ICP OPTICAL EMISSION

# AVIO 200 SPECTROMETER

# Hardware Guide

PerkinElmer®

# Avio™ 200 Spectrometer

## Customer Hardware and Service Guide

## Release Information

| Part Number | Release | Publication Date |
|---|---|---|
| 09931179 | C | June 2017 |

Any comments about the documentation for this product should be addressed to:

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# Contents

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PerkinElmer
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Shelton, Connecticut 06484-4794 USA
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Every day you count on PerkinElmer to provide you with solutions that deliver reliable performance, control operating costs and maximize operational time. Our complete portfolio of consumables, parts, supplies, training and service helps you meet both routine and demanding measurement challenges. We invest heavily in testing and validating our products to ensure you receive guaranteed compatibility and performance-on-time, every time, for every instrument in your laboratory.

Supplies, replacement parts, and accessories can be ordered directly from PerkinElmer, using the part numbers quoted in the guides provided with the instrument.

See our website:

http://perkinelmer.com

PerkinElmer's catalog service offers a full selection of high-quality supplies.

To place an order for supplies and many replacement parts, request a free catalog, or ask for information:

If you are located within the U.S., call toll free 1-800-762-4000, 8 a.m. to 8 p.m. EST. Your order will be shipped promptly, usually within 24 hours.

If you are located outside of the U.S., call your local PerkinElmer sales or service office.

# Safety and Regulatory Information

## Safety Information in the Manual

Safety information is contained in Chapter 1 of this manual. **Before setting up and operating this instrument, carefully read the safety precautions described in this chapter and observe them at all times.**

**Caution** The protection provided by this equipment may be impaired if the equipment is used in a manner not specified by PerkinElmer.

**Attention** La protection fournie par cet équipement risque d'être moins efficace si l'équipement fait l'objet d'une utilisation différente de celle mentionnée par PerkinElmer.

This manual contains important information regarding potential hazards that may arise during the operation of the instrument. It is essential that this information is read and thoroughly understood by all potential users of the instrument.

**The instrument should be used according to the instructions provided in this manual.** If used otherwise, the protection provided by the instrument may be impaired.

In this manual, the following graphic symbols and special text formats are used to set apart important safety information.

**Warning**

A warning indicates an operation that could cause *personal injury* if precautions are not followed.

**Avertissement:** Ceci est un exemple d'avertissement, c'est-à-dire de situation pouvant entraîner des blessures

**Caution** A caution indicates an operation that could cause *instrument damage* if precautions are not followed.

**Attention** Une telle mise en garde signale une opération risquant d'endommager l'instrument si les précautions d'usage ne sont pas respectées

## Regulatory Information

### Safety compliance

Safety information is located in the European Union Declaration of Conformity.

### Electrical protection

#### Insulation

Class I as defined in EN 61010-1.

#### Installation category

This instrument is able to withstand transient overvoltage according to Installation Category II as defined in EN 61010-1 and EN 60664-1.

#### Pollution degree

This equipment will operate safely in environments that contain nonconductive foreign matter and condensation up to Pollution Degree 2 as defined in EN 61010-1 and EN 60664-1.

## *Electromagnetic compatibility (EMC)*

### European Union (EMC Directives)

All information concerning EMC standards is in European Union Declaration of Conformity and these standards may change as the European Union adds new requirements.

### United States (FCC)

This instrument is classified as a digital device used exclusively as industrial, commercial, or medical equipment. It is exempt from the technical standards specified in Part 15 of FCC Rules and Regulations, based on Section 15.103 (c).

## Environment

### Operating Conditions

Warning

**Explosive Atmosphere**
This instrument is not designed for operation in an explosive atmosphere.

**Avertissement : atmosphère explosive**
Cet instrument n'est pas conçu pour fonctionner dans une atmosphère explosive.

### Pollution Degree

This equipment will operate safely in environments that contain non-conductive foreign matter up to Pollution Degree 2 in EN 61010–1.

***Recommended operating conditions:***

- Indoors.
- The location must be free of smoke, dust, corrosive fumes, direct sunlight and excessive vibration.
- Ambient temperature +15 °C to +35 °C (+59 °F to +95 °F), with a maximum change not exceeding 2.8 °C (5 °F) per hour. . For optimum instrument performance, the room temperature should be controlled at 20° ± 2 °C. F
- Relative humidity 20% to 80%, without condensation.
- Altitude in the range -400 m to 2,000 m (-1,312 ft. to 6,562 ft).

***Safe operating conditions:***

- Indoors
- Temperature +5 °C to +40 °C (+41 °F to +104 °F).
- Relative humidity 20% to 80%, without condensation.
- Altitude in the range -400 m to 2,000 m (-1,312 ft. to 6,562 ft).

***Storage conditions:***

- Ambient temperature –20 °C to +60 °C (–4 °F to +140 °F).
- Relative humidity 20% to 80%, without condensation.
- Altitude in the range -400 m to 12,000 m (-1,312 to 39,370 feet).

When you remove the instrument from storage, before unpacking or putting it into operation, allow it to stand for at least a day under the approved operating conditions.

## Symbols Used on the Instrument

The three different types of warning symbols that appear on the instrument are shown below:

---

**Warning**

**This symbol indicates Caution, risk of electric shock.**

**AVERTISSEMENT: Risque de choc électrique.**

---


**Warning**

**This symbol indicates Caution, risk of danger.**
**Documentation must be consulted to determine the nature of the potential hazard and any actions which have to be taken.**

**AVERTISSEMENT: Risque de Danger: Réfère à la documentation de déterminer la nature de l'hasard potentiel et aucunes actions qui sont nécessaire de le réparer.**

---

**This symbol indicates Caution, hot surface.**

**AVERTISSEMENT: La surface est chaude.**

---

The following graphic symbols are also found on the instrument:

| | |
|---|---|
| ○ | **Indicates the OFF position of the main power switch.**<br>**Indique la position Off de l'interrupteur d'alimentation principal.** |
| │ | **Indicates the ON position of the main power switch.**<br>**Indique la position On de l'interrupteur d'alimentation principal.** |
| ∼ | **Indicates alternating current.**<br>**Indique la présence d'un courant alternatif.** |

### *Warning Labels on the Instrument*

### *Labels on the front of the instrument in the sample compartment*

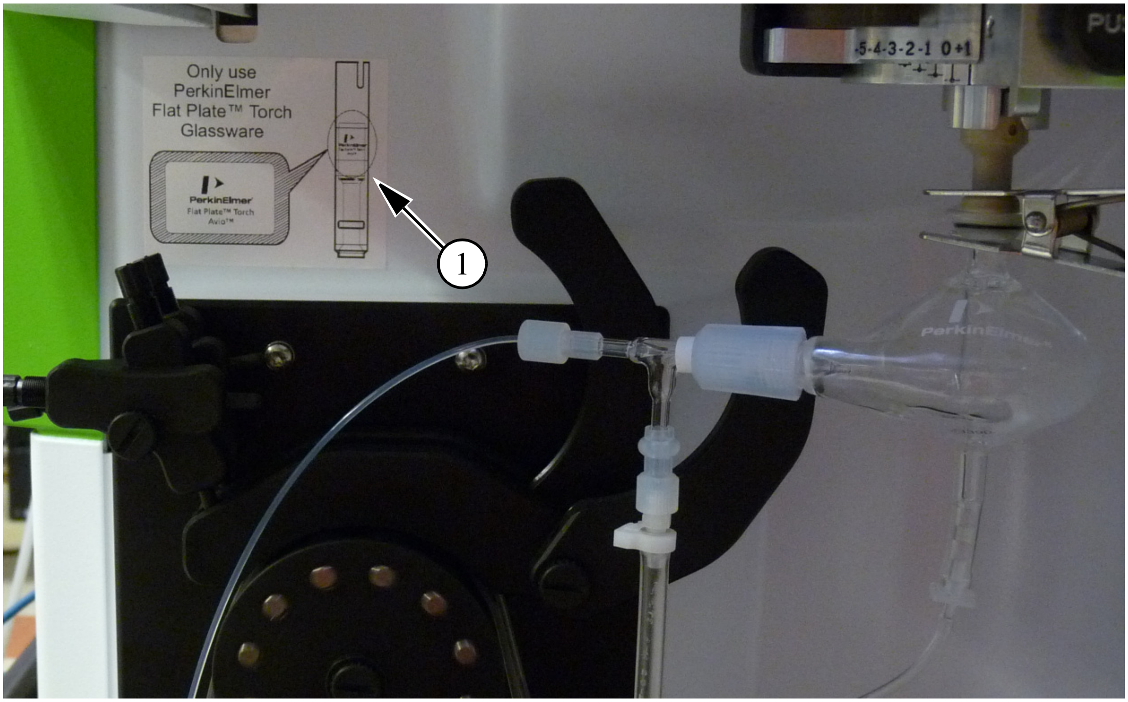



**Figure A. Location of the glassware label in the sample compartment.**

| Location | Instructions for Safety |
|---|---|
| Label #1 in Figure A. | Only use PerkinElmer Flat Plate™ Torch Glassware<br>Seulement utiliser PerkinElmer Flat Plate™ Torch Verrerie. |

### *Caution label on the back of the instrument*

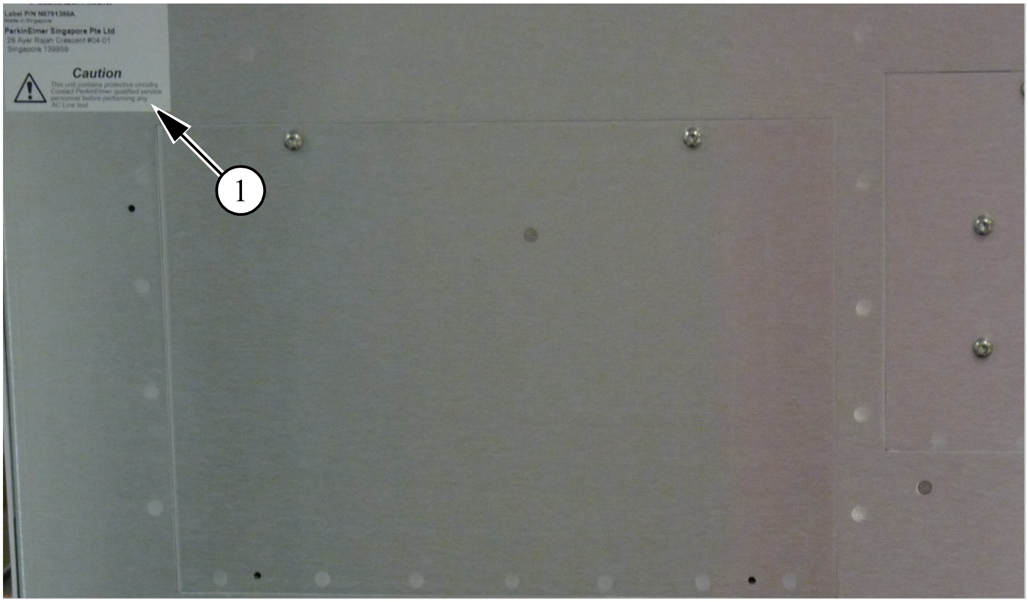



**Figure B.** **Location of caution label on the back of the instrument.**

| Marking | Location | Instructions for Safety |
|---|---|---|
|  | Label #1 in Figure B. | **CAUTION:**<br>**This unit contains protective circuitry. Contact PerkinElmer qualified personnel before performing any AC line tests.**<br><br>**ATTENTION:**<br>**Cette unité contient les circuits protecteurs. Contactez le personnel de service qualifié de PerkinElmer avant d'exécuter n'importe quelle ligne essals a C.A.**. |

### *Warning labels on the left side of the instrument*

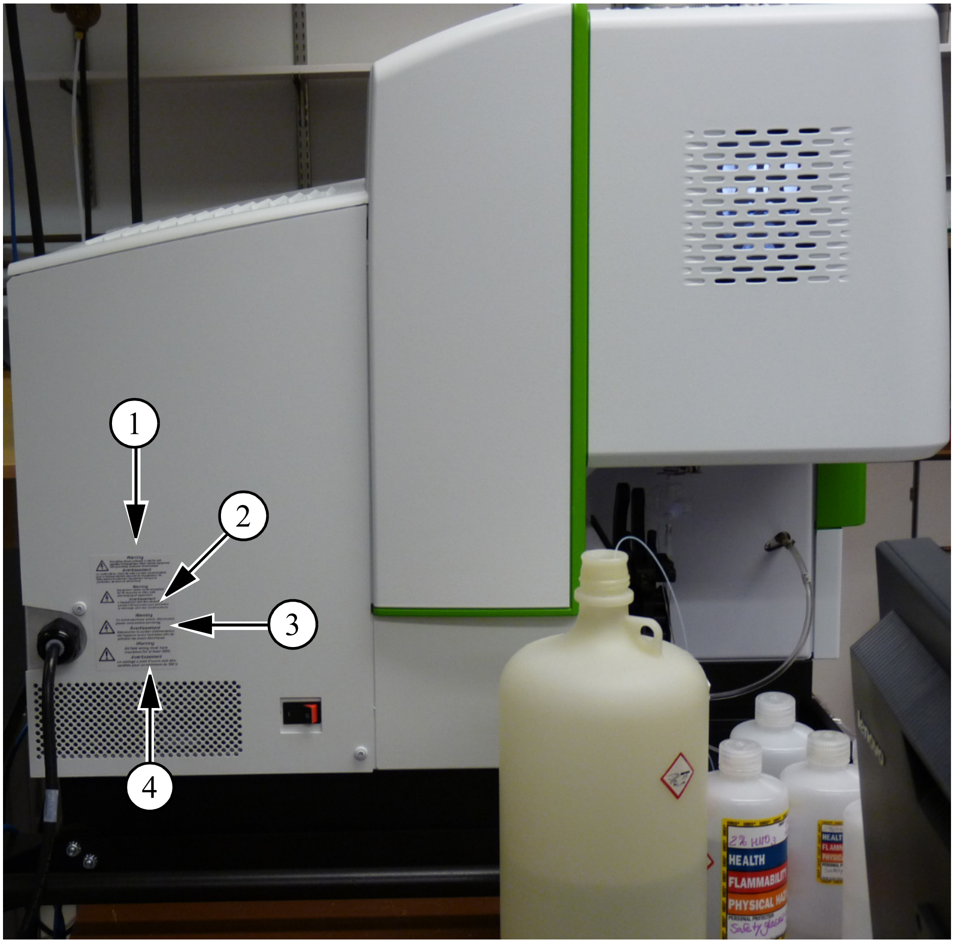



**Figure C.** **Location of warning labels on the left side of the instrument.**

| Marking | Location | Instructions for Safety |
| --- | --- | --- |
|  | Label #1 in Figure C. | **Warning - Grounding circuit continuity is vital for the safe operation of equipment. Never operate equipment with grounding conductor disconnected.**<br>**Attention: La continuité de circuit de mise a la terre est primordiale pour le fonctionnement sécurisé de l'équipment. Ne faites jamais fonctionner l'équipment lorsque le conducteur de terre est deconnecté.** |

| | | |
|---|---|---|
|  | Label #2 in Figure C. | **Warning - Equipment needs to be de-energized for 60 seconds to allow safe discharging of capacitors.**<br>**Avertissement: L’équipement doit etre désactivé pendant 60 secondes pour permettre la décharge sure des condensateurs.** |
|  | Label #3 in Figure C. | **Warning: To avoid electrical shock, disconnect power cord before servicing.**<br>**Avertissement: Débrancher le cordon l’alimentation de l’appareil avant l’entretien afin de prévenir les chocs électriques.** |
|  | Label #4 in Figure C. | **Warning:**<br>**All field wiring must have insulation for at least 300V.**<br>**Avertissement:**<br>**Le cablage a pied d’ouvre doit entre certifiés pour minimum de 300V**. |

### *Warning labels on the right side of the instrument*

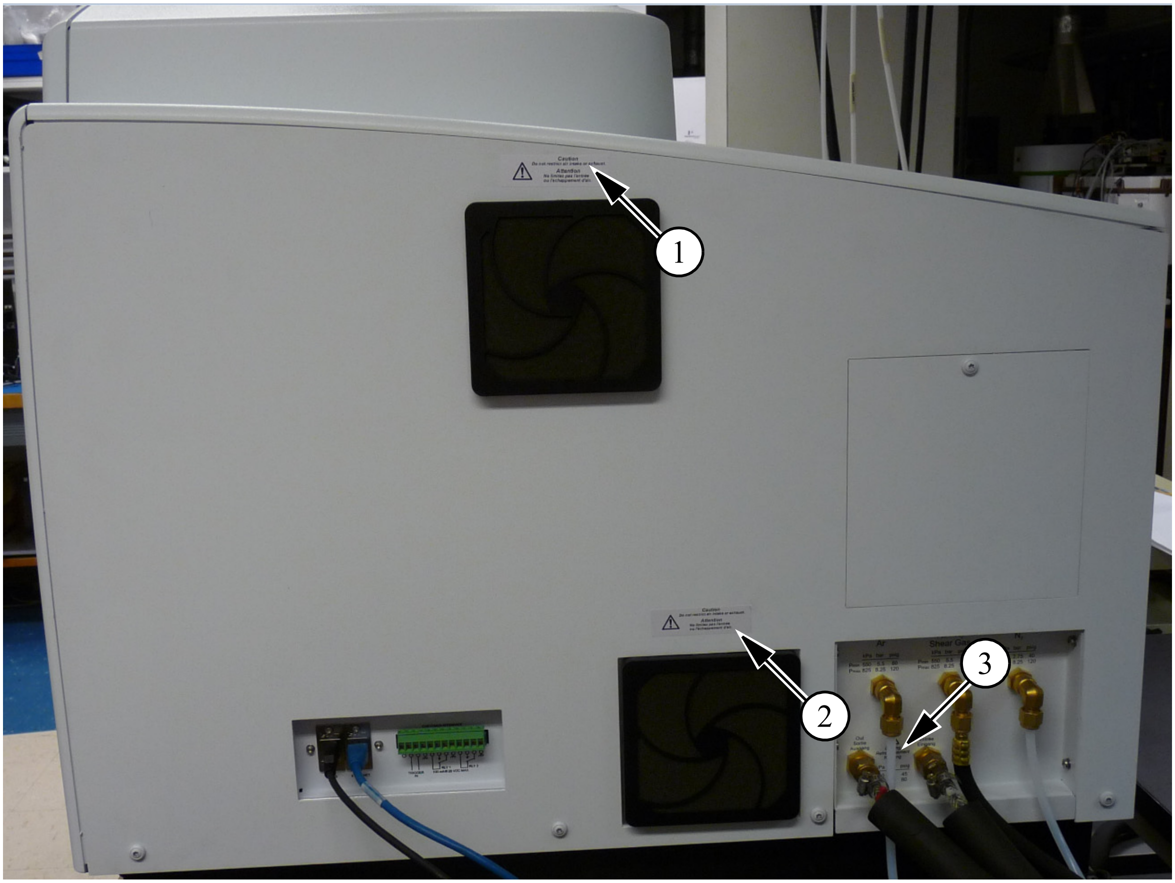



**Figure D. Location of warning labels on the right side of the instrument.**

| Marking | Location | Instructions for Safety |
|---|---|---|
|  | Label #1 in Figure D. | **CAUTION:**<br>**Do not restrict air intake or exhaust.**<br><br>**ATTENTION:**<br>**Ne limitez pas l'entreé ou l'échappement d'air.**<br><br>To provide adequate space for ventilation, allow at least 30 cm (12 inches) of free space around the instrument. Do not obstruct the two air filters. |

| | | |
|---|---|---|
|  | Label #2 in Figure D. | **CAUTION:**<br>**Do not restrict air intake or exhaust.**<br><br>**ATTENTION:**<br>**Ne limitez pas l'entreé ou l'échappement d'air.**<br>To provide adequate space for ventilation, allow at least 30 cm (12 inches) of free space around the instrument. Do not obstruct the two air filters. |
|  | Label #3 in Figure D | **CAUTION:**<br>**Cooling**<br><br>**ATTENTION:**<br>**Refroidissement** |

### *Warning labels in the torch compartment*

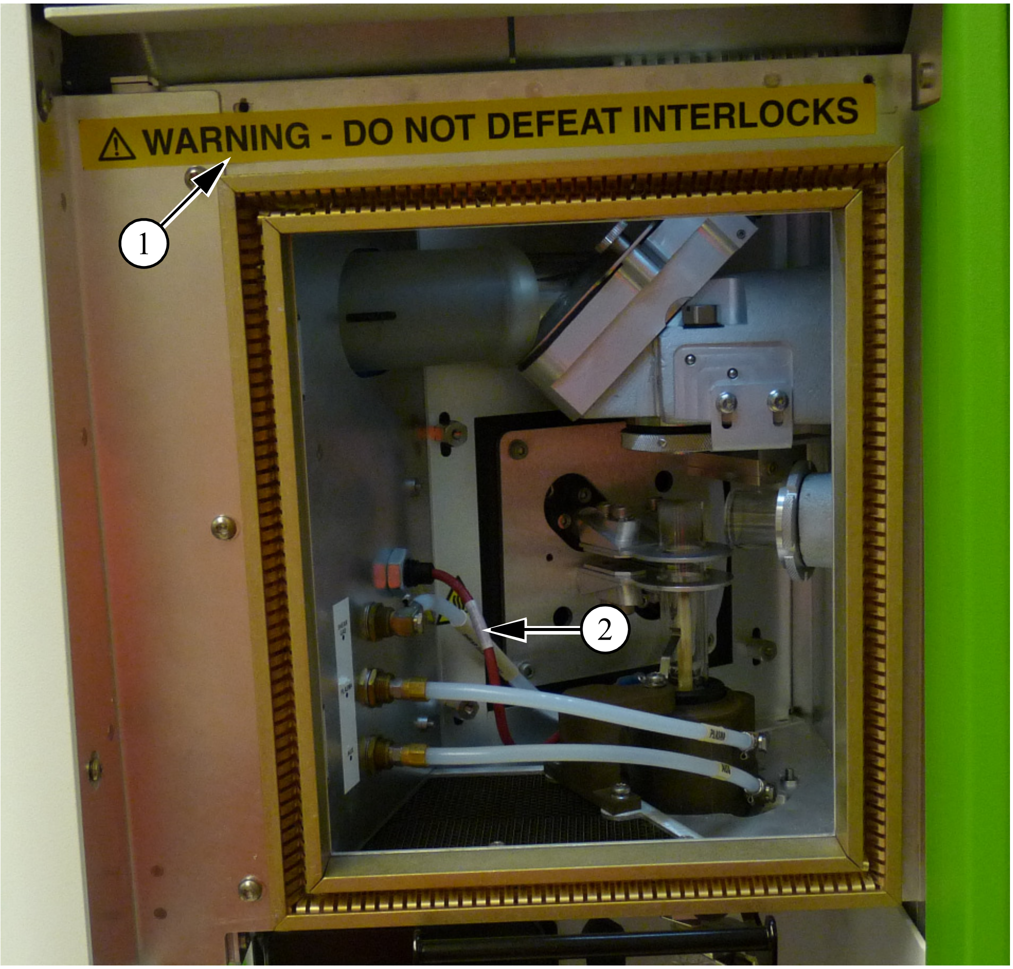



**Figure E.** **Location of warning labels in the torch compartment. .**

| Marking | Location | Instructions for Safety |
|---|---|---|
|  | Label #1 in Figure E | **WARNING – Do not defeat interlocks.**<br>**Avertissement: Ne pas desengager les enclenchements de securite.**<br>The instrument has safety interlocks to protect the operator from exposure to radio frequency and ultraviolet radiation. Do not attempt to defeat the safety interlocks. |

| | | |
|---|---|---|
|  | Label #2 in Figure E | **Risk of hot surfaces.**<br>**Risque de surfaces chaudes.**<br>Wait until the torch and surrounding surfaces have cooled to room temperature before you touch them. |

### *Neon Box Label*


**Figure F. Neon Box Label**

# *Using this Guide*

This manual is your hardware guide to the Avio 200 instrument. Main topics include:

- safety practices
- preparing your laboratory
- a description of the system
- installation
- maintenance
- troubleshooting
- error messages

## Documents to Help You

This manual contains hardware information for Avio 200 instrument. The following documentation is also provided for Avio 200 instrument.

- *Syngistix Software Guide (Part No. 09931145)* is on the Syngistix Document Pack CD. This guide contains basic information on the software, step-by-step procedures, and comprehensive chapters that cover each of the software windows and parameters for reference.

- *Syngistix Data Manager Software Guide (Part No. 09931146)* is on the Syngistix Document Pack CD. This guide contains information on the Syngistix utility that helps you maintain and use the data produced by the Syngistix instrument software.

- *Syngistix Software Installation Guide (Part No. 09931147) is* on the Syngistix Document Pack CD. This guide contains step-by-step procedures for software installation and administration information on the software.

## How this Guide is Organized

*Thoroughly read the Safety chapter before using the instrument. Consult the appropriate reference materials listed at the end of the Safety chapter on page 53.*

| Read Chapter... | To find out about... |
|---|---|
| 1 Safety Practices | Important safety information. |
| 2 Preparing Your Laboratory | The preparation of your laboratory needed for the Avio 200 instrument. Environmental, electrical, space, exhaust, gases, and cooling water requirements are reviewed. |
| 3 System Description | The components of the instrument, how the Echelle spectrometer works and instrument specifications. |
| 4 Installation | This chapter includes information for installing or re-installing the system components (autosampler, computer, and printer) and is provided for your reference should you ever need to move the system. |
| 5 Maintenance | Maintenance and cleaning procedures for the various components of your system, particularly for the sample introduction area. |
| 6 Troubleshooting | Performance checks and troubleshooting information for both hardware and software problems. |

## Using the Index

Use the index to look up information on the different hardware components. If you need to find information on cleaning the nebulizer, for example, look up “nebulizer” in the index. Also, use the index to look up information on the following topics:

- installation
- maintenance
- troubleshooting

## A Word on Troubleshooting

We recommend that you consult the troubleshooting information included in this manual before you call a PerkinElmer service engineer. The Troubleshooting chapter contains suggestions to help you determine systematically whether instrument problems are due to improper analytical techniques, improper selection of instrument parameters, or malfunction of the instrument.

# Safety Practices 1

# Introduction

This chapter describes general practices designed to aid you in safely operating the spectrometer and accessories.

This advice is intended to supplement, not supersede, the normal safety codes in the user's country. The information provided does not cover every safety procedure that should be practiced. Ultimately, maintenance of a safe laboratory environment is the responsibility of the analyst and the analyst's organization.

Please consult all manuals supplied with the spectrometer and accessories before you start working with the instrument. Carefully read the safety information in this chapter and in the other manuals supplied. When setting up the instrument or performing analyses or maintenance procedures, strictly follow the instructions provided.

# Laboratory Guidelines

This section describes some general laboratory safety guidelines. For additional information, we recommend *The CRC Handbook of Laboratory Safety* (1) and *Prudent Practices for Handling Hazardous Chemicals in Laboratories* (2).

## General

**Caution** The protection provided by this equipment may be impaired if the equipment is used in a manner not specified by PerkinElmer.

**Attention** La protection fournie par cet équipement risque d'être moins efficace si l'équipement fait l'objet d'une utilisation différente de celle mentionnée par PerkinElmer.

**Note** This equipment requires no specified inspection or preventive maintenance to ensure the continuous functioning of its safety features.

Before the instrument is installed, the area around, under and behind the instrument’s planned location is to be cleared of any dirt and dust to prevent their entry into the instrument’s interior which could cause a negative effect on performance.

Instructions should advise the responsible body of any tests necessary to check that equipment is still in a safe condition; they should also warn against the repetition of any tests of the safety standard which could damage the equipment and reduce protection against hazards.

PerkinElmer shall specify any parts which are required to be examined or supplied only by PerkinElmer or agents of PerkinElmer

Always wear safety glasses when using the instrument. Safety glasses with side shields will provide an extra margin of safety as well as mechanical protection for your eyes.

For safety reasons and to avoid contaminating samples, be sure that the instrument and work area are kept scrupulously clean. This is especially important when working with toxic elements or when measuring trace amounts of any element. Clean up spilled chemicals immediately and dispose of them properly.

Smoking is a source of significant contamination as well as a potential route for ingesting harmful chemicals.

Food should not be stored, handled, or consumed in the work area.

## Environmental Conditions

The instrument should be used indoors in a laboratory having the environmental conditions as recommended in Environment on page 14.

**Warning**

This instrument is not designed for operation in an explosive environment.

Avertissement: atmosphère explosive
Cet instrument n'est pas conçu pour fonctionner dans une atmosphère explosive.

## Handling of the Instrument

**Contact a PerkinElmer service engineer for assistance in installing or evaluating the system after moving.** The Avio 200 weighs 99kg (218 lbs) or 150 kg (330 lbs) with the shipping container. If the instrument needs to be moved please contact PerkinElmer Service.

### Laboratory Ventilation

Toxic combustion products, metal vapor, and ozone can be generated by the system, depending upon the type of analyses. Combustion products vary with the type of sample analyzed. If the sample compartment door is opened, a maximum of 0.9 liters of Argon may escape during the first minute. After that, 0.1 liters/minute of Argon will continue to escape while the door is open.

An exhaust venting system is always required to remove those gases which are generated during the normal operation of the instrument.

An efficient ventilation system must be provided for the instrument. Detailed specifications for a recommended venting system are described in the section titled Exhaust Vent Requirements on page 58.

## Instrument Safety Practices

This section describes potential hazards and recommended safety practices. You should thoroughly review this information.

This equipment requires no specified inspection or preventive maintenance to ensure the continuous functioning of its safety features.

Do **not** position the instrument so that it is difficult to operate the main power switch which is the disconnecting device.

**Caution** The protection provided by this equipment may be impaired if the equipment is used in a manner not specified by PerkinElmer.

**Attention** La protection fournie par cet équipement risque d'être moins efficace si l'équipement fait l'objet d'une utilisation différente de celle mentionnée par PerkinElmer.

## Safety Interlocks

The instrument has safety interlocks to protect the operator from radio frequency (RF) radiation and ultraviolet radiation, and to prevent access to high voltage areas.

Warning

**Do not attempt to defeat the safety interlocks.** This would place the operator's safety at risk.

**Avertissement:**
**Ne pas tenter de contourner les verrous de sécurité.** Cela placerait la sécurité de l'opérateur à risque.

The following interlocks must be satisfied in order to ignite the plasma. If any of these interlocks is interrupted while the plasma is on, the plasma will automatically be shut down.

- The front door on the torch compartment must be closed before the plasma can ignite.
- Argon pressures for the torch must be correct.
- Emergency Off Switch must be released.
- Cooling water must be flowing to the oscillator.
- Quick change torch must be installed.
- The shear gas must be flowing.

## Radio Frequency Radiation

The instrument generates high levels of Radio Frequency (RF) energy, which is potentially hazardous if allowed to escape. The instrument is designed to contain the RF energy within the shielded enclosures of the sample compartment and the RF power supply. Safety interlocks prevent you from operating the system without all covers, doors, and shields in place.

## Ultraviolet Radiation

The plasma generates high intensity ultraviolet radiation. A safety interlock is used to automatically shut off the plasma if the sample compartment door is opened or the torch is removed. The sample compartment has a viewing window for safely viewing the plasma.

Warning

***Directly* viewing the plasma (without protection) may cause permanent impairment of eyesight.**

**Avertissement:**
**Directement visualisation du plasma (sans protection) peut provoquer une altération permanente de la vue,**

## Electrical Safety

The instrument has been designed to protect the operator from potential electrical hazards. This section describes some recommended electrical safety practices.

Warning

**Lethal voltages are present at certain areas within the instrument. Installation and internal maintenance of the instrument should only be performed by a PerkinElmer service engineer or similarly authorized and trained person.**

When the instrument is connected to line power, opening the instrument covers is likely to expose live parts. Even when the power switch is off, high voltages can still be present. Power supplies inside the instrument may still be charged even if the instrument has been disconnected from all voltage sources.

Warning

**Des tensions mortelles sont présentes dans certaines zones de l'instrument. La maintenance interne de l'instrument ne doit être confiée qu'à un responsable technique PerkinElmer ou à une personne disposant des mêmes autorisations et qualifications.**

Lorsque l'instrument est raccordé à la ligne électrique, l'ouverture de ses capots risque d'exposer des pièces sous tension. Même lorsque l'interrupteur d'alimentation est en position off, de hautes tensions peuvent toujours être présentes. Les condensateurs présents à l'intérieur de l'instrument peuvent continuer d'être sous charge même si l'instrument a été déconnecté de toutes les sources de tension.


**Grounding circuit continuity is vital for safe operation of the equipment.** Never operate equipment with grounding conductor disconnected.

**AVERTISSEMENT**

La continuité du circuit de mise à la terre est cruciale pour la sécurité du fonctionnement de cet équipement. N'utilisez jamais l'équipement avec le conducteur de mise à la terre débranché.


**Connect the instrument to an AC line power outlet that has a protective ground connection.** To ensure satisfactory and safe operation of the instrument, it is essential that the protective ground conductor (the green/yellow lead) of the line power cord is connected to true electrical ground. Any interruption of the protective ground conductor, inside or outside the instrument, or disconnection of the protective ground terminal may impair the protection provided by the instrument.

**Avertissement: Connectez l'instrument sur une prise électrique CA dotée d'un connecteur de mise à la terre.** Pour garantir un fonctionnement sûr et satisfaisant de l'instrument, le conducteur de mise à la terre (fil vert/jaune) du cordon d'alimentation doit être connecté à la véritable terre électrique. Toute interruption du conducteur de mise à la terre, à l'intérieur ou à l'extérieur de l'instrument, ou toute déconnexion de la borne du conducteur de protection risque de nuire à la protection assurée par l'instrument.


**Grounding circuit continuity is vital for safe operation of the equipment.** Grounding is accomplished by use of an IEC60309 instrument power plug furnished by the factory and not removed during or after installation.

**Avertissement: La continuité du circuit de mise à la terre est indispensable au fonctionnement en toute sécurité de l'équipement.** La terre est effectuée par l'utilisation d'une prise d'alimentation de l'instrument IEC60309 fourni par l'usine et ne sont pas retirés pendant ou après l'installation.

The instrument must be correctly connected to a suitable electrical supply. The supply must have a correctly installed protective conductor (earth ground) and must be installed or checked by a qualified electrician before connecting the instrument.

Warning

**Any interruption of the protective conductor (earth ground) inside or outside the instrument or disconnection of the protective conductor terminal is likely to make the instrument dangerous.** Intentional interruption is prohibited.

