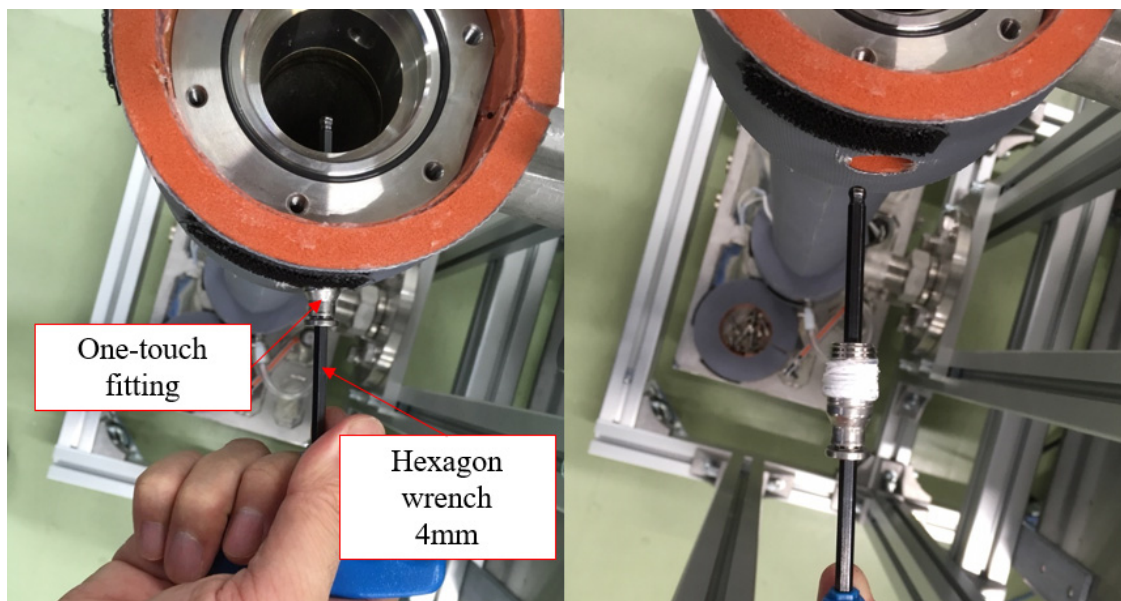


Photo 3-27 Gas cell fitting (transmitter unit side) before (left) and after (right) removing with a hexagon wrench (4mm)

2. Insert a 6mm hex wrench into the fitting on the receiver unit side of the gas cell and rotate it counterclockwise to remove it (Photo 3-28).
Note: The hexagon socket head socket of the fitting is inside. Pass the hexagon wrench through the inside of the gas cell.

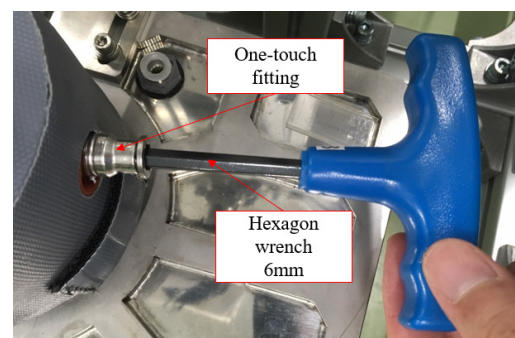


Photo 3-28 Remove the gas cell fitting (on the receiver unit side) with a hexagon wrench (6mm).

3. Wipe the screws of the gas cell.
Remove any residual sealing tape from the gas cell.
4. Wrap the sealing tape (PTFE) around the screws of the new joint.
Refer to "4.4.2 Installation" in the Operation Manual for the wrapping method.
5. Tighten the new fitting to the transmitter unit side and the receiver unit side (tightening torques 7 to 9N · m) in the reverse order of removal.

3.4.2. Replace the transmitter unit fan

The transmitter unit contains a fan for dissipating heat from the laser device. Replace this fan as follows.

Note: Many precision electronic and optical components are built in the transmitter unit. Do not touch or contaminate parts unrelated to this procedure.

1. Open the transmitter panel with the key (see Photo 3-19).
2. Remove the transparent cover of the terminal block and remove the terminal to which the fan cable is connected with the screwdriver (Photo 3-29).

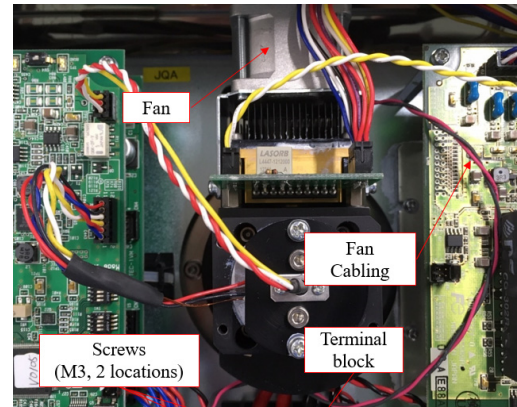


Photo 3-29 Remove screws (M3, 2 positions)

3. Remove the four cable connectors (Photo 3-30).

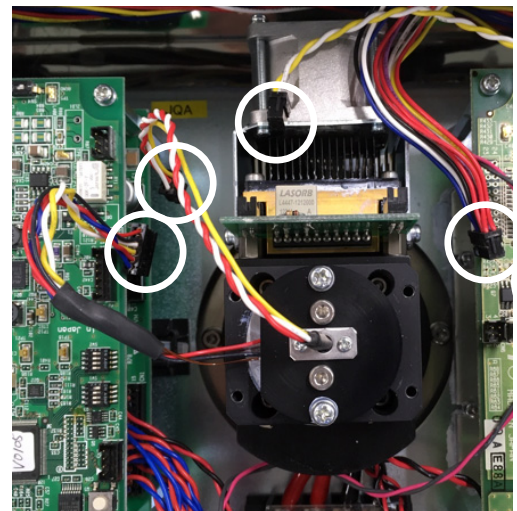
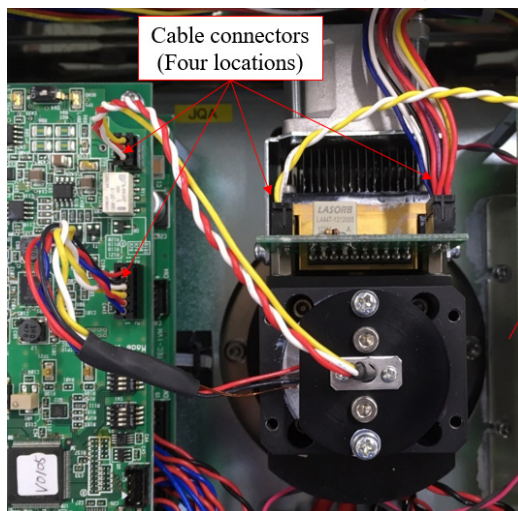


Photo 3-30 Before disconnecting (left) and after disconnecting (right) the cable connectors (four places)

4. Remove the hexagon socket head cap bolt (M3, 4 points) fixing the transmitter module (Photo 3-31) with a 2mm hexagon wrench (Photo 3-32, 3-33). Reuse the removed hexagon socket head cap screws. Store them temporarily in a place where they will not be lost.

