MU 701

UV-VIS detector with Optical Fiber Cell

Technical Guide

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01.07.05	1.0	Initial issue

Contents

1 Specifications

1-1 General specifications

1. Wavelength: 200 to 700 nm
2. Noise: <±1.2x10^{-5} AU in single wavelength mode
   (254 nm, acetonitrile, 2 sec, constant ambient temperature)
   <±3x10^{-5} AU in dual wavelength mode
   (254/280 nm, acetonitrile, 2 sec, constant ambient temperature)
3. Drift: 3x10^{-4} AU/hr
   (acetonitrile, constant ambient temperature, 254 nm)
4. Wavelength accuracy: ±1.0 nm
5. Wavelength repeatability : ±0.1 nm
6. Sensitivity setting range: 0.0001 to 4.0000 AUFS
7. Time constants: 0.05 to 25 sec (15 steps, user-selectable)
8. Polarity : +/-, user-selectable
9. Scanning spectra:
   1) Scan range: 200 to 700 nm
   2) Scan file: Zero scan (5 files)
      Sample scan (5 files)
   3) Scan speed: 60 to 1000 nm/min
10. Wavelength mode: Single and dual wavelength modes, user-selectable
11. Time program:
    Single or dual wavelength, auto-zero, time constant, mark, sensitivity setting range, polarity, lamp ON/OFF, threshold of absorbance or absorbance ratio.
12. Communication: RS232C

1-2 Environmental specifications

1. Operating temperature: 5 to 35 degree C
2. Operating humidity: 35% to 80%, non-condensing
3. Shipping and storage temperature: -25 to 60 degree C
4. Shipping and storage humidity: 20% to 80%, non-condensing
5. Altitude: 2000 m
6. Pollution degree: 2

1-3 Electrical specifications

1. Line frequency : 50 to 60 Hz
2. Line voltage : 100 to 240 V AC
3. Power consumption: 100 VA Max.

1-4 Dimensions and weight

1. Dimensions: 263Wx458Dx203H mm
2. Weight : ca. 9 Kg

1-5 Flow cell

1) Nano-LC flow cell: 6 nl, in inner volume, 4 mm path length
2) Fiber optic: 1.0 meter

* The specifications are subject to change without notice.

Attention! ATAS GL will not accept any liability for damages directly or indirectly caused by (1) use of the MU701 detector for any purpose other than general liquid-chromatograph purpose, 2) connecting this instrument to devices, which do not meet relevant safety standards, 3) modification of the MU701-6NL detector by anyone other ATAS GL, 4) willful or negligent action or omission of customer and 5) failure to establish or maintain the operating environment for the MU701 detector in accordance with the operation manual.

1. Packing List:

The MU 701 is packed in one box with the items shown in the following table.

Item	Cat. No.	Quantity
UV-VIS Detector equipped with nano-LC flow cell 6nL	6001-70105	1
Power cable	6001-70192	1
Plug with ground terminal	6001-19955	1
Time lag fuse (250V/2A)	6001-19910	2
Signal cable (2 meters)	6001-70194	1
Screw driver	6001-	1
Operation manual		1
Performance check list		1

If you find any damage or discrepancies when inspecting the contents of the box, immediately contact the shipping agent and your local ATAS GL agent.

Caution The MU 701 is a precision analytical instrument. Carefully unpack it to avoid bumping the device. Also, to avoid damage during installation, do not carry the detector by holding the front panel.

Caution There is no access required to the detector inside the top cover. All access and maintenance is only through the front and rear panel where the flow cell are located.