**Avertissement: Toute interruption du conducteur de protection (mise à la terre) à l'intérieur ou à l'extérieur de l'instrument ou toute déconnexion de la borne du conducteur de protection risque de rendre l'instrument dangereux.** Il est interdit de procéder à une interruption intentionnelle.

Warning

**Do not operate the instrument with any covers or parts removed.** Disconnect the power cord from the AC line power wherever the cover is removed.

**Avertissement: Ne faites pas fonctionner l'instrument lorsque les capots ou certaines pièces ont été retirés.**
Déconnectez le cordon d'alimentation de l'alimentation CA dès que le capot est retiré.

When working with the instrument:

- Connect the instrument to a correctly installed line power outlet that has a protective conductor connection (earth ground).
- Do **not** operate the instrument with any covers or internal parts removed unless required to do so.
- **Never leave the instrument unattended with the cover off and connected to AC power!**
- Do **not** attempt to make internal adjustments or replacements except as directed in the manuals.
- Disconnect the instrument from all voltage sources before opening it for any adjustment, replacement, maintenance, or repair. If afterwards, the opened

instrument must be operated for further adjustment, maintenance, or repair, this must only be done by a qualified person who is aware of the hazards involved.

- Whenever it is possible that the instrument is no longer electrically safe for use, make the instrument inoperative and secure it against any unauthorized or unintentional operation. The electrical safety of the instrument is likely to be impaired if, for example, the instrument shows visible damage; has been subjected to prolonged storage under unfavorable conditions; or has been subjected to severe stress during transportation.

## High Temperatures

The torch components remain hot for some time after the plasma has been shut off. Allow sufficient time for these items to cool to room temperature before you handle them.

## Hot Exhaust Gases

When the plasma is on, hot gases are vented through the chimney above the sample compartment. An efficient ventilation system must be provided, as referenced in the Exhaust Vent Requirements on page 58. In addition, avoid this area of the instrument to prevent burns.

## Safe Use of Drain Systems

For safe operation of the system, the pumped drain system should be properly installed.

Warning

**Never place the vessel in an enclosed cabinet.** Doing so could result in a build-up of hazardous gases, which may result in a serious explosion or fire.

**Never use a glass drain vessel.** A glass drain vessel may break and spill flammable, toxic, or corrosive liquids.

**Avertissement: Ne jamais placer le navire dans un meuble fermé.** Cela pourrait entraîner une accumulation de gaz dangereux, ce qui peut entraîner une explosion ou un incendie grave.

**Ne jamais utiliser un récipient de vidange de verre.** Un navire de vidange de verre pourrait se briser et renverser de liquides inflammables, toxiques ou corrosifs.

Recommended safety practices for drain systems are given below.

- Place the drain vessel in an area that is visible to the operators who can observe the level of collected effluent and empty the vessel when necessary.
- Check the condition of the drain tubing regularly to monitor deterioration. Organic solvents deteriorate the tubing more quickly than aqueous solutions. When the tubing becomes brittle or cracked, replace it.
- Empty the drain bottle regularly when using organic solvents. Before switching from organic to aqueous solutions, always empty the drain bottle.

## Waste Disposal Procedures

- Carefully monitor the collection of effluent in the drain vessel and empty the drain vessel frequently. When switching between organic and aqueous solutions, flush the drain tube thoroughly and empty and flush out the drain vessel.
- Drain vessels may contain flammable, acidic, caustic, or organic solutions, and small amounts of the elements analyzed. The collected effluent may have to be disposed of as hazardous waste.
- The responsible body is responsible for the correct collection and disposal of waste materials. This includes the necessity for a suitably sized waste container of appropriately resistant material for the collection of organic solvent waste and provision for the removal into an appropriate exhaust system of any gases or vapors which may be produced in hazardous concentrations.

Warning

**Dispose of waste in accordance with the regulations applicable to your locality, state, and/or country.**

**Avertissement: Eliminer les déchets en conformité avec les règlements applicables à votre localité, état, et / ou pays.**

## WEEE Instructions for PerkinElmer Products

or

A label with a crossed-out wheeled bin symbol and a rectangular bar indicates that the product is covered by the Waste Electrical and Electronic Equipment (WEEE) Directive and is not to be disposed of as unsorted municipal waste. Any products marked with this symbol must be collected separately, according to the regulatory guidelines in your area.

The objectives of this program are to preserve, protect and improve the quality of the environment, protect human health, and utilize natural resources prudently and rationally. Specific treatment of WEEE is indispensable in order to avoid the dispersion of pollutants into the recycled material or waste stream. Such treatment is the most effective means of protecting the customer's environment.

Requirements for waste collection reuse, recycling, and recovery programs vary by regulatory authority at your location. Contact your local responsible body (e.g., your laboratory manager) or authorized representative for information regarding applicable disposal regulations. Contact PerkinElmer at the web site listed below for information specific to PerkinElmer products.

**Web address:**

www.perkinelmer.com/WEEE

For Customer Care telephone numbers select "Contact us" on the web page.

Products from other manufacturers may also form a part of your PerkinElmer system. These other producers are directly responsible for the collection and processing of their own waste products under the terms of the WEEE Directive. Please contact these producers directly before discarding any of their products.

Consult the PerkinElmer web site (above) for producer names and web addresses.

## Safe Handling of Gas Cylinders

**Note** The permanent installation of gas supplies is the responsibility of the user and should conform to local safety and building codes.

Gases commonly used with ICP instruments include argon and nitrogen. The major hazard associated with these gases is suffocation. This can occur if the gas is allowed to escape in an enclosed area and displaces the oxygen in the air. These gases are neither explosive nor combustible.

**Warning**

**Contact the gas supplier for a material safety data sheet (MSDS) containing detailed information on the potential hazards associated with the gas.**

Carefully use, store, and handle compressed gases in cylinders. Gas cylinders can be hazardous if they are mishandled.

**Avertissement:** Contactez le fournisseur du gaz afin d'obtenir une fiche de sécurité de produit (MSDS) contenant des informations détaillées sur les dangers potentiels associés au gaz.

Soyez prudent lorsque vous utilisez, stockez et manipulez des gaz comprimés en bouteilles. Les bouteilles de gaz peuvent être dangereuses si elles ne sont pas manipulées correctement.

If liquid argon or nitrogen is used, the gas cylinder must be fitted with an over-pressure regulator, which will vent the cylinder as necessary to prevent it from becoming a safety hazard.

Listed below are some general safety practices for the proper identification, storage, and handling of gas cylinders. Consult References 3 and 4 on page 53 for more detailed information and additional guidelines.

## Identification of Gas Cylinders

- Legibly mark cylinders to identify their contents. Use the chemical name or commercially accepted name for the gas.

**Storing Cylinders**

- Cylinders should be stored in accordance with the regulations and standards applicable to the customer's locality, state, and country.
- When cylinders are stored indoors in storage rooms, the storage room should be well ventilated and dry. Ensure that the ventilation is adequate to prevent the formation of dangerous accumulations of gas. This is particularly important in small or confined areas.
- Do **not** store cylinders near elevators, gangways, or in locations where heavy moving objects may strike or fall against them.
- Use and store cylinders away from exits and exit routes.
- Locate cylinders away from heat sources, including heat lamps. Compressed gas cylinders should not be subjected to temperatures above 52 °C (126 °F).
- Do **not** allow ignition sources in the storage area and keep cylinders away from readily ignitable substances such as gasoline or waste, or combustibles in bulk, including oil.
- Store cylinders standing upright, fastened securely to an immovable bulkhead or permanent wall.
- When storing cylinders outdoors, they should be stored above ground on a suitable floor and protected against temperature extremes (including the direct rays of the sun).

**Handling Cylinders**

- If it becomes necessary to move cylinders, do so with a suitable hand truck after ensuring that the container cap is secured and the cylinder properly fastened to the hand truck.
- Use only gas-pressure regulators, tubing, and hose connectors approved by an appropriate regulatory agency.
- Arrange gas hoses where they will not be damaged or stepped on, and where objects will not be dropped on them.
- Do **not** refill gas cylinders.
- Check the condition of pipes, hoses, and connectors regularly. Perform gas leak tests at all joints and seals of the gas system regularly, using an approved gas leak detection solution.
- When the equipment is turned off, close all gas cylinder valves tightly at the cylinder. Bleed the remainder of the line before turning the exhaust vent off.

## Hazardous Chemicals Warnings

Before using any chemicals or solvents with the instrument, the customer should be thoroughly familiar with all hazards and safety handling practices. Observe the manufacturer's recommendations for use, storage and disposal. These recommendations are normally supplied in the material safety data sheets (MSDS) supplied with the solvents.

**Warning**

**Some chemicals used with this instrument may be hazardous or may become hazardous after completing an analysis.** The responsible body (e.g. Lab Manager) must take the necessary precautions to ensure that the surrounding workplace and the instrument operators are not exposed to hazardous levels of toxic substances (chemical or biological) as defined in the applicable Material Safety Data Sheets (MSDS) or OSHA, ACGIH, or COSHH documents. Venting for fumes and disposal of waste must be in accordance with all national, state, and local health and safety regulations and laws.

Warning

**Avertissement : certains produits chimiques utilisés avec cet instrument peuvent être dangereux ou le devenir une fois l'analyse terminée.** Le responsable (par exemple, le responsable du laboratoire) doit prendre les précautions qui s'imposent afin de veiller à ce que les opérateurs de l'instrument et
l'espace environnant ne soient pas exposés à des niveaux dangereux de substances toxiques (chimiques et biologiques), comme défini dans les fiches de sécurité de produit (MSDS) ou les documents OSHA, ACGIH ou COSHH applicables.
L'évacuation des fumées et l'élimination des déchets doivent être réalisées conformément à l'ensemble des réglementations et lois en matière de santé et de sécurité qui s'appliquent au niveau national, régional et local.

Some definitions of terms used in "Hazardous Chemicals Warnings" above are given next.

**OSHA:** Occupational Safety and Health Administration (United States)

**ACGIH:** American Conference of Governmental Industrial Hygienists

**COSHH:** Control of Substances Hazardous to Health (United Kingdom)

**Responsible body:** "Individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained." [per EN 61010-1].

**Operator:** "Person operating equipment for its intended purpose." [per EN 61010-1].

## Safe Use of Chemical Reagents

This section provides some general safety practices that should be observed when working with any chemicals.

Warning

**Give careful attention to the hazards associated with the chemical reagents being used. Refer to the safety data sheets provided by the manufacturer, for example, Material Safety Data Sheets (MSDS) in the USA (for other names, see Reference 5).**

**Avertissement : Accorder une attention particulière aux risques associés avec les réactifs chimiques utilisés. Consulter les fiches de données de sécurité fournies par le fabricant, par exemple, fiches de données de sécurité (FDS) aux Etats-Unis (pour les autres noms, voir référence 5).**

### Protective Equipment

- Wear appropriate eye protection at all times while handling chemicals. Use safety glasses with side shields, goggles, or full-face shields, according to the types of chemicals being handled.
- Wear suitable protective clothing, including gloves specifically designed to resist the chemicals being handled.

### Use, Storage, and Disposal

Review the following information to ensure the safe use, storage, and disposal of chemicals.

- Use, store, and dispose of chemicals in accordance with the manufacturer's recommendations and regulations applicable to the locality, state, and/or country.
- When preparing chemical solutions, always work in a fume hood that is suitable for the chemicals you are using.
- Conduct sample preparation away from the instrument to minimize corrosion and contamination.
- Clean up spills immediately using the appropriate equipment and supplies such as spill cleanup kits.
- Do **not** put open containers of solvent near the instrument.
- Store solvents in an approved cabinet (with the appropriate ventilation, as required) away from the instrument.

- The responsible body has the responsibility for carrying out appropriate decontamination if hazardous material is spilt on or inside the instrument.

## Sample Preparation

Sample preparation for ICP spectroscopy may require the handling of organic or corrosive solutions. Dilution of samples and adding dilute acid to a liquid sample is generally less hazardous than putting a solid sample into solution. This section will deal specifically with the potential hazards associated with dissolving solid samples, although the information can be applied to any sample handling situation. Also, refer to the general precautions for handling chemicals described at the beginning of this chapter.

Reference 6 contains general information on sample preparation procedures as well as an appendix on laboratory safety. Reference 7 contains information on laboratory safety and sample preparation methods prescribed by the United States Environmental Protection Agency (EPA). Reference 8 contains information on microwave sample preparation, which is not covered in this section.

Solid samples may be put into solution by dissolving the sample in an organic solvent or acidic solution; digesting the sample; or reacting the sample with a fusion mixture. Each of these techniques has certain hazards associated with it.

Warning

**Always wear appropriate eye protection while preparing samples.** Use safety glasses with side shields, goggles, or full-face shields, depending on the chemicals you are handling.

**Avertissement: Toujours porter des lunettes de protection lors de la préparation des échantillons.** Utilisez des lunettes de sécurité avec écrans latéraux, des lunettes ou un écran facial, selon les produits chimiques que vous manipulez.

### Dissolving Solid Samples in Organics

- Always work in a fume hood so that flammable and/or toxic solvents do not concentrate in the work area.

- Wear protective clothing and gloves. Some solvents are readily absorbed through the skin.

When selecting a solvent, consider the following:

- Is the solvent compatible with the equipment?

  Aliphatic hydrocarbons, ketones and esters, alcohols, and xylene, are the most frequently used solvents. Make sure that all equipment that will come into contact with the solvent is compatible with the solvent, e.g., tubing, sample cups, storage and waste containers, etc.

- Is the solvent toxic?

  Avoid solvents known to be health hazards, such as benzene or methyl isobutyl ketone (MIBK).

  Some solvents, such as the halogenated hydrocarbons, generate toxic gases when heated.

Consult the data sheets provided by the manufacturer for information on health hazards (see Reference 5 on page 53).

## Dissolving Solid Samples Using Acids

Dissolving solid samples in aqueous solutions often requires the use of concentrated acids.

**Using Acids**

When using acids, use the following precautions:

- Always work in an acid-resistant fume hood.
- Wear protective clothing, including gloves specifically designed to resist the acid being used.
- Attempt to dissolve the sample in a dilute acid solution before using concentrated acid.
- Add concentrated acid to a sample cautiously. Dissolving a sample in concentrated acid may provoke a vigorous reaction.

## Acid Digestions

Acid digestions, either at atmospheric pressure or at increased pressure, require special care. Spattering and foaming of the sample/acid mixture may expose the user to a hazard, as well as compromise the sample integrity. A digested sample containing concentrated acid will react violently with water.

Perchloric acid and hydrofluoric acid are particularly hazardous to work with.

**Perchloric Acid**

Perchloric acid ($HClO_4$) is extremely corrosive and a powerful oxidizing agent. It presents severe fire and explosion hazards.

Warning

**Before using perchloric acid, you should be thoroughly familiar with its hazards and safe handling practices.** Observe the manufacturer's recommendations for use, storage, and disposal.

**Avertissement: Avant d'utiliser l'acide perchlorique, vous devriez être familier avec ses dangers et les pratiques de manipulation sécuritaires.** Respecter les recommandations du fabricant pour l'utilisation, le stockage et l'élimination.

- Use hoods, ducts, and other devices for removing vapors specifically designed to accommodate this kind of fume. There is a severe explosion hazard if a normal hood is used, or if the hood is not properly used and maintained.
- Use goggles and face shields. Wear protective clothing and polyvinyl chloride gloves. **Do not use rubber gloves.**
- Additional hazards and precautions are given in References 1, 2, 9, 10 and 11.

**Hydrofluoric Acid**

Hydrofluoric acid (HF) is also used for digestions. It is toxic and extremely corrosive. Hydrofluoric acid will readily burn skin, and if the fumes are inhaled, lung tissue. Burns may not be immediately painful or visible. Contact with eyes could result in blindness.

Warning

**Before using hydrofluoric acid, you should be thoroughly familiar with its hazards and safe handling practices.** Observe the manufacturer's recommendations for use, storage, and disposal.

**Avertissement: Avant d'utiliser l'acide fluorhydrique, vous devriez être familier avec ses dangers et les pratiques de manipulation sécuritaires.** Respecter les recommandations du fabricant pour l'utilisation, le stockage et l'élimination.

- Always wear suitable protective equipment, including goggles, a face shield, acid-resistant gloves, and protective clothing when using hydrofluoric acid.
- Do **not** breathe HF vapors. Always work in a fume hood when using hydrofluoric acid.
- Do **not** use a glass beaker. Hydrofluoric acid attacks glass.
- Observe the additional hazards and precautions outlined in References 1, 2, 9, 10 and 11 on page 53.

**Performing Digestions**

When carrying out sample digestions:

- Always work in a hood suitable for the type(s) of chemicals you are using.
- Add very small quantities of the acid dropwise, while observing the magnitude of the reaction.
- Apply heat to a digestion solution slowly in case a further vigorous reaction is initiated.
- Cool the completed digest before transferring it and diluting it. Add water cautiously.

**Digestions at Elevated Pressure**

Acid digestions in a pressure digestion apparatus require special care at several points, in addition to the precautions described above.

Warning

**When using high pressure digestion vessels, consult the manufacturer's instructions and recommendations, particularly regarding organic material and possible explosive reactions.**

Never use perchloric acid in a pressure digestion.

**Avertissement: Lors de l'utilisation des récipients de digestion à haute pression, consulter les instructions et recommandations du fabricant, notamment en ce qui concerne la matière organique et des réactions explosives possibles.**

Ne jamais utiliser de l'acide perchlorique dans une digestion sous pression.

- Use only the manufacturer's recommended amounts of sample and acid for the type of sample you are preparing.
- Be sure the apparatus is in good condition and provides safe release of pressure in the case of excess pressure buildup.
- Cool the apparatus to room temperature before attempting to open it.
- Open the apparatus in a fume hood to vent the entrapped fumes safely.

### Fusion Mixtures

Dissolving a sample by reacting with a fusion-flux mixture is generally chosen when other techniques for sample dissolution fail. The fusion-flux mixture should be carefully selected. Knowledge of fusion-flux mixture/crucible compatibility is essential. Heating the sample-flux mixture may initiate a vigorous or explosive reaction.

**Caution** The fusion matrix will deposit on and dissolve the quartz torch over time. **It is recommended to use the unslotted (0 slots) torch because the slotted torches will dissolve much faster.**

Attention: La matrice de fusion déposera sur et dissoudre le flambeau de quartz au cours du temps. **Il est recommandé d'utiliser la non fendue (0 fentes) torche parce que les torches fendues vont se dissoudre beaucoup plus vite.**

- Heat the mixture slowly and intermittently until the system is characterized.
- If you use a muffle furnace rather than a flame for heating, make a trial using the standard amount of flux but with a smaller amount of sample.
- Most reacted fusion mixtures are dissolved in acidic solutions. Observe the precautions described previously for handling acids.

## Decontamination and Cleaning

Before using any cleaning or decontamination methods except those specified by PerkinElmer, users should check with PerkinElmer that the proposed method will not damage the equipment.

### Decontamination

**Customers wishing to return instrumentation and/or associated materials to PerkinElmer for repair, maintenance, warranty or trade-in purposes are advised that all returned goods must be certified as clean and free from contamination.**

The customer's responsible body is required to follow the "Equipment Decontamination Procedure" and complete the "Certificate of Decontamination". These documents are available on the PerkinElmer public website:

**Procedure:**

http://www.perkinelmer.com/Content/technicalinfo/dts_instrumentdeconprocedure.pdf

**Certificate form:**

http://www.perkinelmer.com/Content/technicalinfo/dts_perkinelmercertificationofdecontaminationform.pdf

If you do not have access to the internet and are located in the U.S., call toll free at 1-800-762-4000 or (+1) 203-925-4602, 8:30 a.m. - 7 p.m. EST and speak to Customer Support.

In Canada, call toll free 800-561-4646 and speak to Customer Support.

If you are located outside of the United States or Canada, please call your local PerkinElmer sales office for more information.

## Cleaning the Instrument

Exterior surfaces may be cleaned with a soft cloth, dampened with a mild detergent and water solution. Do **not** use abrasive cleaners or solvents.

## References


1. Furr, K., ed., *CRC Handbook of Laboratory Safety,* 5th ed., The Chemical Rubber Co. Press, 2000.

2. National Research Council, *Prudent Practices for Handling Hazardous Chemicals in Laboratories,* National Academy Press, Washington, D.C., USA, 1981.

3. Compressed Gas Association (USA), "Safe Handling of Compressed Gases in Containers," pamphlet no. P-1, 2008.

4. Compressed Gas Association (USA), "The Inert Gases – Argon, Nitrogen and Helium," pamphlet no. P-9, 2008.

5. Data sheets provided by chemical manufacturers, for example:
   - Material Safety Data Sheets (MSDS), USA;
   - DIN-Sicherheitsdatenblätter (genormte Formular DIN-Nr 52900), FRG;
   - Product Information Sheets, UK.

6. Horwitz, W., ed., *Official Methods of Analysis,* 18th ed., Association of Official Analytical Chemists, Inc., Arlington, VA, USA, 2010.

7. *Standard Methods for the Examination of Water and Wastewater,* 17th ed, American Public Health Association et al., USA, 2009.

8. Kingston, H.M. and Jassie, L.B., eds., *Introduction to Microwave Sample Preparation,* American Chemical Society, USA, 1988.

9. Bretherick, L., *Bretherick's Handbook of Reactive Chemical Hazards,* 7th ed., Butterworth & Co., Ltd., London, UK, 2006.

10. Sax, N., ed., *Dangerous Properties of Industrial Materials,* 11th ed., Van Nostrand Reinhold, New York, USA, 2004.

11. Bretherick, L., ed., *Hazards in the Chemical Laboratory,* 3rd ed., Royal Society of Chemistry, London, UK, 1981.

12. Roth, L., ed., Sicherheitsfibel Chemie, 4, Auflage, 1979
    ecomed verlagsgesellschaft mbH, 8910 Landsberg/Lech.

# Preparing Your Laboratory 2

# Introduction

The items listed below need to be considered when preparing the laboratory for the Avio 200:

- Environmental Conditions
- Exhaust Vent Requirements
- Laboratory Space Requirements
- Cooling Water Requirements
- Electrical Requirements
- Pneumatic Requirements

# Environmental Conditions

The laboratory in which the Avio 200 Spectrometer system is located must meet the following conditions:

- corrosive-free environment.
- The instrument will operate with a laboratory temperature between 15 and 35 °C (59 - 95 °F). For optimum instrument performance, the room temperature should be controlled at 20° ± 2 °C.
- The heat dissipated directly into the laboratory when the Avio 200 is properly vented is approximately 6600 BTU/hour (2200 W).
- Relative humidity between 20% and 80%, non-condensing. For optimum instrument performance, the relative humidity should be between 35% and 50%.
- Dust levels not above 36 000 000 particles, 0.5 micron or larger, per cubic meter of air. The environment should be relatively dust-free to avoid sample and instrument contamination problems.
- Free of excessive vibration.
- Altitude: in the range -400 to 2,000 m (-1,312 to 6,562 feet)

The Avio 200 has been designed for indoor use. Do not use the instrument in an area where explosion hazards may exist.

**Pollution Degree:**

This product will operate safely in environments that contain nonconductive foreign matter up to Pollution Degree 2 in EN 61010-1.

## Exhaust Vent Requirements

The Avio 200 requires an exhaust vent to remove combustion fumes and vapors from the torch compartment. Exhaust venting is important for the following reasons:

- It protects laboratory personnel from toxic vapors that may be produced by some samples.
- It improves the stability of the ICP torch by removing the effects of room drafts and laboratory atmosphere.
- It helps to protect the instrument from corrosive vapors that may originate from the sample(s).
- It removes dissipated heat produced from the torch and power supply.

**Warning**

***Warning: Toxic fumes***
*The use of ICP-OES instruments without adequate ventilation to outside air may constitute a health hazard. For example, the combustion of halogenated hydrocarbons produces toxic vapors. Extreme care should be taken that exhaust gases are vented properly.*

***Avertissement: Des fumées toxiques***
*L'utilisation d'instruments d'ICP-OES sans ventilation adéquate à l'air extérieur peut constituer un danger pour la santé. Par exemple, la combustion d'hydrocarbures halogénés produit des vapeurs toxiques. Un soin extrême doit être pris que les gaz d'échappement sont évacués correctement.*

The maximum temperature for the ICP torch vent system is 80 °C (176 °F).

The exhaust vent must be directly connected to the instrument chimney and the minimum flow rate is 3400 liters per min (120 cubic feet/min).

**Note** Local electrical codes do not allow PerkinElmer Service Engineers to install the blower and vent assembly.

The blower capacity depends on the duct length and number of elbows or bends used to install the system. If an excessively long duct system or a system with many bends is used, a stronger blower may be necessary to provide sufficient exhaust volume. Alternatively, smooth stainless-steel may be used instead of flexible stainless-steel where flexibility is not required to reduce system friction loss or “drag.” If smooth stainless steel is used, there must be a way to move the vent hood out of the way for servicing. A length of smooth stainless-steel ducting has 20-30% less friction loss than a comparable length of flexible ducting. When smooth stainless-steel is used, elbows must be used to turn corners. These elbows should turn at a center line radius of 150 mm with a maximum bend angle of 45 degrees to reduce friction losses, and the number of elbows should be minimized.

Additional recommendations on the venting system include:

- Make sure duct casing is installed using fireproof construction. Route ducts away from sprinkler heads.
- Locate the blower as close to the discharge outlet as possible. All joints on the discharge side should be airtight, especially if toxic vapors are being carried.
- Equip the outlet end of the system with a back draft damper and take the necessary precautions to keep the exhaust outlet away from open windows or inlet vents and to extend it above the roof of the building for proper dispersal of the exhaust.
- Equip the exhaust end of the system with an exhaust stack to improve the overall efficiency of the system.
- Make sure the length of the duct that enters into the blower is a straight length at least ten times the duct diameter. An elbow entrance into the blower inlet causes a loss in efficiency.
- Provide make-up air in the same quantity as is exhausted by the system. An "airtight" lab will cause an efficiency loss in the exhaust system.
- Ensure that the system is drawing properly by using an air flow meter.
- Equip the blower with a pilot light located near the instrument to indicate to the operator when the blower is on.

1. Place exhaust hose over the instrument exhaust connector.

2. Secure the tie wrap around the exhaust hose.

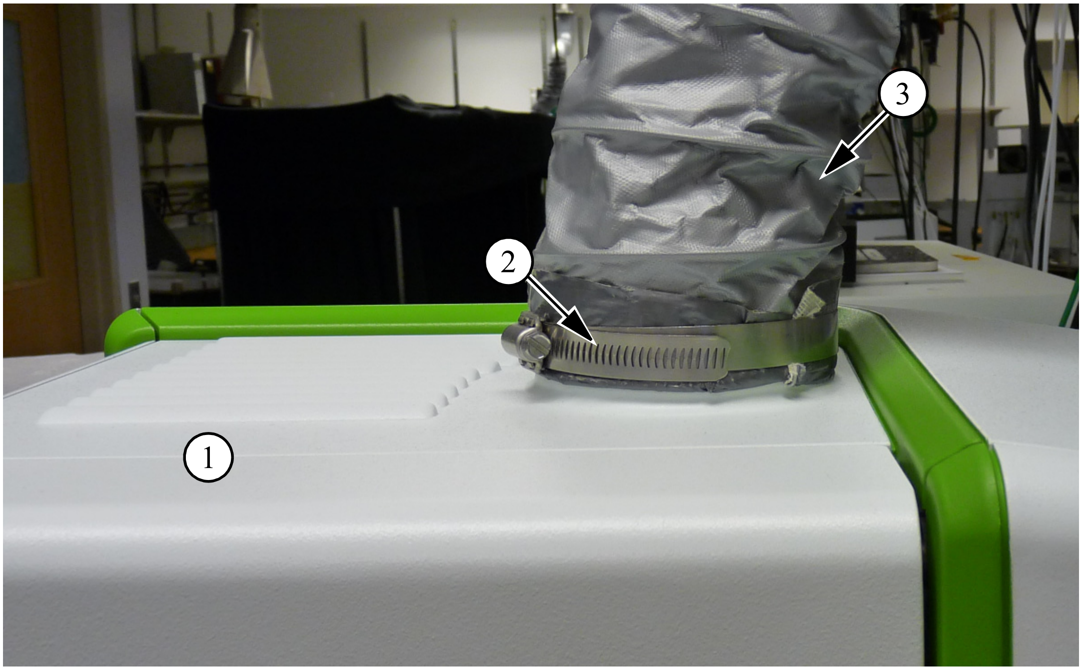



**Figure 2-1 Location of the Torch Compartment Chimney and Vent.**

| Item | Description |
|---|---|
| 1 | Top of Instrument |
| 2 | Hose Clamp |
| 3 | Exhaust Hose |

# Laboratory Space Requirements

The Avio 200 system includes the Avio 200 instrument, a PolyScience Recirculating chiller (or equivalent), a computer, and a printer. The Avio 200 instrument itself includes optics, electronics, a plasma torch, and an RF power supply, all housed in a self-contained unit. The minimum door width must be 81 cm (32 in.).

**Avio 200 Instrument**

The Avio 200 is 65 cm wide (26 in.), 81 cm high (32 in.), and 76cm deep (30 in.). Figure 2-2 illustrates the dimensions of the instrument. The Avio 200 weighs 99kg (218 lbs), or 150 kg (330 lbs) with the shipping container.

The Avio 200 installation kit will included one flexible hose (Part No. N0691578) and two hose clamps (Part No. 09920044) for connecting to the exhaust.

The Avio 200 may be placed on a bench. The main power cable length is 2.4 m (8.0 ft.).

**Computer and Printer**

Refer to the manuals supplied with your computer and printer for dimensions.


**Figure 2-2 Outside Dimensions of the Avio 200.**

| Item | Description |
|---|---|
| 1 | Height 81 cm (32 in.) |
| 2 | Depth 76 cm (30 in.) |
| 3 | Length 65 cm (26 in.) |

### PolyScience Chiller

The PolyScience® WhisperCool™ (or equivalent) is usually located on the floor, to the right side of the instrument. Its dimensions are 36.5-cm (14.4 in.) wide, 67.3-cm (26.5 in.) deep and 61.0-cm (24 in.) high. It weighs 80 kg (178 lbs.). The chiller has air intakes and exhausts that need to be unobstructed. The power is 2850 watts. It requires a minimum of 45.7 cm (18 in.) on all sides for adequate ventilation. The coolant hoses restrict the distance that the chiller can be placed away from the instrument (hose length = 3.6 meters or approximately 12 feet).

**Caution** If a longer hose distance is required for the chiller location, it may be necessary to increase the hose inner diameter to accommodate the specification of **no greater than 15 psig** at the instrument water outlet. The hose inner diameter should also be sized large enough to accommodate the specification of 45 to 80 psig at the water inlet. The hose also needs to be insulated sufficiently to maintain a temperature at the instrument water inlet between 15 °C and 25 °C.

**Attention** Si une distance de tuyau plus long est nécessaire pour la localisation de refroidissement, il peut être nécessaire d'augmenter le diamètre intérieur du tuyau pour recevoir le cahier des charges **ne dépassant pas 15 psig** à la sortie d'eau de l'appareil. Le diamètre intérieur du tuyau doit également être dimensionnée assez grande pour recevoir la spécification de 45 à 80 psig à l'entrée d'eau. Le tuyau doit également être suffisamment isolé pour maintenir une température à l'entrée d'eau de l'instrument entre 15 ° C et 25 ° C.

## *Cooling Water Requirements*

A water supply is required to dissipate heat from the oscillator.

**Recirculating System**

A recirculating system (chiller) must be used. The requirements for the chiller are:

- Cooling Capacity at 20 °C is 2000 watts
  Temperature Stability ±1 °C
  Pump Rate 1 US gal/min. at 55 psi max (45 psi min).
  Coolant: coolant fluid with corrosion inhibitor

A PolyScience Recirculating Chiller meets these requirements and is recommended for the instrument. The PolyScience® WhisperCool™ chiller is available through PerkinElmer in the following two configurations:

- 230V, 60 Hz (Part No. N0772046)
- 240V, 50 Hz (Part No. N0772045)

For detailed information on PolyScience® WhisperCool™ chiller electrical requirements see the following section, **Electrical Requirements**.

The PolyScience® WhisperCool™ chiller comes with its own Instruction Manuals. The headquarters for PolyScience Instruments is located at:

- PolyScience Instruments, Inc.
  6600 West Touhy Ave
  Niles, Il 60714

  USA: (800) 229-7569

  Worldwide: (847) 647-0611

  Fax: (847) 647-1155

## Electrical Requirements

### Avio 200

**Grounding circuit continuity is vital for safe operation of this instrument. Grounding is accomplished by use of an IEC60309 instrument power plug furnished by the factory and not to be removed during or after installation.**

**Avertissement: Mise à la terre la continuité du circuit est essentiel pour une utilisation sûre de cet instrument. La terre est effectuée par l'utilisation d'une prise d'alimentation de l'instrument IEC60309 fourni par l'usine et ne doit pas être retiré pendant ou après l'installation.**

- Avio 200 requires an AC line voltage of 200 - 230 VAC +/-10% (180 - 253 VAC) 50/60 Hz. +/-1% under full instrument load, that has a correctly wired protective earthing system (ground connection) and a separate circuit breaker. Maximum power consumption is 2800 VA. The line power supply must conform with local safety regulations and be checked by a qualified electrician before you connect the instrument to line power.
- The line power supply should be free of line transients in excess of 50 V peak. If the electrical supply voltage produces large AC line voltage fluctuations, a qualified electrician should install a voltage regulator between the electrical outlet and the instrument.
- The Avio 200 instrument is supplied with a 2.5 m (98 in.) line power cord that supplies both the spectrometer and the RF Generator. The line power supply point must be within 2.5 meters of the rear of the spectrometer.
- Connect the spectrometer, computer, printer, and any accessories to the same phase of the line power supply and the same protective earth.

**Note** PerkinElmer instruments will normally operate within ± 10% of the specified voltage and within ± 1% of the specified frequency, unless otherwise noted. If the power line is unstable, fluctuates in frequency or is subject to surges, additional control of the incoming power by the user may be required.
The Avio 200 must **not** have a Ground Fault Circuit Interruptor (GFCI) protected outlet. The instrument will trip the interruptor if this type of outlet protection is used.

The Avio 200 is equipped with an IEC60309 250 V 16/20A 2 pole plus protective earth plug (PerkinElmer Part No. 09997530) that inserts into an equivalent IEC60309 series receptacle (Perkin Elmer part number 09290304 or 09290305 surface mount version) both of which are contained in the N0770425 conduit box kit that ships with the instrument.