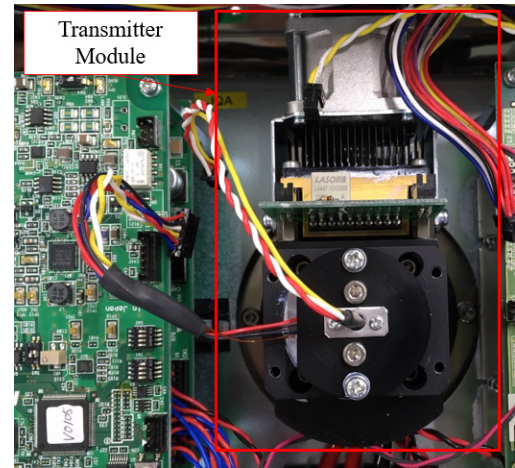


Photo 3-31 Transmitter Module

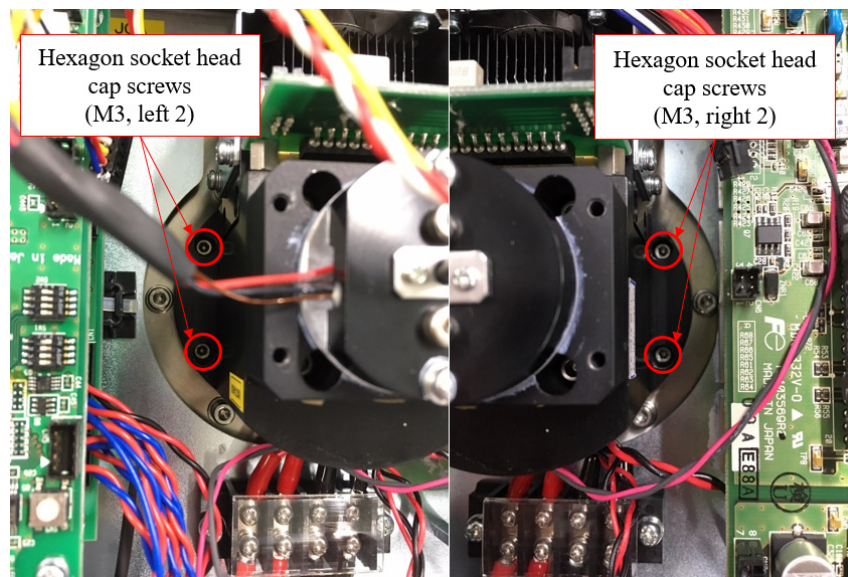


Photo 3-32 Hexagon socket head cap bolts (2 on the left and 2 on the right)

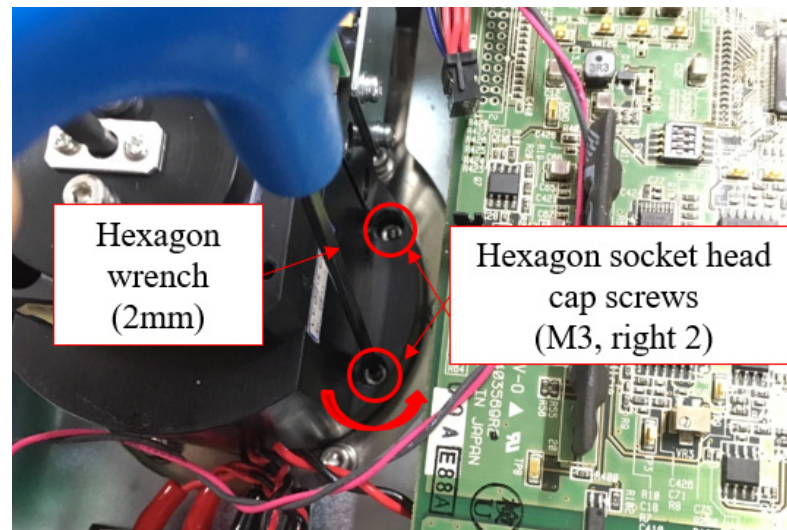


Photo 3-33 Remove the bolts with hexagon sockets (4 points) with a hexagon wrench (2mm)

5. Lift and remove the transmitter module.

Note: The transmitter module is in contact with the main body with grease, so even if it is pulled up straight, it cannot be removed because of the vacuum. To remove, rotate it and pull it up so that air enters between the transmitter module and the main body (Photo 3-34). The transmitter moves rapidly at the moment when it comes off. Do not drop the transmitter module or hit other places.

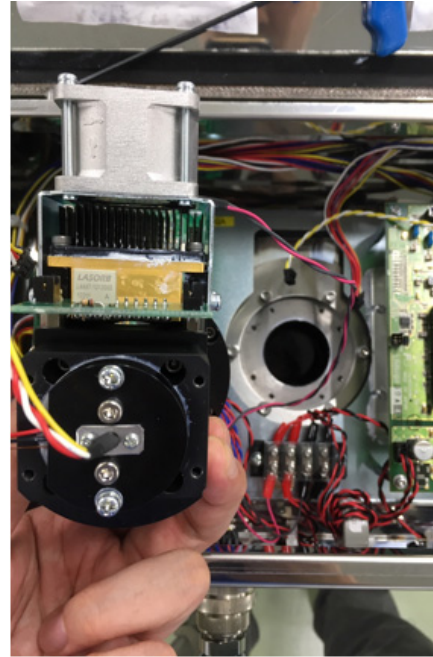
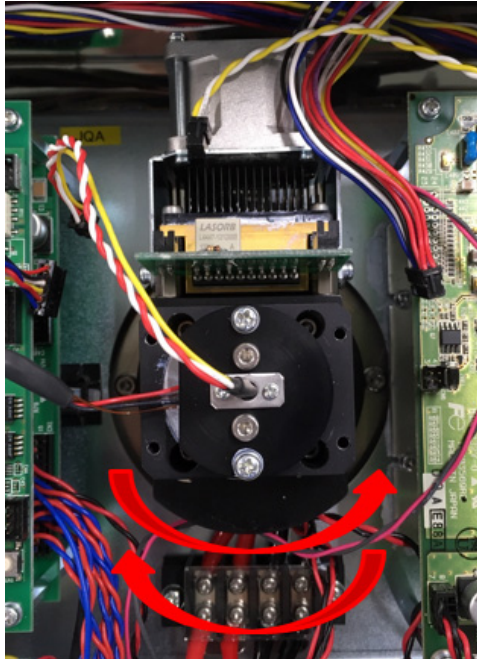


Photo 3-34 Pull the transmitter module up (left) while rotating it left and right, and remove it (right)

6. Remove the screws (four screws) that fix the fans of the transmitter module with the screwdriver (Photo 3-35).

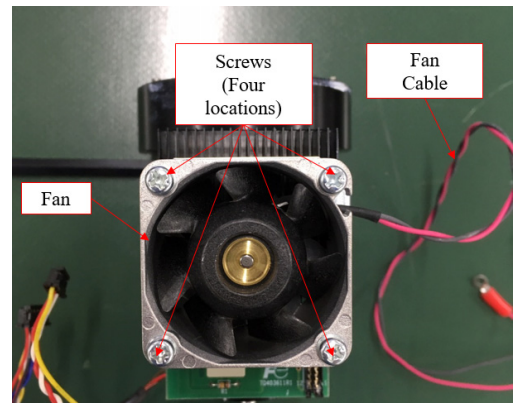


Photo 3-35 Remove the screws (four screws) that fix the fan with the screwdriver.

7. Replace with a new transmitter unit fan (Photo 3-36) and assemble according to the reverse procedure.
Note: Install the fans and transmitter modules in the same direction as before.