2 Parts list:

2-1 Spare parts list

Table 2-1: Spare parts list

Item	Catalog number	Quantity
Optical Fiber Cable 1m	6001-70140	1
Optical Assembly for nano-LC Flow Cell	6001-70150	1
Sensor Assembly for nano-LC Flow Cell	6001-70160	1
Nano-LC Flow Cell 18nL	6001-70167	1
Nano-LC Flow Cell 6nL	6001-70170	1
Nano-LC Flow Cell 2nL	6001-70172	1
D2 Lamp	6001-70220	1
Time lag fuse (250V/2A)	6001-19910	2
Union for Capillary Tube	6001-70196	1
Switching Regulator 24V	6001-70180	1
Switching Regulator 5V	6001-70182	1
Motor Driver	6001-70184	1
Power Supply for D2 Lamp	6001-70186	1
Main Circuit Board	6001-70188	1
Operational Panel Assembly	6001-70190	1
Optical Block Assembly	6001-70165	1
Power Cable	6001-70192	1
Signal Cable	6001-70194	1
Connector for Signal Cable	6001-70198	1

2-2 Optional parts list

Table 2-2: Option parts list

Item	**Catalog number**	**Quantity**
Optical Fiber nano-LC Flow Cell Assembly 18nL	6001-70120	1
Optical Fiber nano-LC Flow Cell Assembly 6nL	6001-70125	1
Optical Fiber nano-LC Flow Cell Assembly 2nL	6001-70130	1
Nano-LC Flow Cell 18nL	6001-70167	1
Nano-LC Flow Cell 6nL	6001-70170	1
Nano-LC Flow Cell 2nL	6001-70172	1

3 Inspection Method:

3-1 Lamp energy

1) Deliver HPLC-grade acetonitrile at a flow-rate of 1μl/min with ATAS GL Micro-LC pump like MP711.
2) Enter a 254-nm wavelength.
3) Under the standard screen, press the upper arrow key to display the lamp energy including sample beam (Sam:) and reference beam (Ref:) energies in the top line.

Example of displaying the lamp energy

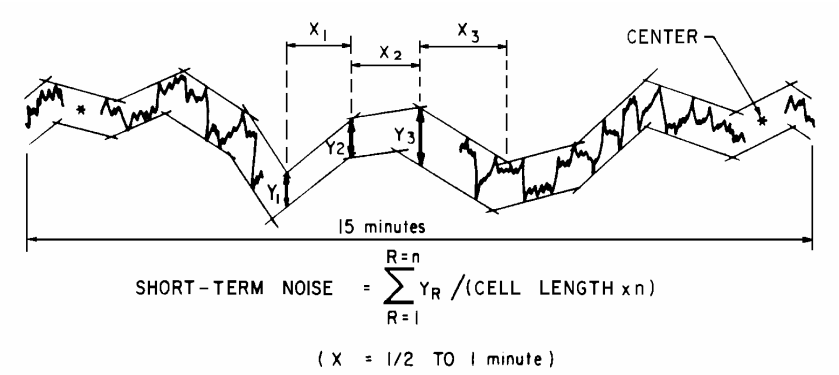
Sam: 800 Ref: 1100 254 nm 0.0000 AU 1.0000 FS/1 V ABS

4) After warming-up for 90 min, record the lamp energy including sample and reference beam energies.
5) Check that the recorded values of reference and sample beam energies are 1000 and 500 or more, respectively.

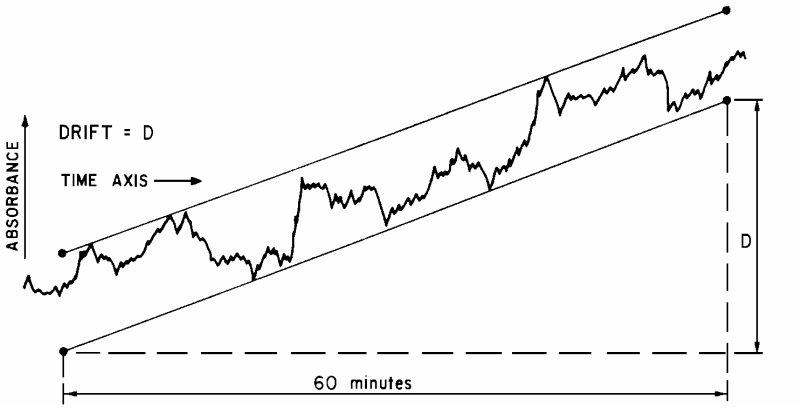
3-2 Noise and Drift

After verifying the lamp energy, perform the following procedures to verify noise and drift of the MU701 detector.