As an alternative you can use the following receptacle part numbers which can be directly ordered from Hubble. For the US/Canada (20A service) use PerkinElmer Part Number 09997529 Hubble Part No. C320R6SVL or C320R6W. For Europe (16A service) use Hubble Part No. C316R6S. Also, Conduit Box-Cast Device Back Box Hubble Part No. SP 20301 is available for the above Hubble versions.

**Computer and Printer**

Refer to the guides supplied with your computer and printer for electrical requirements. The computer and printer must share a common earth ground with the Avio 200.

**PolyScience Chiller**

The specific electrical requirements for the PolyScience® WhisperCool™ Chiller are printed on a serial number label located on the back of the unit. The voltage of the power source must meet the specified voltage ±10%. In addition, an adequate ground connection must be provided.

**For 60 Hz installations,** the PolyScience® WhisperCool™ Chiller, 60 Hz, 15A unit is supplied with a 15-ampere, 250-volt Hubbell #4570-C Twist-Lock power plug (NEMA L6-15P configuration). A Hubbell #4560 or equivalent receptacle (NEMA L6-15R configuration) is also required, and is supplied with the instrument.

(NEMA: The National Electrical Manufacturer's Association)

**For 50 Hz installations,** to accommodate most countries, the PolyScience 220/240 V, 50 Hz, 15A unit is supplied with two detachable line cords.

# Pneumatic Requirements

## Argon

Liquid or gaseous argon can be used with the Avio 200 system. The use of liquid or gaseous argon tanks is determined primarily by the usage rate. Liquid argon is usually less expensive per unit volume to purchase, but cannot be stored for extended periods. If liquid argon is used, the tank should be fitted with an over-pressure regulator for safety reasons. The over-pressure regulator vents the tank as necessary to keep the argon cool enough to remain in its liquid state, thus preventing the cylinder from exploding due to pressure build-up. A tank of liquid argon containing 160 liters will typically last for 80 hours of continuous running time.

Gaseous argon tanks do not require venting and consequently can be stored for longer periods without loss. A tank of gaseous argon will last 5 to 6 hours of running time. The normal argon usage is 9-20 liters/min. with a maximum of 25 liters/min (0.04 - 1.0 cu. ft/min). The argon flow for the system (including the ICP) may vary between 1 and 25 L/min.

**Caution** *Gas delivery lines from the argon tank should be contaminant-free and not made of plastic. Teflon delivery lines are acceptable.*

**Attention** *Conduites de distribution de gaz de la cuve d'argon doivent être exemptes de contaminants et pas en matière plastique. Lignes de livraison de Téflon sont acceptables.*

Available argon pressure should be between 550 to 825 kPa (5.5 to 8.25 bar or 80 to 120 psig ).

Argon can be purchased from local suppliers. The argon for use with ICP systems should be 99.996% pure.

## Purge Gas

Nitrogen or argon can be used to purge the Avio 200 spectrometer optics. The purge gas high flow is 8 L/min. The low gas flow is 1.5 L/min.

**Caution** *Gas delivery lines from the purge gas tank should be contaminant-free and not made of plastic. Teflon delivery lines are acceptable.*

**Attention** *Conduites de distribution de gaz de la cuve d'argon doivent être exemptes de contaminants et pas en matière plastique. Lignes de livraison de Téflon sont acceptables.*

The available pressure should be between 275 and 825 kPa (2.75 to 8.25 bar or 40 to 120 psig).

The purge gas should be 99.999% pure and is available from local suppliers.

### Shear Gas

Air or nitrogen can be used to shear the plasma for the Avio 200. The Avio 200 RF generator typically consumes the shear gas at a rate of 25 L/min.

The flow rate should be approximately 25 L/min (1.0 cu. ft/min).

Available pressure should be between 550 and 825 (5.5 to 8.25 bar or 80 to 120 psig).

### Regulator

A pressure regulator for use with either argon or nitrogen is available from PerkinElmer as Part No. 03030284. To connect the regulator to the instrument gas controls, use the 1/4-in. Swagelok connector. The gas tube provided has 1/4-in. Swagelock fittings.

# System Description 3

# Introduction

The Avio 200 instrument consists of three major components: the spectrometer, the ICP Source and the sample introduction system. Each component is further divided into the different modules described below. This modular system design facilitates system access, testing and servicing.

For the Avio 200, the two standard sample introduction systems are:

- Baffled cyclonic spray chamber with a Meinhard K1 nebulizer
- Scott spray chamber with a cross flow nebulizer

The spectrometer for the Avio 200 consists of the following modules:

- Optics module
- Spectrometer electronics module
- Spectrometer pneumatics module

The ICP source for the Avio 200 consists of three modules:

- RF generator module
- High voltage power supply module
- Plasma pneumatics module

The sample introduction system for the Avio 200 is comprised of:

- A Quick-Change Adjustable Torch Module
- Spray chamber and nebulizer
- Peristaltic pump for the sample and drain

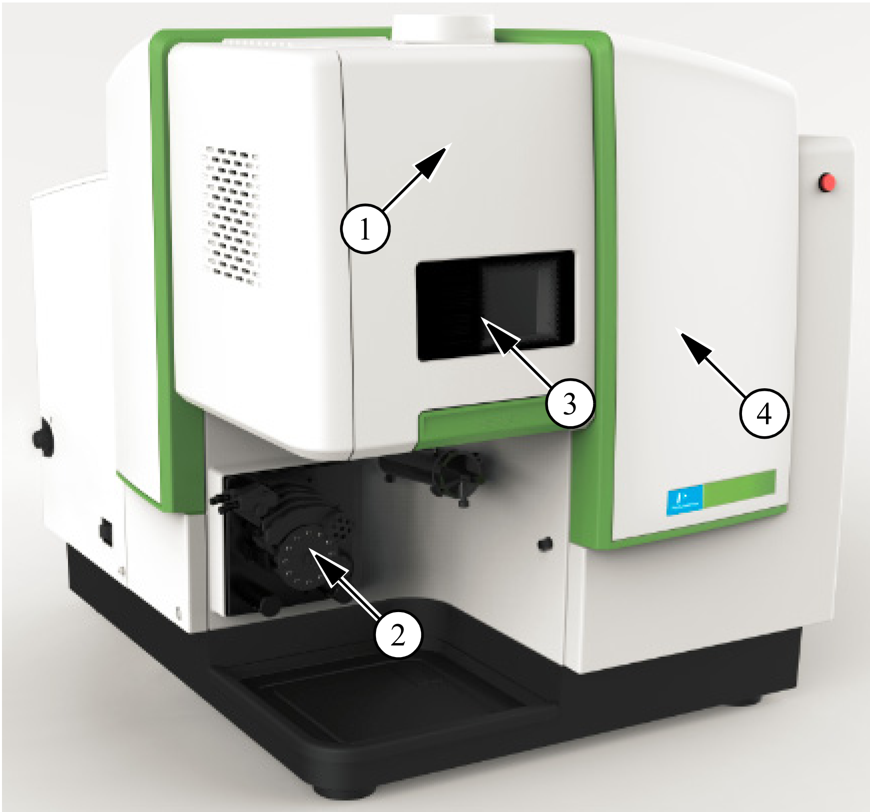



**Figure 3-1. The Avio 200**

| Item | Description |
|---|---|
| 1 | Quick Change Adjustable Torch Module (inside) |
| 2 | Peristaltic Pump |
| 3 | Viewing Window |
| 4 | Spectrometer |

# Spectrometer

## Introduction

The core of the optical system is comprised of a dual Echelle monochromator with a dual, backside-illuminated, cooled, CCD detector. The system is specifically designed for ICP-OES. Computer controlled transfer optics direct the radiation from the plasma into the monochromator. The optics housing is sealed and continuously purged with high purity nitrogen.

Signals at the required analytical wavelengths are measured using a scanning CCD (charged coupled device) based technology, with simultaneous measurement of the background emission and a neon spectrum for active wavelength correction.

## Transfer Optics

The computer controlled transfer optics are used to select either radial or axial viewing of the plasma and to direct the radiation from the plasma onto the entrance slit of the monochromator. The exact viewing position, (horizontal and vertical position), can be selected in the software.

An automatic shutter closes between measurement cycles to reduce the exposure of the optics to excess UV radiation.

## Monochromator

In the dual Echelle monochromator, the prism monochromator acts as a preselection system to select the required wavelength range to pass on to the Echelle monochromator. Optimally positioned slits and baffles result in very low stray light levels reaching the Echelle monochromator. The prism and Echelle dispersion systems use Littrow configurations, designed to eliminate astigmatism, with identical, 300 mm focal length, 10° off-axis, parabolic, collimating and focusing mirrors.

The Echelle grating has 79 lines/mm with a blaze angle of 63.4°. The grating is used in the higher orders, where the high efficiency and high dispersion allow a relatively short focal length resulting in a compact optical system.

Wavelength selection is achieved by simultaneous rotation of the prism and grating. Since the maximum rotation required for either element is not more than ± 2°, the average wavelength selection time is less than 2 seconds. To further optimize the analysis time, the wavelengths required are sorted to minimize the change-over time between any two consecutive wavelengths.

The dual monochromator system enables relatively high slits to be used with no loss of image quality, which contributes to the high optical throughput. In addition, part of the slit height is used for the simultaneous measurement of a neon reference spectrum for wavelength correction.

Two slit width settings are available, optimized for UV and visible wavelengths. The system automatically selects the correct slit for each analytical measurement.

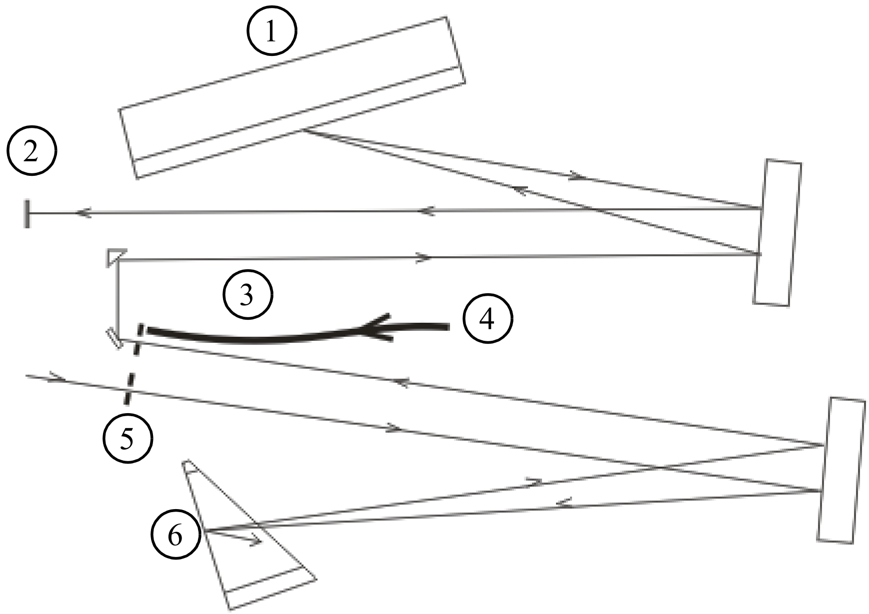



**Figure 3-2 Monochromator**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Echelle Grating | 4 | Fiber optic for the neon reference beam |
| 2 | Detector | 5 | Entrance Slit |
| 3 | Intermediate Slit | 6 | Prism |

## Detector

The detector is a two-dimensional CCD device containing approximately 25,600 pixels. The photosensitive area is separated into two differently sized arrays that are used for separate reference and analytical measurements. The analytical signal is measured in the larger, lower array.

The rear of the actual detector area is thinned to a few micrometers to allow illumination from the rear. This prevents the absorption of radiation by components other than the detector pixels and maximizes the quantum efficiency without the use of a fluorescent coating.

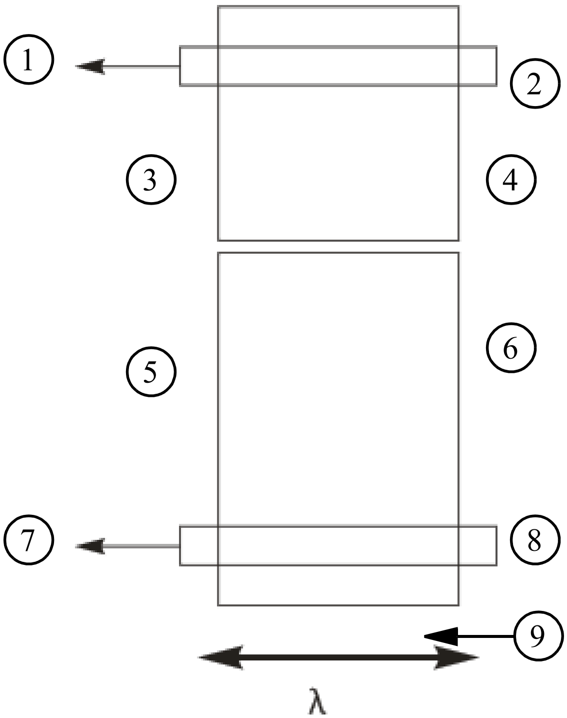



**Figure 3-3 Detector**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Output | 6 | CCD Array |
| 2 | Register for the reference measurement. | 7 | Output |
| 3 | 2 mm | 8 | Register for the reference measurement |
| 4 | CCD Array | 9 | 3 mm |
| 5 | 3.5 mm | | |

At 240 nm the array covers a wavelength range of approximately 0.52 nm, and at 850 nm, approximately 25 nm. Thus the emission line for the analyte of interest and emission on each side of the analytical line fall simultaneously on the array. This allows simultaneous measurement of the analyte and background signals.

To improve performance and reduce noise levels, the CCD detector is cooled between –7 and –8 °C with an integrated Peltier cooler. The entire CCD is hermetically sealed and the housing filled with dry nitrogen.

**How the CCD works**

Photons of radiation from the analyte emission strike the photosensitive area of the detector where photoelectrons are produced in each pixel of the detector. The electrons are moved into the register where they accumulate as electric charge. The charge is allowed to accumulate for the period selected for the integration time. At the end of the integration time, the charge is transferred out of the register to the signal processing electronics. The pixels in each vertical row are binned into the register for the respective array. This use of an effective pixel length of 3 mm results in the low noise performance typical of CCD devices.

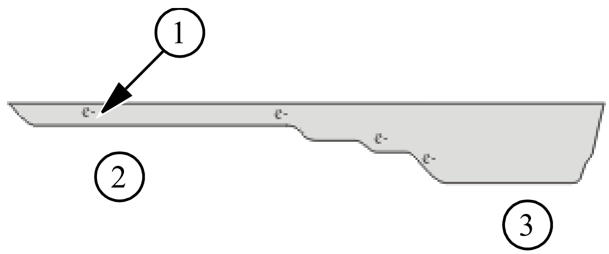



**Figure 3-4 Storage of photoelectrons during integration.**

| Item | Description |
|---|---|
| 1 | Photons |
| 2 | Photosensitive Register |
| 3 | Register |

### Wavelength Correction

The optical system uses a two-component, active wavelength stabilizing system. The overall stability is controlled by temperature and neon in the optics housing.

Any residual deviations are compensated for by measuring a neon reference spectrum simultaneously with each measurement of an analytical emission line. The output from a neon discharge lamp is collected by an optical fiber and projected onto the top half of the intermediate slit in the monochromator, which is the entrance to the Echelle monochromator. The neon spectrum passes through the Echelle system with the analytical radiation and illuminates the top array of the detector. The neon spectrum acts as a wavelength scale to enable active wavelength correction.

## ICP Source

### RF Generator

The Avio 200 uses a 40-MHz free-running solid state RF generator. The RF power from the solid state oscillator is used to ionize the argon in the torch and excite the atoms of the liquid sample so that they emit energy at their atomic wavelength in the form of photons. The photons from the torch are detected optically and measured electronically in the spectrometer section of the Avio 200. The photons are displayed in terms of wavelength and intensity, which are converted to sample concentration.

The RF generator provides a power output of 1000 to 1500 watts. The power output levels are computer-controlled and may be adjusted in one-watt steps for different sample matrices.

The RF generator is designed with RF Power Control (RFPC), using a power control loop which maintains the plasma setting regardless of line voltage fluctuations and changes in the plasma.

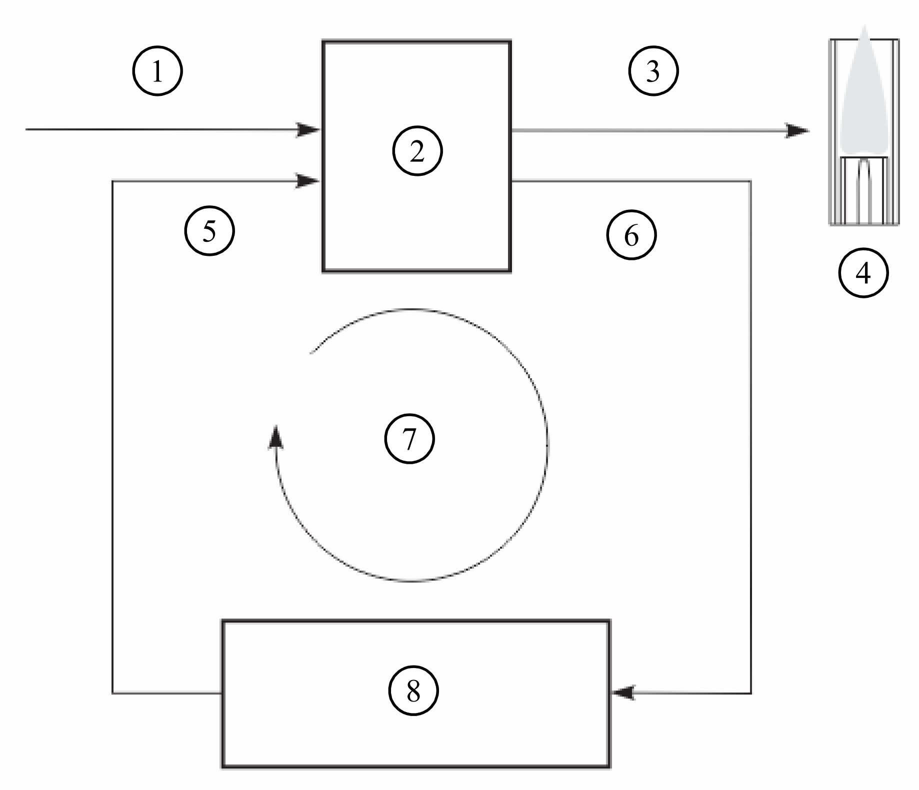



**Figure 3-5** **Block diagram illustrating the RF Power Control (RFPC)**

| Item | Description |
|---|---|
| 1 | AC Power Input |
| 2 | 40 MHz RF Power Generator |
| 3 | RF Power to Plasma Induction Plates |
| 4 | Plasma |
| 5 | Control Feedback Signal |
| 6 | Power Measurement Signal |
| 7 | RF Power Control Loop |
| 8 | Microprocessor |

### RF Control Electronics

The RF generator uses solid-state circuits. The solid state RF generator is designed to significantly increase reliability and reduce the need for recalibration.

The RF generator also monitors plasma conditions. If the plasma is unstable, the system automatically shuts it off.

To ensure operator safety and to protect the instrument from damage, the system includes extensive use of RF shielding and safety interlocks. Proper RF shielding and filtering are provided so that the system complies with regulations regarding radio frequency radiation.

## Sample Introduction System

### Sample and Torch Compartments

The sample compartment has a front door to provide easy access to the torch compartment with the sample introduction model inserting into the torch compartment through the bottom of the compartment. The sample introduction system is always visible and accessible even during operation. The spray chamber, nebulizer, injector and torch can all be accessed underneath the torch compartment without opening the door. The torch compartment door has a window so that the operator can safely view the plasma and safety interlocks that shut down the plasma if the door is opened during operation. The torch compartment has extensive shielding to prevent exposure to radio frequency radiation.

### Quick-Change Adjustable Torch Module

The Quick-Change Adjustable Torch Module consists of the quartz torch, injector, spray chamber, and nebulizer/end cap – all in one assembly. This module can be quickly removed from the sample compartment. This adjustable mount allows the torch an adjustment of up to 5 mm.

**Torch**

The torch has a standard alumina injector with a 2.0 mm inner diameter and a sapphire injector in 2.0 mm diameter. Other injectors available include alumina injectors in different sizes for optimum sample loading of the plasma and quartz injectors for different sample types.

In addition, adapters are available for special applications, such as the use of an ultrasonic nebulizer.

**Spray Chamber**

Depending on the instrument configuration ordered, the instrument may include a Scott-type spray chamber with a GemTip Cross-Flow nebulizer or a baffled cyclonic spray chamber with a Meinhard K1 nebulizer. Other combinations are also available. A Ryton, double-pass Scott-type spray chamber with the GemTip Cross-Flow pneumatic nebulizer is one of the standard configurations. This rugged combination provides the best results for a variety of elements and sample types.

## *Nebulizers*

PerkinElmer offers these nebulizers for a wide variety of applications:

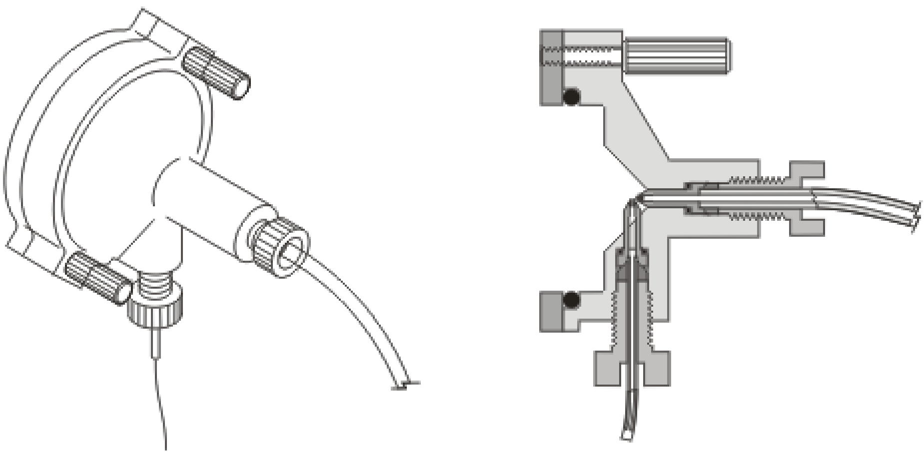


**Figure 3-6 GemTip Cross-Flow nebulizer and end cap N0780546 (also shown in cross-sectional view).**

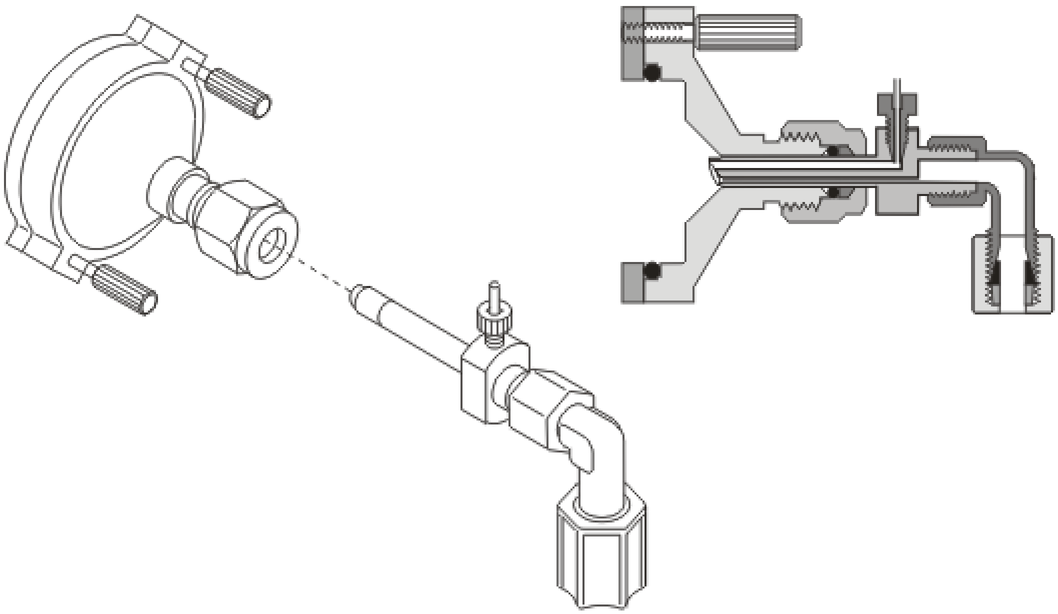


**Figure 3-7 GemCone nebulizer and end cap N0680343 (also shown in cross-sectional view).**

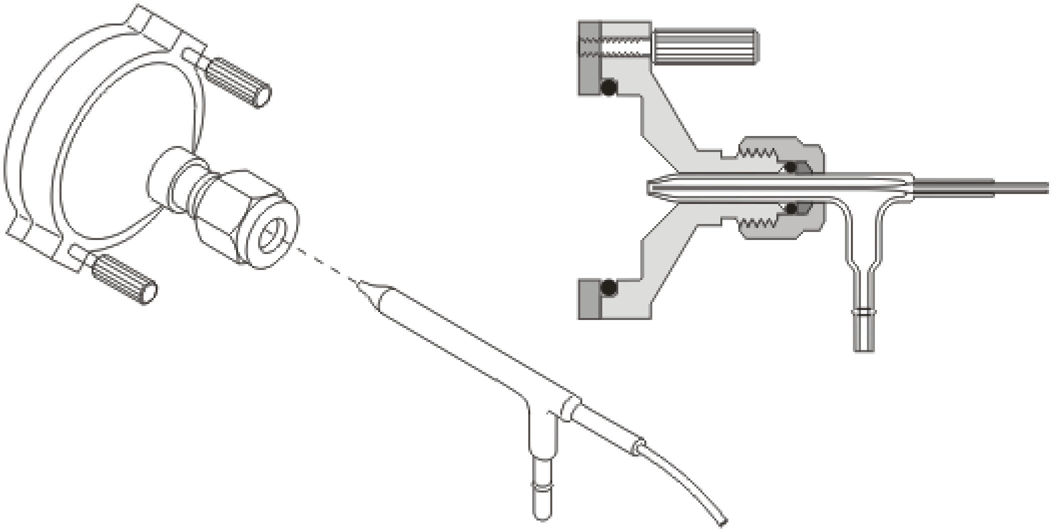


**Figure 3-8** **Concentric glass nebulizer and end cap N0680343 (also shown in cross-sectional view).**

| Description/Part No. | Uses/Advantages |
| --- | --- |
| GemTip Cross-Flow Nebulizer end cap N0780546 | Good general purpose nebulizer for the analysis of strong mineral acids (including HF) and samples with less than 5% dissolved solids. Uses GemTips made of sapphire and ruby in a Ryton end cap for maximum chemical resistance. |
| GemCone (Conespray) Nebulizer<br>High Solids: N0690670<br>Low Flow: N0690671 | High Solids GemCone is for samples with high dissolved solids (up to 20%). Low Flow GemCone permits lower nebulizer gas flow rates, useful for spectral lines with high excitation energies and for providing a more robust plasma. GemCone nebulizers require an end cap (Part No. N0680343) for use with the Scott spray chambers. |

| | |
|---|---|
| Concentric Glass Nebulizer (MEINHARD) | Provides excellent sensitivity and precision for aqueous solutions and samples with few dissolved solids (less than 1%). Self-aspirating. Not to be used with solutions containing hydrofluoric acid. PerkinElmer offers four types, Meinhard (A, C, K1 and K3), which are described below. All require an end cap (Part No. N0680343) for use with the Scott spray chambers. The Meinhard nebulizer will aspirate liquid sample without pumping. The nebulizer may also be operated with externally pumped sample, provided that the sample flow is not significantly below the natural aspiration rate. |
| MEINHARD Type A 00472020 | General purpose Meinhard nebulizer. |
| MEINHARD Type K1 N0777707 | Low Ar Flow nebulizer for routine aqueous samples. |
| MEINHARD Type K3 N0681574 | Low Ar Flow nebulizer for organic samples. |
| U-6000AT$^+$ Ultrasonic Nebulizer N0691709 (115 V) N0691710 (230 V) | For samples with low analyte and low matrix concentrations. Typically improves detection limits by a factor of 10 over conventional pneumatic nebulizers. |
| Mira Mist Nebulizer N0775330 | The Mira Mist Nebulizer is recommended for aqueous solutions. Organics will wet the nebulizer tip and performance will deteriorate. |

## Peristaltic Pump

The peristaltic pump is fully computer-controlled. As an added feature, the pump speed can be programmed to run at a fast speed for the read or rinse cycle. The TubingSaver mode is a feature for extending the life span of pump tubing.

## Autosampler

PerkinElmer offers autosamplers for automated sample handling. These autosamplers consist of a sample table, a sample tray, and a motorized sampling arm with an attached probe. Different sample trays are available for each autosampler, covering a variety of sample volumes and total sample capacity requirements.

# Switches and Controls

## Main On/Off Switch

The Main Instrument switch is used to turn on the spectrometer (and is normally left on). Once the plasma has been ignited, you should wait one half hour for the system to stabilize before running samples.

## Interlocks

Interlocks are designed to ensure operator safety and protect the instrument from damage. The main system interlocks are described below.

The following interlocks must be satisfied in order to ignite the plasma. If any of these interlocks is interrupted while the plasma is on, the plasma will automatically be shut down. Before you can ignite the plasma:

- The torch compartment door must be closed;
- the Emergency Off (EMO) switch on front of instrument must be released;
- the argon pressure for the torch must be correct;
- the cooling water must be flowing to the oscillator;
- the torch must be installed;
- the shear gas pressure must be correct.

## EMO Switch

The **Emergency Off** (EMO) switch is the illuminated red switch on the front of the instrument. If it is blinking slowly the instrument is in the middle of an ignition cycle. It blinks rapidly after the Emergency Off Switch is depressed. This is an indication that the switch has been depressed and to remind you to push the switch again to release it. This switch shuts off the plasma in an emergency by disconnecting the main voltage circuitry in the RF generator. To restart, you must release the switch by pressing the switch again. Reset the RF generator using the software Reset button. This reset can be found by opening **Diagnostics** in the Syngistix for ICP software, going to plasma tab and selecting the **Advanced** button.(The spectrometer stays on.)


**Figure 3-9 Location of Red Emergency Plasma Off Switch .**

| Item | Description |
|---|---|
| 1 | Emergency Off Switch |

## Software Controls

Many of the hardware settings are controlled by the software.

- *RF Power:* Power levels can be adjusted in 1-watt increments.
- *Plasma and auxiliary argon flow rates:* Flow rates can be automated during the analysis with specific flow rates for each element if desired. Plasma argon is adjustable in 1 L/min increments. Auxiliary argon is adjustable in 0.1 L/min increments.
- *Nebulizer argon flow rate:* The flow rate is automatically controlled using a mass flow controller in 0.01 L/min increments.
- *Pump rate:* By specifying the desired flow rate (adjustable in 0.1 mL/min increments) and the tubing diameter, the software calculates the pump speed.
- *Nitrogen purge rate:* A high or normal flow rate can be specified.
- *Dark current measurement:* A shutter under software-control can be closed to block light from the plasma from reaching the detector in order to measure dark current.
- *TubingSaver:* A feature for extending the life span of pump tubing for the peristaltic pump.
- The area of the plasma viewed by the optical system can be adjusted horizontally and vertically using a computer-controlled moveable transfer optic. The software also has a built-in optimization function for plasma viewing.

# Connections to Electrical, Gas, and Cooling Water Supplies

See the following figure.

| Marking | Function |
|---|---|
| **O I** | Main power switch. |
| ⚠ | Connections for remote control of accessories. Do not exceed the stated voltage and current:<br>Umax = 30 V AC, Imax = 0.5 A AC<br>Umax = 30 V DC, Imax= 2 A DC |
| ⚠ | Line power cord, permanently attached with an IEC 309 connector. Connect to 200-240 VAC, 15 A, IEC-309 line power outlet. |
| **$N_2$** | Purge gas inlet for nitrogen (or argon). Use hose N0690275 |
| **Air / $N_2$ Shear Gas** | Shear gas inlet for air or nitrogen. Use Air hose N0770348<br>included with Air Dryer Filter and regulator assembly. |
| **Ar** | Argon inlet for torch. Use Argon hose N0690274. |
| **$H_2O$ IN (Red Tie)** | Cooling water inlet. Use hose N0770341 from the chiller. |
| **$H_2O$ OUT (White Tie)** | Cooling water outlet. Use hose N0770342 to the chiller. |

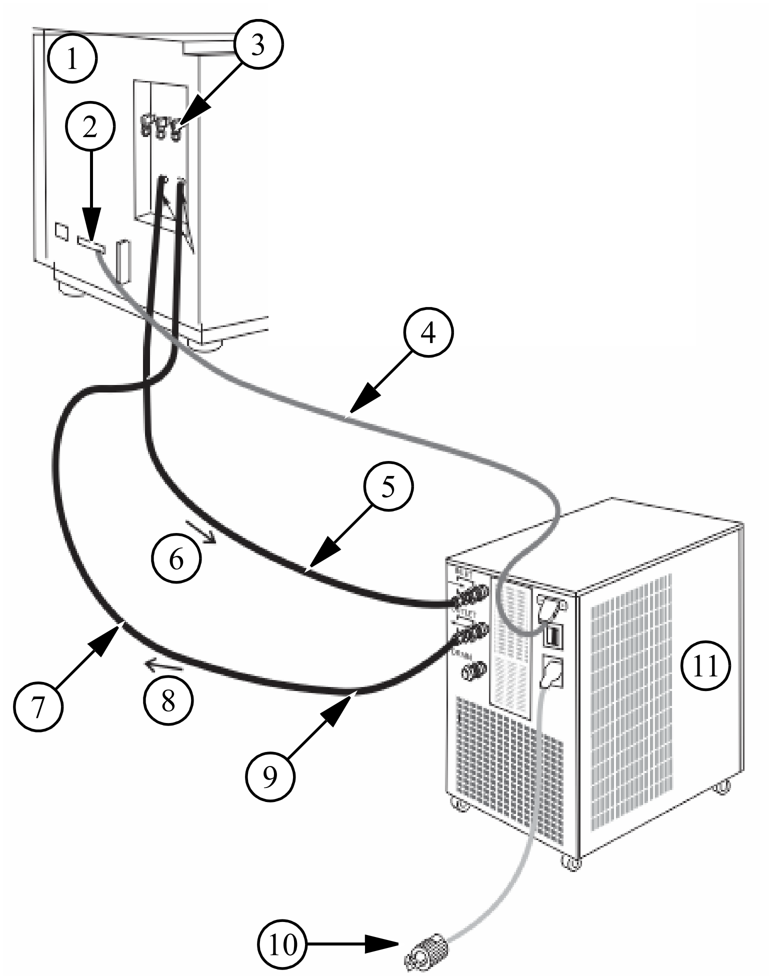



**Figure 3-10** **Electrical, gas, and cooling water connections on the spectrometer side of the instrument .**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Avio 200 | 7 | Coolant In |
| 2 | Terminal Strip (For the Chiller Remote) | 8 | To Avio In |
| 3 | Gas Supply | 9 | Coolant Supply Hose (Part No. N0770341) |

| Item | Description | Item | Description |
|---|---|---|---|
| 4 | Remote Cable (Part No. N0770175) | 10 | Line Cord Plug |
| 5 | Coolant Drain Hose (Part No. N0770342) | 11 | Chiller |
| 6 | From Avio Out | | |

## System Initialization

When you switch on the spectrometer:

1. The Peltier cooling system for the detector starts to cool the detector.

2. The system sets up all the motors for the optics at the default positions for the axial viewing mode.

3. The system has been continuously monitoring the detector temperature. When the temperature is stable at about -8 °C, the system continues with the initialization.

