SPECTRO CIROS VISION

ENG

Optical emission spectrometer with
inductively-coupled plasma excitation

SPECTRO

ENG

ENG

Table of Contents

ENG

1 Unit description

1.1 Function

The SPECTRO CIROS VISION is an automatic optical emission spectrometer providing simultaneous measurements. It uses inductively-coupled plasma excitation and a semiconductor-based detector system for quantitative and semi-quantitative analysis of liquids.

The liquid sample is nebulized and fed into the plasma as an aerosol. The high temperature of the plasma (6000-8000 K) evaporates the sample. The molecules contained in the sample dissociate into atoms. The atoms are excited and partly ionized.

The excited atoms and ions emit an element-specific radiation. A transfer optics feeds this radiation into the optical system.

The emitted radiation is diffracted into its spectral components in the optical system. The intensity is measured using semiconductor detectors (CCD).

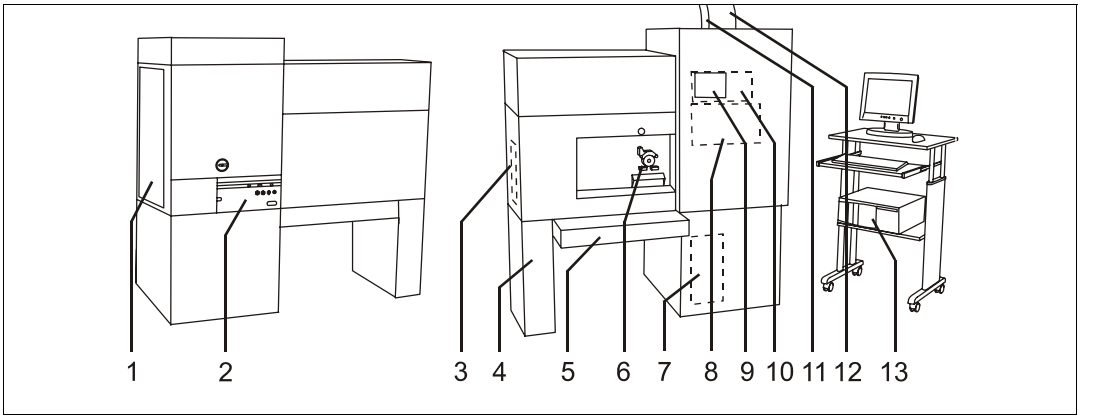
After processing the measuring signals in the unit, the measured element intensities are evaluated by the Smart Analyzer software.

Methods are set up prior to measuring. Calibration functions for each element to be determined are stored in these methods. Concentrations are calculated from the measured intensities, using these methods. The concentrations are displayed on the screen. They are also printed on a printer (can be activated as required) or saved in a database.

ENG

1.2 Overview

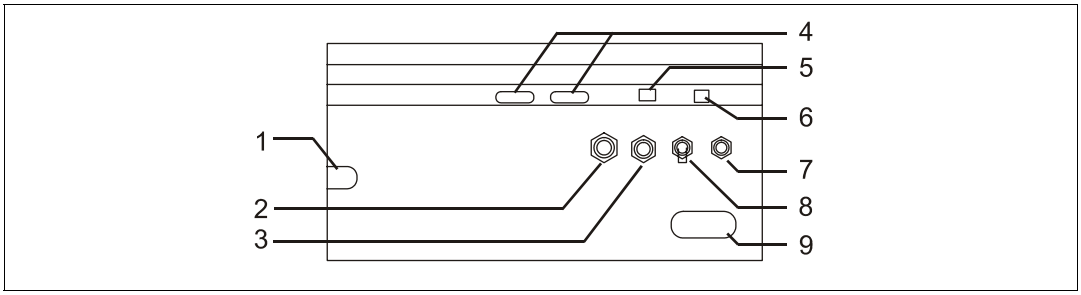
1.2.1 Unit



No.	Component
1	Air filter
2	Connections
3	Gas cleaning cartridge of UV plus system
4	Table (option)
5	Extendable shelf (table option)
6	Peristaltic pump (sample transport)
7	Waste container

No.	Component
8	Sample introduction system
9	Window to observe plasma
10	Generator door, torch box
11	Generator exhaust
12	Torch box exhaust
13	PC

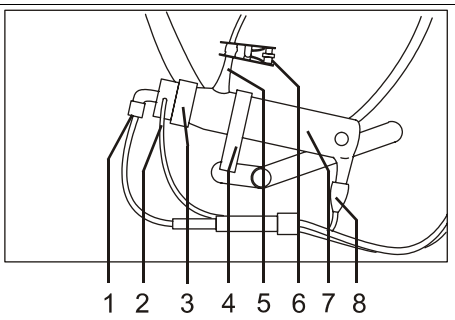
1.2.2 Connections (rear side)



No.	Component
1	Power supply lead-through
2	Inlet water connection (only EOP)
3	Outlet water connection (only EOP)
4	DIN measuring bus connection for accessories
5	Webcam connection (option)

No.	Component
6	PC connection (TCP/IP)
7	Argon connection
8	O2 additional gas connection (option)
9	Waste hoses lead-through

1.2.3 Sample introduction system



No.	Component
1	Argon connection
2	Sample introduction connection (from peristaltic pump)
3	Nebulizer
4	Spray chamber mounting