1) Press the ZERO key to perform absorbance offset.
2) Set the test conditions as follows,
   ① Absorbance range: 1AUFS for data system
   ② Response time: 2 sec
   ③ Output voltage: 1 volt for data system
3) Start data system to monitor baseline continuously for over 120 min..
4) Measure noise and drift of the detector referring the following procedures.
   ① Noise: Draw pairs of parallel lines, each pair corresponding to between 0.5 and 1 minute in length, to form an envelope of all observed random variations over any 15-min period. Draw the parallel lines in such a way as to minimize the distance between them. Measure the vertical distance, in AU, between the lines. Calculate the average value over all the segments. Divide this value by the cell length in centimeters to obtain the static short-term noise.



② Drift: Draw the pair of parallel lines that minimizes the vertical distance separating these lines over one hour of measurement. The slope of either line is the static drift expressed in AU/hr.



5) Refer the standards to evaluate the results.

Standards (change in ambient temperature: <2 degree C/hr)

1) For nano-LC flow cell (18-nL inner volume)
   Drift of the baseline: 3×10^{-4} AU/hr
   Noise of the baseline: $\pm1.0\times10^{-5}$ AU
2) For nano-LC flow cell (6 or 2-nL inner volume)
   Drift of the baseline: 4×10^{-4} AU/hr
   Noise of the baseline: $\pm1.5\times10^{-5}$ AU

If the change in ambient temperature was less than 5 degree C, you can use a double reference standard (e.g., a drift standard of 6×10^{-4} AU/h can be used in the detector equipped with a 18-nl flow-cell).

3-3 Wavelength accuracy

1) Change wavelength with 1-nm step within a range of 651 to 661 nm, and record the sample beam energies of the D2 lamp.
2) Check that the maximum value of the sample beam energies appears at a 656-nm peak wavelength of D2 lamp, and the accuracy is better than ±1.0 nm.

4 Maintenance:

4-1 Routine maintenance of the flow-cell

In order to obtain optimal performance, minimal routine maintenance of the flow-cell is required. First, it is very important to flush buffed mobile phase out of the flow-cell with pure water each time the detector is shut down. The process can prevent that evaporation of the solvent causes crystal buildup when the detector is not in use. The crystal buildup results in clogging of the flow line including flow-cell, damage to the parts of the flow-cell.
Second, use the filtered and degassed mobile phase to reduce baseline noise and drift, decrease fluctuations of the system pressure, and prolong operating-life of the column.
Finally, use 10% methanol or ethanol to fill the flow-cell to prevent microbial growth when the detector is not in use.

4-2 Cleaning and replacing of the flow-cell

The contamination of the flow-cell can lead to 1) decreased sample-beam energy of the lamp, 2) increased baseline noise and drift, and 3) calibration failure. The detector requires periodical flushing or cleaning of the flow-cell.

4-2-1 Procedures for cleaning the flow-cell

1) Disconnect the column from the inlet tubing of the flow-cell, and connect a waste tubing at outlet of the flow-cell.
2) At inlet, connect the 5-ml syringe equipped with an adapter in which HPLC-grad water is filled, and inject water to flush the flow-cell.
3) Inject 100 % methanol instead of water.
4) Inspect whether the contamination has been removed. If no, make repeated injection, or continuous pumping of the solvents.
5) Reconnect the column to resume flow of the mobile phase, and conform whether the lamp energy increases obviously when the baseline becomes stable.

Note!
When the mobile phase is immiscible in water, you can use an intermediary solvent (e.g., i-propanol) before resuming flow.

4-2-2 Replacing of the flow cell

Caution  To avoid the possibility of eye damage from ultraviolet radiation exposure, turn off the detector power before replacing the flow-cell.

If it is required, you can choose the following procedures to replacing the flow-cell.
1) Turn the detector power off.
2) Disconnect fluidic connections and remove the column.
3) Unscrew four entrance- and exit-side fixing screws referring Fig.4-1.