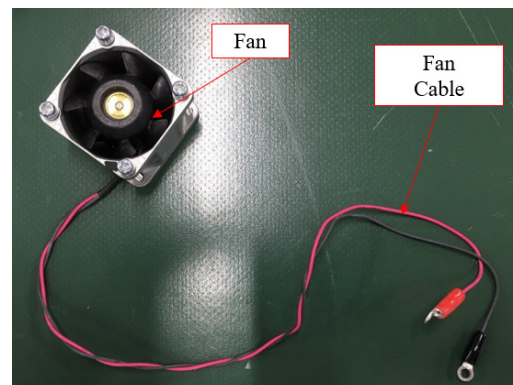


Photo 3-36 Transmitter unit fan

3.4.3. Assembly of solenoid valve, fan, ejector, and replacement of tubes and fittings in the receiver unit

The receiver unit contains fittings, tubes, solenoid valves, and fans for dissipating heat from the printed circuit board. Replace them with the following procedure.

Note: A large number of precision electronic and optical components are built in the receiver unit. Do not touch or contaminate parts unrelated to this procedure. Remove the receiver unit from the detection unit before starting operation.

1. Unlock and open the panel of the receiver unit using the box key for the receiver/transmitter unit (see Photo 3-22).
2. Please take pictures of the inside of the receiver unit according to each procedure. An example is shown in Photo 3-37. This is because the wiring and piping can be restored and the deterioration status of the parts can be recorded.

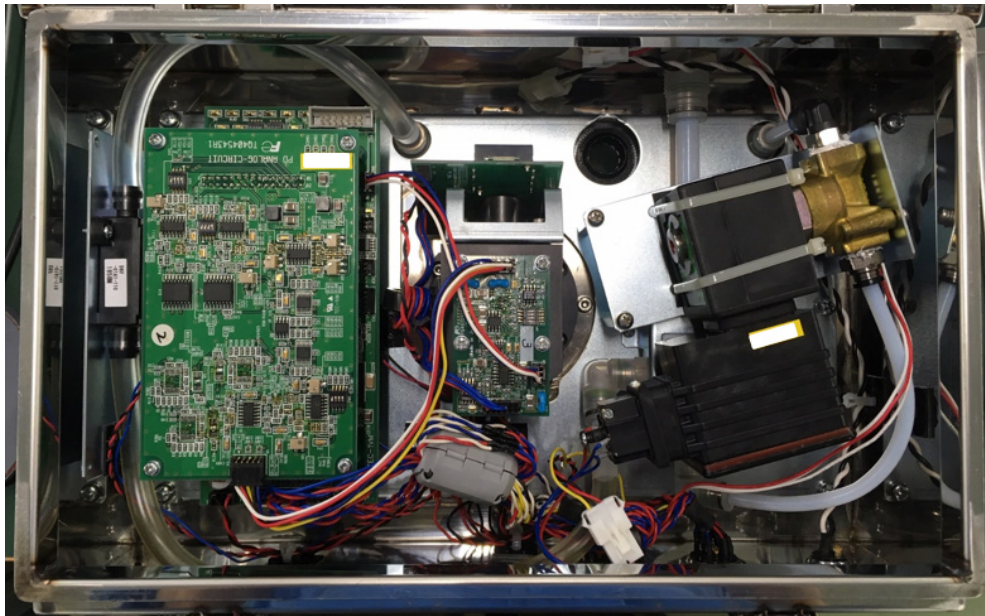


Photo 3-37 Inside the receiver unit

3. Remove the printed circuit board (PD Analog) shown in Photo 3-38. Pull out the cable from the connector and remove the four screws. Be careful that the printed circuit board (PD Digital) is connected with the connectors on the bottom. Pull out the printed circuit board (PD Analog) vertically toward the front perpendicular to the plane of this document in Photo 3-38. These are reused. Store them temporarily so that they will not be lost.

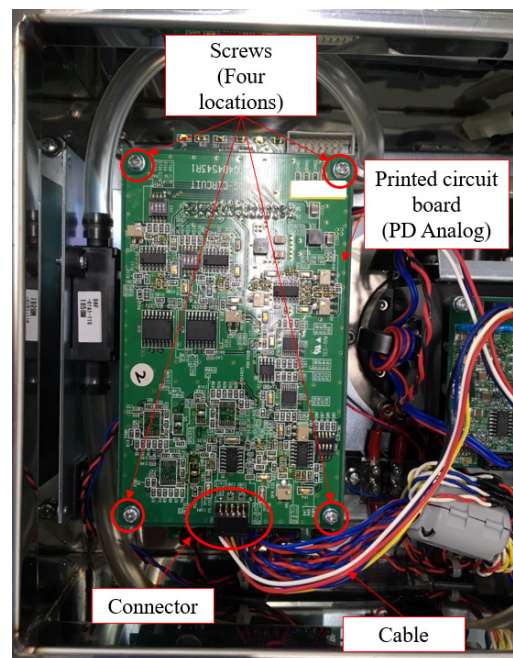


Photo 3-38 Remove the PCB (PD Analog)

4. Remove the printed circuit board (PD Digital) shown in Photo 3-39. Pull out the cable from the connector (4 points) and remove the stud (4 points) with a 6mm nut driver. Pull out the PCB (PD Digital). These are reused. Store them temporarily so that they will not be lost.

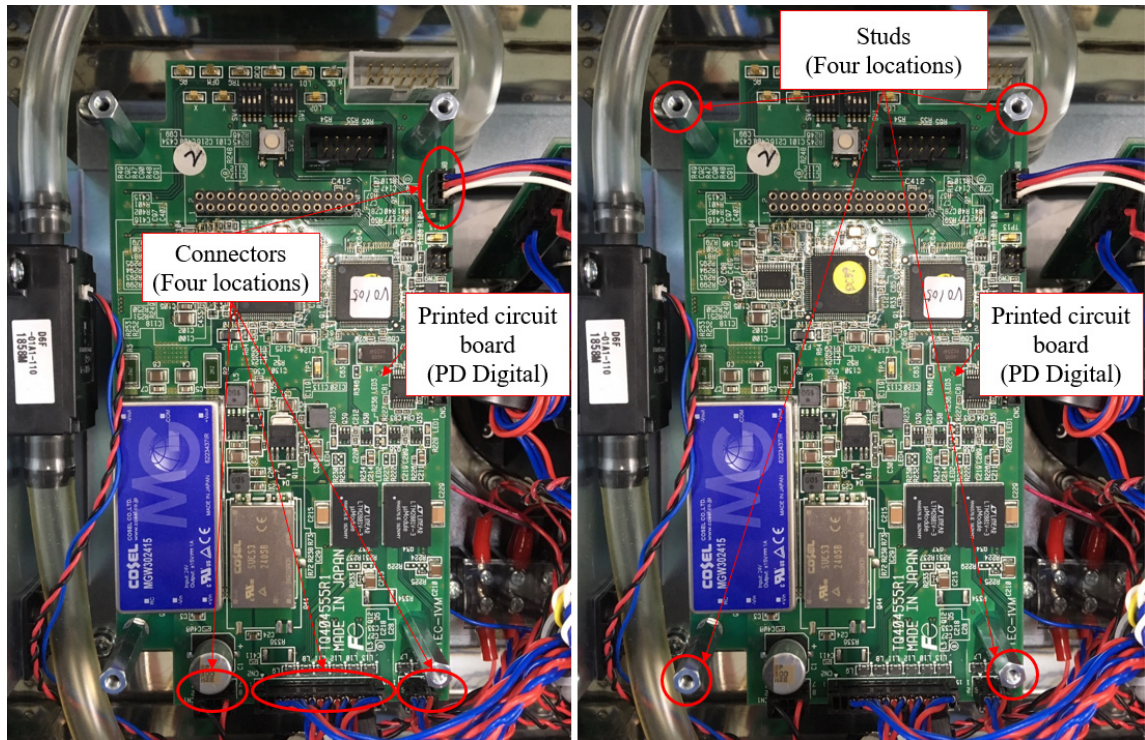


Photo 3-39 Remove the PCB (PD Digital). Connectors (left) and studs (right)

5. Remove the hexagon socket head cap bolt (M3, 4 points) (Photo 3-41) fixing the receiver module (Photo 3-40) with a 2mm hexagon wrench (see Photo 3-33). Reuse the removed hexagon socket head cap screws. Store them temporarily in a place where they will not be lost.