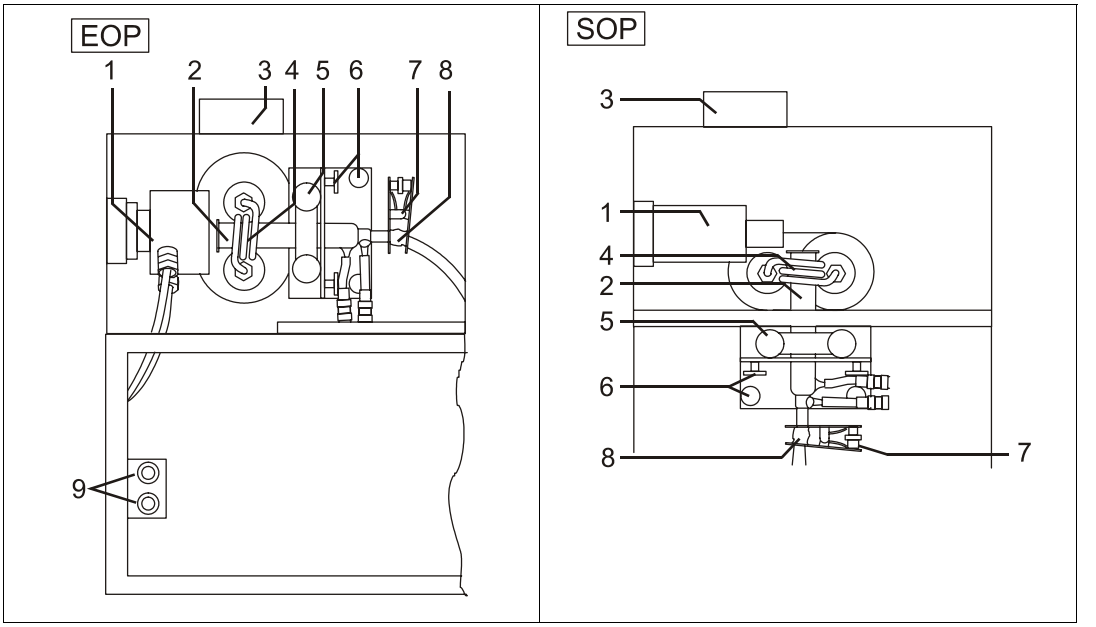
No.	Component
5	Connection to connecting elbow (EOP) or torch (SOP)
6	Clamp
7	Spray chamber
8	Waste connection

ENG

1.2.4 Plasma Chamber

The torch in the torch box is mounted horizontally in systems with axial plasma observation (EOP) and vertically in systems with radial plasma observation (SOP).

The plasma interface necessary for the axial version is equipped with water cooling.



No.	Component
1	Plasma interface
2	Torch
3	Exhaust for torch box and torch
4	Load coil
5	Torch fixing screw

No.	Component
6	Torch adjusting screws
7	Clamp
8	-Connection to spray chamber (SOP) or connecting elbow (EOP)
9	Plasma interface water cooling connection

ENG

2 Safety

Every user of the unit must have understood the present Operating Instructions. This applies in particular to the safety regulations.

2.1 User information

- Absolutely comply with all safety regulations. Compliance with regulations serves your safety.
- Observe all safety and accident prevention regulations at all times while operating, maintaining and repairing the unit. This is e.g. DIN EN 61010 or a comparable national standard.
- Maintenance and repair may only be carried out by qualified personnel.
- Check if the safety devices work properly after every maintenance or repair. This check is to be carried out according to VBG4 / DIN EN 61010 or a comparable national standard.
- Always have the unit maintained at the intervals specified by the manufacturer and document the maintenance activities. This serves for maintaining the operational safety of the unit.
- Never tamper with the safety devices! If you feel that a safety device does not work properly, shut down the unit immediately.
- Absolutely observe the information labels provided on the unit.
- Only genuine spare parts may be used for repairing the unit. The use of non-genuine spare parts will result in loss of CE conformity.
- The unit may be operated only in networks with a protective earth conductor.
- The unit may be operated only in a dry environment (protection class IP 20, DIN 40050).
- If a roller-equipped unit is used on an inclined floor, it may roll away during operation. Secure the unit while in operation. This applies also when the unit is on a transport carriage.
- Observe the associated safety regulations when using auxiliary agents and operating utilities.
- Disconnect the mains power plug before opening the unit.

2.2 Intended use

Only liquid samples may be analyzed with this unit.

If SPECTRO CIROS VISION is used with the corresponding accessories (e.g. SPECTRO SASSY, Laser Ablation System), solid samples can be analyzed as well.

ENG

2.3 Unallowed operating conditions

Operating the unit is not allowed if one of the following conditions applies:

- If the unit is faulty or damaged.
- If the unit is not subject to regular maintenance.
- If the ambient conditions do not comply with the specification.
- If the area where used is not at commercial/industrial premises.

2.4 Residual risk

This unit has been manufactured in accordance with the state of the art. Nevertheless, a residual risk cannot be completely excluded.

Warning! Danger of injury!

- The sample introduction system may contain dangerous sample residues.
  - ⇨ Take suitable safety precautions before working on it.
  - ⇨ Observe the safety data sheets as well as the risk and safety guidelines which apply to the sample material and/or the solvent used.
- Vapours may be generated from the sample material. These may be toxic and/or corrosive.
  - ⇨ Ensure that protective equipment is worn in such cases, e.g. a breathing apparatus.
- The sample material may be toxic and/or corrosive.
  - ⇨ Always ensure that during operation, the Plexiglas protective pane is installed in front of the sample feed system.
- The torch and the load coil heat up during operation.
  - ⇨ Always let the components cool down before working on them.

3 Technical data

Designation	Value
Electric connection	230 V AC ± 10 %, 50/60 Hz Phase + neutral + PE, CEE 32A plug
Instrument power consumption	5 kVA
Instrument required line protection	30 - 32 A (slow-blow)
Temperature range	+ 18°C – + 30°C (64 - 95 °F)
Air humidity range	< 80% (not condensing)
Air quality	Free of corrosive components and high dust concentrations
Argon gas connection	
Inlet pressure during operation	7.5 bar (109 psi) A maximum Ar inlet pressure of 10.0 bar (145 psi) must not be exceeded under any circumstances.
Quality	≥ 4.6 (99.996 %)
Consumption	≤ 25 l/min
Oxygen supply for the Auxiliary gas (optional, for organic applications only)	
Inlet pressure during operation	4.0 bar (58 psi)
Quality	≥ 4.5 (99.995 %)
Exhaust	
Torch box	250 m³/h (300 m³/h SOP) (150 cft/min, (175 cft/min (SOP))
Generator	250 m³/h (150 cft/min)
Cooling (EOP only)	
Medium	Water
Heat dissipation	approx. 1 kW
Inlet temperature	5 – 25 °C (41 - 77 °F)
Temperature difference between inlet and outlet	15°C max. (max 32 °F)
Free of impurities	> 1 mm (> 3/64 inch)
Flow rate	1.5 – 2.5 l/min (0.4 - 0.7 gal/min)
Pressure	1 - 5 bar (14.5-72.5 psi)
Water connection	5 m long ½“ (approx.16 ft) hose with connections

ENG

4 Transportation/Setting-up

4.1 Dimensions and weight

Designation	Value
Unit height	1,050 mm (41.4'')
Unit width	1,620 mm (63.8'')
Unit depth	770 mm (30.3'')
Unit weight	approx. 355 kg (~782 lbs)

Transportation of the unit to the installation location is the customer'sresponsibility.