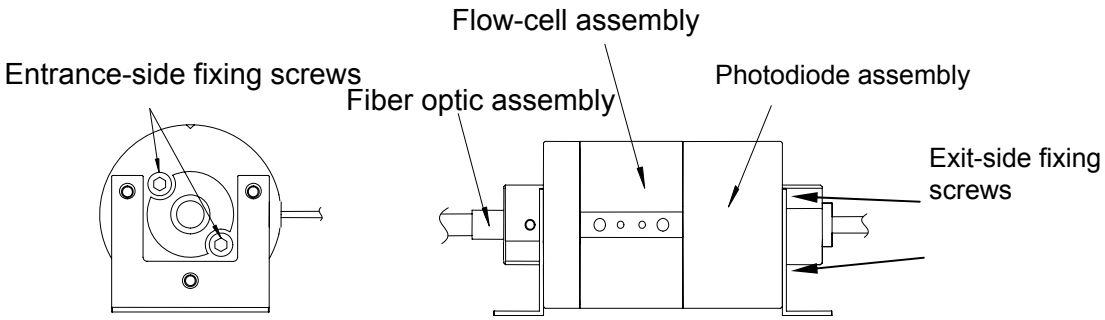


Fig.4-1: Disassembly of the flow-cell

Attention!

Don't disassemble the flow-cell assembly to avoid any damage to the parts of the flow-cell.

4) Remove fiber optic and photodiode assemblies from the flow-cell assembly.
5) Remove two O-rings from the flow-cell assembly.

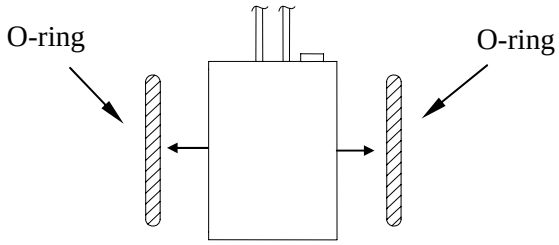


Fig.4-2: Removing of the O-rings

6) Insert the O-rings into a new flow-cell assembly.

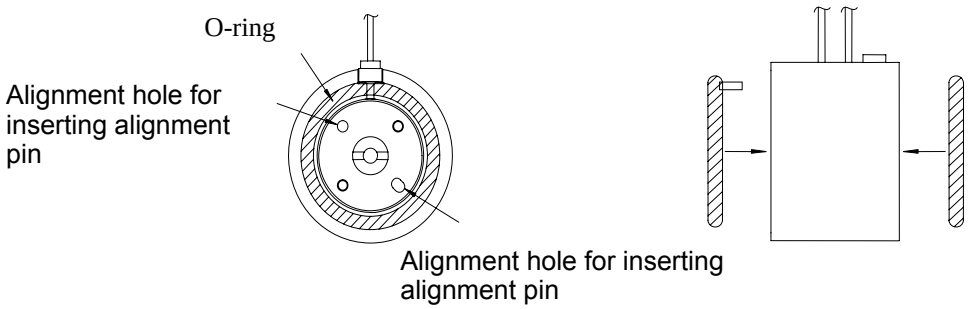


Fig.4-3: Inserting of the O-rings

7) Position the grooves carved on flow-cell and fiber optic assemblies in alignment, and insert the alignment pin located on the fiber optic assembly into the alignment hole on the flow-cell assembly.

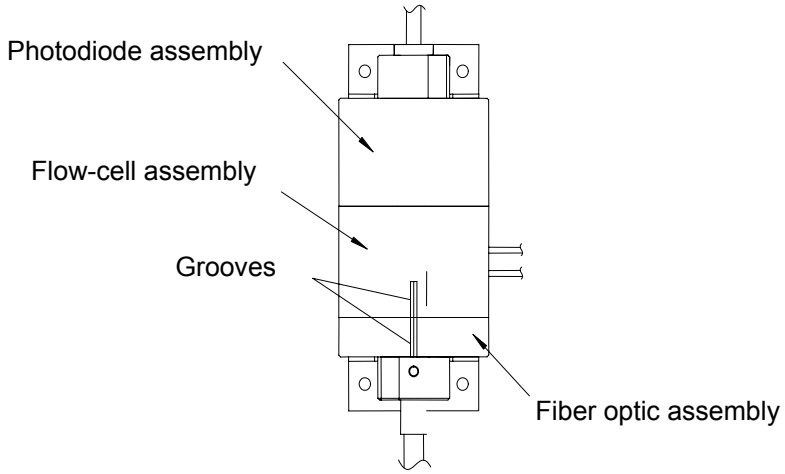


Fig.4-4: Assembling the flow cell

8) Insert and tighten the entrance- and exit-side fixing screws to complete placing of the flow-cell.