4. The system performs a dark current measurement; this takes about 30 seconds.

5. The system switches on the neon reference lamp and measures the intensity. If the energy is too low, the system displays an error message. When the measured intensity is above the lower limit, the system is ready for use.

System initialization takes less than 10 minutes. The spectrometer initialization is completed when the spectrometer sends a "system ready" message to the computer and can be viewed under the diagnostics - spectrometer window. Once the plasma has been ignited, you should wait one half hour for the system to stabilize before running samples.

# Technical Data

## General

| | |
|---|---|
| **Principle** | Inductively coupled plasma optical emission spectrometer. Computer controlled, using a special application program running under a graphical user interface. |
| **Power requirements** | 200 to 240 V AC ~, 50/60 Hz<br>Power consumption 2800 VA (maximum) |
| **Electrical protection** | Insulation: Class I<br>Pollution degree: 2 |
| **Safety standards** | See the Declaration of Conformity. |
| **EMC standards** | See the Declaration of Conformity. |
| **Environmental requirements** | Recommended temperature: +15 °C to +35 °C (59 °F to 95 °F)<br>20–80% relative humidity; non-condensing<br>Altitude in the range 0 m to 2,000 m. |
| **Dimensions** | Width: 132 cm, (52 inches)<br>Height: 76 cm, (30 inches)<br>Depth: 81 cm, (32 inches) |
| **Mass (weight)** | 100 kg, (220 lb.) Instrument alone, not including the computer, autosampler, and chiller. |

## ICP Plasma Generator System

**Frequency:** 40 MHz, free-running

**Output Power Stability:** <0.1%

**Power Output:** 1000 to 1500 watts, computer-controllable in 1 watt increments. RF generator is located in the left side of the instrument for efficient use of laboratory space.

**RF Shielding:** Meets all FCC certification requirements for RF emissions.

**Plasma Induction Plates**

**Cooling Water:** System requires a flow of 1 gal/min at 310 to 550 kPa at a temperature between 15 °C and 25 °C. A recirculating cooling system is required (PolyScience® WhisperCool™ chiller or equivalent is recommended).

**Automatic Ignition:** Plasma ignition is computer controlled and totally automated. The plasma can be turned on at a set time, warming up the system prior to an analysis, and can be turned off automatically after an analysis.

**Safety Interlocks:** System checks water flow, shear gas flow, argon pressures, emergency plasma off switch, torch compartment door interlocks, torch installed and plasma stability. The status of these interlocks is constantly monitored and text information is displayed on the computer screen. If any interlock is interrupted, the plasma is shut down automatically.

## Gas Flow Controls

**Plasma Argon Flow:** Closed-loop flow control using a proportional valve and a measured pressure across a known resistor. Computer-controlled to regulate the flow automatically within the range of 8 to 20.0 liters/minute in 1.0 liter/minute increments.The flow system is interlocked to prevent ignition without plasma gas flowing.

**Auxiliary Argon Flow:** Closed-loop flow control using a proportional valve and a measured pressure across a known resistor. Computer-controlled to regulate the flow automatically within the range of 0 to 2.0 liter/minute in 0.1 liter/minute increments.

**Nebulizer Argon Flow:** Computer-controlled, using a mass flow controller and is variable between 0 and 2.00 liter/minute in 0.01 liter/minute increments.

**Shear Gas:** A compressed-air shear gas (18-20 liters/minute) is used to push the plasma plume out of the optical path, minimizing the impact of self-absorption in the cooler plasma plume.

## *Sample Introduction System*

**Torch:** Demountable design using one-piece quartz tubing for plasma and auxiliary gas flow. The standard torch is supplied with a 2.0-mm alumina injector for full corrosion resistance to all acids, including hydrofluoric and aqua regia. A 0.8-mm injector is available as an option for analysis of very volatile organic solutions. As options, 3.0-mm, 1.6-mm and 1.2-mm quartz injectors are available.

**Spray Chamber:** Scott-type designed to minimize pulsations from the peristaltic pump and constructed of Ryton for complete corrosion resistance to most acids, including HF, and all organic solvents normally used in ICP analyses.

The Avio 200 also supports the baffled cyclonic spray chamber and Meinhard K1 nebulizer. This sample introduction system provides the best precision and detection limits. This system cannot be used with HF.

**Nebulizer:** Cross-flow design with chemically resistant GemTips manufactured from corrosion-resistant (sapphire tips in a PEEK body) material. The system can routinely handle 50% (v/v) solutions of HCl, $HNO_3$, $H_2SO_4$, $H_3PO_4$, 20% (v/v) HF and 30% (v/v) NaOH. Up to 20% NaCl can be aspirated by the nebulizer for 1 hour without clogging. The system is fully compatible for use with other nebulizers such as ultrasonics, concentrics (Meinhard) and GemCone types.

**Peristaltic Pump:** A four channel, variable speed, computer-controlled pump. Speed is variable from 0.2 to 7 mL/minute in 0.1 mL/minute increments using 0.76 mm (0.030 inch) tubing.

**Torch Mount:** In Quick-Change Torch Module is optimized by computer-controlled movement of the first transfer mirror.

**User Plasma Viewing:** The full plasma is viewed through a UV-blocking, low-transmittance window located in the sample compartment door.

## Optical System

**Monochromator:** Wavelength range: 165 nm – 800 nm. High throughput, f/6, dual Echelle monochromator. Echelle grating: 79 line/mm, blaze angle: 63.8 °. Dispersing prism: 30 ° quartz. Spectral bandpass: 0.009 nm at 200 nm, 0.027 nm at 700 nm.

**Transfer Optics:** Computer-controlled toroidal mirrors.

**Detector:** Dual, backside-illuminated, cooled, CCD detector. Cooling to between -7 and -8 °C with integrated Peltier cooler. Detector area: approximately 3 x 5 mm split into a reference and an analyte array with separate read-out registers. Reference array: 64 x 192 pixels of 18 x 32 µm. Analyte array: 64 x 192 pixels of 18 x 56 µm. Read-out noise: 30 electrons. Dark current: 150 electrons/pixel/second. Read-out time: 64 µs. Full well capacity: 1.1 million electrons. Charge transfer efficiency: 0.99995.

**Wavelength correction:** Temperature sensor for the optics housing. Spectrum from a neon discharge lamp is collected with each analytical wavelength measurement and acts as a wavelength scale to enable active wavelength correction.

# Installation 4

# Installation Summary

**Contact a PerkinElmer service engineer for assistance in installing or evaluating the system after moving.** The Avio 200 weighs 99kg (218 lbs) or 150 kg (330 lbs) with the shipping container. If the instrument needs to be moved please contact PerkinElmer Service.

A PerkinElmer service engineer should install your system for the first time or help you in moving the system. This chapter is provided for your reference should you need information on moving the system, or reinstalling accessories. In conjunction with this material, be sure to consult the *Safety Practices chapter beginning on page 29* and *Preparing Your Laboratory chapter beginning on page 55*. The following sections are included in this chapter:

The installation of the system is divided into the following steps:

- Moving the Instrument
- Connecting the Gases and Cooling Water
- Connecting the System Components
- Installing the Quick-Change Adjustable Torch Module
- Installing and Setting Up the Autosampler
- Setting the Torch Viewing Position
- Switching on the System
- Setting Instrument Parameters

## Setting Up the Computer and Printer

To install the ICP software, computer, and printer, refer to *Syngistix Software Installation Guide* on Syngistix Document Pack CD.

## Moving the Instrument

**Caution** *If moving the Avio 200 will subject the instrument to any freezing temperatures you **must** contact a PerkinElmer service engineer to assist you in the move. The PerkinElmer service engineer will flush all traces of cooling water from the RF generator to prevent freezing of RF generator components.*

**Attention** *Si le déplacement du Avio 200 assujettira l'instrument à des températures de congélation, vous devez contacter un technicien de maintenance PerkinElmer pour vous aider dans le mouvement. L'ingénieur de service PerkinElmer rincera toutes les traces de l'eau de refroidissement du générateur RF pour empêcher le gel des composants RF du générateur.*

If you must move the instrument any great distance, especially if the instrument may be subject to vibration or jolts, **contact a PerkinElmer service engineer to assist you in moving your system**.

If you are only moving the instrument within the lab or to a laboratory nearby, you may use the following procedure.

- Remove the Quick-Change Torch module.
- Remove the chiller.
- Remove any accessories, for example an autosampler.
- Disconnect all gas and water lines.
- Remove the computer and printer.
- Attach the handles.

- Lift the instrument onto a movable table or put it in the wooden platform originally shipped with the instrument. See the Unpacking Instructions (Part No. 09931178).
- Lift into position at the new location. Make sure that the new location complies with the laboratory requirements; see *Laboratory Space Requirements* on page 61.
- Remove the handles.
- Connect the instrument to the exhaust using the one flexible hose (Part No. N0691578) and two hose clamps (Part No. 09920044) fin the installation kit.
- At the new location reconnect the Quick-Change Torch module, the chiller, any accessories, gas and water lines, the computer and the printer; see the procedures later in this chapter *Installing the Quick-Change Adjustable Torch Module* on page 116.

## Connecting the Gases and Cooling Water

After the instrument has been moved into its position, it can be connected to the various services in the laboratory.

### Connecting the Gases

**Note** All gas hose connections use 1/4 inch Swagelok fittings.

Use two wrenches when making Swagelok connections. Use a space collar (Part No. 09920125), supplied in the hose kit) at each Swagelok connection. Tighten the Swagelok nut until you can no longer turn the knurled space collar. *Only if you cannot locate a space collar,* tighten the nut until it is finger-tight, then turn it an additional 1/4 turn with a wrench. Pre-swaged fittings should be turned 1/8 turn past finger-tight. Do not over-tighten fittings. Check for leaks with all the connections made.

**Caution** *The pneumatic tubing kinks easily. Install it so that it is less likely to twist, fold and kink.*

**Attention** *Les kinks de tubes pneumatiques facilement. Installez-le de sorte qu'il est moins susceptible de se tordre, plier et kink.*

Connect the gases to the instrument as described in the following procedures.

**Connecting the Nitrogen Supply**

1. Connect the instrument to the nitrogen supply using the nitrogen hose (Part No. N0690275), uses 1/4-in. Swagelok fitting) using a 1/4-in. space collar (Part No. 09920125) on both ends of the tubing. Refer to Figure 4-1.

2. Set the nitrogen supply regulator between 275 kPa and 825 kPa (2.75 to 8.25 bar or 40-120 psig).

3. Check for leaks using a proprietary leak testing fluid for high purity gas lines.

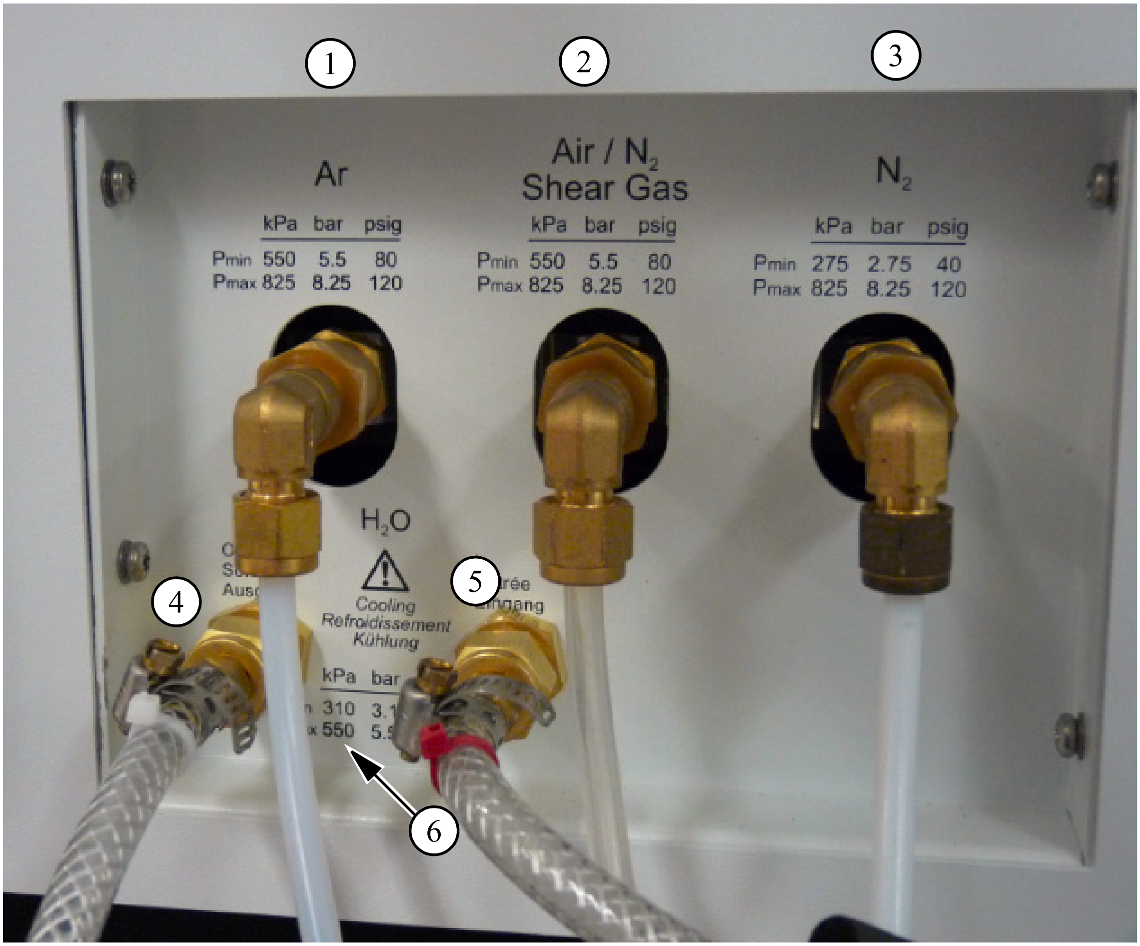



**Figure 4-1. Pneumatic, water and shear gas connections.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Ar Supply | 4 | Out (Water Hose with White Tie Wrap) |
| 2 | Air/ $N_2$ Shear Gas Supply | 5 | In (Water Hose with Red Tie Wrap) |
| 3 | $N_2$ Supply | 6 | Cooling minimum pressure no maximum |

### Connecting the Argon Supply

Use the following procedure to connect the argon supply.

---

**Caution** *Gas delivery lines from the argon tank must be contaminant-free and not made of plastic, although PTFE lines are acceptable.*

**Attention** *Des lignes de distribution de gaz à partir du réservoir d'argon doit être exempt de contaminants et non pas en matière plastique, bien que des lignées de PTFE sont acceptables.*

---

1. Connect the instrument to the argon supply using the argon hose (Part No. N0690274), uses a 1/4-in. Swagelok fitting) using a 1/4-in. space collar (Part No. 09920125) on both ends of the tubing.

2. Set the argon supply regulator between 550 kPa and 825 kPa (5.5 to 8.25 bar or 80-120 psig).

3. Check for leaks using a proprietary leak testing fluid for high purity gas lines.

### Connecting the Shear Gas Supply

The shear gas used is typically compressed air; however, nitrogen may also be used. The shear gas must be clean and dry, so the instrument includes an air dryer filter assembly (Part No. N0775325) and is included in the Installation kit (Part No. N0790432). For more information on the requirements for the shear gas supply, refer to ***Pneumatic Requirements*** on page 66.

An air hose (Part No. N0770348) with 1/4-in. Swagelok fittings at each end, is supplied in the hose kit that is shipped with the instrument. A second air hose is also included. The following procedure describes how to connect the PerkinElmer air compressor, filter and regulator.

---

**Note** f you are using house air, it must be clean and dry. The instrument includes an air dryer assembly (Part No. N0775325). Refer to **Connecting the Shear Gas Supply** later in this chapter.

---

1. Install the Air Dryer Filter as described in the instructions that are included with the filter.

2. Locate the air hose (Part No. N0770348, which uses 1/4-in. Swagelok fittings at each end). Connect the air hose from the air compressor to the AIR IN fitting on the Air Dryer Filter using a 1/4-in. space collar at both ends. Make sure the air flow is in the proper direction, as indicated by arrows on top of the filters.

3. Locate the second air hose (Part No. N0770348, uses 1/4-in. Swagelok fittings at each end) that is shipped with the instrument in the hose kit. Connect the air hose from the AIR OUT fitting on the Air Dryer Filter using a 1/4-in. space collar at both ends.

**Setting the Shear Gas Pressure**

Warning

***Do not set the air compressor pressure higher than 690 kPa (100 psig). The maximum pressure and temperature that the filter bowls can withstand is 1035 kPa (150 psig) at 50 °C (125 °F). At a higher pressure, the filter bowls can be blown off and cause injury.***

***Avertissement: Ne pas régler la pression du compresseur d'air supérieure à 690 kPa (100 psig). La pression et la température maximale que les cuvettes de filtre peut supporter est de 1035 kPa (150 psi) à 50 ° C (125 ° F). Lors d'une pression plus élevée, les bols de filtre peuvent être arrachés et causer des blessures.***

The following procedure describes how to set the shear gas pressure when using the PerkinElmer Air Dryer Filter.

1. Make sure the shut-off valve on the Air Dryer Filter is closed (knob turned fully clockwise), then set the air pressure on the air compressor to between 550 kPa and 825 kPa (5.5 to 8.25 bar or 80-120 psig).

2. Check that the metal covers are in position on the filter bowls and the filter bowl holding rings are properly locked.

**Warning**

***Before opening the shut-off valve, always check to make sure the filter bowls are properly secured.*** *Injury can result if the bowls are blown off.*

***Avertissement: Avant d'ouvrir le robinet d'arrêt, toujours vérifier pour vous assurer que les bols de filtre sont correctement fixés.*** *Des blessures peuvent survenir si les bols sont arrachés.*

3. Open the shut-off valve fully (turn counterclockwise). Partial opening may defeat the action of the water separator portion of the system.

4. Close the shut-off valve fully (knob turned fully clockwise), then set the air pressure on the air compressor to between 550 kPa (5.5 bar and 80 psig) and 825 kPA (8.25 bar and 120 psig).

5. Connect the air hose from the Air Dryer Filter to the SHEAR GAS SUPPLY fitting on the side of the spectrometer.

6. Open the shut-off valve fully (turn counterclockwise).

## Connecting the PolyScience Chiller

The PolyScience® WhisperCool™ Chiller must be used to supply cooling water to the instrument. The PolyScience® WhisperCool™ Chiller comes with a complete instruction manual. You should be familiar with this manual before proceeding.

**Note** A qualified electrician must install the single wall receptacle for the PolyScience® WhisperCool™ chiller.

The PolyScience® WhisperCool™ is available through PerkinElmer in the following two configurations:

208/230V, 60 Hz
220/240V, 50 Hz

## Connecting the Chiller to the Instrument

**Teflon tape (PTFE tape) should be used for all pipe-thread (NPT) fittings.** Use of Teflon tape can prevent leaks.

Connect the instrument to the chiller inlet using coolant drain hose. The direction of the flow through the system can be controlled by the way the hoses are connected to the chiller. The "INLET" port will draw liquid into the chiller; the “OUTLET" port will pump liquid out. See the following figure for the location of the cables.

1. Locate the instrument return/Output coolant line (Part No. N0770342) and connect to the chiller "INLET" fitting. The instrument water outputs have a fitting and tubing to connect them to the return or drain. Use 3/8-in. space collars (Part No. 09920584) at the instrument. The following figure shows the water supply connections at the instrument.

2. Locate the instrument Input coolant lines (Part No. N0770341), which uses 3/8-in Swagelock fittings) and connect to the chiller “OUTLET” fitting. Use a 3/8-in. space collars (Part No. 09920584) at the instrument. The following figure shows the chiller connections. *Figure 4-4* on *page 109* shows the water supply connections at the instrument.

3. Make sure that the hoses and fittings are tight and that there are no bends or crimps in the hoses.

## Remote Chiller Connections

The chiller can be turned on or off via the software. Your service engineer will connect the remote cable (Part No. N0770175) from the chiller to the Avio 200 so that the chiller can be operated remotely. To make sure that the chiller can be operated remotely the red wire must be connected to position 9 and the black wire connected to position 11. See the following two figure for the location of the cable connections.

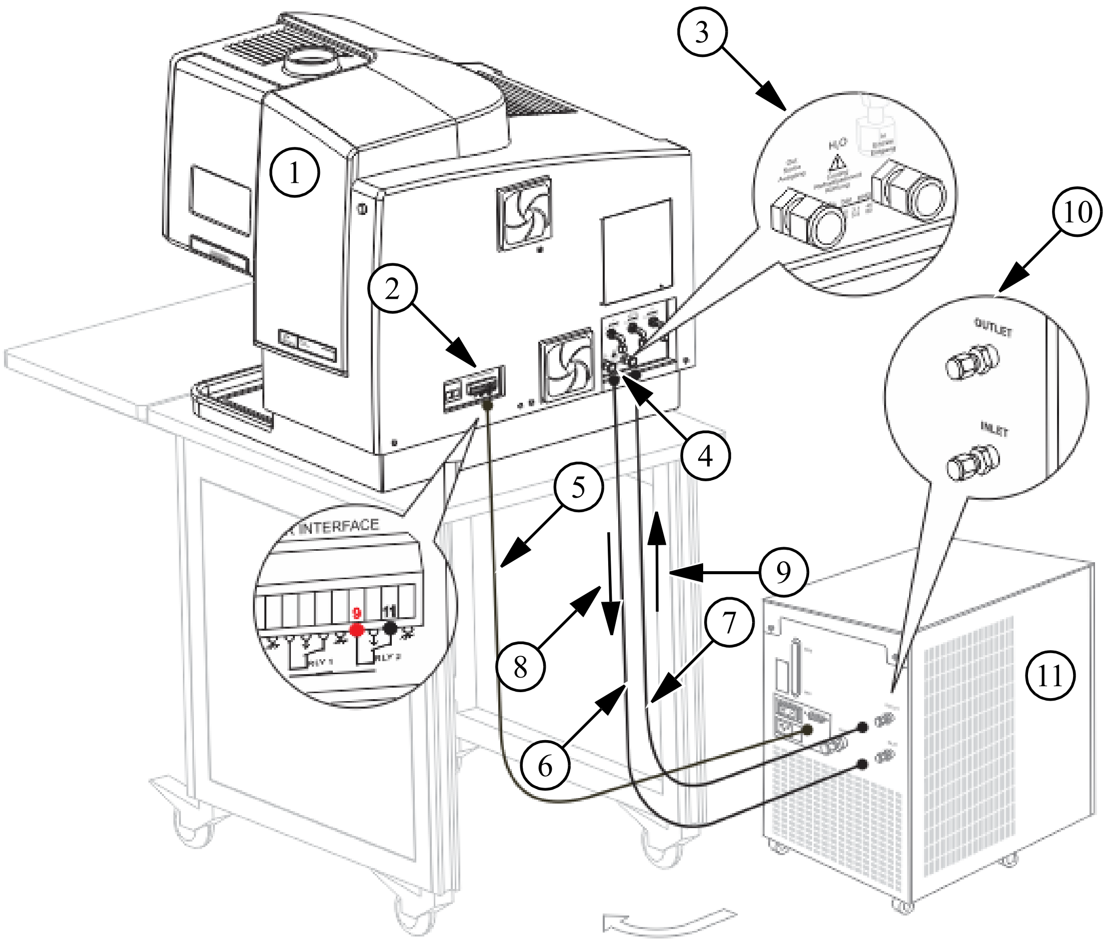



**Figure 4-2 Remote chiller connections.**

| Item | Description |
|---|---|
| 1 | Avio 200 |
| 2 | Terminal Strip Part No. 09987900 (For the Chiller Remote) |
| 3 | Instrument Water Hookup Detail |
| 4 | 3/8 in. Space Collars (Part No. 09920584) |
| 5 | Remote Cable (Part No. N0770175) |

| Item | Description |
|---|---|
| 6 | Coolant Drain Hose (Part No. N0770342) White Tie Wrap |
| 7 | Coolant Supply Hose (Part No. N0770341) Red Tie Wrap |
| 8 | to Chiller In |
| 9 | To Avio In |
| 10 | Chiller Connection Detail |
| 11 | Chiller |

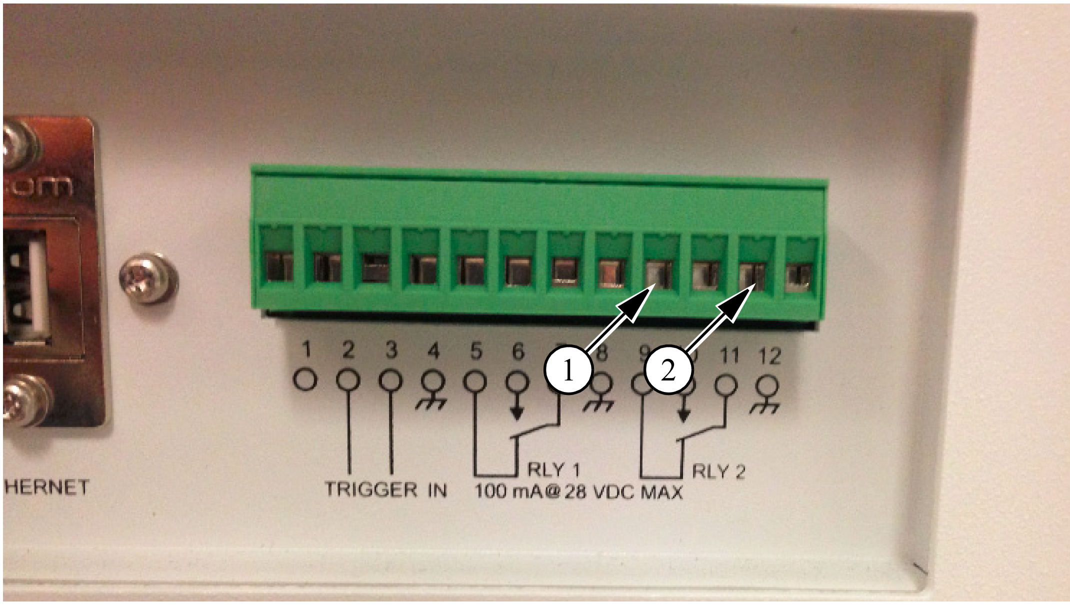



**Figure 4-3 Detail for Remote Chiller Connections**

| Item | Description |
|---|---|
| 1 | Red wire to position 9 |
| 2 | Black wire to position 11 |

### Remote Chiller Operations

The remote chiller will automatically be on when the Avio 200 Spectrometer is warming up. The warming up period includes just being turned on, coming out of Sleep mode or Standby mode.

If the instrument has just been turned on, starting the software will automatically begin warm up. Initiating the software will have no effect on the chiller if the chiller is already on.

If the Avio 200 Spectrometer is in Sleep or Standby mode and the instrument is still ignited, the chiller will remain on. If the instrument is not ignited in Sleep or Standby mode the chiller will turn itself off.

**Note** The plasma should **never** be ignited if the chiller is off.

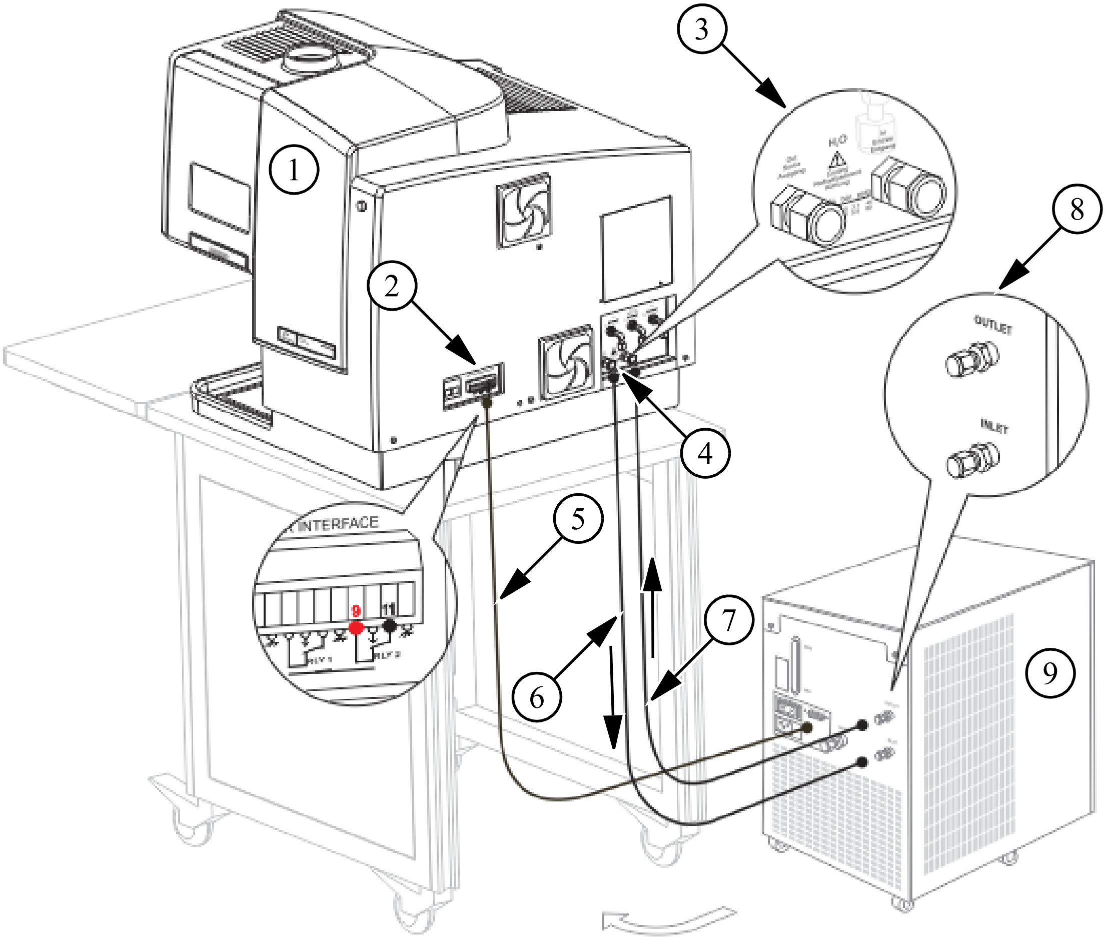



**Figure 4-4 Water flow diagram with the chiller**

| Item | Description |
|---|---|
| 1 | Avio 200 |
| 2 | Terminal Strip Part No. 09987900 (For the Chiller Remote) |
| 3 | Instrument Water Hookup Detail |
| 4 | 3/8 in. Space Collars (Part No. 09920584) |
| 5 | Remote Cable (Part No. N0770175) |

| Item | Description |
|---|---|
| 6 | Coolant Drain Hose (Part No. N0770342) White Tie Wrap-Water Out |
| 7 | Coolant Supply Hose (Part No. N0770341) Red Tie Wrap-Water In |
| 8 | Chiller Connection Detail |
| 9 | Chiller |

**Filling the PolyScience Chiller**

Use the following procedure to fill the PolyScience® WhisperCool™ Chiller, and refer to the following figure.

1. Turn the filler cap counter clockwise and lift the cap off.
2. Fill the reservoir with the coolant fluid with inhibitor (Part No. N0776200). The chiller reservoir has a capacity of 4.2 liters (1.1 US gallons).
3. Keep some coolant fluid beside the unit and proceed to **Starting Up the PolyScience Chiller**. The reservoir tank may need to be topped off once the unit has been started.

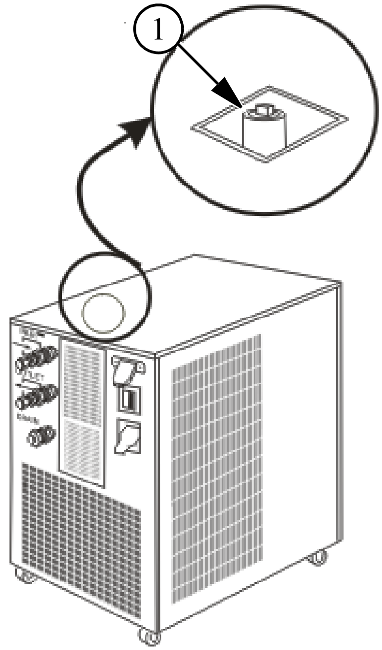



**Figure 4-5** **Filling the chiller.**

| Item | Description |
|---|---|
| 1 | Reservoir Cap |

## *Starting Up the PolyScience Chiller*

Check the following before starting up the PolyScience® WhisperCool™ Chiller:

- All plumbing connections are tight.
- The chiller reservoir is full.
- The chiller power cord is plugged in.

1. Turn the On/Off switch to the On position. The refrigeration system and the recirculation pump will start.
2. With the chiller running, top off the reservoir tank, reinstall the reservoir cap and turn clockwise to tighten.
3. Install the reservoir access panel and secure it with its screws.

## Connecting the System Components

| Warning | **Electrical Hazard**<br>**To prevent potential injury to yourself and damage to the instrument, switch OFF all instruments in the system and disconnect them from the line power supply before you perform the procedures described below.**<br><br>**Danger électrique**<br>**Pour éviter les risques de blessures pour vous et d'endommager l'appareil, éteindre tous les instruments dans le système et les déconnecter de l'alimentation de la ligne avant d'effectuer les procédures décrites ci-dessous.** |
|---|---|

The system component connections are as follows (see the following figure):

- Ethernet cable from the computer to the instrument Ethernet connector on the spectrometer side of the instrument. RS232 cable from an optional autosampler to the computer.