Unloading the unit from the truck and further transport to the place of installation requires an elevating platform and/or a fork lift truck and personnel to ensure safe unloading.

We strongly recommend that you entrust a local forwarding agent with the further transport to the installation location. SPECTRO will not assume any responsibility for transportation on your premises.

Please check the useable capacity and the dimensions of any required elevators and the clear width of outside and other doors prior to installation.

The SPECTRO Service Department will be glad to assist you at any time in case of questions on the further transportation of the unit.

4.2 Setting-up

Caution! Measurement error!

- Shocks to the unit during the measuring process produce measurement errors.
  - ⇨ For this reason, install the unit so it will not be subject to shocks.
- Measurement errors also result from temperature differences inside the unit.
  - ⇨ Install the unit so that it cannot heat up on one side only.

Observe the following information regarding unit installation:

- Avoid mechanical bumps.
- All connections are on the rear side.
- The unit must be accessible from all sides for maintenance. Set up the unit accordingly. The minimum clearance from other objects on all sides including the rear side is 20 cm (8 “).
- In case the optional table was not included in the order:
  - A table of corresponding dimensions and load-carrying capacity is required, see page 11.
- In addition to the space required by the SPECTRO CIROS VISION, some space is needed for the argon supply if no fixed gas connections are available.
- The SPECTRO CIROS VISION is operated exclusively from the front side. Sufficient space should be provided for the computer workstation (keyboard, monitor, printer and possibly sample changer) and operating personnel.

4.3 Dust load

Avoiding contamination problems in the analysis requires a relatively dust-free environment.

The maximum dust load should not exceed 36 million particles (0.5 µm (0.00002”) or bigger) per cubic metre of air. Operating the unit in an environment with a higher dust load shortens maintenance intervals and may damage the unit. Example for comparison: a usual, clean office environment contains 18 to 36 million particles per cubic metre of indoor air.

To avoid unit damage, the unit must also be set up in an environment which is free from corrosive vapours.

Air conditioning of the room will only be required under extraordinary conditions. Minor variations of the room temperature are compensated by the unit design. However, one-sided heating-up must be avoided at any rate.

ENG

4.4 Transportation

Caution! Damage to unit!

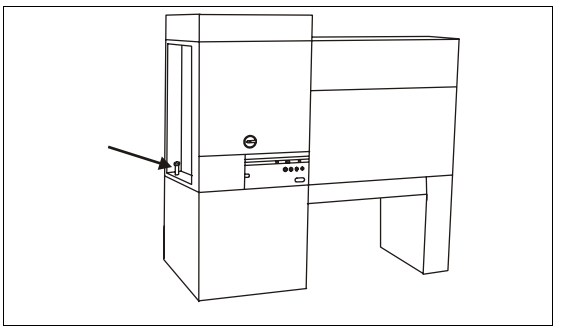
If the unit is to be moved to another place of installation after setting it up, the unit may be damaged.

Secure the unit for transportation. Contact the SPECTRO Service Department in this matter.

The unit may be raised for fork lift truck transportation.

Proceed as follows to raise the unit:

1. Remove the unit side panels.
2. Turn the elevating screws down one by one.
   - ⇨ The unit is raised.
   - ⇨ Do not tilt the unit when turning the elevating screws.



✓ Raising the unit is now complete.

4.5 Storage

Caution! Damage to unit!

At an ambient temperature below 2°C (36 °F), the cooling water will freeze and damage the unit (EOP only).

Avoid storing the unit at temperatures as low as mentioned above. If this cannot be avoided, ensure that there is no cooling water left inside the unit (blow it out at the connections on the rear side) (EOP only).

Storage conditions: Room temperature 2 – 40°C (36 - 104 °F)

4.6 Gas supply

Caution! Measurement error!

Impurities of the argon supply will produce measurement errors and/or will make ICP operation impossible.

Ensure oil- and grease-free laying of the argon supply line.

The unit requires an argon supply.

A suitable pressure reducer/regulator is required for the argon supply (bottles or liquid gas tank).

- Primary pressure 200/300 bar (2900/4350 psi)
- Controllable output pressure 0 – 10 bar (0-145 psi)

Argon supply is by a tubing included in SPECTRO's scope of supply (5 m (approx.16 ft) long, OD/ID = 8/6 mm). This tubing is screwed to the connection on the rear side of the unit. The connector on the instrument side is included in the scope of supply. The connector on-site is customer specific and therefore not part of the delivery.

The following flow rates are used in normal operation:

Coolant:	12 - 20 l/min
Auxiliary gas:	0.4 - 2 l/min
Nebulizer gas:	0.1 - 1.5 l/min

4.7 Cooling (EOP version only)

The SPECTRO CIROS VISION EOP has an integrated water cooling system. An upstream air/water cooling system is also available as an option.

Primary water supply is by the 3 m (approx. 10 ft) water tubing that are included in the scope of supply.

The laboratory shut-off valve must be equipped either with a union nut (1/2") or with a connecting nipple for a hose (ID 3/8"). Sufficient water drain capacities must also be provided, see page 11.