Attention!
In order to prevent contamination, use powder-free gloves when replacing of the flow-cell.

When you verify the basic performance of the detector, you have recorded the energy at 254 nm of the new lamp. You can use the lamp energy values to troubleshoot the detector to determine whether 1) the flow-cell is contaminated, and 2) the lamp needs to be replaced.
The deuterium lamp used in the detector, generally, has a operating-time of about 2000 hours. The operating-time is defined as the energy level decreased to half of a new lamp. However, performance requirements and permitted tolerances are dependent on different applications.
When 1) the detector fails at startup, 2) a highly noisy baseline leads to a decrease in sensitivity, and 3) the used time is far larger than 2000 hours, you can consider replacement of the lamp on the detector.

Caution To avoid the possibility of eye damage from ultraviolet radiation exposure, turn off the detector power before opening the cover.

Warning To avoid the possibility of electrical shock, after always turn the detector power off and disconnect the power cord, perform the replacement of the lamp.

4-3 Replacement of the lamp

4-3-1 Procedures of replacing the lamp

1. Turn the detector power off.
2. Open the front panel.
3. Unscrews two screws on the lamp shut-down plate, and remove the plate.
4. Wait for 30 to 60 min to cool the lamp.
5. Disconnect the electronic connector of the lamp power shown in Fig.4-5.

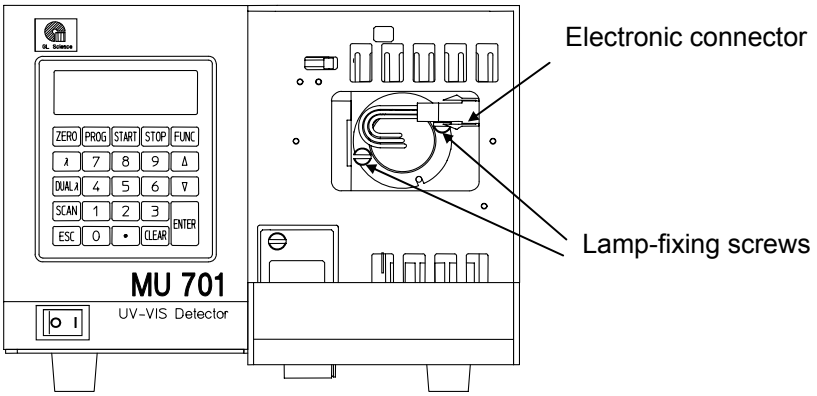


Fig.4-5: Connector of the lamp power

6. Loosen two lamp-fixing screws.
7. Pull gently the lamp assembly out.
8. Unscrew the lamp-fixing screws from the lamp assembly.
9. Before installing a new lamp, inspect the new lamp and lamp housing.

Table 4-1 Deuterium lamp for the MU701 detector

Part name	Cat. No
Deuterium lamp	6001-19900

Attention!

Do not touch the cylindrical glass bulb on the new lamp. Contamination/fingerprints will cause an increase in noise and drift of the detector.
If the lamp needs cleaning, use ethanol or methanol and lens tissue to clean carefully.

10. Position the new lamp, so that the cut-out on the metal flange of the lamp is inserted into the alignment pin (referring Fig.4-6).
11. The lamp bottomed into position, insert two lamp-fixing screws and tighten them.
12. Reconnect the electronic connector of the lamp.
13. Replace the lamp shut-down plate using two screws.
14. Close the front cover.
15. After completing the above procedures, turn on the detector power to resume operation of the detector.