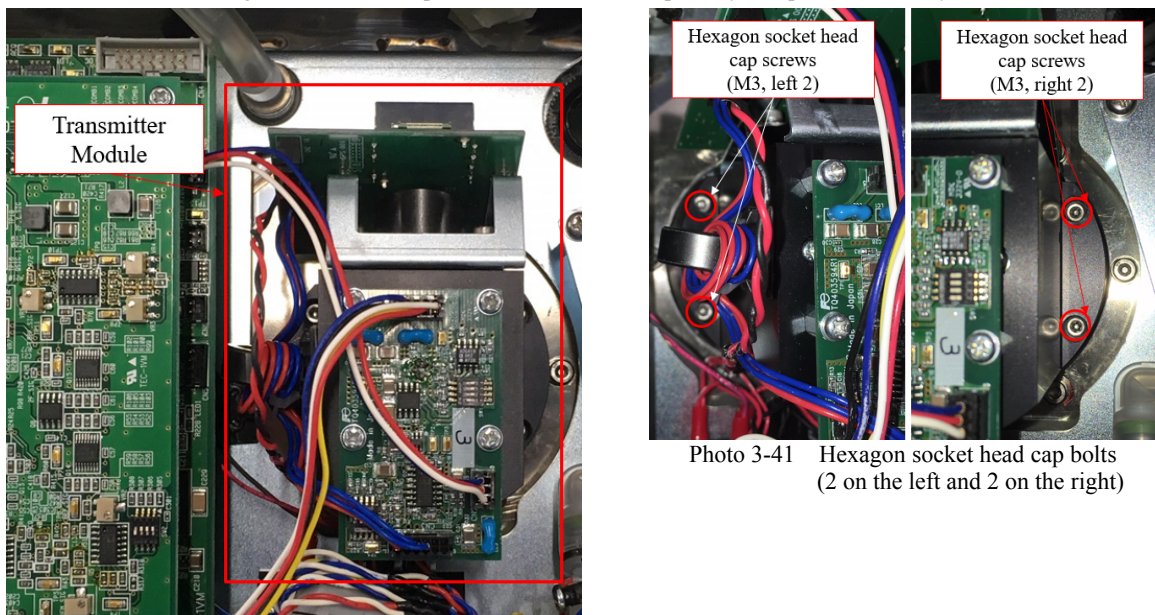


Photo 3-41 Hexagon socket head cap bolts (2 on the left and 2 on the right)

Photo 3-40 Receiver module

6. Remove the solenoid valve shown in Photo 3-42. First, remove the connector shown in Photo 3-43.

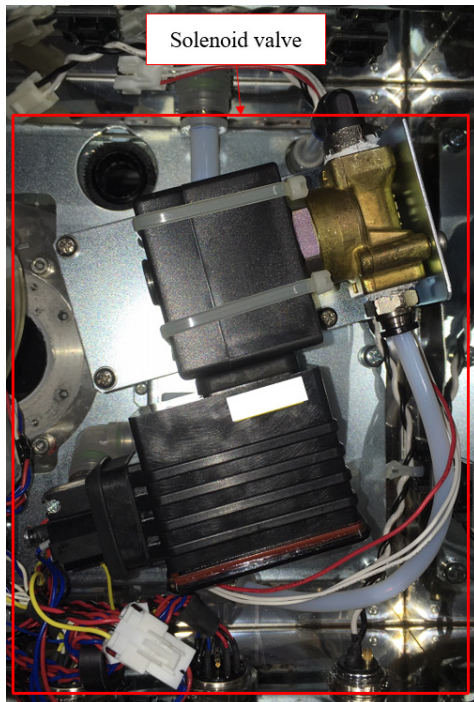


Photo 3-42 Solenoid Valve Assembly

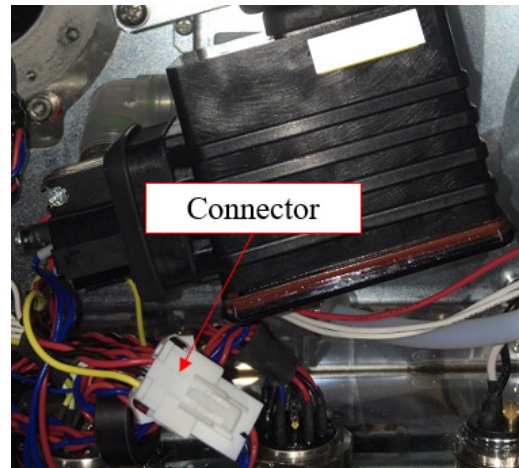


Photo 3-43 Connector

7. Pull the tube out of the fitting shown in Photo 3-44. Pull out the pipe while pushing the ring of the fitting uniformly.

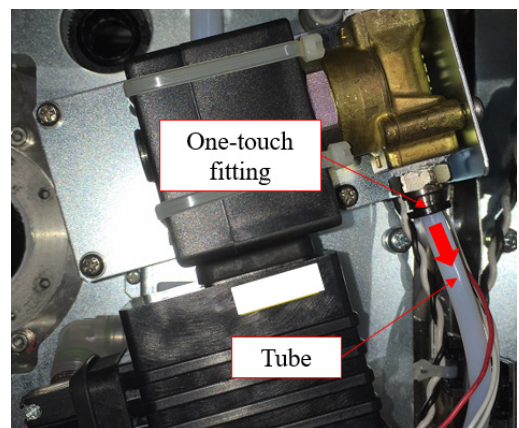


Photo 3-44 Fitting and tube

8. Remove the four screws shown in Photo 3-45 with the screwdriver.

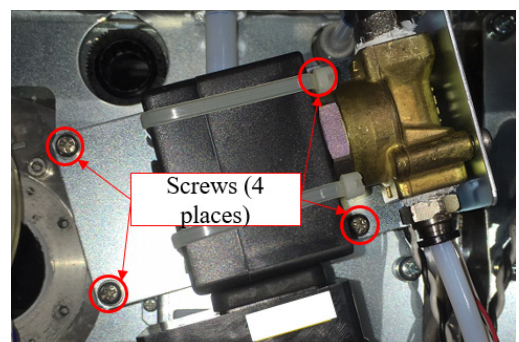


Photo 3-45 Screws (4 places)

9. Pull out the tube from the fitting shown in Photo 3-46 and remove the solenoid valve from the receiver unit. The solenoid valve can be removed by lifting the solenoid valve while pushing the ring of the fitting uniformly.