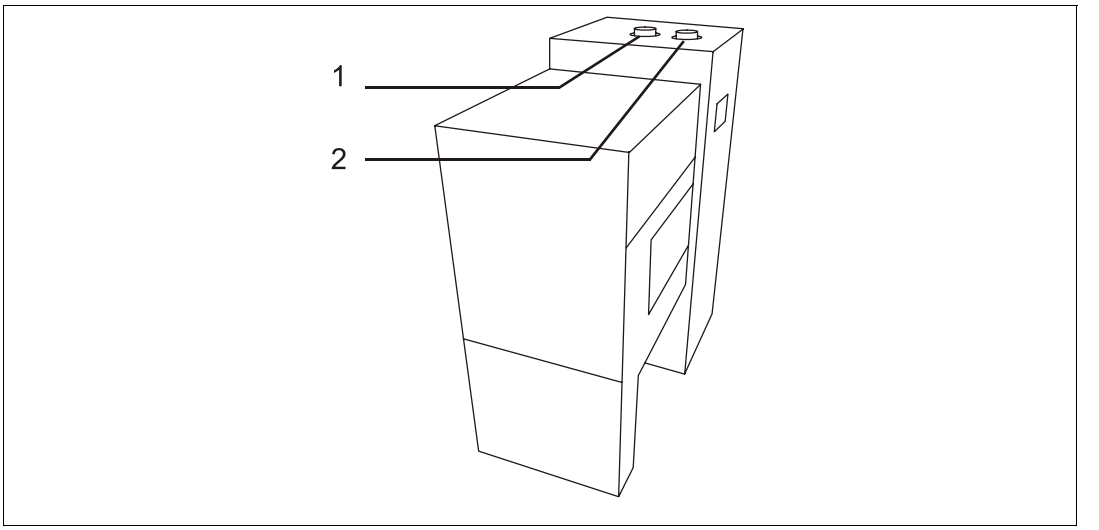
ENG

4.8 Exhaust air (to the outside)

Exhaust air chimneys are provided at the top of the unit.

The corrosion-free exhaust air chimneys must be connected with the laboratory exhaust air system using a non-flammable, flexible and corrosion-resistant hose (ID 100 mm). The fan must be resistant to chemicals and designed to operate at temperatures of up to 80°C. The exact position of the exhaust air chimneys can be taken from the figure.

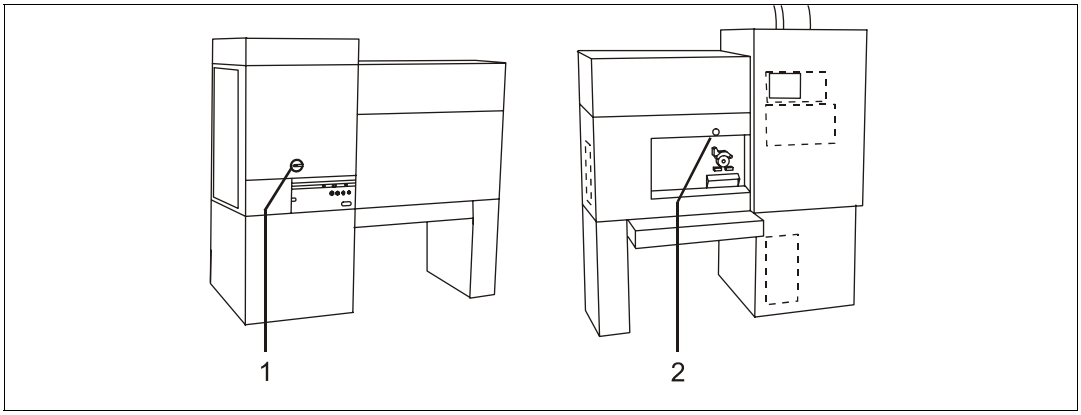
All installation must be carried out in a professional manner and in accordance with valid technical regulations in order to exclude hazards to life and limb and to material property.



Instrument	Exhaust capacity at the chimney	
	1 (rear) Generator exhaust	2 (front) Torch box exhaust
EOP	250 m3/h / 150 cft/min	250 m3/h / 150 cft/min
SOP	250 m3/h / 150 cft/min	300 m3/h / 175 cft/min

5 Operation

5.1 Overview of controls



No.	Control	Function
1	Main switch	Power supply
2	Plasma Off	Switches the plasma off

5.2 Preparing the unit for operation

Before switching on the unit, proceed as follows:

1. Install the torch and the sample introduction system, see page 25.
2. Set the argon pressure to 7.5 bar (109 psi).
   ⇨ The plasma cannot be started at a pressure of < 7.0 bar (102 psi). A corresponding error message will be displayed.
3. Ensure that the exhaust system is activated and that the specified exhaust capacity is reached.
4. Ensure that water cooling is active (EOP only).
5. Ensure that all doors are closed.

✓ The unit is ready for use.

ENG

5.3 Switching on the unit, operational readiness, starting the plasma

To switch on the unit, proceed as follows:

1. Turn the main switch to ”On“.
   - ⇨ The unit is ready for operation.
   - ⇨ Allow the unit to stabilize for 30 minutes after switching it on (optical system).
2. Switch on the computer.
   - ⇨ The operating system boots up.
3. Start the unit software SMART ANALYZER VISION after the operating system has been completely booted.
4. Select the function ”Setup Devices“ in the ”System“ menu.
   - ⇨ Flush the the sample introduction system for 2 minutes with Ar.
     - ⇨ Set the following gas flows:
       - Plasma gas: 10 l
       - Auxiliary gas: 1 l
       - Nebulizer gas: 1 l
     - ⇨ Click on the ”Apply“ button.
5. Activate plasma ignition by clicking on the ”Plasma“ button in the generator list.
   - ⇨ The sample introduction system is automatically flushed with argon.
   - ⇨ The message ”Plasma is starting“ is displayed in the status line.
   - ⇨ At the end of this process (2 minutes), the plasma ignites.
6. Switch on the pump.
   - ⇨ To do this, open the dialogue box ”Device Control Parameters“
   - ⇨ Click on the ”Pump“ button in the generator list.
     - ⇨ Depending on the application, distilled water or a matrix blank solution is aspirated for 20 to 30 minutes to heat up and stabilize the components.