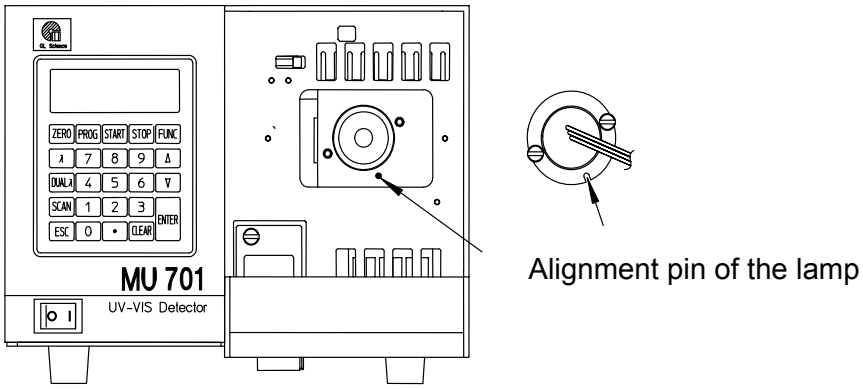


Fig.4-6: Alignment of the lamp

16. When the detector warm up normally, record the item and date of replacing the lamp by referring section 4-9-2 Setting/operating for maintenance in operational manual.

17. Under the standard screen, press the up arrow key to display the lamp energies of the sample and reference beams. Conform whether the reference beam energy is over 1000.

Attention!

If you forgot installing the lamp shut-down plate, the following message would be displayed after the detector completed starting up.

MESSAGE! Lamp maintenance Turn POWER off

When the above message is displayed, perform the following procedures to start up you detector: 1) turn the detector power off, 2) remove the front cover, 3) replace the lamp shut-down plate and close the front cover, and 4) turn the detector power to restart up the detector.

Caution ⚠ Lamp surface becomes extremely hot (>200 degree C) during operation, the lamp must be cooled for 30 to 60 min after turning off the detector.

Caution ⚠ To prevent the possibility of shattering the lamp, remove/install the lamp carefully because the inside of lamp is under slight negative pressure.

4-3-2 Resuming normal operation of the detector

Before ready to use the detector normally, ATAS GL recommends that you make a warming up of 30 hours. This process can result in shorten initially-fluctuated time of a new lamp, and increase in the initial stability of light intensity.

4-4 Replacement of the fuse

Warning To avoid the possibility of electrical shock, after always turn the detector power off and disconnect the power cord, perform the replacement of the fuse.

Warning For continued protection against fire hazard, replace fuse only with that of the same type and rating shown in Table 4-2.

Table 4-2: Fuse for the MU701 detector

Part name	Cat. No
Time lag fuse (250 V/2 A)	6001-1990

Perform the following procedures to replace the fuse:

1. Turn the detector power off.
2. Disconnect the power cord.
3. Inserting a flat-blade screwdriver into the fuse holder slot on the rear panel of the detector, and pull out the fuse holder from the power-input connector.
4. Remove the fuse from the fuse holder, and insert the new fuse into the fuse holder. (If there is a spare fuse in other side of the holder, you can use the spare fuse to replace.)
5. Insert the holder into the receptacle, and push the holder so it locks into position.
6. Connect the power cord into the power-input connector.