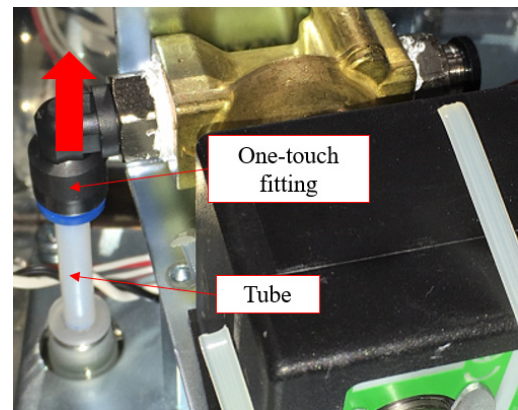


Photo 3-46 Fitting and tube

10. The detached solenoid valve assembly is shown in Photo 3-47. Please exchange this for a new one.

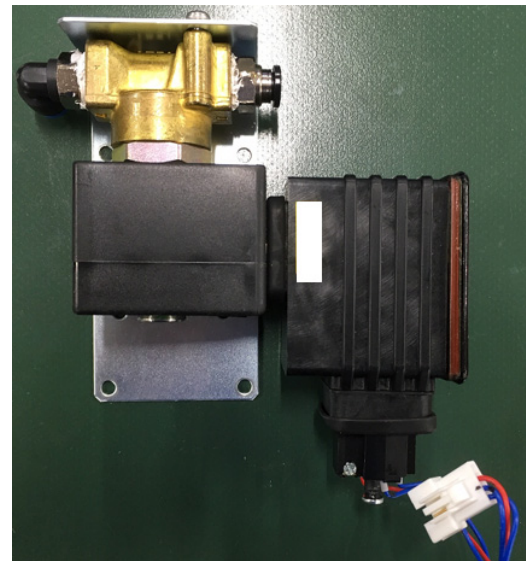


Photo 3-47 Solenoid valve assembly

11. Photo 3-48 shows the receiver unit according to the procedure described above. Photo 3-48 shows the components to be replaced in the following steps.

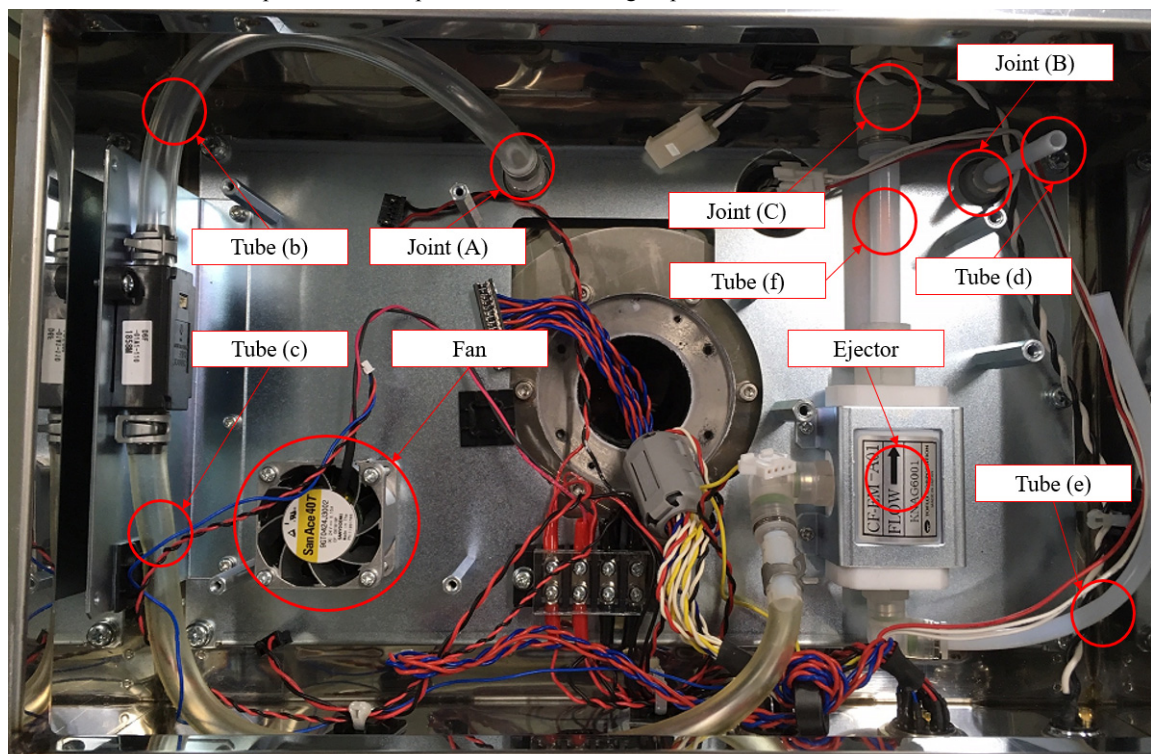


Photo 3-48 Parts to be replaced in the following procedure

12. Replace the receiver unit fan in the same manner as in steps 2, 6, and 7.
13. Remove the tubes (b) (200mm) and (c) (300mm) by referring to "3.2 Maintenance of the detection unit". Remove tube (d) (67mm) from the one-touch fitting. Replace these with new ones.
14. Then remove the ejector assembly. Remove the five screws shown in Photo 3-49. Remove the holder of the ejector assembly. These should be reused.

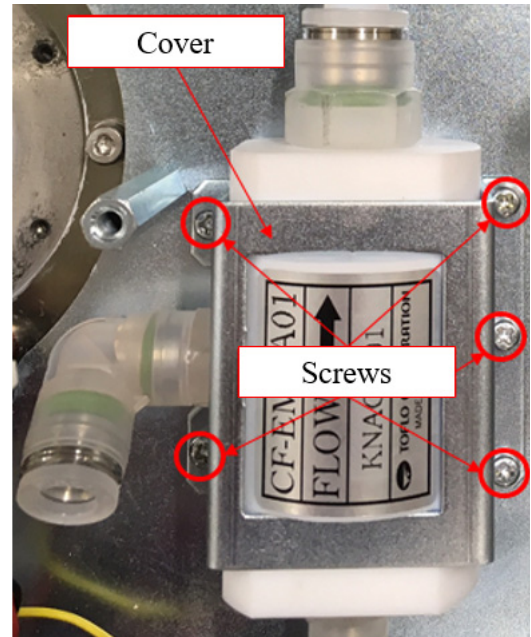


Photo 3-49 Remove the screws (5 positions) and remove the holder of the ejector assembly.

15. Remove the nut of the joint (C) using a monkey wrench as shown in Photo 3-50. Remove the tube (f) (70mm) from the fitting (C) and remove the fitting (C) from the box of the receiver unit. Also, remove the ejector assembly, tube (e) (180mm) and tube (f) from the receiving section. All of these are replaced with new ones.

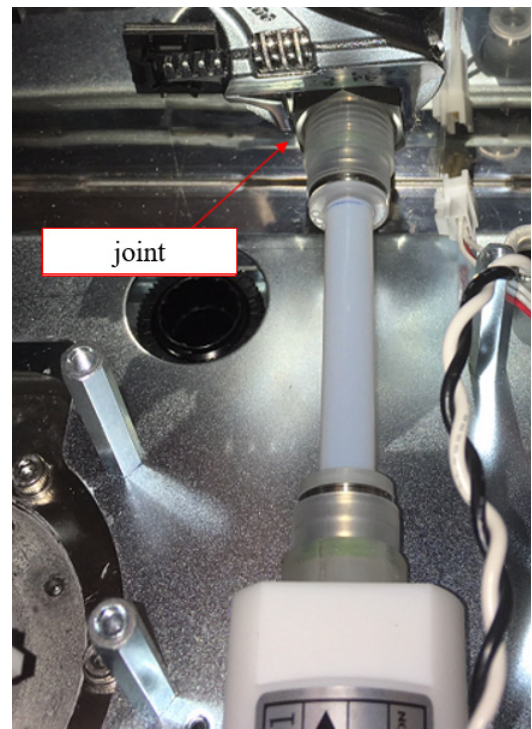


Photo 3-50 Remove the joint (C) using a Monkey wrench.