✓ The unit is now switched on and the plasma has been started.

5.4 Switching off the plasma/Switching off the unit

Note

Leave the unit in standby mode whenever possible (main switch set to ”On“). This ensures purity of the inert atmosphere inside the optics compartment (required for obtaining high transparency in the UV range) and provides stable temperature conditions (necessary for good long-term stability during the measurement).

When the unit was switched off for an extended period, stabilizing can take up to 6 hours, depending on the ambient temperature.

To switch off the unit, proceed as follows:

1. Flush the sample introduction system for approx. 10 minutes with a suitable blank solution, e.g. distilled water for aqueous applications.
   ⇨ This avoids crystallizations in the sample introduction system.
2. In the Smart Analyzer Vision software, select either:
   - the function ”Setup Devices“ in the ”System“ menu and activate plasma shut-down in the generator list by clicking on the “Plasma” button or
   - press the ”Plasma Off“ button on the unit front side.

   ⇨ The plasma extinguishes.
3. Exit the unit software (SMART ANALYZER VISION) by selecting the ”Exit“ function in the ”File“ menu.
   ⇨ The program is terminated.
4. Select the dialogue item "Shut down" in the “Start” menu of the operating system and confirm the dialogue box.
   ⇨ The computer is turned off.
5. Switch off water cooling (EOP system only).
6. Switch off the exhaust.
7. Close external argon supply valves.
8. Release the pressure clamps of the peristaltic pump and relieve the pump tubings by removing them from their clamps.
9. Switching the unit off completely:
   ⇨ Turn the main switch to ”Off” (see note).

✓ The unit is now switched off.

ENG

5.5 Performing measurements

5.5.1 Preparing measurements

Before starting measurements, proceed as follows:

1. Ensure that the optical system is reprofiled, see page 20.
2. Carry out a standardization if required, see page 21.
3. Carry out a calibration if required, see page 21.
4. Check the safety measures if you work with hazardous or corrosive samples.

✓ The unit is now ready for measuring samples.

Reprofiling of the optical system

The optical system must be reprofiled

- after switching on and temperature stabilization.
- before setting up a new method.
- before carrying out high-precision measurements.

Reprofiling requires a solution of the following composition:

Element	Concentration mg/L
Cl	(contained in HCl)
Fe	10
K	10
La	10
Mg	5

Element	Concentration mg/L
P	10
S	50
Sc	10
Ti	10

The solution must also contain:

- 20 ml/l HCl
- 20 ml/l HNO3

Proceed as follows to reprofile the optical system:

1. Ignite the plasma.
2. Flush the sample introduction system for 20 to 30 minutes by aspirating distilled water as a sample.
3. Select the function ”Reprofile optics“ in the ”System“ menu.

4. Follow the instructions displayed by the software.
   ⇨ Ensure that the composition of the reprofiling solution is correct.

✓ Optical system reprofiling is now complete.

Standardization of a method

Standardization is carried out as required. The frequency depends on the requirements on measuring accuracy.

To standardize proceed as follows:

1. Select the function ”Method Measurements“ in the ”Analysis“ menu.
   ⇨ The ”Measure Standard” dialogue is displayed.
2. Select ”Standardization“.
3. Activate the first standard in the list.
4. Feed the corresponding sample to the sample introduction system by means of the peristaltic pump.
5. Click on the “Measurement“ button.
   ⇨ The method is standardized.
6. When the measurement is complete, terminate it using function key F8.
7. Activate the next standard in the list.
8. Click on the “Measurement“ button one more time.
9. When the measurement is complete, terminate it using function key F8.
10. Proceed in this way until all standards contained in the list were measured.
11. When all standards contained in the list were measured, click on the ”Calculate“ button.

✓ The method is now standardized.

Calibrating a method

The unit is calibrated by using an equivalent procedure as for standardization, however, calibration must be selected in the ”Measure Standard” dialogue.

Measuring control standards

Control standards are measured by using an equivalent procedure as for standardization, however, control standards must be selected in the ”Measure Standard” dialogue.

ENG

5.5.2 Measuring samples

Proceed as follows to carry out a measurement:

1. Load a method using function key F9.
   - ⇨ If there is no method in the list, you must create a suitable method, first . To do this, use the online help.
2. Feed the sample to be measured to the sample introduction system by means of the peristaltic pump.
3. Start the measurement by pressing function key F5 (single measurement) or F6 (multiple measurement).
   - ⇨ The measurement is carried out automatically.
   - ⇨ When the measurement is complete, the results are displayed on the screen.
   - ⇨ Terminate the measurement by pressing function key F8.

✓ The measurement is now complete.

Carry out further measurements as required.

ENG

6 Maintenance

6.1 Maintenance schedule

The maintenance intervals specified in the following table are guideline values which should be observed as a minimum requirement. The maintenance intervals may vary, depending on the use of the unit.

To ensure flawless unit function, carry out the following maintenance work:

Start of work	**Maintenance work to be carried out**
Check argon supply	Min. pressure in bottle: 40 bar (580 psi).
Peristaltic pump tubing and sample introduction system tubing	Check for damage and flow.

Weekly maintenance work	
Plasma control fiber:	Check for damage and soiling. Clean or replace if required, see page 30.
Nebulizer	Check for soiling and plugging. Clean if required, see page 27.
Spray chamber	Check for soiling and streaks. Clean if required, see page 28.
Backup of analysis data	

Monthly maintenance work	
Torch box	Check torch and spray chamber for damage and soiling. Clean or replace if required, see page 25.
Nebulizer	Check quality of aerosol generation, see page 29.
Air filter (behind the right side of unit)	Replace if dirty.
Cylindrical air filter of oscillator cooling (behind the front left unit cover)	Replace if dirty (switch off instrument prior to exchange!).

Further maintenance work	
Replace the gas cleaning cartridge	See page 24.
Load coil	Check for corrosion. Clean if required, see page 29.
Pump tubings	Check for damage. Replace if required, see page 31.

ENG

6.2 Replacing the gas cleaning cartridge

Caution! Damage to unit!