**Note** Extending Ethernet cables by making tandem connections will compromise instrument communication.

- The Avio 200 is equipped with an IEC 309 250 V 16/20A 2 pole plus protective earth plug (PerkinElmer Part No. 09997530) that inserts into an equivalent IEC 309 series receptacle (see Section 2, Electrical Requirements).
- Connect the computer and printer to electrical power as described in the guides provided with these items.

**Note** Make sure that the computer and printer share a common ground with the instrument.

**Caution** **Risk of damage to the instrument.**

Make sure that signals from accessories connected to the instrument connector do not exceed:

**Vmax = 30 V AC, Imax = 0.5 A AC**
**Vmax = 30 V DC, Imax = 2 A DC**

**Attention** **Risque d'endommagement de l'instrument.**

Assurez-vous que les signaux provenant des accessoires connectés au connecteur de l'appareil ne dépassent pas:

**Vmax = 30 V AC, Imax = 0,5 A AC**

**Vmax = 30 V DC, Imax = 2 A DC**

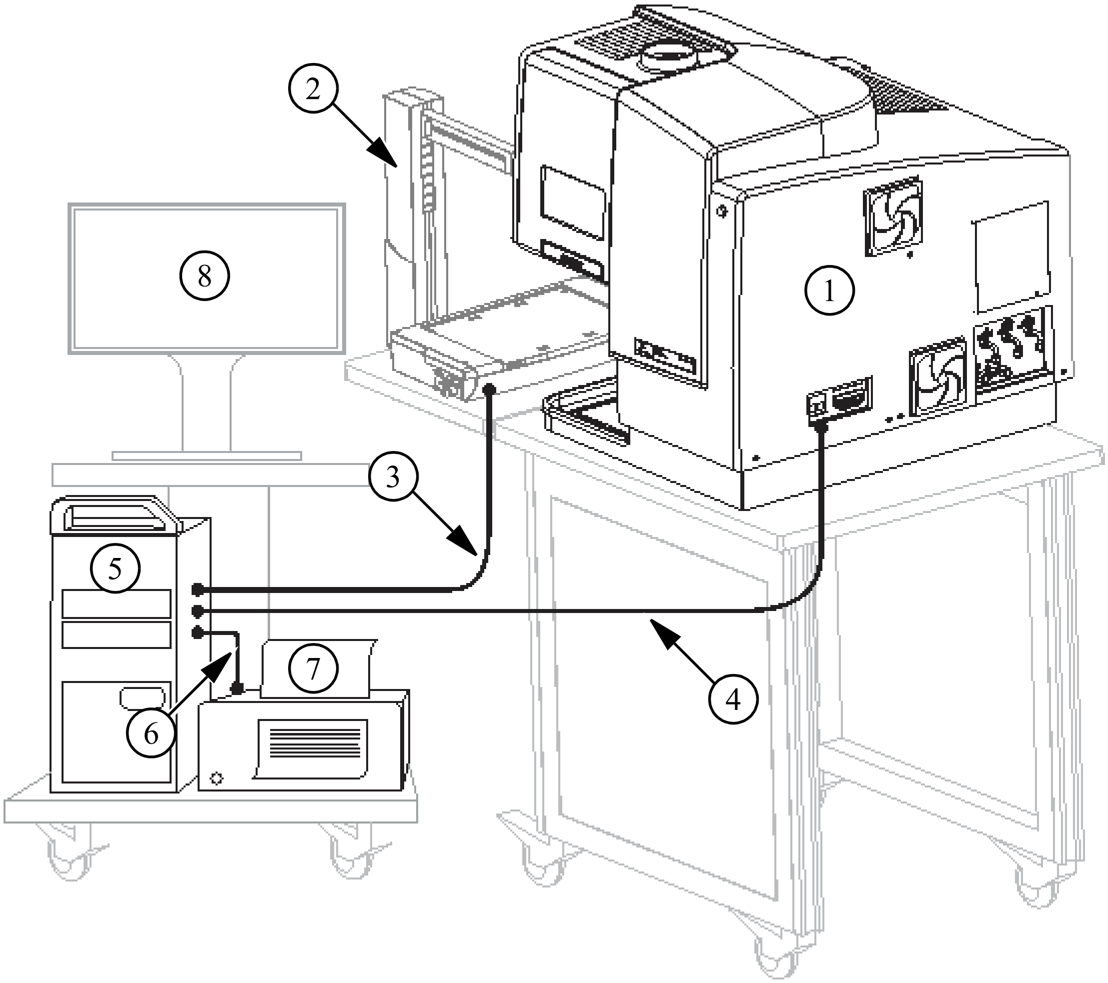



**Figure 4-6** **System component connections**

| Item | Description |
|---|---|
| 1 | Avio 200 |
| 2 | Autosampler |
| 3 | RS-232 Cable Part No. B0507701 Computer to Autosampler |
| 4 | Ethernet Cable from Computer to Instrument |

| Item | Description |
|---|---|
| 5 | Computer |
| 6 | Connection From Computer to Printer |
| 7 | Printer |
| 8 | Monitor |

## Connecting the USB Cable for the PlasmaCam™

To be able to view the plasma from the ICP software you need to attach the USB cable from the USB connection located at the right side of the instrument to the USB connection on your computer.

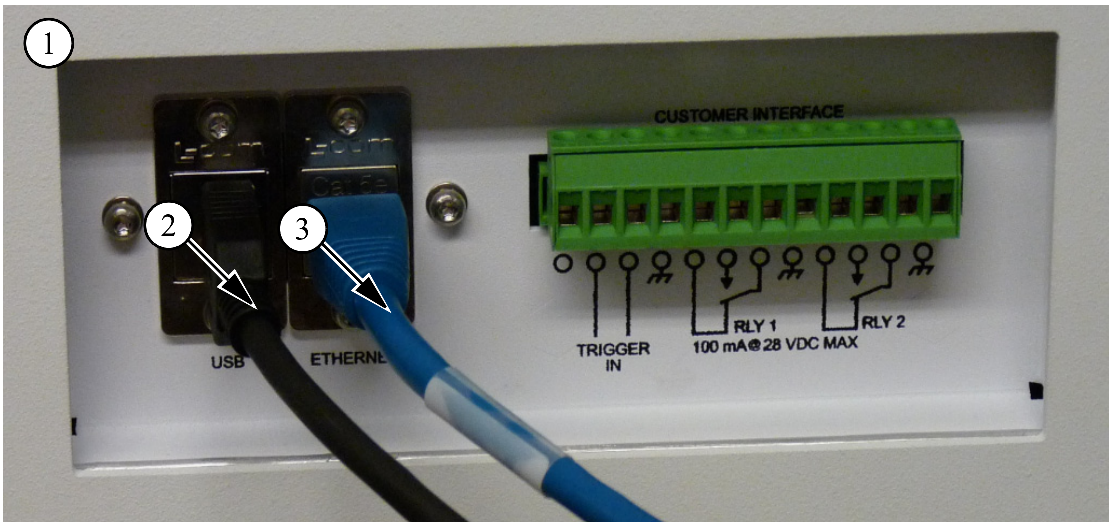



**Figure 4-7** **Installing USB cable for the PlasmaCam**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Right side of instrument | 3 | Ethernet connection |
| 2 | USB Connection to USB Port | | |

# Installing the Quick-Change Adjustable Torch Module

The Quick-Change Adjustable Torch Module is shipped pre-assembled as one unit. It includes the torch, spray chamber, injector, and nebulizer.

## Installing the Quick-Change Adjustable Torch Module

**Caution** **Only** use PerkinElmer Flat Plate Torch Glassware$^{TM}$. **Using any other glassware will damage the torch.**

**Attention** **Utiliser uniquement** PerkinElmer Plate Flat Torch GlasswareTM. **L'utilisation de tout autre verrerie endommager la torche.**

Before installing the Quick-Change Adjustable Torch Module in the sample compartment, check that the plasma induction plates are in place. See *Figure 4-20* on *page 131*.

While doing this procedure refer to the following two figures

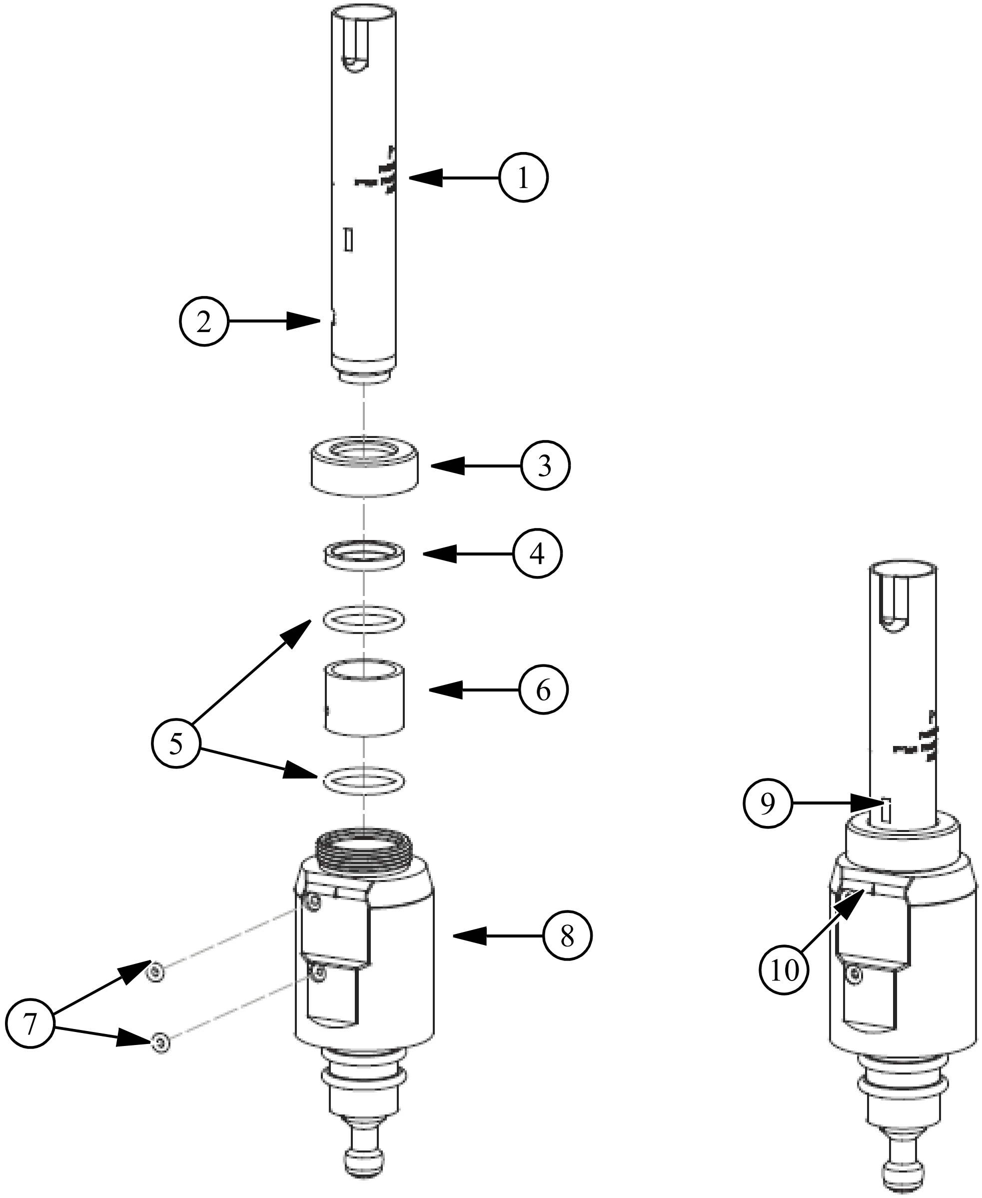
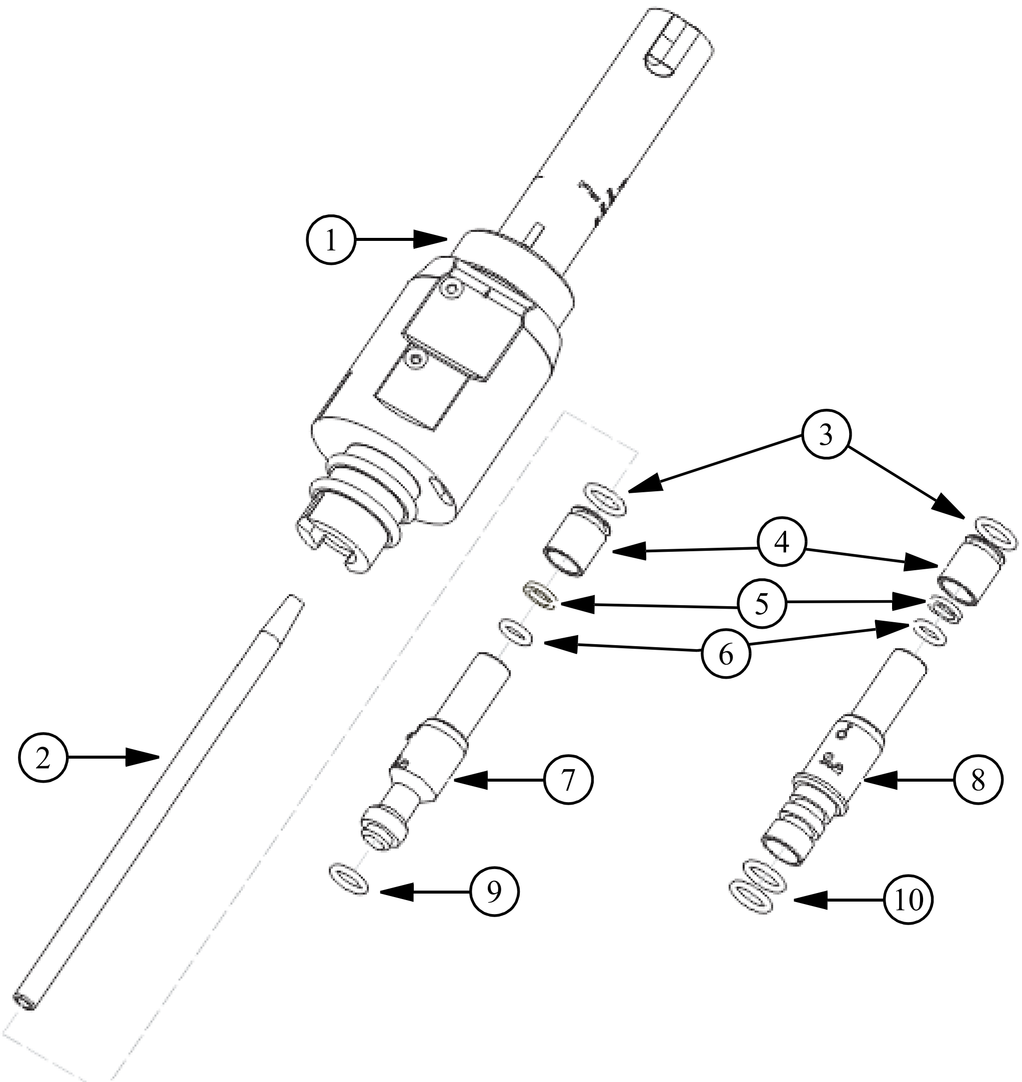



**Figure 4-8** **Replacing the torch**

.

| Item | Description |
| --- | --- |
| 1 | Torch glass (Part No. N0790131 |
| 2 | Torch cutout |
| 3 | Knurled Nut (Part No. N0776027) |
| 4 | Washer (Part No. N0776028) |
| 5 | O-ring (Part No. 09902223) |
| 6 | Spacer (Part No. N0791125) |
| 7 | O-ring color code blue (Part No. N0791334) |
| 8 | Cassette (Part No. N0791285) |
| 9 | Stripe on torch |
| 10 | Index mark on torch holder |


1
2
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**REFERENCE PARTS**

**N0790141**
CYCLONIC INJECTOR ASSEMBLY

**N0790156**
SCOTT INJECTOR ASSEMBLY

**N0790440**
ORING KIT FOR AVIO SCOTT INJECTOR

**N0790441**
ORING KIT FOR AVIO CYCLONIC INJECTOR

**N0790437**
ORING KIT AVIO TORCH

**09220410**
ORING REMOVAL TOOL

**Figure 4-9 Torch Assembly.**

| Item | Description |
|---|---|
| 1 | Knurled Nut (Part No. N0776027) |
| 2 | Injector 2mm Alumina (Part No. N0791183) |
| 3 | O-Ring Color Coded Blue (Part No. N0791333) |
| 4 | Lock Collar (Part No. N0791163) |
| 5 | Washer (Part No. N0776014) |
| 6 | O-Ring (Part No. 0992207) |
| 7 | Cyclonic Injector Adapter (Part No. N0790143) |
| 8 | Scott Injector Adapter (Part No. N0790154) |
| 9 | O-Ring (Part No. 09926070) |
| 10 | O-Ring (Part No. 09200518) |

1. Open the torch compartment door.

2. Take the torch cassette body and insert the o-ring, and then the PEEK sleeve (spacer) into it. Ensure that the hole on the PEEK sleeve lines up with the top hole on the torch cassette body.

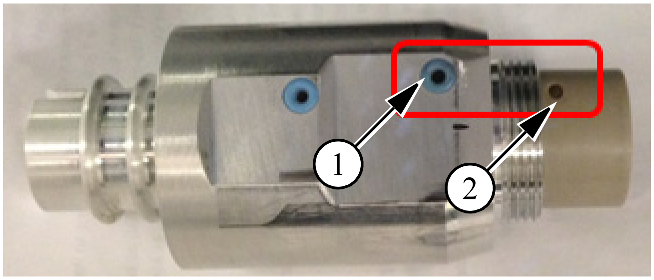


**Figure 4-10 O-Rings and Torch Cassette Body**

| Item | Description |
|---|---|
| 1 | O-Ring in Torch Cassette body |
| 2 | Hole in PEEK Sleeve |

3. Fully insert the PEEK sleeve into the torch body cassette.

4. Make sure the holes between the PEEK sleeve and the torch cassette body line up when fully inserted. The holes must line up and be empty, and the PEEK sleeve should not be visible.

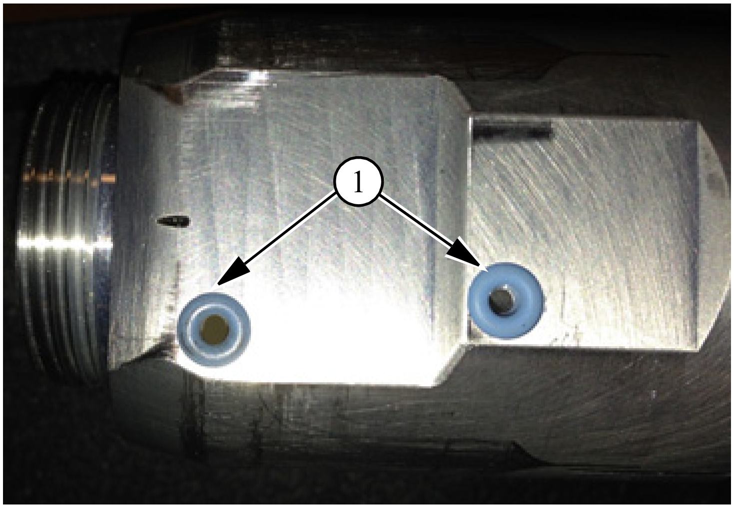


**Figure 4-11 PEEK Sleeve Inserted iin the Torch Cassette Body**

| Item | Description |
|---|---|
| 1 | Holes Properly Lined up and Empty |

5. Make sure that the PEEK sleeve is sitting lower in the torch body.This will allow room for the additional pieces to be installed (*see Figure 4-12*).

6. Install the remaining pieces on the PEEK sleeve (spacer): o-ring, PTFE washer, knurled nut, and torch glassware. Fully seat the torch glassware and align the etched rectangle with the alignment mark on the torch cassette body

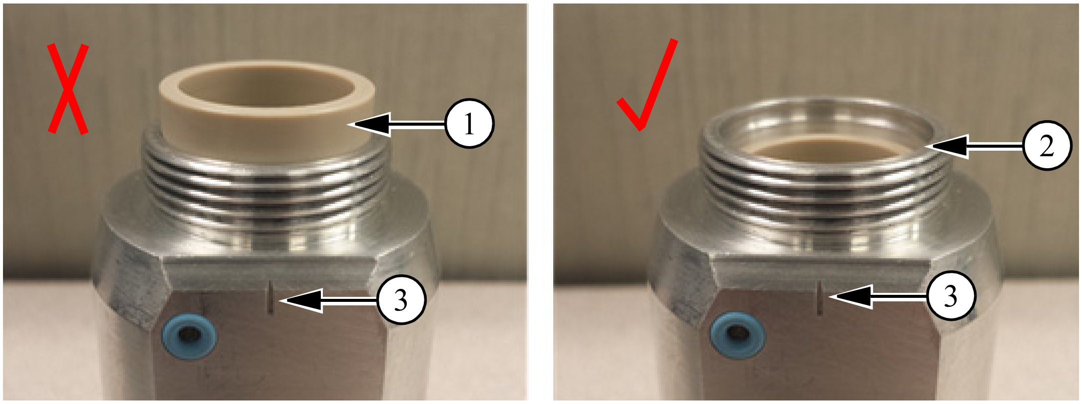


**Figure 4-12 Incorrect and Correct Position of the Peek Sleeve**

| Item | Description |
|---|---|
| 1 | Incorrect positioning of the top of the PEEK sleeve. There is not enough room for additional pieces to be installed |
| 2 | Correct positioning of the top of the PEEK sleeve. There is enough room for additional pieces to be installed |
| 3 | Alignment mark |

Warning

***When installing the Torch Module in the next steps, do so carefully so you will avoid breaking the torch and risking possible injury.***

***Avertissement: Lors de l'installation du module de la flamme dans les prochaines étapes, faire avec soin afin que vous éviter de casser la torche et un risque de blessure possible.***

7. Check that the tip of the injector sits below the Aux tube (the inner glass tube) by 1-2mm.

8. For proper alignment, make sure that the mark on the injector (#2) and the line on the torch body (#3) line up.

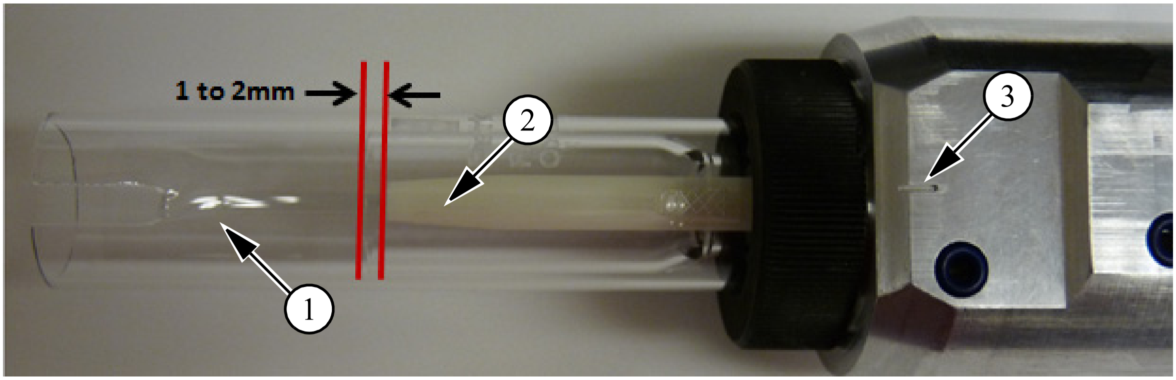


**Figure 4-13 Injector Visible Through Torch**

| Item | Description |
|---|---|
| 1 | Torch |
| 2 | Injector |
| 3 | Alignment Line |

9. Insert the pin of the injector into the groove and rotate it to the right (clockwise) to lock it in place.

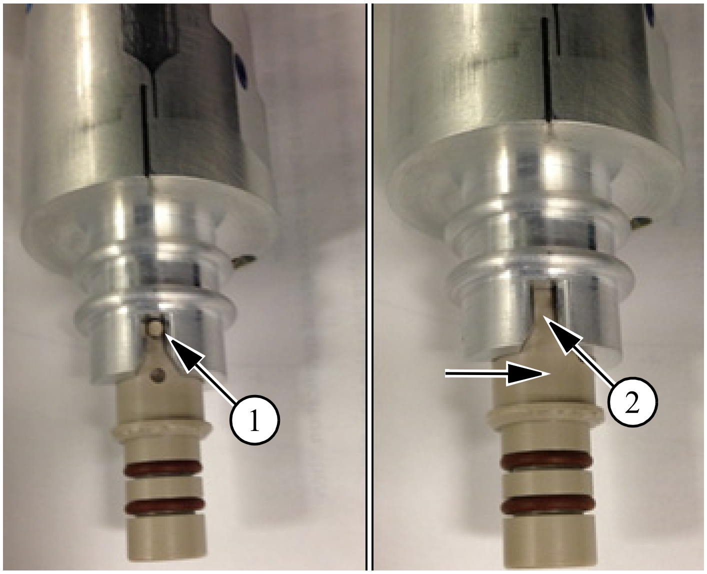


**Figure 4-14 Locking the Injector In Place**

| Item | Description |
| --- | --- |
| 1 | Pin in Groove |
| 2 | Pin rotated to right (no longer visible). Injector locked in place |

10. Insert the torch cassette into the instrument.
11. Line up the black line on the torch cassette body with the pin on the instrument.

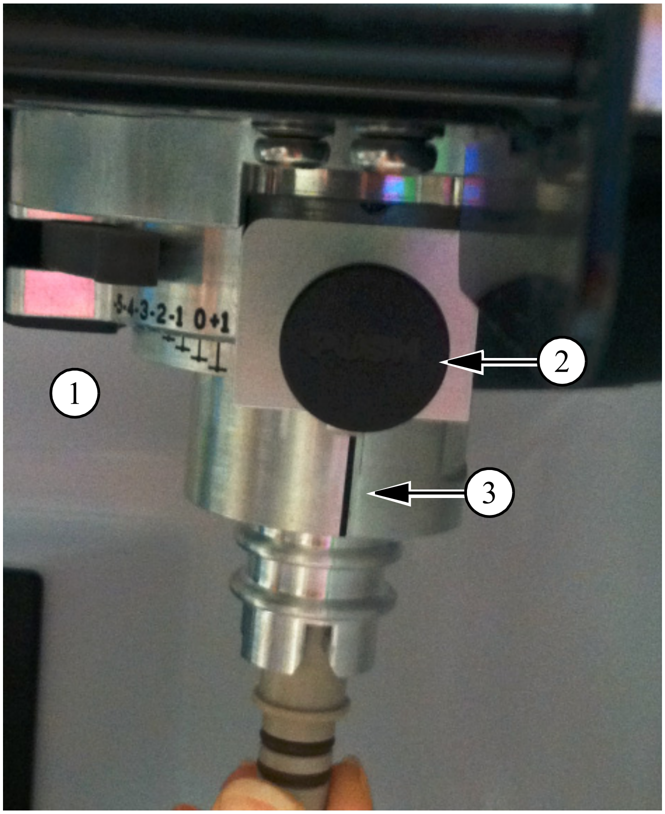


**Figure 4-15 Lining up the black line with the locking pin**

| Item | Description |
|---|---|
| 1 | Sample Compartment |
| 2 | Black Locking Pin |
| 3 | Black Line for Alignment |

12. From the bottom of the sample compartment carefully insert the torch cassette.

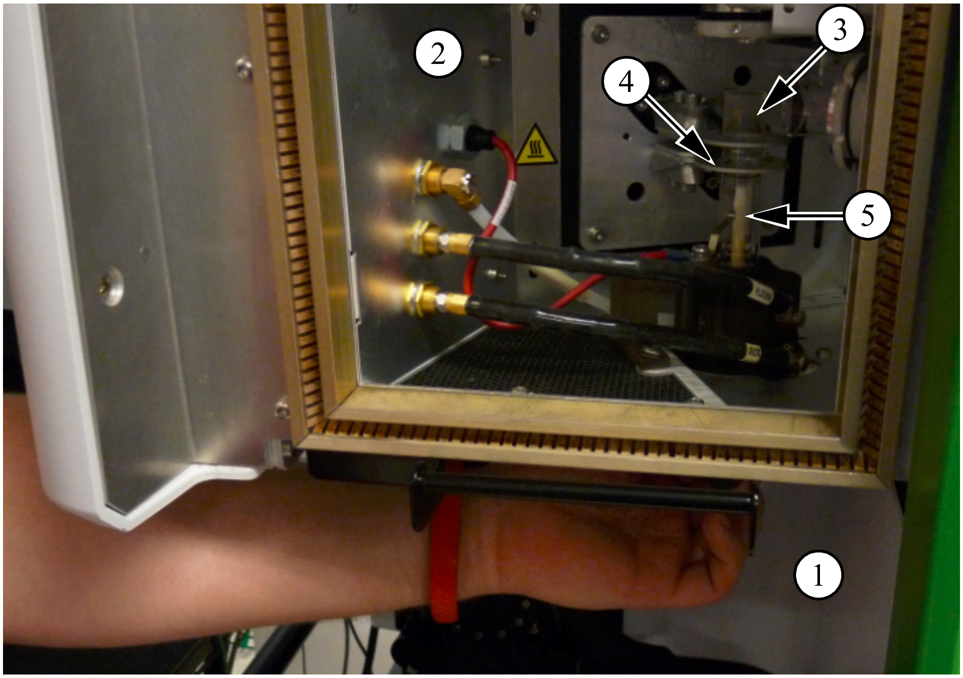


**Figure 4-16** **Inserting the torch**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Sample compartment | 4 | Plasma induction plates |
| 2 | Torch Compartment | 5 | Injector |
| 3 | Torch | | |

**Caution** Wear gloves when you handle the torch glassware.

**Attention** Portez des gants lorsque vous manipulez la verrerie de la torche.

13. Push the torch up carefully through the flat induction plates until the torch cassette body is fully inserted.

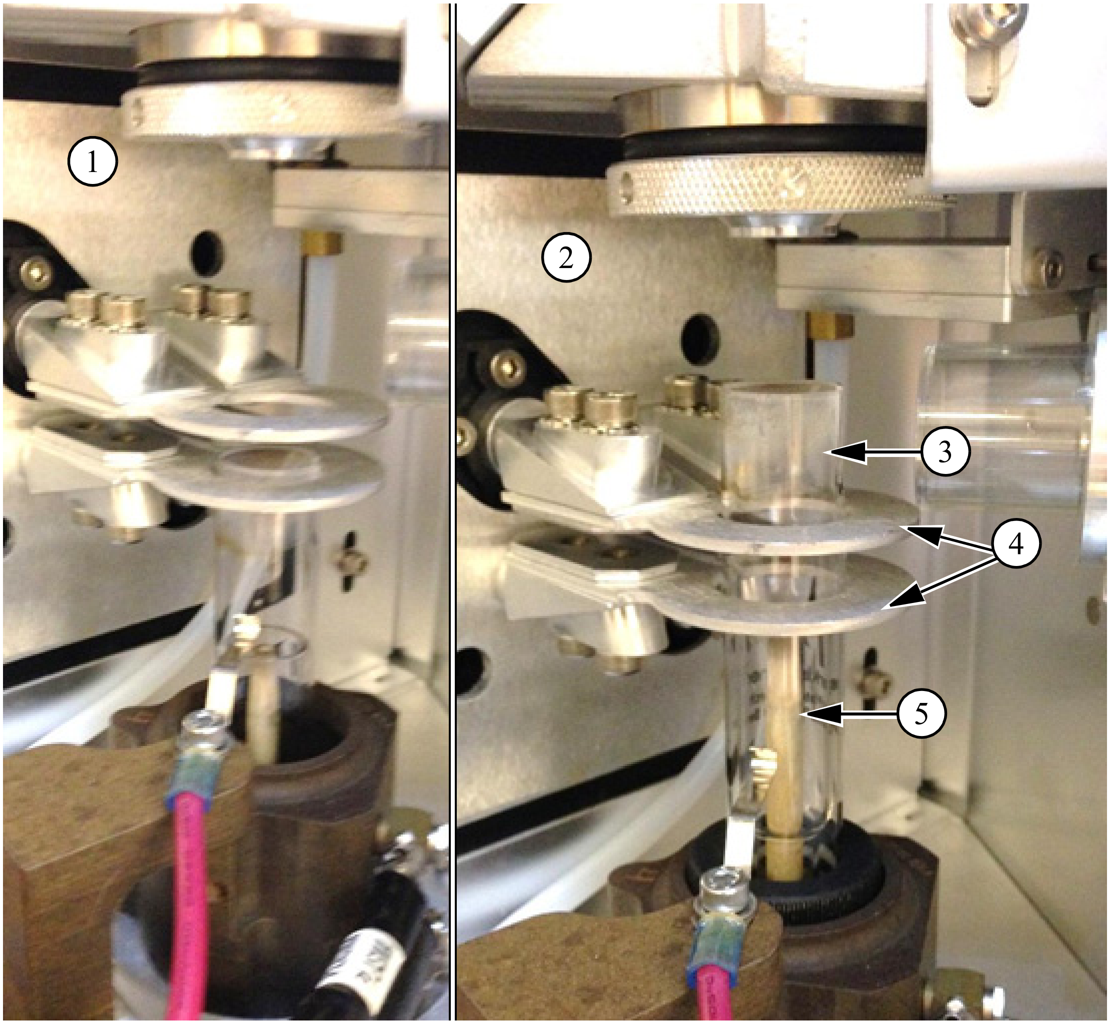


Figure 4-17 Inserting the torch

| Item | Description | | |
|---|---|---|---|
| 1 | Torch Compartment. Torch Not Installed. | 4 | Plasma induction plates |
| 2 | Torch Compartment. Torch Installed. | 5 | Injector |
| 3 | Torch | | |