16. Remove the four screws shown in Photo 3-51.

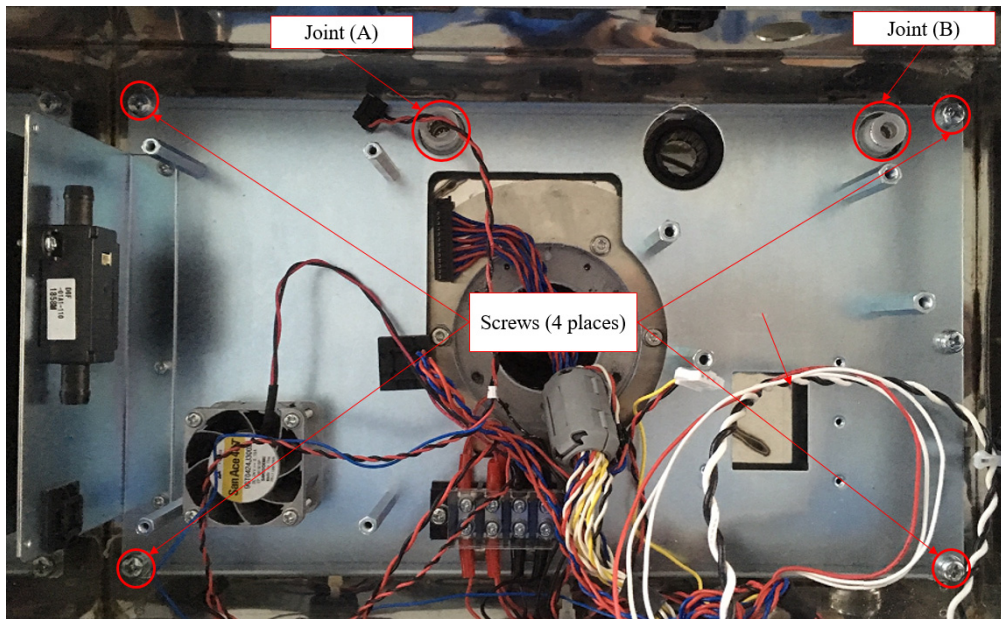


Photo 3-51 Remove the screws (4 points) with the screwdriver.

17. Lift the bottom plate fixed with the screws described in the preceding section as shown in Photo 3-52. The nuts of joints (A) and (B) are exposed. Remove joints (A) and (B) in the same manner as in step (15).
Note: Since the bottom plate is still connected to the cable through the terminal block, it cannot be removed from the receiver unit. To avoid forcefully disconnecting cables, do not move them beyond the limits shown in Photo 3-52.

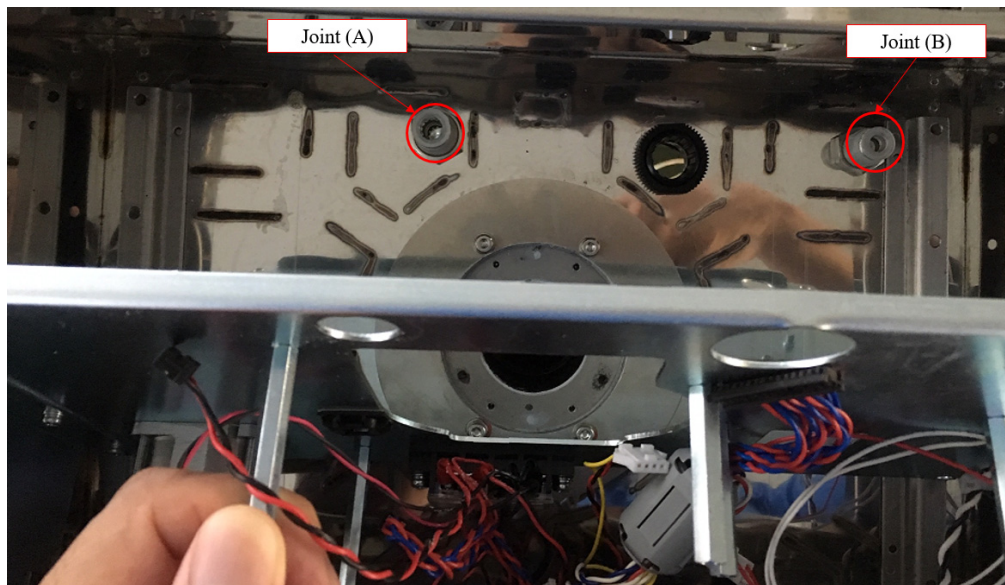


Photo 3-52 Pull up the bottom plate (rotate around the terminal block side) to expose the nuts of fittings (A) and (B).

18. Reverse the previous procedure and reassemble. However, the following parts are replacement parts, so please assemble them using new ones.
- Solenoid valve assembly
 - Fan
 - Ejector assembly
 - Tube (b)~(f)
 - Joint (A)~(C)

Reuse and assemble parts other than the above parts.

In each process, refer to the photograph taken at the time of decomposition and confirm that it is correct before assembling.

3.4.4. Replace the DC power supply in the Interface box

Replace the DC power supply (24V) and DC power supply (12V) (Photo 3-53) in the upper right corner of the Interface box.

Record the color of the wiring and the connection points by taking pictures, and remove all the connected terminals using a the screwdriver.

The power supplies is attached to the rail. Pull out them while pushing in the protrusion on the upper of the power supply. Install the new product in the reverse order and connect the wiring.

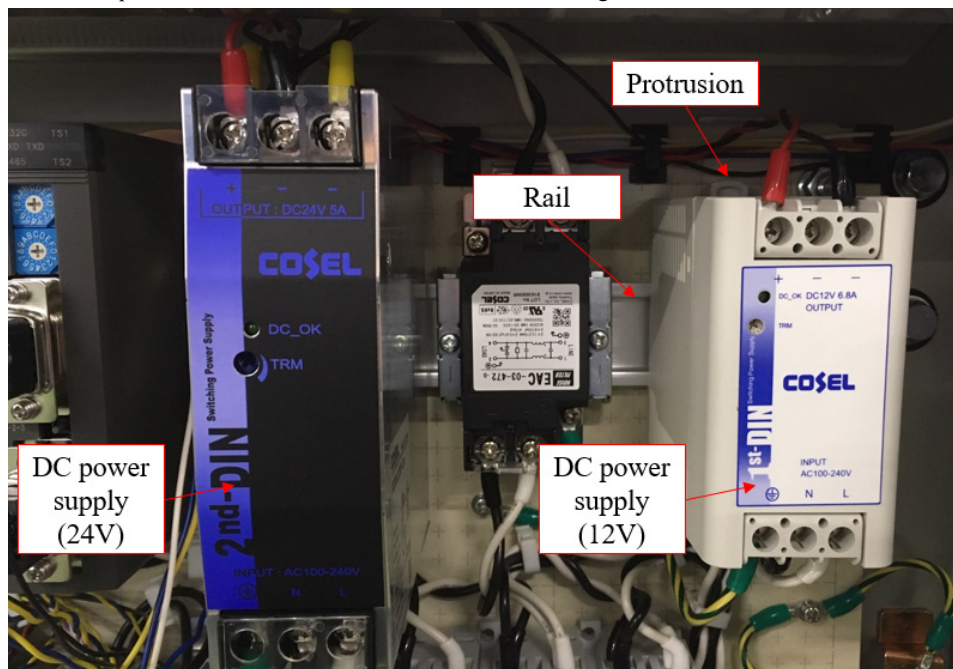


Photo 3-53 DC power supply inside the Interface box

3.4.5. Replacement of extraction unit

Replace the extraction unit with another unit. Refer to the instruction manual and install a new extraction unit.