Turn off the unit at the main switch prior to starting any work on it. If the unit is switched on and the gas cleaning cartridge has been removed, the diaphragm pump (circulating the argon atmosphere inside the UV compartment) works against the closed connections. This may damage the pump.

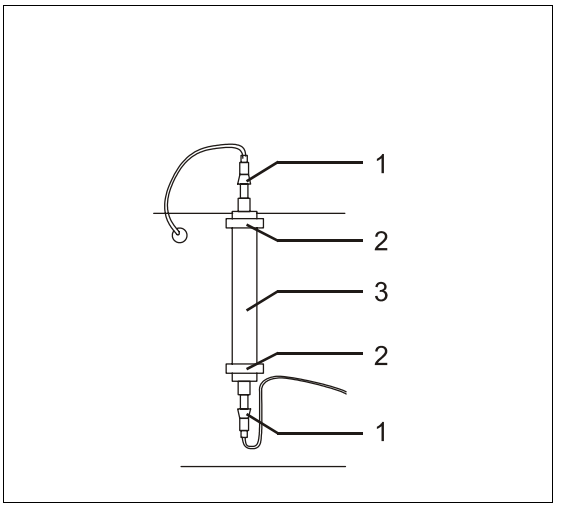
For this reason, always switch off the unit using the main switch on the rear side before removing the gas cleaning cartridge.

In normal condition, the filter cartridge has a blue colour. As it is consumed, its colour slowly changes to violet. The gas cleaning cartridge must be replaced before it is totally used up.

To replace the filter cartridge, proceed as follows:

1. Turn off the unit completely using the main switch.
2. Open the left side panel of the unit.
3. Open the quick-release locks of connections (1) and the clamps (2) and remove the gas cleaning cartridge (3).
4. Install the new gas cleaning cartridge and the side panel.
   - ⇨ Note down the date of installation on the new gas cleaning cartridge.

✓ The gas cleaning cartridge replacement is now complete.



Note

Note down the date of removal of the old gas cleaning cartridge and return it to SPECTRO (in the original packing if possible). The old filter cartridge can be recycled.

Please observe that otherwise, the gas cleaning cartridge must be disposed of as hazardous waste.

6.3 Cleaning the torch

Warning!

- The torch and the load coil may be very hot.
  - ⇨ Let the torch cool down for 10 to 15 minutes before working on it.
- The torch components that are not made of quartz glass may be damaged by the cleaning solution or its vapours.
  - ⇨ Clean only the quartz glass of the torch in the cleaning solution.

Proceed as follows to clean the torch:

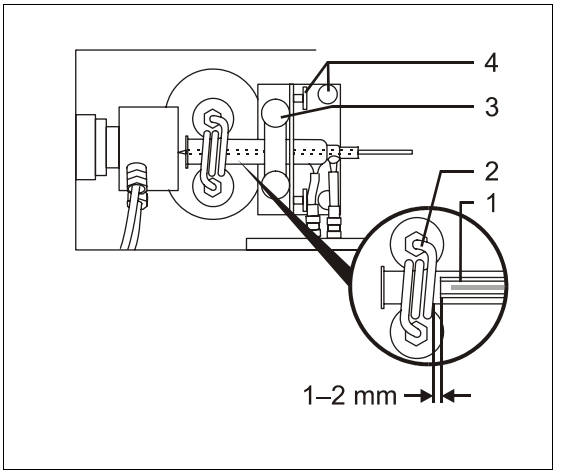
1. Switch off the plasma.
2. Release the connections on the torch.
3. Release and remove the clamp from the torch and the spray chamber.
4. Loosen the screws of the torch holder.
5. Remove the torch.
6. Clean the torch.
   - ⇨ To do this, remove the tubing with the metal fittings (quick-release locks).
   - ⇨ Put the torch in aqua regia (a mixture of one part concentrated nitric acid and three parts concentrated hydrochloric acid).
     - ⇨ Hazardous substance! Observe the corresponding information on hazardous materials.
   - ⇨ Let the acid/cleaning solution act on the torch for approx. 15 minutes.
   - ⇨ After this, rinse the torch with distilled water and dry it completely. This can be done best in a drying oven.
7. Reinstall the torch.

- Torch for axial plasma observation

  ⇨ The clearance between the end of the middle tube of the torch (1) and the right end of the load coil (2), as seen from the front, is 1 – 2 mm.

  ⇨ Adjust the clearance and secure the torch with the fixing screws (3).

  ⇨ Center the torch within the load coil.using the centering screws (4)

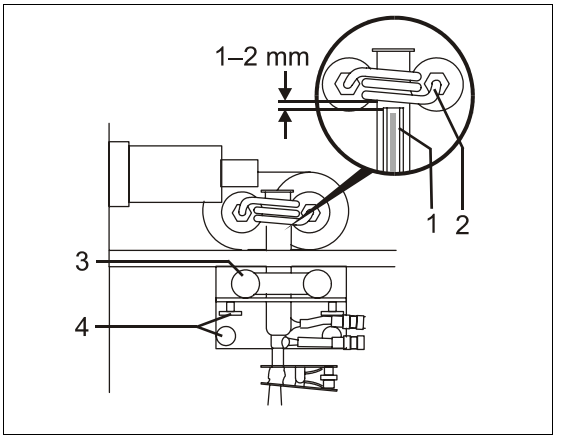


- Torch for radial plasma observation:

  ⇨ The clearance between the end of the middle tube of the torch (1) and the bottom end of the load coil (2) is 1 – 2 mm.

  ⇨ Adjust the clearance and secure the torch with the fixing screws (3).

  Center the torch within the load coil, using the centering screws (4)



✓ Cleaning of the torch is now complete.

6.4 Cleaning the nebulizer (Standard Crossflow Nebulizer)

Warning! Danger of injury!

- There may be acid residues in the nebulizer and in the spray chamber.
  - ⇨ Observe the corresponding information on hazardous materials.
- Glass parts may break when handled incorrectly and cause skin cuts.
  - ⇨ Use appropriate care and/or take safety precautions (e.g. wear gloves).