14. As you push the torch into position make sure that the slot on the torch is facing the radial purge window.

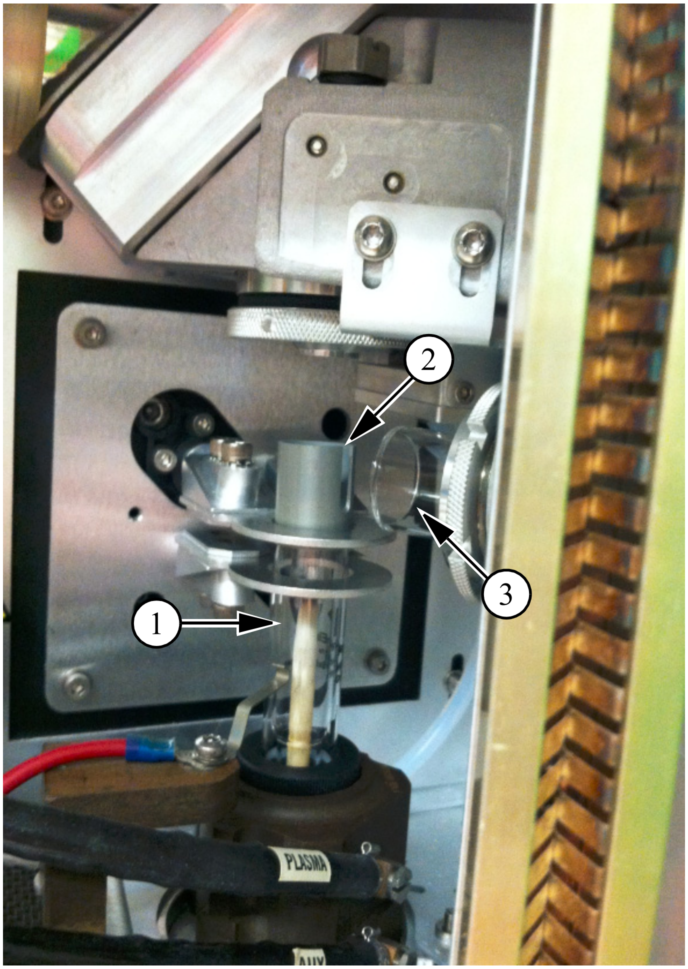


**Figure 4-18 Location of slot on torch**

| Item | Description |
|---|---|
| 1 | Torch |
| 2 | Slot |
| 3 | Radial purge window |

15. Once the torch cassette is in the proper position go back to the sample compartment and push in the black locking pin. This will lock the torch cassette into position

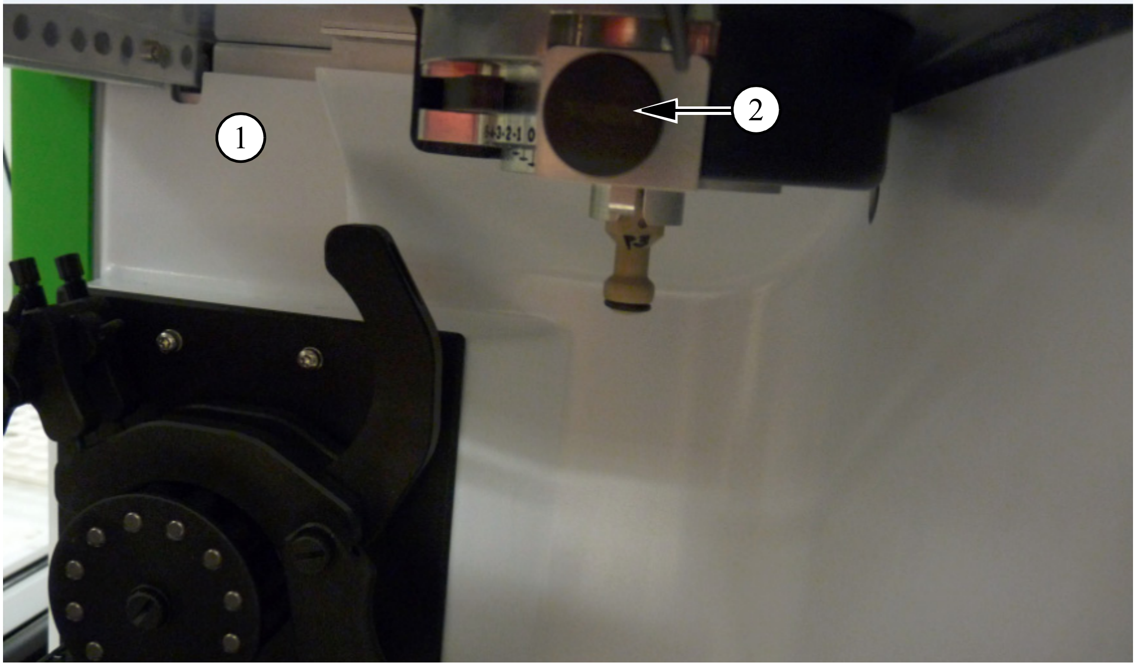


**Figure 4-19 Location of locking nut**

| Item | Description |
|---|---|
| 1 | Sample compartment |
| 2 | Black locking pin |

16. Make sure that the ignitor contact is touching the torch.

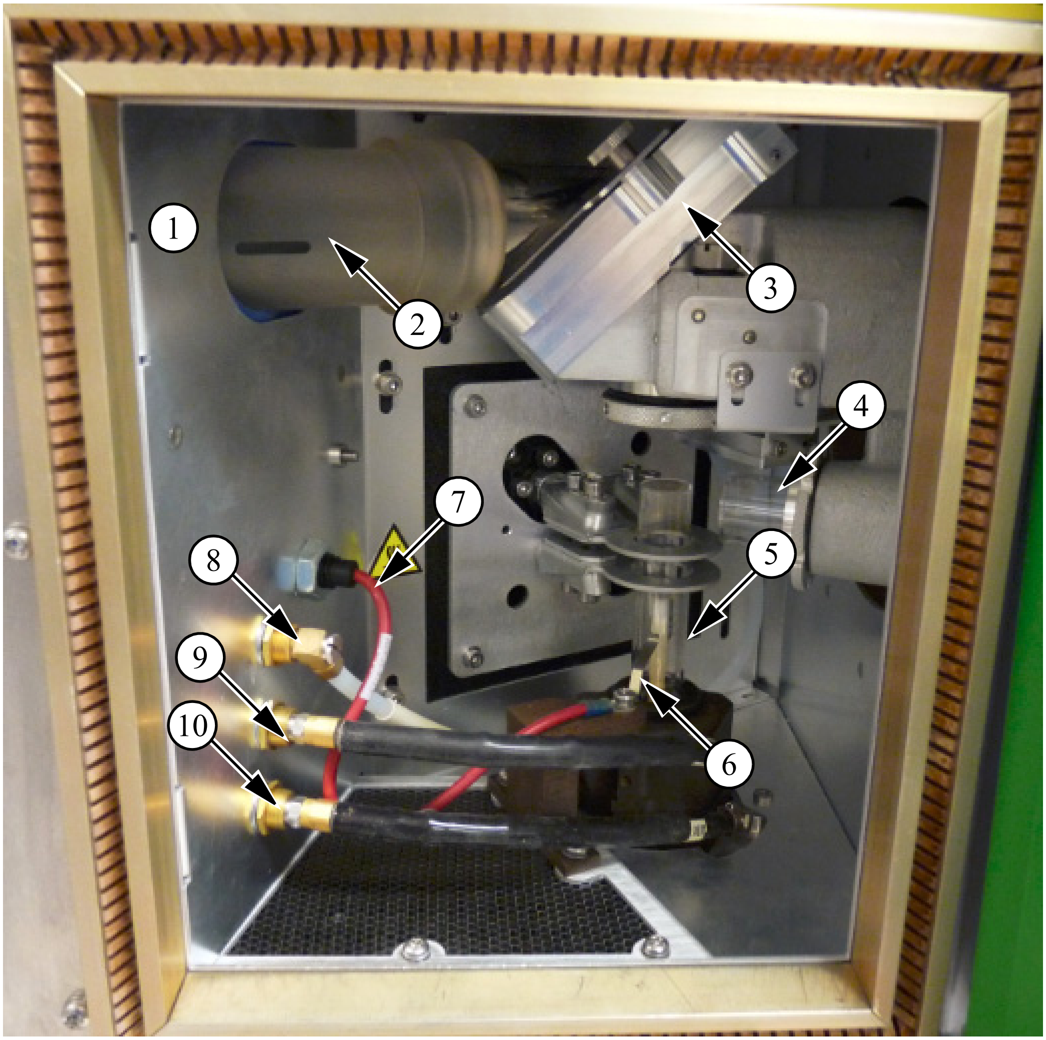


**Figure 4-20 Installing the torch into the sample compartment.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Inside of the Torch Compartment | 6 | Ignitor Contact |
| 2 | Plastic Air Vent Tube | 7 | Ignitor Cable |

| Item | Description | Item | Description |
|---|---|---|---|
| 3 | Axial Flat Optic | 8 | Shear Gas Connection |
| 4 | Radial Purge Window | 9 | Plasma Gas Connection |
| 5 | Torch | 10 | Aux Gas Connection |

## Connecting the Scott Spray Chamber

1. After the torch and injector are installed, attach the Scott chamber clip assembly to the bottom of the injector adapter.

2. Find the shelf on the injector.

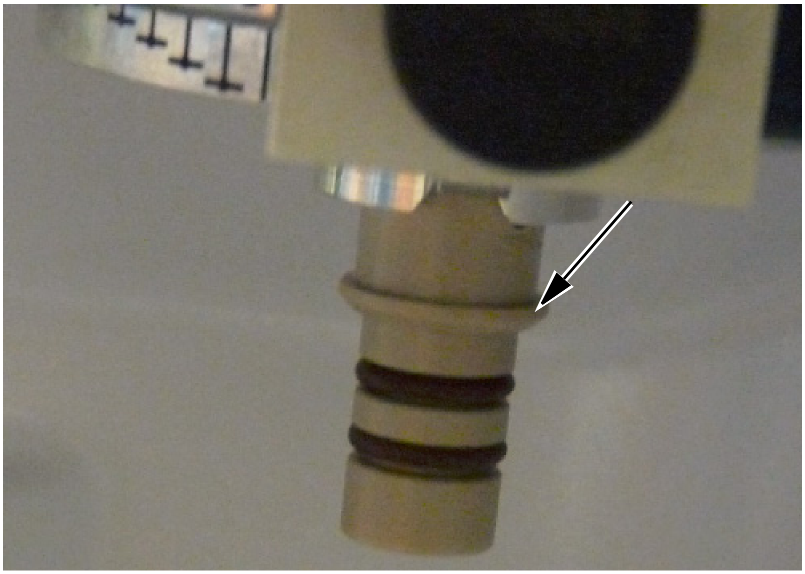

**Figure 4-21 Location of Shelf on Injector**

3. Find the shelf located on the Scott spray chamber clip assembly.

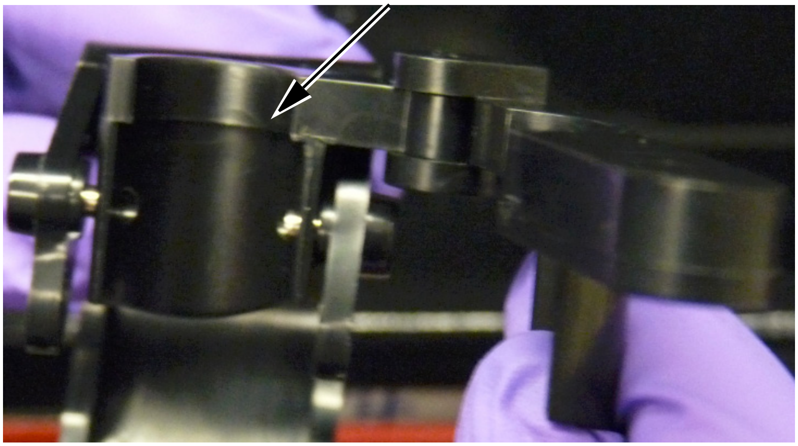

**Figure 4-22 Location of Shelf on Scott Spray Chamber Clip Assembly**

4. Add the Scott spray chamber clip to the injector.
5. Make sure that the Scott spray chamber clip rests securely on the injector shelf.

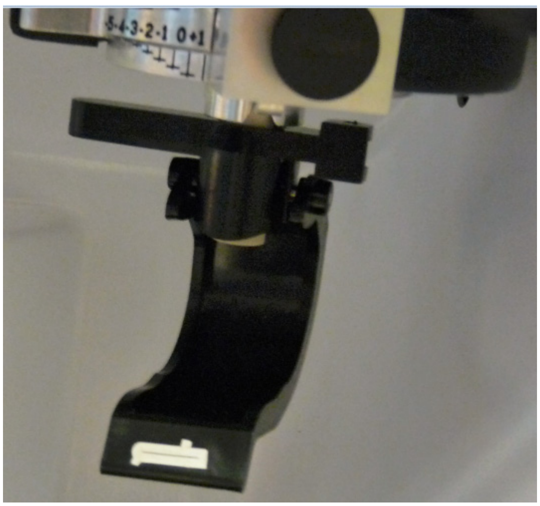

**Figure 4-23 Scott Spray Chamber Clip Assembly in Place**

6. With the Scott spray chamber clip assembly handle open insert the bottom of the injector adapter into the opening of the Scott spray chamber.

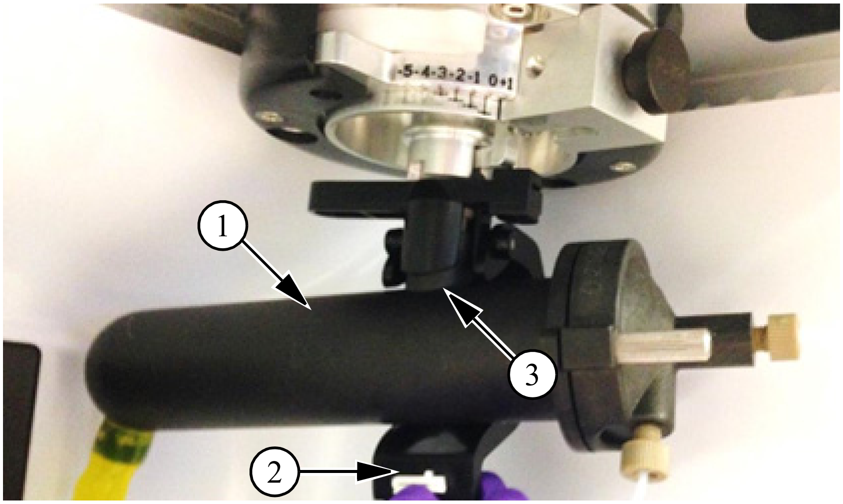


**Figure 4-24 Scott Spray Chamber Clip Assembly Open**

| Item | Description |
|---|---|
| 1 | Scott Spray Chamber in Place |
| 2 | Scott Spray Chamber Assembly open |
| 3 | Opening in Scott Spray Chamber |

7. Close the clip by pulling it up. This secures the Scott spray chamber into the injector and seals the o-rings.

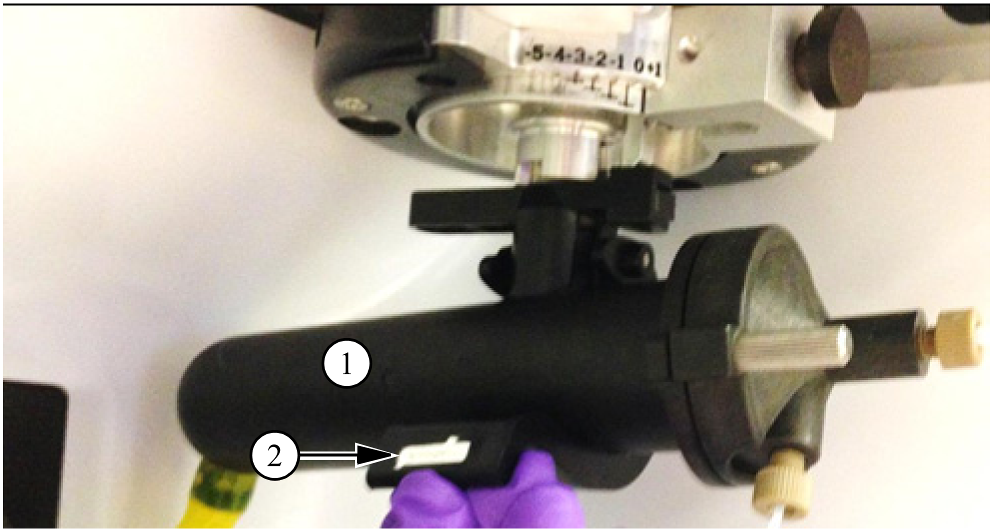


**Figure 4-25 Scott Spray Chamber Clip Assembly Closed**

| Item | Description |
|---|---|
| 1 | Scott Spray Chamber in Place |
| 2 | Scott Spray Chamber Assembly closed |

8. Before attaching the drain tubing to the spray chamber drain, check that it is in good condition and replace if necessary.

9. Before connecting the sample capillary tubing to the nebulizer sample inlet, check that the sample capillary tubing is in good condition. Replace the tubing if necessary.

10. The Scott system is now fully installed.

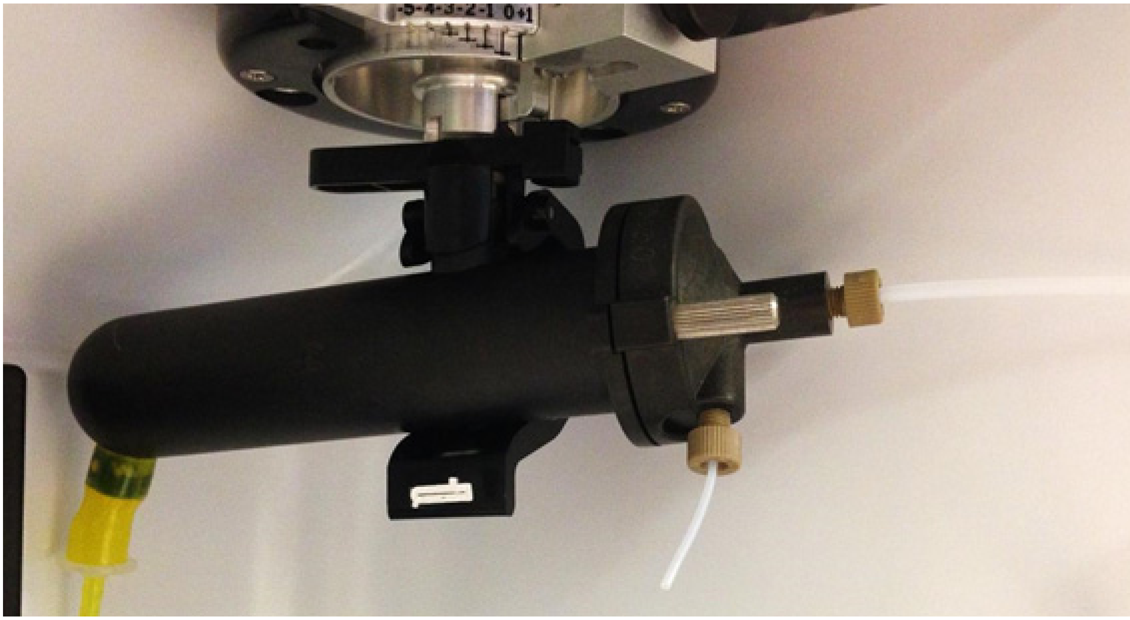

**Figure 4-26 Scott Spray Chamber Installed**

## *Connecting the Nebulizer (NEB) Tubing*

To connect the nebulizer (Neb) tubing follow these steps and refer to the next figure.

1. Connect the end of the nebulizer (NEB) argon tubing to the nebulizer end cap and the other end to the quick disconnect by pushing the male quick connect fitting into the quick disconnect.

2. Make sure that the Teflon tubing is in good condition. Replace the tubing if necessary. Connect the sample capillary tubing to the nebulizer sample inlet.

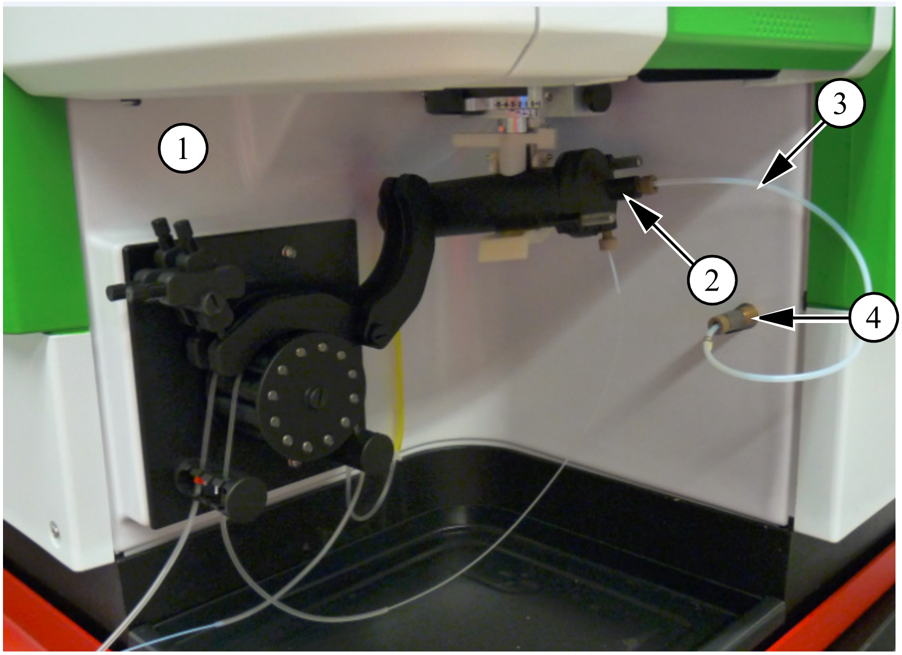


**Figure 4-27 Nebulizer connections**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Sample compartment | 3 | Neb tubing |
| 2 | Nebulizer end cap | 4 | Quick Connect |

3. For more detailed instructions on connecting the tubing, see *Table 5-7 on page 245*.

4. Connect the drain tubing to the spray chamber.

For instructions on connecting tubing to the peristaltic pump see the section *Peristaltic Pump* on page 244.

## *Connecting the Cyclonic Spray Chamber*

**Warning**

**Handle the cyclonic spray chamber carefully to avoid breaking the glassware and possible injury.**

**Avertissement: Manipuler avec soin la chambre de nébulisation cyclonique pour éviter de casser la verrerie et des blessures.**

1. Install the concentric nebuilzer assembly to cyclonic spray chamber. See *Concentric Glass Nebulizer* on page 237.

2. With one hand carefully holding on to the base of the cyclonic spray chamber, and with the other hand holding the clip, attach the clip to the bottom of the injector adapter and the top of the spray chamber. See the following figure.

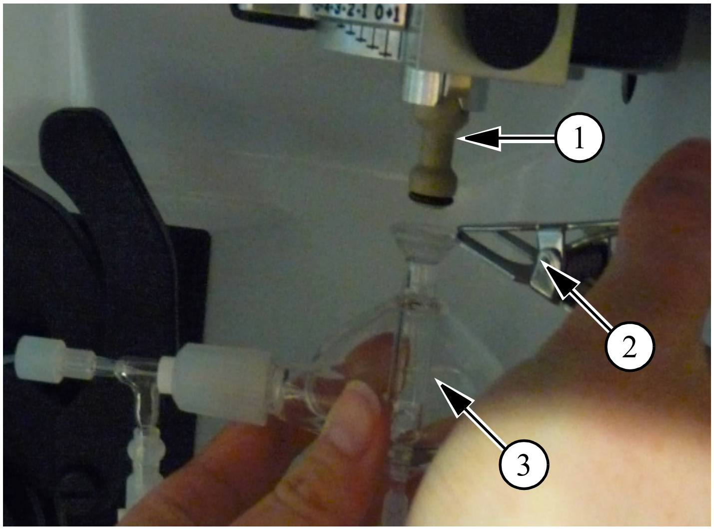


**Figure 4-28** **Installing the Cyclonic Spray Chamber**

| Item | Description |
|---|---|
| 1 | Injector |
| 2 | Clip |
| 3 | Cyclonic Spray Chamber |

3. The following figure shows the cyclonic spray chamber in place.

4. The white spacer should be installed around the neck of the nebulizer. See the following figure. The white spacer puts the nebulizer in a position for good intensity and precision. Slight adjustment from this position might provide even better performance.

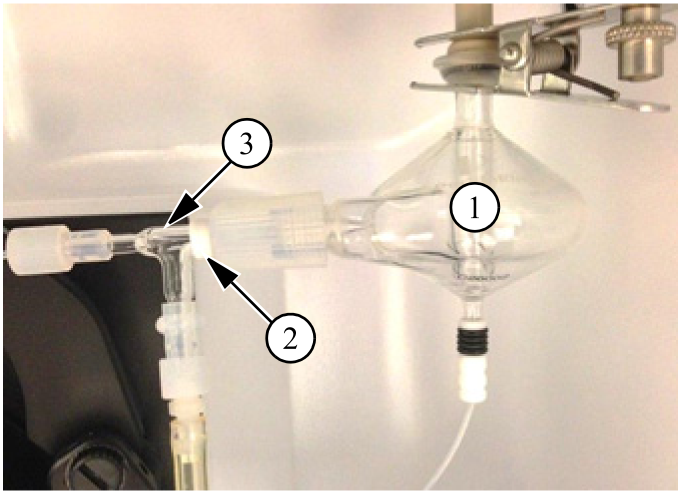


**Figure 4-29 Cyclonic Spray Chamber in Place**

| Item | Description |
|---|---|
| 1 | Cyclonic Spray Chamber |
| 2 | White Spacer |
| 3 | Nebulizer |

# Setting the Torch Position

After you have installed the torch and spray chamber you will need to set the torch position to get optimal performance.

**Note:** *In most cases the optimal position is -3. For more information on Setting Instrument Parameters see page 153.*

1. Open the latch by pulling the latch out to the left.

2. Raise or lower the inner adjustment plate to either a positive or negative value. In the following figure, the inner adjustment plate needs to be raised until the horizontal black line is just below the -3 to reach the optimal, desired position.

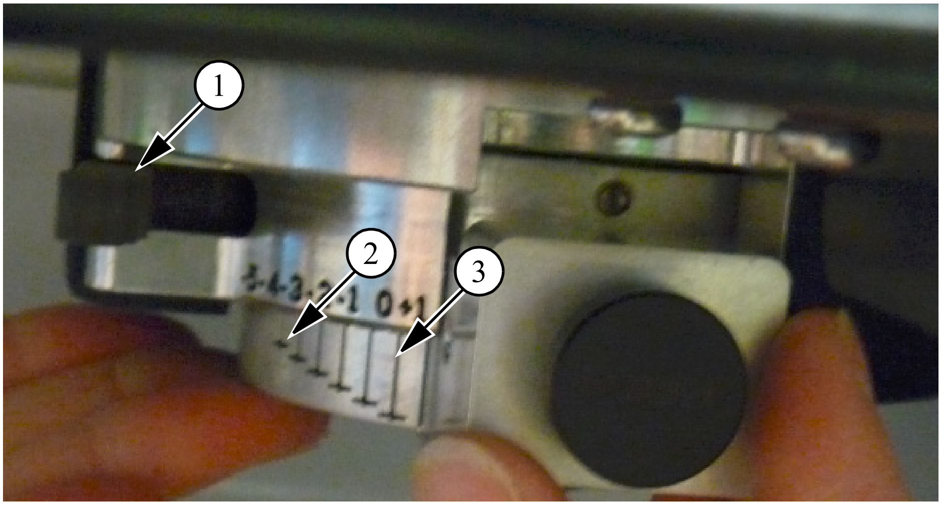


**Figure 4-30 Setting the Position**

| Item | Description |
|---|---|
| 1 | Latch Open |
| 2 | Black Line Beneath -3 |
| 3 | Inner Adjustment Plate |

3. Once you have reached the desired value, hold the inner adjustment plate in place and lock the latch by pushing the latch in towards the right.

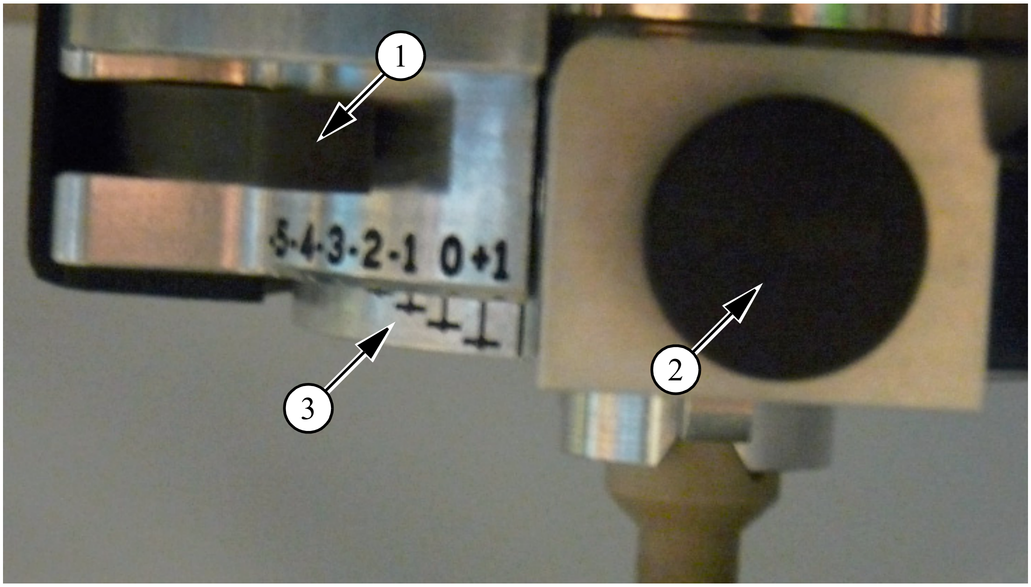


**Figure 4-31 Locking Into Position**

| Item | Description |
|---|---|
| 1 | Latch Closed |
| 2 | Locking Pin |
| 3 | Inner Adjustment Plate in Place |

## Installing The Autosampler

The instrument can be used with the PerkinElmer S10 Autosamplers. The following procedures describe the electrical connections necessary to install the PerkinElmer autosamplers.

After the autosampler is installed, the software must be configured for the type of autosampler you are using. This can be done during the software installation or, in the ICP software, by selecting the Configure Autosampler command from the System menu. See the *S10 Autosampler User's Guide (Part No. 09931133)* for detailed information on installing the autosampler.

To connect the S10 Autosampler follow this procedure:

1. Locate the connectors on the underside of the autosampler as shown in following figure.

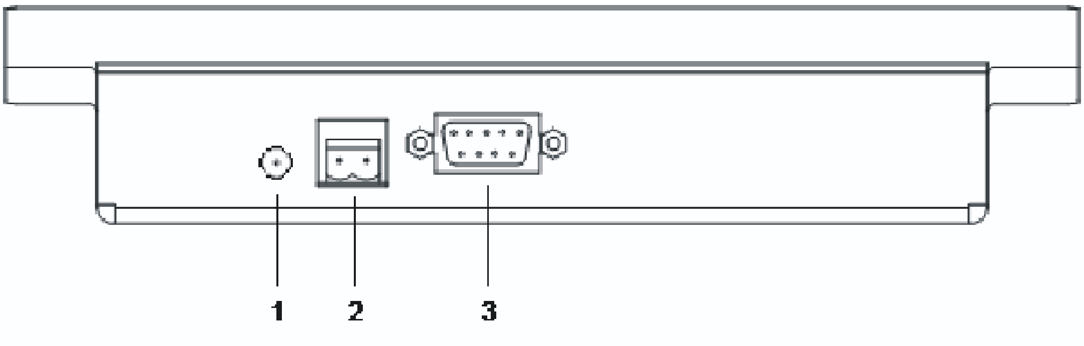


**Figure 4-32 Electrical connectors and switches located on the underside of the autosampler.**

| Item | Designation | Function |
|---|---|---|
| 1 | Power | Power input socket; for 12 V supply from plug-in power supply. |
| 2 | Event | Potential-free relay contact to activate an external system. |
| 3 | Com | RS232/Serial communication port. |

2. Place the autosampler either adjacent to the spectrometer or on top of the spectrometer.

   When used alone, the autosampler is connected directly to the nebulizer's sample tube. Since the length of the sample tube has an influence on the aspiration rate of the nebulizer, you should position the autosampler as close to the spectrometer as possible. See the following figure.

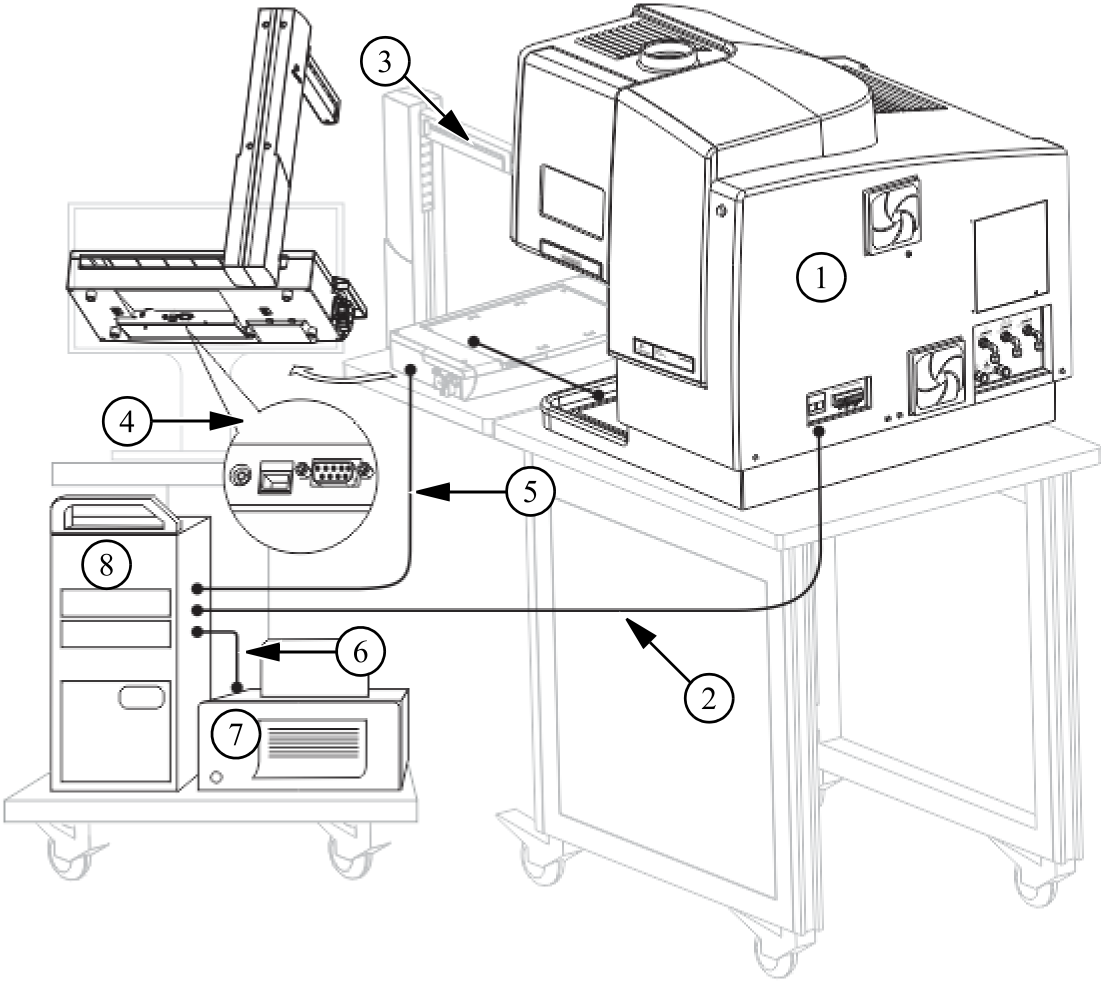


**Figure 4-33 Electrical connection for the S10 autosampler to the Avio 200**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Avio 200 | 5 | Connection From Computer to S10 Autosampler |

| Item | Description | Item | Description |
|---|---|---|---|
| 2 | Serial Communication Cable | 6 | Connection From Computer to Printer |
| 3 | S10 Autosampler in Position | 7 | Printer |
| 4 | Detail of Underside of S10 Autosampler Connections | 8 | Computer |

3. Connect the RS232/serial communication cable (Part No. 09290259) provided, between the Com 1 port on the underside of the autosampler (as shown in *Figure 4-33* on *page 144*) and one of the Com ports on the PC.