3.4.6. Calibration and Leakage test

Do calibration and leakage test.

3.4.7. Trial

Perform reinstallation and trial operation according to the operation manual. Refer to the instruction manual and troubleshooting in this manual to cope with any problems in operation.

4. TROUBLE SHOOTING

In this chapter, the cause identification and countermeasures are described in the form of YES or NO questions.

Troubleshooting procedures :

- (1) If a trouble occurs, check the contents of the alarm, etc. to determine the phenomenon of the trouble.
- (2) Follow the flow described in the section corresponding to each phenomenon to investigate and answer a series of questions. If the answer is yes, no action is necessary. Go to the next question. If the answer is no, take action and proceed to the next question.
- (3) Once you have gone to the end, record and report to us all YES, NO, survey results and countermeasures, regardless of whether the problem has been resolved or not. Even if the problem is resolved, please report on measures to prevent recurrence of the problem in the future.

The contents described in this chapter are also useful as inspection contents to prevent troubles from occurring.

4.1. Power supply

Phenomena: Power is not turned on.

1. Start: Is the power supply specifications (voltage AC90 ~ 115V, frequency 50/60Hz) correct (YES/NO)?

Check	Check the power supply specification of the power supply panel. If the specification of the power supply is incorrect, the power will not be turned on.
Actions	Supply the power supply with the correct specifications.

2. Are power cables wired as specified (YES/NO)?

Check	Confirm that the L, N, and PE terminals of the power supply terminal blocks are correctly wired according to "4.6.2 Wiring to the outside of the device" in the instruction manual. If it is incorrect, the power is not turned on.
Actions	Correct the wiring.

3. Is the power supply voltage supplied as specified (YES/NO)?

Check	Check the voltage between L and N of the terminal block of the power supply with a digital multimeter. If the voltage is outside the specified range, the power is not turned on.
Actions	Check the voltage from the switch of the power supply panel to the terminal block successively to eliminate the disconnection or switch-off state.

4. Are normal voltages output from the components inside the Interface box (YES/NO)?

Check	Refer to the wiring diagram (Fig. 1-2) and check the output voltage of the following components using a digital multimeter with the power switch (three points) turned on. CP1 (AC100V), CP2 (AC100V), CP3 (AC100V), NF1 (AC100V), SWP1 (DC24V), SWP2 (DC12V).
Actions	The component is disconnected from the normal output voltage or the component fails. Repair and replace the failed component.

5. Please report the results to us. This is the end.

4.2. Sample gas flow rate

Phenomena: The sample gas flow rate is too low.

1. Start: Is instrumentation air exhausted from the exhaust port of the detector (YES/NO)?

Check	Check that air is exhausted from the exhaust port of the detection unit (receiver unit) while the power is on. The sample gas is extracted and circulated by the instrumentation air flowing to the ejector assembly in the detection unit.
Actions	If the air is not exhausted, first adjust the pressure and flow rate of the instrument air to the normal values. If there is still no exhaust, the flow of instrumentation air is stopped because the solenoid valve in the detection unit is malfunction or the ejector assembly is clogged. Replace either or both. The exchange method is described in "3.4. Overhaul". The piping from the exhaust port may be clogged. Replace the piping in this case.

2. Is the piping to the extraction unit clogged (YES/NO)?

Check	Pull out any of the piping and fittings from the sample gas inlet of the receiver unit to the extraction unit and disconnect, and check the sample gas flow rate. The sensor for the sample gas flow rate is located inside the receiver unit. If the flow rate of the sample gas exceeds 500 mL/min, the piping up to the sample gas flow rate is normal.
Actions	Identify pipings or fittings that are clogged and replace them with new ones.

3. Is the filter in the extraction unit clogged (YES/NO)?

Check	Refer to the piping diagram. Remove the filter element from the rear of the filter to check that the inlet and outlet of the filter are not clogged.
Actions	Replace the filter element. Replace the entire filter if the entrance or exit of the filter is blocked clogged.

4. Are the pipes inside the extraction unit from the gas sampling tube to the filters clogged in the middle (YES/NO)?

Check	Refer to the piping system diagram (Fig. 1-7) to check whether the fitting from the gas sampling probe to the filter and the PTFE tube are dirty and clogged.
Actions	Identify clogged parts and replace them with new ones.

5. Please report the results to us. This is the end.

Phenomena: The sample gas flow rate is too high.

1. Start: Is instrumentation air pressure too high (YES/NO)?

Check	Check the instrument air pressure is in range from 0.3 MPa to 0.4 MPa.
Actions	Adjust the instrument air pressure is in range from 0.3 MPa to 0.4 MPa. If it does not work well, adjust the pressure lower than 0.3 MPa.

2. Please report the results to us. This is the end.

4.3. Instrument air

Phenomena: The pressure of instrumentation air drops.

1. Start: Is the instrument air supply equipment and piping normal (YES/NO)?

Check	Check that the compressor, regulator, mist separator, oil filter, dryer, piping and fittings are normal.
Actions	Maintain them. Check that the piping is as described in "4.5.2 Piping for Instrumentation Air tube" in the instruction manual.

2. Is the instrument air flow rate of the detector increasing (YES/NO)?

Check	Check the value of "AO4 proportional valve control DA value" from the Modbus communication or PC loader. If this value exceeds 900, the piping is clogged. (Explanation) In the detection unit, the flow rate of instrument air is controlled by a solenoid valve so that the flow rate of the sample gas becomes a constant value of 500 mL/min. If the sampling flow path becomes narrow due to dirt or the like, the solenoid valve is opened more to maintain the sample gas flow rate, and the flow rate of instrument air increases. "AO4 proportional valve control D/A" indicates the degree of opening of the solenoid valve. On the other hand, if the flow rate of instrument air increases, the instrument air pressure decreases due to pressure loss in the piping. Instrument air flow does not increase because there is no such flow control mechanism on the extraction unit (the instrument air flow rate is determined by the fixed orifice).
Actions	Since the piping is clogged, follow the procedures described in 6.2 "Reduction of sample gas flow rate" above to investigate and take countermeasures.

3. Please report the results to us. This is the end.

4.4. Concentration readings

Phenomena: Concentration readings are too low.

1. Start: Is the condition for continuous measurements satisfied (YES/NO)?

Check	Check that the conditions for the continuous measurement condition described in 3.4 "Continuous Measurement" in the operation manual are satisfied.
Actions	Ensure that all conditions for continuous measurement are met. If any of the conditions for entering continuous measurement are not satisfied, the device is placed in standby state. The lighting pattern of the LED indicator light can be used to check whether or not the device is in standby mode. Since instrument air also circulates in the detection unit, the indication concentration value is almost 0.