To clean the nebulizer, proceed as follows:

1. Flush the sample introduction system for approx. 10 minutes with a suitable blank solution, e.g. distilled water for aqueous applications.
2. Switch off the plasma.
3. Release the clamp between the torch and the spray chamber.
4. Carefully pull the spray chamber to the right (EOP) or to the bottom (SOP) in order to separate the spray chamber from the torch.
5. Disconnect all other connections from the nebulizer and the spray chamber.
6. Remove the spray chamber.
7. Separate the nebulizer from the spray chamber by slightly twisting it and disconnect the argon connection.
8. Remove the metal connector of the argon connection.
9. Put the nebulizer into a beaker and carefully fill it with diluted hydrochloric acid.
   - ⇨ Hazardous substance! Observe the corresponding information on hazardous materials.
10. Let the acid act for up to 15 minutes (depending on the degree of soiling).
    - ⇨ When heavy soiling must be removed, a suitable acid or aqua regia may be required.
    - ⇨ If there are deposits on the capillary tube, clean them very carefully with a fine copper wire.
11. After this, flush the nebulizer with distilled water and let it dry completely.
12. Reinstall the components.
13. Check aerosol generation and optimize the gas flow of the nebulizer, see page 30.

✓ Cleaning of the nebulizer is now complete.

ENG

6.5 Cleaning the spray chamber (Standard Scott Chamber)

Warning! Danger of injury!

- There may be acid residues in the nebulizer and in the spray chamber.
  - ⇨ Observe the corresponding information on hazardous materials.
- Glass parts may break when handled incorrectly and cause skin cuts.
  - ⇨ Use appropriate care and/or take safety precautions (e.g. wear gloves).

To clean the spray chamber, proceed as follows:

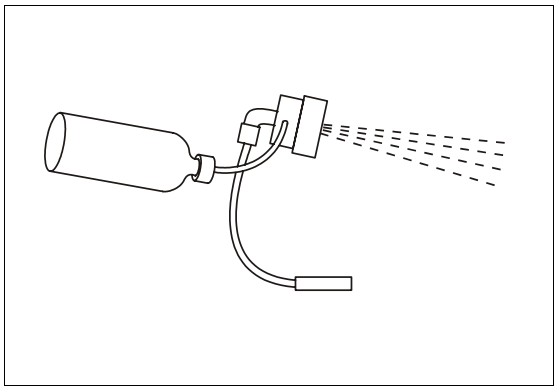
1. Flush the sample introduction system for approx. 10 minutes with a suitable blank solution, e.g. distilled water for aqueous applications.
2. Switch off the plasma.
3. Release the clamp between the torch and the spray chamber.
4. Carefully pull the spray chamber to the right (EOP) or to the bottom (SOP) in order to separate the spray chamber from the torch.
5. Remove the spray chamber.
6. Separate the nebulizer from the spray chamber by slightly twisting it.
7. Disconnect the waste connection from the spray chamber cap and remove the cap from the spray chamber by slightly twisting it.
8. Clean the spray chamber.
   - ⇨ First, use a suitable diluted acid solution (e.g. hydrochloric acid or nitric acid 1:10).
     - ⇨ Hazardous substance! Observe the corresponding information on hazardous materials.
   - ⇨ After this, use a laboratory cleaning agent for removing traces of fatty substances (streaks) if required.
   - ⇨ Now flush the spray chamber thoroughly with distilled water.
9. Reinstall the components.
10. Optimize the nebulizer gas flow, see page 29.

✓ Cleaning of the spray chamber is now complete.

6.6 Checking aerosol generation of the nebulizer

Proceed as follows to perform the check:

1. Remove the nebulizer, see page 27, but without disconnecting the argon connection.
2. Set the nebulizer gas flow determined for the nebulizer in the “Device Control Parameters” dialogue box.
3. Using a spray bottle, force distilled water through the nebulizer connection for sample introduction.
   ⇨ The spray coming out must be evenly V-shaped. If this is not the case, the nebulizer may be clogged and must be cleaned, see page 27.



4. Reinstall the components.

✓ Checking the aerosol generation is now complete.

6.7 Cleaning the load coil

Warning! Danger of burns!

The torch and the load coil may be very hot.

Let the torch cool down for 10 to 15 minutes before working on it.

The load coil may corrode because of the sample vapours.

Proceed as follows to clean the coil:

1. Switch off the unit.
2. Remove the torch, see page 25.
3. Clean the load coil with a narrow brush (e.g. a toothbrush) and a grinding paste (e.g. toothpaste).
4. Remove the grinding paste completely from the load coil.
5. Reinstall the components.

✓ Cleaning of the load coil is now complete.

6.8 Cleaning the plasma control fiber

Warning!

- Isopropanol vapours are dangerous to health. Vapour/air mixtures which represent a fire and explosion hazard may also form.
  - ⇨ Observe the corresponding information on hazardous materials.
  - ⇨ Ensure appropriate precautionary measures are taken when using isopropanol. Always wait for the isopropanol to evaporate before switching on the plasma.
- The torch and the load coil may be very hot.
  - ⇨ Let the torch cool down for 10 to 15 minutes before working on it.

Proceed as follows for cleaning:

1. Clean the surface of the fibre with a cotton cloth.
   - ⇨ Before cleaning, immerse the cotton cloth in diluted hydrochloric acid (1:10).
     - ⇨ Hazardous substance! Observe the corresponding information on hazardous materials.
2. Repeat this procedure with distilled water and isopropanol.
3. If the optical fiberis very soiled, clean it using wet grinding paper (1200 grit) and then polish it with wet grinding paper (4000 grit).
   - ⇨ To do this, loosen the screws and pull the optical conductor out of its bracket.

✓ Cleaning of the plasma control fiber is now complete.

6.9 Optimizing the nebulizer gas flow

After each assembly, the nebulizer gas flow must be optimized.

The following is required for optimizing:

- Distilled water
- Solution with 5 mg/l of manganese
- Method for the emission line of manganese at 257.61 nm.