4. Connect the autosampler to the line power supply using the plug-in power supply provided.

   The plug-in power supply uses a wide-range input of 100-240 VAC, 50-60 Hz.

   Plug the power cord into the power supply, then plug the other end of the power cord into the power source.

5. Connect the spectrometer and other components in the system to the line power supply.

**Note** To avoid problems of interference caused by earth loops, always connect the computer, printer and other components to the same phase of the line power supply. The most convenient method is to use a multisocket outlet.

6. Switch on all components of the system, following the routine in the manual for your spectrometer.

### *Fitting and Connecting the Autosampler Sampling Probe*

**Caution** When you fit the sampling probe, take care **not** to press forcefully in any direction on the autosampler arm since this can damage the arm.

The sampling probe is a complete assembly. Do **not** attempt to take the probe apart as this will damage it and reassembly is not possible.

**Never** attempt to move the sampling probe holder along the autosampler arm by hand. The autosampler may be damaged if the tower is moved by hand when it is under system control.

Disconnect the power supply to the autosampler if you need to manually move the tower.

**Attention** Lorsque vous correspondez à la sonde de prélèvement, prendre soin de ne pas appuyer avec force dans une direction quelconque sur le bras de l'échantillonneur automatique car cela peut endommager le bras.

La sonde de prélèvement est un ensemble complet. Ne pas essayer de prendre la sonde à part comme cela l'endommager et le réassemblage est pas possible.

**Ne jamais tenter** de déplacer le support de sonde de prélèvement le long du bras du passeur à la main. L'échantillonneur automatique peut être endommagée si la tour est déplacé à la main quand il est sous le contrôle du système.

Couper l'alimentation à l'échantillonneur automatique si vous avez besoin de déplacer manuellement la tour.

### Fitting the Sampling Probe

1. If not already done, carefully insert the sampling probe guide from above into the sampling probe holder on the autosampler arm and push it down fully, as shown in the following figure.

2. Carefully insert the sampling probe from above into the probe guide.

3. Push the sampling probe down until about 20 mm protrudes from the bottom end of the probe guide, then position the O-ring on the probe to set this position, as shown in the following figure.

   This is not the final position for the sampling probe. The probe can be adjusted when the rinsing port has been set up. See the following procedure, *Adjusting the Sampling Probe Height* on page 149.

---

**Note** The standard sampling probe is a PTFE-lined epoxy polymer tube. This polymer is resistant to the acids, alkalis and organic solvents normally used in atomic spectroscopy. If your samples contain an organic solvent that attacks this polymer, a PTFE-lined stainless steel sampling probe is offered as an option (Part No. B3000152).

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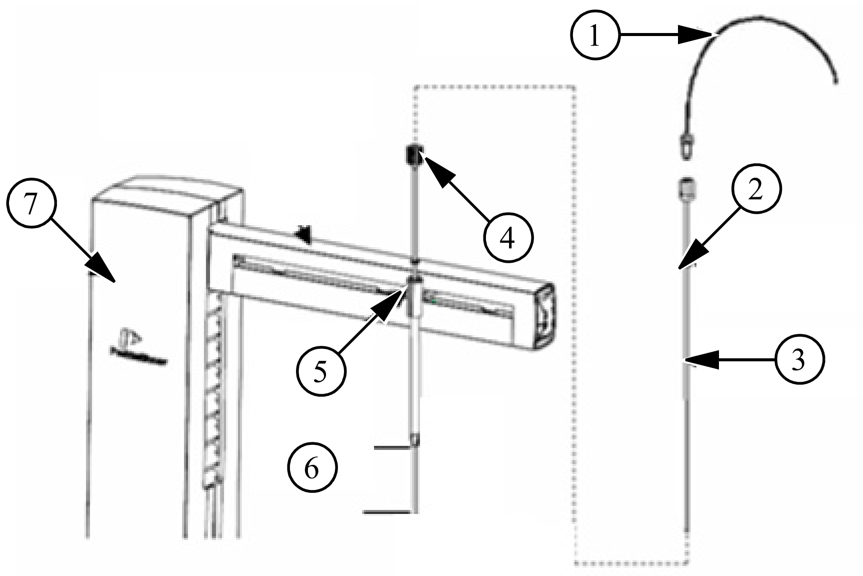



**Figure 4-34** **Inserting the sampling probe.**

| Item | Description |
|---|---|
| 1 | Sample Tube |
| 2 | O-Ring |
| 3 | Sampling Probe |
| 4 | Sampling Probe Guide |
| 5 | Holder |
| 6 | About 20 mm |
| 7 | Tower |

## Adjusting the Sampling Probe Height

**Note** The procedure described below assumes that you are using a spectrometer operated via ICP software. If you are using an AA or ICP-MS instrument, please refer to the information on operating an autosampler in the online help for the respective instrument.

1. Install the rinsing-port rack on the autosampler.

   See the procedure *Assembling Sample Racks* starting on page 61 *i*n the *S10 Autosamplers User's Guide (Part No. 09931133)* for more information.

2. Place the rinsing port in the rinse location in the sample rack.

   See the procedure *Installing the Rinsing Port on the Rack* starting on page 55 in the *S10 Autosamplers User's Guide (Part No. 09931133)* for more information.

3. In the ICP software, from the main menu make the following selections:

4. If the sample probe is suspended over the rinse position select the **Instrument tab -> Load Tray** to lower the probe. If the sample probe is not at the rinse position select the **Instrument tab -> Go To Wash** to move it there.

5. Carefully push the sampling probe down until it bottoms in the rinsing port. Then pull the sampling probe up by about 15mm as shown in the following figure. Use the O-ring on the probe to prevent it from slipping down. The sampling probe is now in the correct height.

6. To remove the sample rack, first select **Instrument** tab**->Load Tray** to raise the sampling probe, then remove the rack.

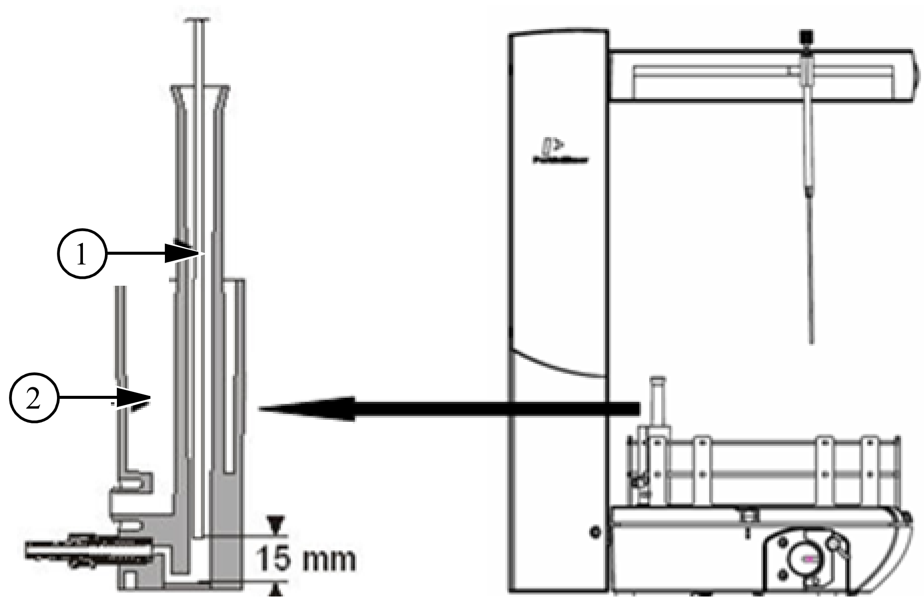



**Figure 4-35** **Inserting the sampling probe.**

| Item | Description |
|---|---|
| 1 | Sampling Probe |
| 2 | Rinsing Cup Probe |

This completes installation of the sampling probe. For detailed information on adjusting the sample probe height and connecting the sample tube between the sample probe and the spectrometer's sample input system see the *S10 Autosamplers User's Guide (Part No. 09931133).*

## Setting the Torch Viewing Position

This procedure adjusts the torch viewing position for the highest signal intensity. Perform this procedure when:

- the instrument or software is first installed
- the instrument is moved to a new location
- the torch is removed or replaced
- the plasma induction plates are replaced

1. Switch on the computer and spectrometer, and if required, the autosampler.
2. Switch on the exhaust ventilation system.
3. Start the ICP software.
4. In the **Instrument** tab**->Devices->Autosampler** tab, and make sure that the software is configured for the autosampler tray you are using.
5. In the **Instrument** tab**-> Plasma Control** and ignite the plasma. Allow the torch to warm up for half an hour before you start the alignment.
6. Prepare a solution containing 1 ppm manganese.
7. In the **Instrument** tab**-> Spectrometer Control**.
   The Spectrometer Control window appears.
8. Select **Axial** or **Radial**. We recommend that you first do the alignment in one viewing mode, then select the other viewing mode and repeat the procedure.
9. To view spectra collected during the procedure, open the **Spectra Display** window.
10. Click on **Align View** in the Spectrometer Control window to open the **Align View** dialog or select **Align View** from the software ribbon.
11. Select the element and wavelength. This is the wavelength that the system will use to measure the intensities at different viewing positions and locate the position that gives the highest intensity. Your options are:

    Select Manganese, which is typically used as the alignment wavelength for the majority of analyses.

-or-

Select another element from the drop-down list. This feature is for specialized analyses where you want to optimize the intensity for an individual analyte of interest. This may adversely affect the intensities of other analytes.

12. Set the **Read Delay** time.

13. Aspirate a solution containing the element you have selected.

    When using radial viewing, the system adjusts the lateral viewing position only.

    When using axial viewing, the system adjusts both coordinates.

    The system will determine the intensity at the selected wavelength while adjusting the viewing position in incremental steps. In the Results window, a report is generated that gives the intensities found at each position. The system changes the **Torch Viewing Position** to the position that gives the highest intensity. In the Spectrometer Control window, the software resets the coordinates so that the 0 and 15 position is at the location of highest intensity.

14. Click on **Align**.

## Switching On the System

**Note** If you switch off the spectrometer or turn off the purge gas, air slowly diffuses into the spectrometer optics. To make sure that the instrument is always ready for use, especially when you intend to make measurements at wavelengths below 190 nm, always leave the main switch of the spectrometer in the On position and leave the purge gas turned on.

1. Switch on the exhaust ventilation system.

2. Set the gas supplies to the correct pressures.

    - Argon torch gas: 5.5 to 8.25 bar or 80-120 psig.
    - Air/$N_2$ Shear gas: 5.5 to 8.25 bar or 80-120 psig.
    - $N_2$ gas: 2.75 to 8.25 bar or 40-120 psig.

3. Make sure that the torch is correctly installed, the torch compartment door is shut, and the EMO switch is released.
4. Make sure the drain vessel is empty.
5. Switch on the spectrometer, and if required, the autosampler.
6. Switch on the chiller.
7. Switch on the computer and start the ICP software.
8. In the in the **Instrument** tab, click on **Plasma Control** and ignite the plasma.

Allow the torch to warm up for 30 minutes before you start making measurements.

# Setting Instrument Parameters

## General Parameter Settings

Optimum conditions will depend on the type of analyses being performed. You use the ICP software to set up the instrument parameters. The following settings are general recommendations. For more information on the parameters, refer to the Software Guide on the software CD. The following parameters are set in the method:

- We recommend you use Auto integration with the following settings:

  **Read Parameters**
  **Time: Auto:** Min: 0.5 sec, Max: 2 sec

  A Max time of 50 seconds may be required for detection limit work.
- Make sure that the read delay, wash time, and rinse times are sufficient.
- Re-check the Interelement Corrections (IECs) if you make any changes to the ionization or excitation characteristics of the plasma after collecting IEC data. This would include changing the source conditions or changing the nebulizer or the torch.
- To compensate for spectral interferences, use Background Correction, Interelement Correction (IEC), or Multi-component Spectral Fitting (MSF). Confirm using interference check standards.
- To compensate for matrix effects, use internal standardization.

## *Instrument Settings for Aqueous Solutions*

| For Cross-Flow Nebulizers | Aqueous |
|---|---|
| Nebulizer Flow: | 0.6 L/min |
| RF power | 1500 watts |
| Auxiliary Flow: | 0.2 L/min |
| Plasma Flow: | 8 L/min |
| Sample Flow Rate: | 1.5 to 2.5 mL/min |
| Equilibration Time: | 8 sec |
| Torch Position | -3 |

| For Meinhard Nebulizers | Aqueous |
|---|---|
| Nebulizer Flow: | 0.7 L/min |
| RF power | 1500 watts |
| Auxiliary Flow: | 0.2 L/min |
| Plasma Flow: | 8 L/min |
| Sample Flow Rate: | 1.0 to 2.5 mL/min |
| Equilibration Time: | 8 sec |
| Torch Position | -3 |

### Instrument Settings for Organic Solutions

| **Parameter** | **Baffled Cyclonic Spray Chamber, Low-Flow GemCone Nebulizer and 1.2 mm Injector** |
|---|---|
| **RF power** | 1500 Watts |
| **Nebulizer Flow** | 0.35 L/min |
| **Auxiliary Flow** | 0.6 L/min |
| **Plasma Flow** | 10 L/min |
| **Sample Flow Rate** | 1.0 to 4.0 mL/min |
| **Equilibration Time** | 15 s |
| **Torch Position** | -3 |

### Instrument Settings for High Dissolved Solids

| **Parameter** | **Baffled Cyclonic Spray Chamber, Sea Spray Nebulizer and 2.0 mm Alumina Injector** |
|---|---|
| **RF power** | 1500 Watts |
| **Nebulizer Flow** | 0.65 L/min |
| **Auxiliary Flow** | 0.3 L/min |
| **Plasma Flow** | 10 L/min |
| **Sample Flow Rate** | 1.5 mL/min |
| **Equilibration Time** | 15 s |
| **Torch Position** | -3 |

For more information refer to the *Baffled Cyclonic Spray Chamber Kit Instruction Sheet (09936506)*.

For the analysis of organics it may be necessary to open the sample compartment door while the instrument is in operation

### *Hardware Settings and Options*

Below is a brief list of hardware options and settings that you must set or optimize for particular analytical requirements.

- Make sure you use solvent resistant tubing for organic solvents. See *Table 5-7 on page 245*.

- When the pump is not in use, release the pressure plate and release the tubing to prevent flat spots from forming. It is recommended to flush the tubing with DI water at the end of an analysis to preserve tube life. If running the instrument unattended you can set the instrument to flush at the end of an analysis using the automatic shutdown/start-up options. It is also recommended to enable tubing saver if the instrument is set to shutdown automatically while running unattended.

- Make sure that the spray chamber is being drained properly to avoid solution filling the torch.

- For radial viewing, two different windows are available. If you intend to make measurements near the detection limit, use the longer window. Instructions for removing the window that are given in *Removing and Cleaning the Windows* on page 199.
- PerkinElmer offers different types of nebulizers for a wide variety of applications. For descriptions of the nebulizers and their different uses and advantages, see *Nebulizers* on page 81.

## Shipping List

Every day you count on PerkinElmer to provide you with solutions that deliver reliable performance, control operating costs and maximize operational time. Our complete portfolio of consumables, parts, supplies, training and service helps you meet both routine and demanding measurement challenges. We invest heavily in testing and validating our products to ensure you receive guaranteed compatibility and performance - on-time, every time, for every instrument in your laboratory.

**Table 4-1. Shipping Kit (Part No. N0790010)**

| Part No. | Description | Quantity |
|---|---|---|
| 02113330 | Product Certification | 1 |
| N0770425 | Receptacle-AC Power 250 Volt | 1 |
| N0790432 | Installation Kit | 1 |
| N0791214 | Shipping Pack | 1 |
| N0790210 | Instrument Assembly | 1 |
| N0790433 | Spares Kit | 1 |
| N0790606 | Torch Assembly-ADJ Scott/X-FLO | 1 |

**Table 4-2. Shipping Kit (Part No. N0790011)**

| Part No. | Description | Quantity |
|---|---|---|
| 02113330 | Product Certification | 1 |
| N0770425 | Receptacle-AC Power 250 Volt | 1 |
| N0790432 | Installation Kit | 1 |
| N0791214 | Shipping Pack | 1 |
| N0790210 | Instrument Assembly | 1 |
| N0790434 | Spares Kit | 1 |
| N0790607 | Torch Assembly-ADJ Cyclonic/Conc | 1 |

**Table 4-3. Installation Kit (Part No. N0790432)**

| Part No. | Description | Quantity |
|---|---|---|
| 09200486 | Wide Mouth Bottle 15L HDPE | 1 |
| 09936225 | ICP-OES Instrument Maintenance Log Book | 1 |
| N0690271 | Drain Bottle Cap Assembly | 1 |
| N0770183 | Hose Kit (includes gas and cooling water hoses) | 1 |
| N0775325 | Air Duct Filter Assembly with R250 Regulator | 1 |
| N0790448 | Wrench Assembly | 1 |
| N0691578 | Exhaust Hose Duct | 1 |
| 09920044 | Stainless Steel Hose Clamp 1.87 TO 5 Diameter | 2 |
| 09290332 | Cable Assembly- CAT5E RJ45 24AWG Plug 15 ft | 1 |

**Table 4-4. Spares Kit (Part No. N0790433)**

| Part No. | Description | Quantity |
|---|---|---|
| N0582325 | Concepts, Instrumentation and Techniques in ICP-OES (Book) | 1 |
| 09931178 | Unpacking Instructions for Avio 200 | 1 |
| 00473550 | Flex solvent Tubing (package of 12) | 1 |
| 02506516 | Round Tygon Tubing B44-3 0.125 ID | 0.98 |
| 02506532 | Round Tygon Tubing F4040A 0.375 ID | 0.063 |
| 09902033 | O-Ring- 1.359 ID 0.139WD | 1 |
| 09903730 | Barb Fitting 1/8 TBG 1/16 TBG | 2 |
| 09908265 | Clear Polyethylene Tubing- 0.023 ID | 1 |
| 09908585 | PVC Pump Tubing 0.045 ID Red-Red | 1 |
| 09908587 | PVC Pump Tubing 0.030 ID Black-Black | 1 |
| 09920186 | Barb Fitting Coupler Tubing 3/32 TBG 3/32 | 2 |
| 09920267 | Barb Male Fitting Tubing 10-32 UNF 3/32 | 2 |
| 09920865 | Barb Fitting Coupler Tubing 3/32 TBG 1/16 | 3 |
| 09921045 | O-Ring 0.126 ID 0.040WD | 2 |
| 09923037 | PVC Pump Tubing 0.045 ID Red-Red | 1 |
| 09923383 | Cap Sleeve- 0.406 IN BRN Vinyl | 1 |
| 09985708 | Tube Sleeve 0.032 ID | 10 |
| 09985729 | PVC Solvent Flex Tubing 0.06 ID Yellow | 10 |
| 09985735 | PVC Solvent Flex Tubing 0.11 ID Yellow | 0.98 |
| 09995098 | Fan Filter 4.5 SQ Foam | 1 |

**Table 4-4. Spares Kit (Part No. N0790433)**

| | | |
|---|---|---|
| N0695414 | Adapter Drain | 1 |
| N0790131 | Torch Assembly | 1 |
| N0790437 | O-Ring Adjustable Torch Kit | 1 |
| N0790438 | O-Ring Kit for Scott Cross Flow Spray Chamber | 1 |
| N0791183 | 2mm Alumina Injector | 1 |

**Table 4-5. Spares Available (Part No. N0790434)**

| Part No. | Description | Quantity |
|---|---|---|
| N0582325 | Concepts, Instrumentation and Techniques in ICP-OES (Book) | |
| 09931178 | Unpacking Instructions for Avio 200 | |
| 00473550 | Flex solvent Tubing (package of 12) | 1 |
| 02506516 | Round Tygon Tubing B44-3 0.125 ID | 0.98 |
| 02506532 | Round Tygon Tubing F4040A 0.375 ID | 0.063 |
| 09902033 | O-Ring- 1.359 ID 0.139WD | 1 |
| 09903730 | Barb Fitting 1/8 TBG 1/16 TBG | 2 |
| 09908265 | Clear Polyethylene Tubing- 0.023 ID | 1 |
| 09908585 | PVC Pump Tubing 0.045 ID Red-Red | 1 |
| 09908587 | PVC Pump Tubing 0.030 ID Black-Black | 1 |
| 09920186 | Barb Fitting Coupler Tubing 3/32 TBG 3/32 | 2 |
| 09920267 | Barb Male Fitting Tubing 10-32 UNF 3/32 | 2 |
| 09920865 | Barb Fitting Coupler Tubing 3/32 TBG 1/16 | 3 |
| 09921045 | O-Ring 0.126 ID 0.040WD | 2 |

**Table 4-5. Spares Available (Part No. N0790434)(Continued)**

| | | |
|---|---|---|
| 09923037 | PVC Pump Tubing 0.045 ID Red-Red | 1 |
| 09923383 | Cap Sleeve- 0.406 IN BRN Vinyl | 1 |
| 09985708 | Tube Sleeve 0.032 ID | 10 |
| 09985729 | PVC Solvent Flex Tubing 0.06 ID Yellow | 10 |
| 09985735 | PVC Solvent Flex Tubing 0.11 ID Yellow | 0.98 |
| 09995098 | Fan Filter 4.5 SQ Foam | 1 |
| N0695414 | Adapter Drain | 1 |
| N0790131 | Torch Assembly | 1 |
| N0790436 | O-Ring Cyclonic K1 Torch Kit | 1 |
| N0790437 | O-Ring Kit for Cyclonic K1 Spray Chamber | 1 |
| N0791183 | 2mm Alumina Injector | 1 |

# Maintenance 5

# Introduction

This chapter describes the routine maintenance procedures required to keep your instrument in proper working condition and to ensure the highest possible level of performance. It includes maintenance checks that should be done on a daily basis and maintenance procedures that should be done periodically depending on instrument use. This chapter is divided into several sections, each section covering maintenance procedures for a particular component of the system.

You should perform only the maintenance procedures described in this chapter. Record your daily maintenance procedures in the *ICP-OES Maintenance Log (Part. No. 09936225)*. If additional maintenance is required, contact a PerkinElmer service engineer. This instrument requires no specified inspection or preventive maintenance to ensure the continuous functioning of its safety features.

**Caution** Before using any cleaning or decontamination methods except those specified by the manufacturer, users should check with the manufacturer that the proposed method will not damage the equipment.

**Attention** Avant d'utiliser toutes les méthodes de nettoyage ou de décontamination, sauf celles qui sont spécifiées par le fabricant, les utilisateurs doivent vérifier auprès du fabricant que la méthode proposée ne sera pas endommager l'équipement.

# Daily Checks

The following maintenance procedures should be done on a daily basis. Make sure to inspect and replace any hoses which show signs of wear because their failure could cause a hazard.

## Daily Cleaning

At the end of each working day, it is recommended that you flush out the sample introduction system for five minutes with the plasma on. After analyzing aqueous solutions, flush with deionized water or a 2% nitric acid solution, followed by deionized water. After analyzing organic solutions, flush the system using clean solvent. Also clean the spectrometer housing using a mild lab detergent.

## Argon Supply

Make sure that an adequate supply of argon is available and connected to the system. Check that the argon tank(s) have sufficient pressure, and that a spare tank is ready if necessary. Argon can be purchased from local suppliers. The argon for use with ICP systems should be 99.996% pure.

<u>Argon output pressure:</u> 550-825 kPa (80-120 psig)

## Purge Gas Supply

The optical path must be purged with either nitrogen or argon. Nitrogen is the recommended purge gas due to its lower cost. Make sure that an adequate supply of purge gas is available and connected to the system. Check that the cylinder has sufficient pressure, and that a spare cylinder is ready if necessary.

The purge gas should be 99.999% pure and is available from local suppliers.

<u>Nitrogen output pressure:</u> 275-825 kPa (40-120 psig)

## Shear Gas Supply

The Avio 200 requires a supply of shear gas. The shear gas used is typically compressed air; however, nitrogen may also be used. Make sure that an adequate supply of shear gas is available and connected to the system. Check that the supply has sufficient pressure, and that a spare cylinder is ready if necessary.

<u>Shear Gas output pressure:</u> 550-825 kPa (80-120 psig)

## Chiller

Fill the reservoir up with the coolant fluid with inhibitor (Part No. N0776200). The chiller reservoir has a capacity of 4.2 liters (1.1 US gallons).

<u>Cooling water pressure:</u> 310-550 kPa (3.1 to 5.5 bar or 45-80 psig)

## Vent

Check that your vent system is switched on and is not blocked. Check regularly for proper flow rate of the vent system (120 CFM/min).

### Torch and Plasma Induction Plates

Inspect the torch, glassware, and aerosol injector tube. The glassware should be clean, with no traces of deposits or signs of melting.

**Caution** To extend the life and aid in preventing devitrification of glassware, it is necessary to remove all traces of alkali on glassware caused by handling it with bare hands. To remove the alkali, wipe the glassware clean with cotton wool dipped in alcohol.

**Attention** Pour prolonger la durée de vie et de l'aide dans la prévention de la dévitrification de la verrerie, il est nécessaire d'éliminer toute trace d'alcali sur la verrerie provoquée par la manipulation à mains nues. Pour supprimer l'alcali, essuyez la verrerie propre avec un coton imbibé d'alcool.

**Caution** When the humidity in your lab is high, water can condense on the plasma induction plates when the torch is not in operation. **To prevent damage to the plasma induction plates, use a soft dry cloth to gently dry the plasma induction plates before igniting the torch.** Be careful not to change the position of the plasma induction plates.

**Attention** Lorsque le taux d'humidité dans votre laboratoire est élevé, l'eau peut se condenser sur les plaques à induction de plasma lorsque la torche ne fonctionne pas. Pour éviter d'endommager les plaques à induction de plasma, utilisez un chiffon doux et sec pour sécher doucement les plaques à induction de plasma avant d'allumer la torche. Veillez à ne pas modifier la position des plaques à induction de plasma.

### Nebulizer

Check that the nebulizer is not clogged and that the sample capillary tubing is clean and in good condition. Flush the nebulizer daily with deionized water.

### Peristaltic Pump and Drain

Inspect the pump tubing before operating and after every few hours of use. Replace the tubing when flat spots develop (approximately every eight hours of use). Refer to the section on the peristaltic pump for the appropriate tubing for different solvents.

When the pump is not in use, release the pressure plate and release the tubing to prevent flat spots from forming. If you are planning to leave the pressure plate clamped overnight, we recommended that you use the *TubingSaver* feature.

To enable to *TubeSaver* feature start up the ICP software. Go to the **Instrument** tab **-> Devices -> Pump** from the dropdown menu. In the Pump screen select a checkmark in the **Enable TubingSaver** box.

Always remove the sample capillary or the autosampler probe from the solution it is in when you are finished using the pump. Otherwise, the solution will siphon into the spray chamber and flood it.

Be sure the drain tubing is firmly attached to the spray chamber and liquid flows smoothly through the pump. Keep the drain tubing clear of debris. Empty the drain bottle as needed.

# Periodic Checks

The frequency of maintenance required will be determined by the amount of use the system receives, the cleanliness of the environment, and the number and nature of the samples being analyzed. You should consider the usage of your spectrometer and establish a suitable maintenance schedule, with particular emphasis on the following areas of the system.

## Torch Assembly and Plasma Induction Plates

Clean the torch components periodically according to the instructions given later in this chapter to remove accumulated deposits. If using organic solvents, check the injector and torch regularly for carbon buildup. Replace any cracked or worn O-rings on the torch assembly.

**Caution** To extend the life and aid in preventing devitrification of glassware, it is necessary to remove all traces of alkali on glassware caused by handling it with bare hands. To remove the alkali, wipe the glassware clean with cotton wool dipped in alcohol.

**Attention** Pour prolonger la durée de vie et de l'aide dans la prévention de la dévitrification de la verrerie, il est nécessaire d'éliminer toute trace d'alcali sur la verrerie provoquée par la manipulation à mains nues. Pour supprimer l'alcali, essuyez la verrerie propre avec un coton imbibé d'alcool.

The plasma induction plates must be kept clean to prevent arcing across the plasma induction plates. Inspect the plasma induction plates for any deformations or carbon buildup. Contact your PerkinElmer Service Representative to replace the plasma induction plates if there are any signs of pitting. Pitting causes weakness in the plasma induction plates which can result in a hole in the plasma induction plates and a gas leak.

## Purge Viewing Window/Tubes

Remove and examine the window or purge tube for deposits. If you notice a drop in UV performance clean or replace the windows. Clean according to the instructions given later in this chapter or replace as necessary.

## Nebulizer

Check the nebulizer spray pattern with deionized water. Clean or replace the nebulizer as necessary.

## Spray Chamber

Check for leaks around the nebulizer and drain fitting. Inspect the spray chamber for deposits and check the condition of the O-rings.

## Peristaltic Pump

Check that the pump rollers are clean, not scored, free from deposits due to spills, and move freely. Remove and clean the pump head if necessary. Replace the pump rollers if necessary.

Periodically observe the drain tubing. Liquid should drain smoothly from the spray chamber. If not, adjust the pump tension on the pump tubing.

## Drains

Check the spray chamber drain fittings, tubing and connections and replace if necessary.

## General System Maintenance

- **Air filters:** clean or replace the spectrometer and generator air filters as necessary.
- **Chiller:** Flush out the chiller every 6 months. Fill the chiller reservoir with the coolant fluid that includes inhibitor (Part No. N0776200). The chiller reservoir has a capacity of 4.2 liters (1.1 US gallons).

---

Caution **Do not use deionized or tap water in the chiller. Only use coolant fluid that includes inhibitor (Part No. N0776200).**

Attention **Ne pas utiliser déminéralisée ou l'eau du robinet dans le refroidisseur. Utiliser uniquement du fluide de refroidissement qui comprend un inhibiteur (N0776200).**

---

Refer to Chapter 4, Installation for more information on filling the chiller.

## Torch Viewing Position Alignment

The torch viewing position alignment procedure is used to set the plasma viewing position of the spectrometer entrance optics for the highest signal intensity. See *Setting the Torch Viewing Position* on page 151.

Perform this procedure when:

- the instrument is first installed or moved to a new location, or
- the torch is removed or replaced, or
- the plasma induction plates are replaced **(important)**

## Performance Checks

Several checks should be done periodically to check instrument performance. These include the sodium bullet test to check the nebulizer argon flow, the Background Equivalent Correction (BEC) test, and Coefficient of Variation (CV) test. These tests are described in Chapter 6, Troubleshooting.

## Cleaning the Sample Introduction System

See the following table for the recommended cleaning procedures for the sample introduction system.

**Table 5-1. Recommended Cleaning Procedure**

| | |
|---|---|
| Daily cleaning | After analyzing aqueous solutions, flush with deionized water, or 2% nitric acid, followed by deionized water. After analyzing organic solutions, flush using a clean solvent. |
| Torch<br>Injector<br>Spray Chamber | Soak in 5-20% nitric acid or aqua regia; use an ultrasonic cleaner if available. For more detailed information, see **Cleaning the Torch** later in this chapter. |
| O-Rings | Clean with soap and water, rinse thoroughly. |
| GemTips for Cross-Flow Nebulizer | Clean with soap and water, rinse thoroughly; or use a 2% solution of nitric acid. |

**Table 5-1. Recommended Cleaning Procedure (Continued)**

| | |
|---|---|
| GemTip or GemCone Nebulizer/End Cap Assembly | Clean with soap and water; rinse thoroughly. |
| Concentric Glass (MEINHARD) Nebulizer | Do *not* use an ultrasonic cleaner. Do *not* use a cleaning wire. See **Concentric Glass Nebulizer** later in this chapter. |
| Mira Mist Nebulizer | For the longest life and best performance, wash your nebulizer by simply running water as a sample for 10 minutes at the end of the day before shutting down the plasma. Any other form of washing is usually unnecessary. Please **DO NOT** wash your nebulizer in acid or solvents to 'prevent salt build up'. **DO NOT** use surfactants as they will destroy the surface tension at the tip and performance. **The tip is very easily damaged and should NEVER be touched with fingers, tissues, or anything else**. |
| Spray Chamber | By handling the spray chamber oil and dirt can accumulate on it and this will affect performance. To assure proper wetting wipe the spray chamber with acetone to remove all oils and dirt. |
| Pump Head | Remove and clean with water or a mild solvent. |
| Purge Viewing Windows/Tubes | Clean with deionized water and dry with a soft cloth. To clean difficult stains, refer to the information in this chapter. |

# Quick-Change Adjustable Torch Module

The Quick-Change Adjustable Torch Module consists of the torch assembly, spray chamber, and nebulizer. These components are easily removed from the system for regular inspection and maintenance. Normal wear on these components is shown by metal or salt deposits on the quartzware or injector, glazed or devitrified quartz, worn O-rings, or clogged nebulizer tips.

All the O-rings in the sample introduction system must be in place and be in good condition. Otherwise, pressure leaks may occur, which can cause difficulties in igniting the plasma and poor performance.

It is good practice to have spare parts available before removing any of the parts of this module, particularly the torch, since it may be accidentally broken. Replacement parts are listed at the end of this chapter.

## Plasma Torch

**Caution** **Only** use PerkinElmer Flat Plate Torch Glassware™. **Using any other glassware will damage the torch.**

**Attention** Utiliser uniquement PerkinElmer Plate Flat Torch Glassware ™**.** **L'utilisation de tout autre verrerie endommager la torche.**

The plasma torch assembly is comprised of a quartz torch with an inner quartz tube, injector, and adapter for securing the injector into an inlet in the spray chamber. The injector supplied is an alumina injector with a 2.0 mm inner diameter. Other injectors available include alumina injectors of different inner diameter for varying sample flow rate, quartz injectors for different sample types and sapphire injectors for silicon applications. For more volatile solvents, use a smaller diameter injector.