2. Is there a leakage in the middle of the piping for the sample gas (YES/NO)?

Check	Perform a leakage test. If the leakage test fails, the exhaust gas will be diluted by extracting air somewhere in the sample gas tube and the concentration reading will drop.
Actions	Check the piping for cracks, disconnections, and connections between the fittings and piping. In particular, the fitting and piping may deteriorate several times, which may cause leakage. Replace any defective parts with new ones. If the piping length is too long, it is also effective to cut the deteriorated tip with a tube cutter and replace the tip only. Perform the leakage test again after the replacement.

3. Please report the results to us. This is the end.

Phenomena: Concentration readings are too high.

1. Start: Is the light transmittance decreased? (YES/NO)

Check	Check the light transmittance from the Modbus communication or PC loader.
Actions	Perform the inspection of the window unit and gas cell described in "3.2 Maintenance of the detection unit". If the optical system becomes clean, the light transmittance may recover. Check whether the detection unit is installed properly, referring to "4.3. Installing the detection unit" in the instruction manual. Tightening the bolt with a step or tilt on the wall surface may cause the gas cell to bend and cause the optical axis of the laser to shift. In this case, loosen the tightened bolts to check whether the light transmittance recovers.

2. Please report the results to us. This is the end.

Phenomena: Concentration of readings do not change.

1. Start: Is the light transmittance decreased? (YES/NO)

Check	Check the light transmittance from the Modbus communication or PC loader.
Actions	Perform the inspection of the window unit and gas cell described in "3.2 Maintenance of the detection unit". If the optical system becomes clean, the light transmittance may recover. Check whether the detection unit is installed properly, referring to "4.3. Installing the detection unit" in the instruction manual. Tightening the bolt with a step or tilt on the wall surface may cause the gas cell to bend and cause the optical axis of the laser to shift. In this case, loosen the tightened bolts to check whether the light transmittance recovers.

2. Is there any signal during maintenance or scrubber stoppage (YES/NO)?

Check	Check the state of "Maintenance in progress" or "EGCS operation/stop" from the Modbus communication or PC loader or DI1, DI5.
Actions	Make sure the status is in the "Non-maintenance" mode and "EGCS operation" mode. Otherwise, the indication concentration value is held at 0.

3. Please report the results to us. This is the end.

4.5. Standby

Phenomena: Continuous measurements stops and remains standby.

1. Start: Is the status in warm-up (YES/NO)?

Check	Check that the status is warm-up, using the LED indicator light or Modbus communication.
Actions	Since the status is warm-up within 120 minutes after the power is turned on, the status is not in the continuous measurement state. Wait until the warm-up is released after 120 minutes have elapsed.

2. Is there an instrument error (YES/NO)?

Check	Check whether there is an instrument error from the Modbus communication or PC loader or DO7.
Actions	If an instrument error has occurred, check the contents and troubleshoot the corresponding phenomena.

3. Is there any signal during maintenance or scrubber stoppage (YES/NO)?

Check	Check the state of "Maintenance in progress" or "EGCS operation/stop" from the Modbus communication or PC loader or DI1, DI5.
Actions	Make sure the watch is in the "Non-maintenance" mode and "EGCS operation" mode. Otherwise, it is not in the continuous measurement state.

4. Is the gas temperature input not available, or is the gas temperature input out of range (YES/NO)?

Check	Check the gas temperature input value from the Modbus communication or PC loader.
Actions	Check that the gas temperature input value is 5 to 60°C.

5. Please report the results to us. This is the end.

4.6. Instrument error

Phenomena: An instrument error has occurred.

Check	Check the contents of the instrument error from the Modbus communication or PC loader.
Actions	Record the YES/NO for the following items and follow the instructions.

1. If the sample gas flow rate is low, proceed to "4.2 Sample gas flow rate".
2. In case of instrument air pressure drops, proceed to "4.3 Instrument air".
3. If the temperature at the extraction unit is abnormal, check that the panel at the extraction unit remains open. If it is open, close it and wait 120 minutes. If it is still abnormal, measure the ambient temperature of the extraction unit and check whether it is within the specifications of the product. If the error is not resolved, please inform us of the situation.
4. If the light transmittance is abnormal (light transmittance drops), the optical axis may be misaligned or the optical system may become dirty. Loosen the bolt that fixes the detection unit and record whether the optical axis shift changes while checking the light transmittance. If there is no change, refer to "3.2 Maintenance of the detection unit" and check the window unit of the transmitter unit and receiver unit and clean the gas cell. If the abnormality is not resolved by these inspections, please inform us of the situation.
5. If the LD temperature control is defective, the laser element or the temperature control function of the laser element may be abnormal. Please inform us of the situation.
6. If the temperature of the receiver unit is abnormal or the temperature of the transmitter unit is abnormal, abnormal heat generation of the printed circuit board is considered. Please inform us of the situation.
7. Please report the results to us. This is the end.

4.7. Modbus communication

Phenomena: Modbus communication error. (communication error between host systems and the product)

1. Start: Is the CPU module inside the Interface box abnormal? (YES/NO)

Check	Check the alarm status of CPU module referencing "6.2 CPU module in the instruction manual".
Actions	If the CPU module is abnormal, replace the internal batteries with new ones. If the error is still not resolved, the CPU module must be replaced. Please contact us.

2. Is the LAN cable disconnected (YES/NO)?

Check	Check the alarm status of CPU module referencing "6.2 CPU module in the instruction manual".
Actions	If the "Ethernet status" lamp is off, it is suspected that the LAN cable is disconnected. Please insert the cable if the LAN cable is disconnected. If the cable is cut, replace the LAN cable. If the error is still not resolved, please contact us.

3. Please report the results to us. This is the end.

4.8. Leakage test

Phenomenon: Leakage test fails.

1. Start: Are the plugs attached correctly? (YES/NO)

Check	Check that the plug (A) is tightened by hand without using a tool.
Actions	Retighten the plug (A) with a tool such as a monkey wrench.

2. Are the fittings dirty or damaged? (YES/NO)

Check	Check all fittings on the sample gas flow path for contamination or damage.
Actions	Use a blower or cloth to remove dirt and foreign matter. If it is damaged, replace it with a new product. (Explanation) The fitting is a consumable. Repeated removal and installation of the pipes can lead to deterioration and leakages, and even if you cannot see any damage, replacement with a new product can eliminate abnormalities.

3. Are the tubes dirty or damaged? (YES/NO)

Check	Check all tubes on the sample gas flow path for contamination or damage.
Actions	Please replace the dirty or damaged pipe with a new product. If the tip is dirty or damaged, it is also useful to cut it with a tube cutter to regenerate the tip without contamination or damage. (Explanation) The tube is a consumable. Repeated removal and installation of the pipes can lead to deterioration and leakages, and even if you cannot see any damage, replacement with a new product can eliminate abnormalities.

4. Is the tube disconnected from the one-touch fittings? (YES/NO)

Check	Check that all the tubes on the sample gas flow path are inserted into the one-touch fittings where they hit the back of the fitting and cannot be inserted any further.
Actions	Push the tube deeper into the one-touch fitting and push it until it stops.

5. Please report the results to us. This is the end.

Note: The leakage test method is reducing pressure rather than increasing pressure, so the acceptance conditions are quite stringent. If there is a leakage in the flow path of the sample gas, it will be rejected. The cause of the failure is often at the connection between the fitting and the tube. Perform the above procedure without omission to eliminate the leakage.



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