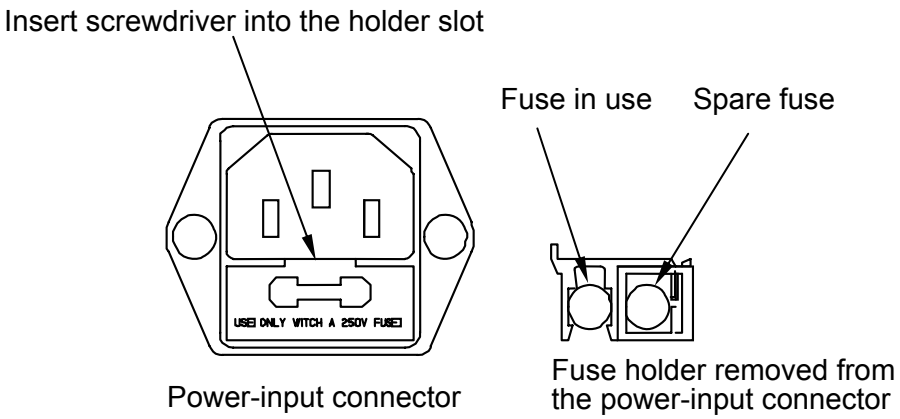
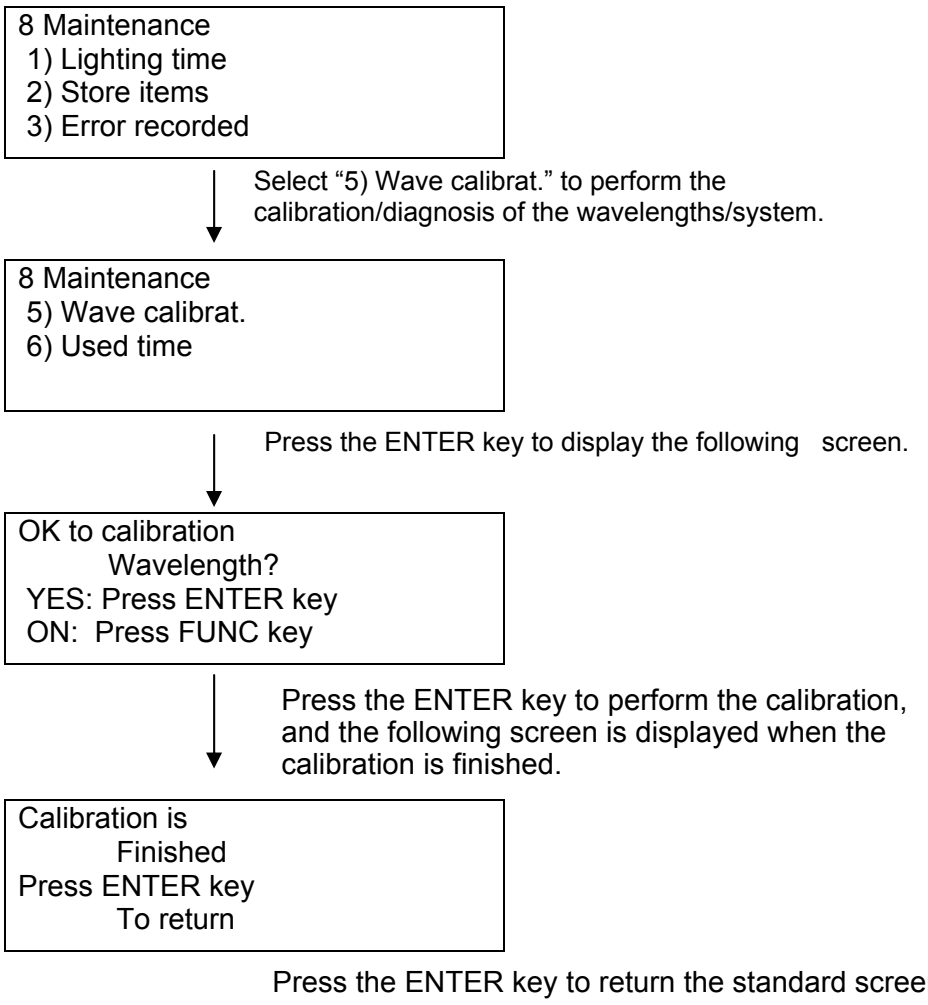


Fig.4-7: Replacement of the fuse

4-5 Wavelength calibration

Pump an HPLC-grade solvent (e.g., methanol, water, or acetonitrile) to wash out any compounds remained in the flow cell, and fill the flow cell with the solvent. During operating in single wavelength mode, perform a manual wavelength calibration by following procedure to conform whether the wavelengths is accurate and the system operates properly.



Attention!

If the flow cell contains some compounds that can lead to absorbance especially over the range of close to 656 nm peak, the detector would fail in the calibration process without any message.