Proceed as follows to optimize:

1. Aspirate distilled water as a sample and carry out three measurements.
2. Calculate the average.
3. Increase gas flow stepwise and measure again for each step.
4. Repeat this procedure with the 5 mg/l manganese solution.

5. Calculate the signal-to-background ratio (SBR) for each gas flow rate of the nebulizer according to the following formula:

$$SBR = \frac{\text{Intensity of manganese solution} - \text{Intensity of water}}{\text{Intensity of water}}$$

   ⇨ When the signal-to-background ratio is plotted as a function of the nebulizer gas flow rate, a parabolic curve results.

6. Adjust the nebulizer gas flow according to the best SBR (highest value).

✓ Optimization of the nebulizer gas flow is now complete.

6.10 Maintenance of pump tubing

Damaged or worn pump tubing affects the unit performance. For this reason, the tubing must be checked at regular intervals (each time before starting work) and replaced as necessary.
Proceed as follows to replace the tubing:

1. Flush the sample introduction system for approx. 10 minutes with a suitable blank solution, e.g. distilled water for aqueous applications.
2. Switch off the plasma.
3. Release the pressure clamps of the peristaltic pump and relieve the pump tubing by removing them from their clamps.
4. Fold the pressure clamps aside, disconnect the tubing from the pump head and remove the connected capillary tubes.
5. Connect the capillary tubes with the new pump tubing.

   ⇨ While doing so, observe the correct inside diameter. The required inside diameter and consequently the pumping capacity depends on the nebulizer used. The following applies to the Cross-Flow nebulizer included in the scope of supply as a standard item:

   - Sample introduction channel: Inside diameter 0.89 mm (Orange-orange stops).
   - Waste channel: Inside diameter 1.8 mm (Blue-green stops).

6. Put the tubing around the pump head, attach the stops to the brackets and close the pressure clamps.
7. The pressure is set as follows, using the adjusting screws:

   I. Switch on the pump and aspirate a suitable blank sample, e.g. distilled water for aqueous applications.

      ⇨ To do this, open the “Device Control Parameters” dialogue box and click on the “Pump” button in the generator list.

   II. Loosen the adjusting screws until no liquid is pumped.

III. Now increase the pressure until the pump just starts pumping liquid. Adjust the correct pressure by closing the respective adjusting screw by half a turn.

✓ Replacement of pump tubing is now complete.

7 Troubleshooting

Caution! Damage to unit!

The unit may be damaged if repairs are not carried out properly. Do not attempt to repair the unit yourself. Always contact the SPECTRO Service Department.

Fault	Reason	Remedy
Generator does not start	Power supply	Check instrument power supply (fuses, main switch)
Error message: No argon on main valve	Argon supply interrupted	• Check argon supply • Check argon inlet pressure (should be 7.5 bar)
Error message: No cooling water (EOP)	Water supply interrupted	• Check to ensure system (tubing, etc.) is not blocked (dirt, lime deposits) • Check flow amount
	Water inlet pressure too low	Increase inlet pressure (approx. 4 bar/60 psi)
Error message: Generator door open	Door incorrectly closed	Check closing mechanism
Error message: Current error on start	Error during start routine	Repeat start procedure
Torch melts	Torch incorrectly adjusted within the load coil	Check if torch is centered
	Aerosol tube blocked	Take out and clean
	Leak in the argon connection to the torch	Search for leak with soapy solution and seal
	Auxiliary gas flow set too low	Increase flow rate
	Leak in the nebulizer system	Search for leak with soapy solution and seal
Plasma cannot be lit	No Tesla spark	Spark plug / cable not connected to the quick-snap connection on the argon inlet for the Coolant gas. Insulation tube not correctly positioned over ignition cable connection to Ar inlet for coolant on torch

Fault	Reason	Remedy
	Torch not correctly centered within the coil	Check adjustment
	Oxygen in the sample introduction system	Flush the sample introduction system with argon
	Wrong argon quality	Argon with a quality of 4.6 or better is required (purity ≥ 99.996%)
Plasma asymmetrical	Aerosol tube incorrectly adjusted (demountable torch)	Center aerosol tube
	Argon flush of light tube to optic to high	Reduce light tube flush rate
	Exhaust rate set too high	Reduce exhaust rate
Plasma flickers or pulsates	Humidity or deposits in the aerosol tube	Clean and dry aerosol tube or replace it
	Aerosol pulsates (deposits in nebulizer)	• Clean nebulizer • Replace pump tubing
Plasma too bright	Power set too high	Decrease power
	Leak in torch (demountable)	Check O-rings
	Oxygen in sample introduction system	Check for and repair leaks
Plasma extinguishes when nebulizer gas is turned on	Aerosol tube is not centered in the torch (demountable)	Adjust aerosol tube
	Sample feed tubing has been disconnected from nebulizer	Attach again and check fitting
	Oxygen in sample introduction system	Before starting again, flush the system with argon
	There is a leak in the sample introduction system	Search for and repair leak
No channel can be seen in the plasma	Aerosol tube is not correctly centered (demountable torch)	Adjust aerosol tube
	Nebulizer flow rate is set too low	Optimize nebulizer flow rate again

Fault	Reason	Remedy
	Leakage in the torch (demountable)	• Check O-rings in torch and quick snap connections for argon inlet tubing • Lightly apply vacuum grease to the ground ball joint on the torch • Check the clamp between the torch and the spray chamber
	Nebulizer blocked	Take out and clean nebulizer
	Leakage in drain	Search for and repair leak
Nebulizer frequently blocked	No water in argon humidifier	Fill argon humidifier with distilled water until half full
Error message: Waste container full	Waste container is full	Remove the cover of container and suitably dispose of discharge
Sparking-over at the coil	Humidity	Turn off generator and dry coil with tissue paper (if humidity is visible)
	Dirt on the coil	Clean coil with toothbrush
	Torch is not in the center of the coil	Center torch within the coil again

8 Spare and consumable parts

Spare and consumable parts for this unit can be found under "Support - Parts Catalog" on the SPECTRO website (www.Spectro.com).