Regularly inspect the torch glassware and aerosol injector tube. The glassware should be clean, with no traces of deposits or signs of melting. Give particular attention to the inner quartz tube. Before removing the torch for cleaning, be sure to have a spare torch available, in case it should break.

The quartz torch is shown in the next figure.

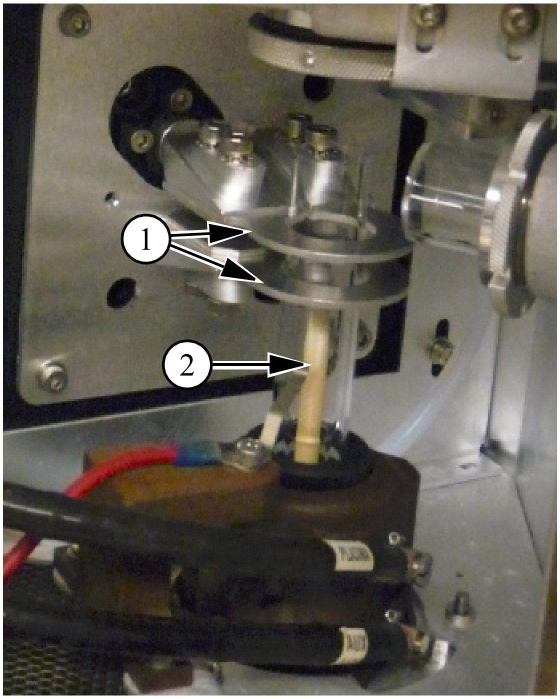



Figure 5-1. Quartz Torch.

| Item | Description |
|---|---|
| 1 | Plasma Induction Plates |
| 2 | Torch |

## Plasma Induction Plates

Regularly inspect the plasma induction plates. They should not show any signs of deforming or pitting.

If your lab has high humidity, check the plasma induction plates to make sure they are dry. Use a soft dry cloth to dry the plasma induction plates if necessary. To replace and adjust the plasma induction plates refer to the procedure, see *Replacing the Plasma Induction Plates* on page 197.

## *Removing the Injector*

Once the spray chamber has been removed, the injector can be removed without removing the entire torch assembly. To do this procedure follow these steps.

1. Turn off the plasma if it is on.

---

Warning

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

---

2. Pull out the locking pin.

3. Rotate the injector adapter to the left, then pull gently down - when the locking pin is out and you apply pressure, the whole torch body could come out.


**Figure 5-2 Removing the spray chamber assembly and injector.**

| Item | Description |
|---|---|
| 1 | Scott spray chamber |
| 2 | Injector lock |
| 3 | Injector |

### *Removing and Disassembling the Torch*

1. Turn off the plasma if it is on.

**Warning**

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

2. From the sample compartment remove the spray chamber. See *Removing the Scott Spray Chamber* on page 189 or *Removing the Cyclonic Spray Chamber* on page 193.

3. Open the torch compartment door.

**Warning**

**When installing the Torch Module in the next steps, do so carefully so you will avoid breaking the torch and risking possible injury.**

**Avertissement: Lors de l'installation du module de la flamme dans les prochaines étapes, faire avec soin afin que vous éviter de casser la torche et un risque de blessure possible.**

4. At the top of the sample compartment is the black locking pin. With one hand on to the base of the torch holder. With the other hand pull out the black locking pin.

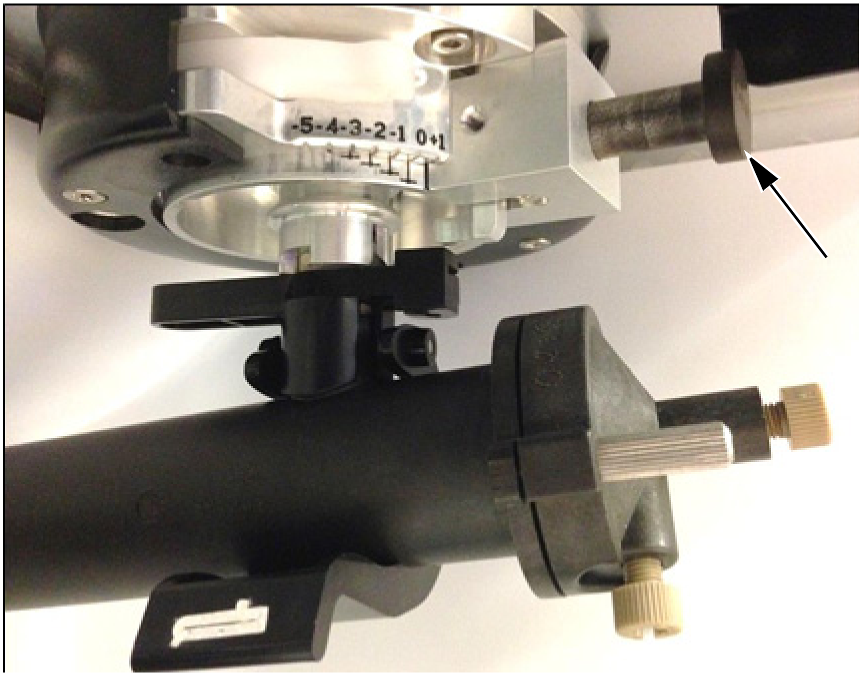



**Figure 5-3 Black Locking Pin Pulled out**

5. Carefully slide the torch holder through the plasma induction plates and out of the instrument.

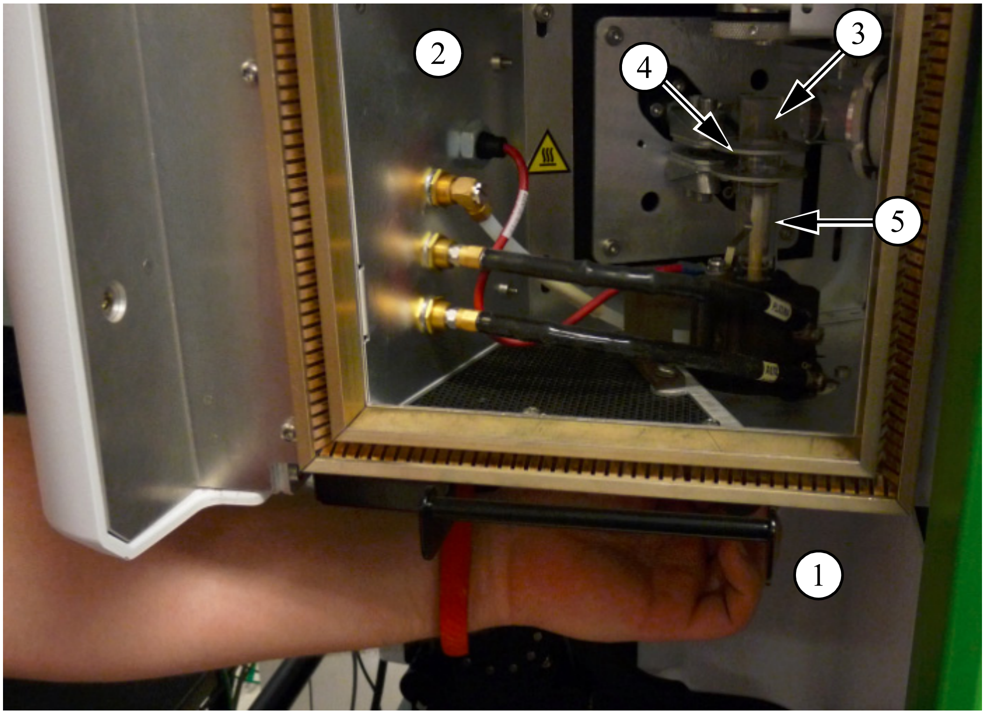



**Figure 5-4 Removing the torch coupler from the torch mount.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Sample compartment | 4 | Plasma induction plates |
| 2 | Torch Compartment | 5 | Injector |
| 3 | Torch | | |

**Caution** Wear cotton gloves when you handle the torch glassware.

**Attention** Porter des gants de coton lorsque vous manipulez la verrerie de la torche.

6. Inspect the glassware. If damaged the glassware will have to be removed from the torch cassette.

7. Slide out the injector assembly straight out from the bottom of the torch cassette.

8. Loosen the knurled nut to remove the glassware.

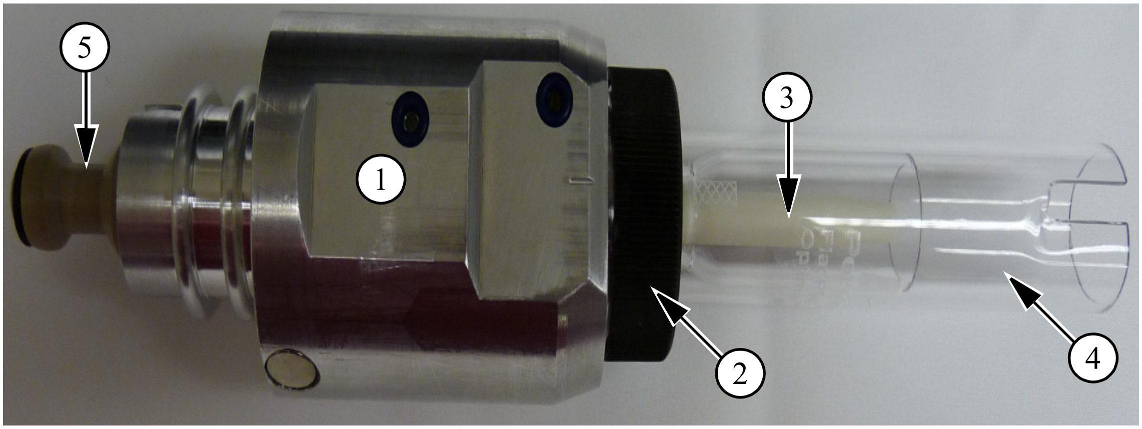



**Figure 5-5 Torch Glassware in Cassette**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Torch Cassette | 4 | Glassware |
| 2 | Knurled Nut | 5 | Injector Adaptor |
| 3 | Injector | | |

**Warning**

In the next step, be sure to carefully remove the torch so you will avoid breaking the glassware and risking possible injury. If the torch does break, discard the broken torch and replace. Remove the knurled nut, sleeve and washers on the torch mounting shaft to make sure that all glass fragments are removed.

Avertissement: Dans l'étape suivante, assurez-vous d'enlever soigneusement la torche de sorte que vous éviter de casser la verrerie et un risque de blessure possible. Si la torche ne se brise, jetez la torche cassée et le remplacer. Retirer l'écrou moleté, manchon et rondelles sur l'arbre de montage de la torche pour vous assurer que tous les fragments de verre sont enlevés.

9. Inspect the torch, if it is cracked replace with a new torch. If the torch needs to be cleaned see the next section *Cleaning the Torch* on page 184 for more information.

10. With the glassware removed inspect the O-rings in the torch cassette for wear or damage.

11. If the O-rings need to be removed, use your gloved finger to remove them using the O-ring removal tool (Part No. 09220410). **Do not** use a knife blade because the blade will cut the O-rings and damage the O-ring seats. Replace with new O-rings. See Figure 5-8 for a view of the location and part numbers of the O-rings.

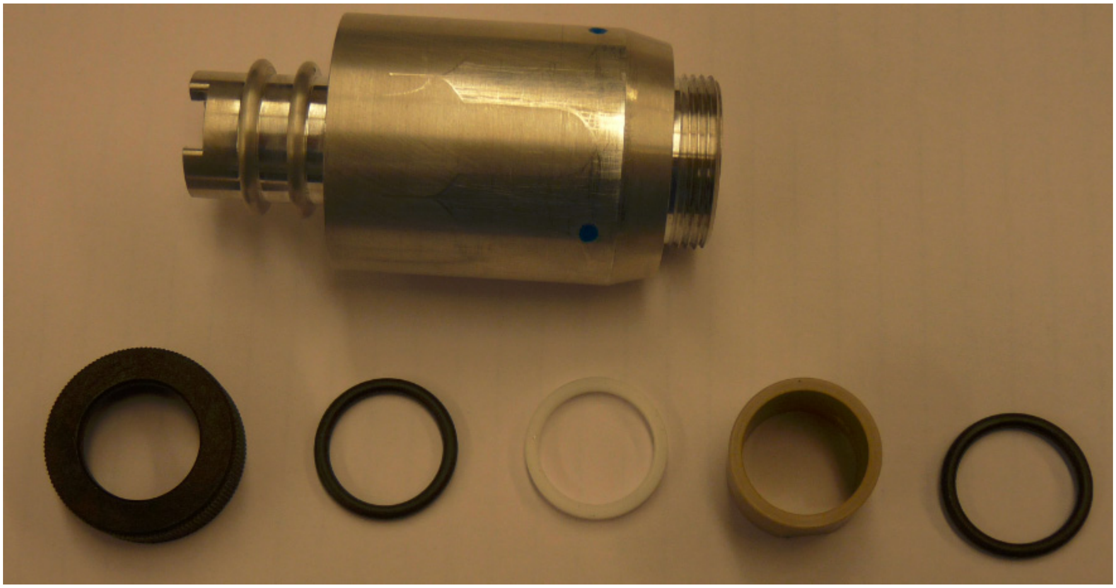
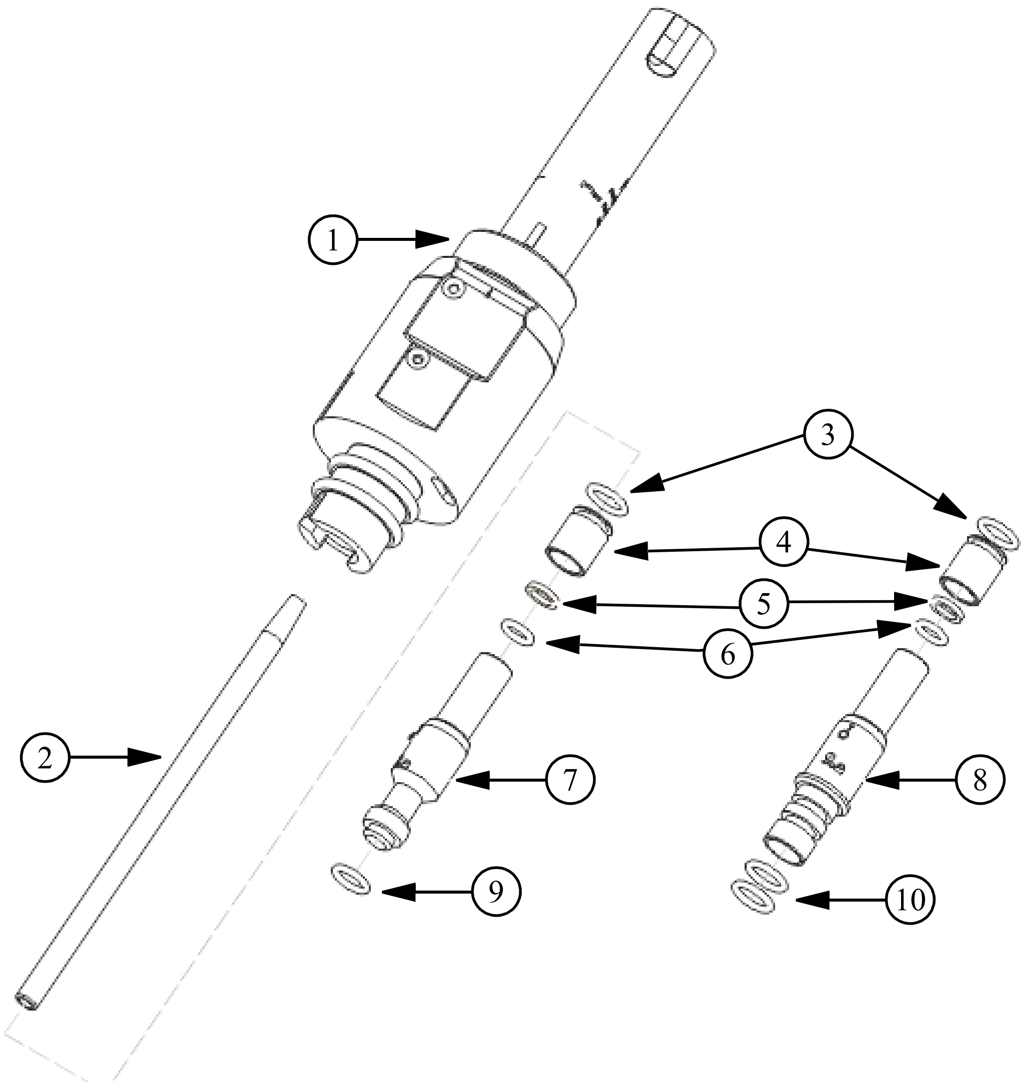


**Figure 5-6 O-Rings in Torch Cassette**

12. With the injector assembly removed check the O-rings. Replace any that are worn or damaged. There are three O-ring kits: O-ring kit for the Avio Scott injector (Part No. N0790440), O-ring kit for the Avio cyclonic injector (Part N0790441) and the O-ring kit for the Avio Torch (Part No. N0790437). See the following figure.


1
2
3
4
5
6
7
8
9
10

**REFERENCE PARTS**

**N0790141**
CYCLONIC INJECTOR ASSEMBLY

**N0790156**
SCOTT INJECTOR ASSEMBLY

**N0790440**
ORING KIT FOR AVIO SCOTT INJECTOR

**N0790441**
ORING KIT FOR AVIO CYCLONIC INJECTOR

**N0790437**
ORING KIT AVIO TORCH

**09220410**
ORING REMOVAL TOOL

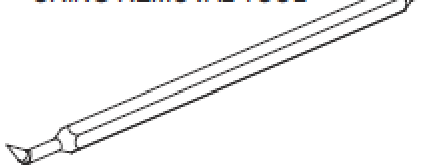


**Figure 5-7 Torch Assembly.**

| Item | Description |
|---|---|
| 1 | Knurled Nut |
| 2 | Injector 2mm Alumina (Part No. N0791183) |
| 3* | O-Ring Color Coded Blue (Part No. N0791333) |
| 4 | Lock Collar (Part No. N0791163) |
| 5 | Washer (Part No. N0776014) |
| 6 | O-Ring (Part No. 0992207) |
| 7 | Cyclonic Injector Adapter (Part No. N0790143) |
| 8 | Scott Injector Adapter (Part No. N0790154) |
| 9 | O-Ring (Part No. 09926070) |
| 10 | O-Ring (Part No. 09200518) |

*See the note on page -185.

## Cleaning the Torch

The torch components should be cleaned regularly to remove accumulated deposits. After prolonged use, a torch may lose its transparency and become crystalline. In this condition, called devitrification, the torch is very fragile. You should not attempt to clean a devitrified torch, but it can still be used. If the torch is cloudy, this generally does not affect performance because the plasma is either viewed through the slot on the torch, or, for axial viewing, through the open end of the torch.

If you have been analyzing aqueous solutions, the torch glassware and injector tube should be cleaned in an acid bath. An ultrasonic bath may be used. Start with a solution of 5% nitric acid or aqua regia and, if deposits persist, increase the acid concentration, up to 20% if necessary. Acid solutions must be used with care. Observe all of the manufacturer's safety recommendations. These recommendations are normally provided in a material safety data sheet (MSDS) supplied with the chemical.

---

**Caution** To extend the life and aid in preventing devitrification of glassware, it is necessary to remove all traces of alkali on glassware caused by handling it with bare hands. To remove the alkali, wipe the glassware clean with cotton wool dipped in alcohol.

**Attention** Pour prolonger la durée de vie et de l'aide dans la prévention de la dévitrification de la verrerie, il est nécessaire d'éliminer toute trace d'alcali sur la verrerie provoquée par la manipulation à mains nues. Pour supprimer l'alcali, essuyez la verrerie propre avec un coton imbibé d'alcool.

---

Use of hydrofluoric acid for cleaning the torch is **not** recommended.

If you have been analyzing organic solutions, the torch glassware and injector tube can be cleaned using a solvent or diluted soap solution. Be sure to inspect the torch and injector daily for carbon buildup. A muffle furnace can be used if necessary to remove organic deposits on the torch or injector. Place the torch or injector in a muffle furnace at 500 °C to 550 °C for several hours.

After cleaning the torch, dry it thoroughly using clean air or nitrogen. No moisture should be present.

O-rings may be cleaned with soap and water. An ultrasonic bath may be used. Replace if cracked or worn. A torch O-ring kit is available. See the list of replacement parts later in this section.

**Note:** *The dark blue torch O-ring (Part No. N0791334) on the outside of the torch and the dark blue O-ring on the outside of the injector adapter (Part No. N0791333) should be replaced after 300 insertions. Use the O-ring removal tool (Part No. 09220410) to remove. See Figure 5-7 and Figure 5-8.*

**O-Ring Removal Tool**


## *Replacing the Torch*

1. Loosen the knurled nut and firmly grasp the torch and push it slowly into the torch mount. Rotate the torch so that the stripe on the torch lines up with the index mark on the torch mount and the guide pin on the torch coupler. Firmly tighten the knurled nut. See the following figure.

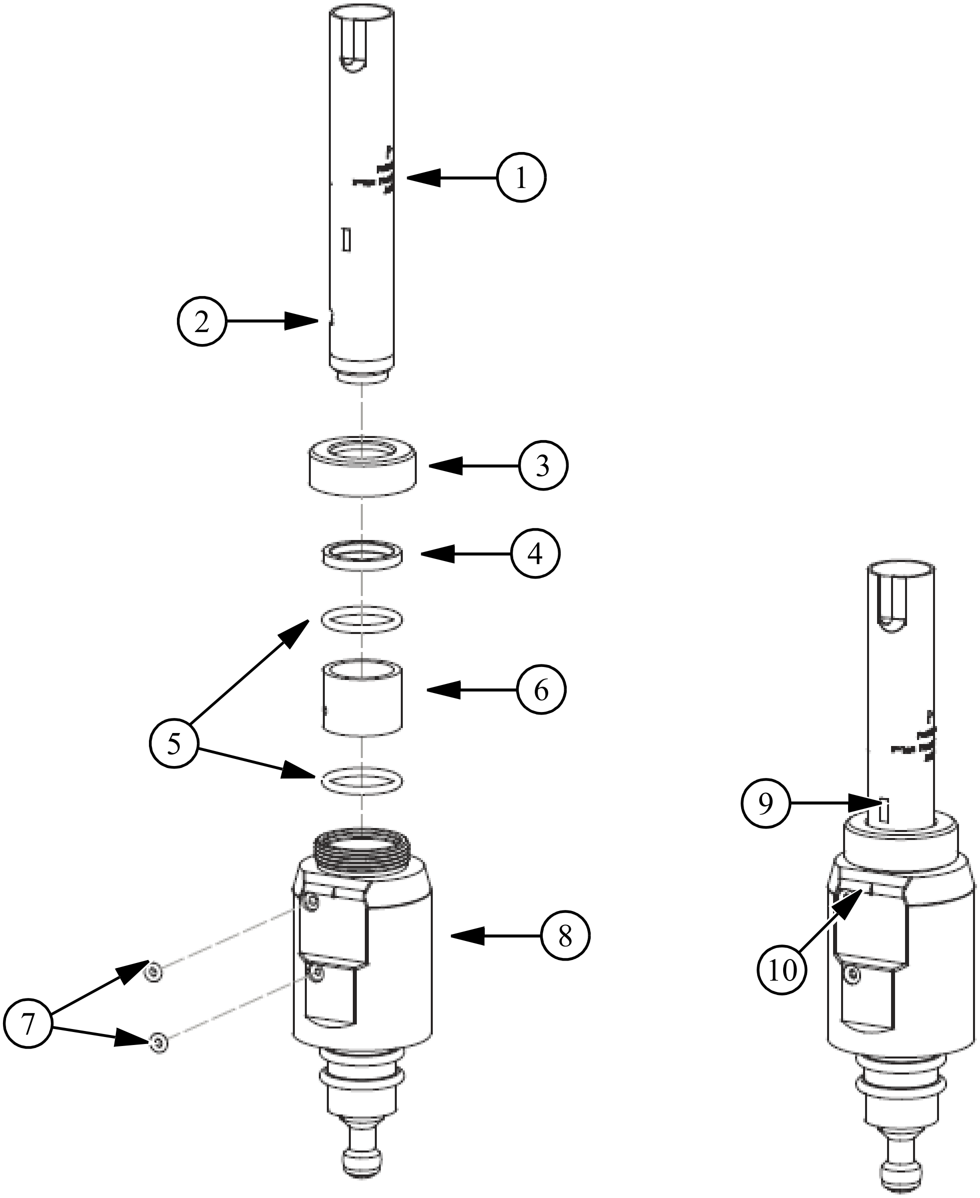



**Figure 5-8** **Replacing the Torch**

.

| Item | Description |
|---|---|
| 1 | Torch glass (Part No. N0790131) |
| 2 | Torch cutout |
| 3 | Knurled nut (Part No. N0776027) |
| 4 | Washer (Part No. N0776028) |
| 5 | O-ring (Part No. 09902223) |
| 6 | Spacer (Part No. N0791125) |
| 7* | O-ring color code blue (Part No. N0791334) |
| 8 | Cassette (Part No. N0791285) |
| 9 | Stripe on torch |
| 10 | Index mark on torch holder |

*See the note on page -185.

**Note** If the torch glass does break, discard the broken torch and replace the torch glass. Remove the knurled nut, sleeve and washers and make sure that you remove all glass fragments.

2. Slide in the injector assembly straight into the bottom of the torch cassette then rotate to the right to lock in place.

3. Tighten the knurled nut.

## *Replacing the Torch on the Mount*

The following steps describe how to replace the torch in the mount. Refer to the next two figures.

**Caution** **Only** use PerkinElmer Flat Plate Torch Glassware™. **Using any other glassware will damage the torch.**

**Attention** Utiliser uniquement PerkinElmer Plate Flat Torch Glassware™. **L'utilisation de tout autre verrerie endommager la torche.**

Before installing the Quick-Change Adjustable Torch Module in the sample compartment, check that the plasma induction plates are in place.

1. If the plasma was on, turn off the plasma.

**Warning**

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

2. Open the torch compartment door.
3. At the top of the sample compartment is the black locking pin. This is area where the torch will be removed or inserted.

**Warning**

***Remove the torch only if it is cool.***

**Avertissement:** Retirez la torche que si elle est cool.

4. With one hand loosen the black locking knob while holding the torch by its base with your other hand.
5. Slowly move the torch down through the induction plates and out of the sample compartment.

6. If needed, clean the torch, see *Cleaning the Torch* on page 184. If the torch is cracked or broken carefully dispose of the torch.

**Warning**

***When installing the Torch Module in the next steps, do so carefully so you will avoid breaking the torch and risking possible injury.***

**Avertissement: Lors de l'installation du module de la flamme dans les prochaines étapes, faire avec soin afin que vous éviter de casser la torche et un risque de blessure possible.**

**Caution** Wear cotton gloves when you handle the torch glassware**.**

**Attention** Porter des gants de coton lorsque vous manipulez la verrerie de la torche.

7. To install the torch see *Installing the Quick-Change Adjustable Torch Module* on page 116.

# Scott Spray Chamber

Check the spray chamber periodically for leaks around the nebulizer end cap and drain fitting. Examine the end cap O-ring for cracking and wear and replace if necessary. Deposits and plated out metals can accumulate in the spray chamber, which can introduce “memory effects.” Usually, aspirating a strong acid or solvent will clean out these deposits. If not, remove the spray chamber and clean it in a 5% to 20% nitric acid bath

## Removing the Scott Spray Chamber

1. Place the sample tubing in deionized water and turn on the pump to flush the spray chamber. Remove the sample tubing from the deionized water and continue to run the pump a few minutes until the spray chamber is fully drained. Then turn off the pump.

2. Disconnect the spray chamber drain tubing from the pump tubing for the drain. Be careful not to have liquid spill out of the disconnected drain tubing. Spilled liquid should be cleaned up immediately. Check that the tubing is in good condition and replace if necessary

3. Disconnect the sample tubing from the nebulizer inlet. Check that the tubing is in good condition and replace if necessary

4. Disconnect the nebulizer argon fitting from the gas fitting on the quick disconnect.

5. Open the Scott spray chamber clip assembly that holds the spray chamber in place. The action of opening the clamp will partially push the spray chamber down.

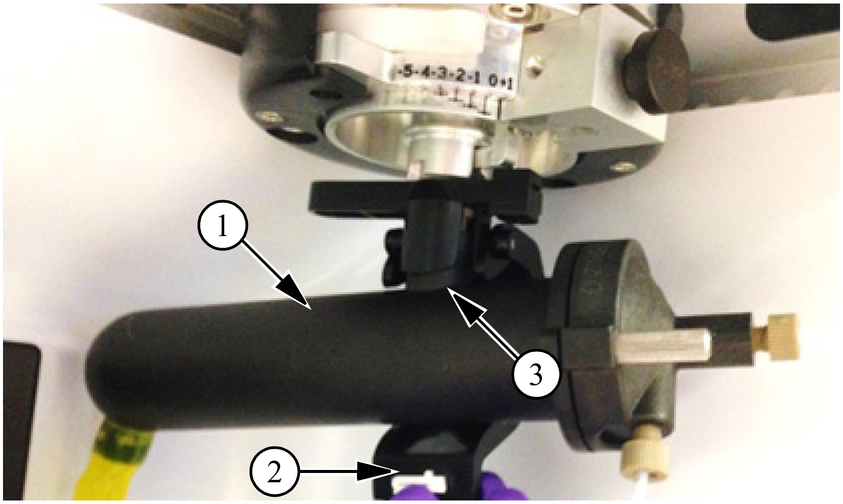



**Figure 5-9 Scott Spray Chamber Clip Assembly Open**

| Item | Description |
|---|---|
| 1 | Scott Spray Chamber in Place |
| 2 | Scott Spray Chamber Assembly open |
| 3 | Opening in Scott Spray Chamber |

6. Firmly hold onto the spray chamber and pull down to disconnect it from the injector adapter.

7. Replace with a new Scott spray chamber. For the full installation procedure see *Connecting the Scott Spray Chamber* on page 132.

## *Removing the End Cap from the Spray Chamber*

1. Loosen, but do not remove, the two knurled screws in the nebulizer end cap. Support the spray chamber with one hand as you twist the end cap and end cap ring, together, off the spray chamber.

2. Examine the spray chamber for any obstructions or wear.

3. The spray chamber has an inner tube that is pressure fitted and difficult to remove. The outer chamber can be damaged if you attempt to remove a tightly fitting inner tube. If the inner tube is damaged, the complete spray chamber should be replaced.

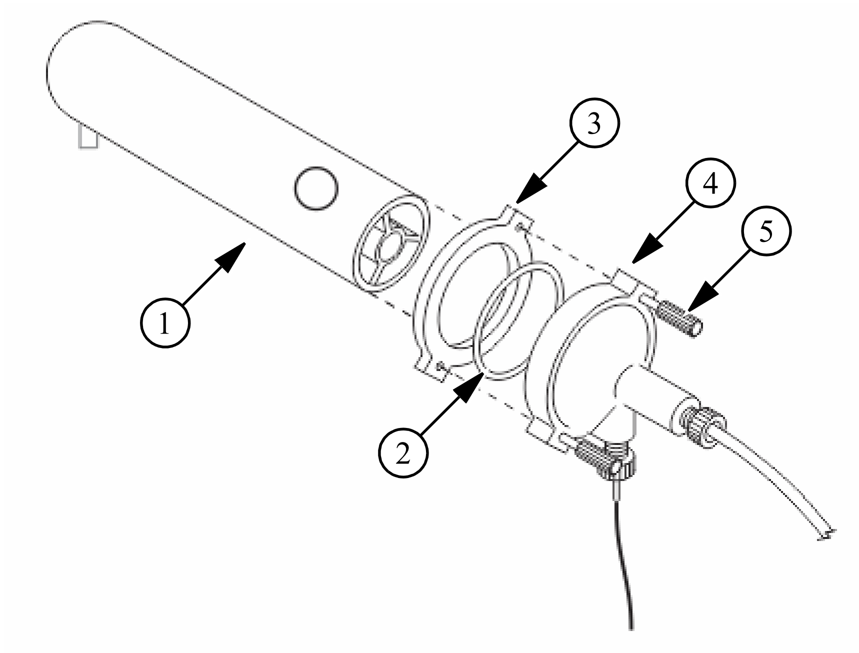



**Figure 5-10** **Spray chamber, end cap, and associated parts. (Illustration shows cross-flow nebulizer end cap assembly, Part No. N0780546.)**

| Item | Description |
| --- | --- |
| 1 | Scott Spray Chamber (Part No. N0791499) |
| 2 | O-Ring (Part No. 09902033) |
| 3 | End Cap Ring (Part No. 00473543) |
| 4 | End Cap (Part No. N0681688 not complete assembly) |
| 5 | Knurled Screw (2) (Part No. 00473539) |

## *Cleaning the Scott-Type Spray Chamber*

If you have been analyzing aqueous solutions, the spray chamber should be cleaned in an acid bath. An ultrasonic bath may be used. Start with a solution of 5% nitric acid or aqua regia and, if deposits persist, increase the acid concentration, up to 20% if necessary. Acid solutions must be used with care. Observe all of the manufacturer's safety recommendations. These recommendations are normally provided in a material safety data sheet (MSDS) supplied with the chemical.

If you have been analyzing organic solutions, the spray chamber can be cleaned using a solvent or diluted soap solution. Be sure to inspect the torch and injector daily for carbon buildup.

O-rings may be cleaned with soap and water. An ultrasonic bath may be used. Replace if cracked or worn. A torch O-ring kit is available. See the list of replacement parts at the end of this chapter.

### Replacing the Scott-Type Spray Chamber

See the procedure *Connecting the Scott Spray Chamber* on page 132.

## Cyclonic Spray Chamber

The cyclonic spray chamber is a glass spray chamber. The cyclonic spray chamber may be used with the concentric glass, low-flow GemCone, and high flow GemCone nebulizers.

There are two cyclonic spray chambers. The baffled cyclonic spray chamber (Part No. N0791352) is recommended for all aqueous and most organic solutions. For really volatile organics, cyclonic spray chamber (Part No. N0777497) can be used.

### Removing the Cyclonic Spray Chamber

Warning

**Handle the cyclonic spray chamber carefully to avoid breaking the glassware and possible injury.**

**Avertissement: Manipuler avec soin la chambre de nébulisation cyclonique pour éviter de casser la verrerie et des blessures.**

1. Disconnect the tubing to the cyclonic spray chamber.

2. With one hand carefully holding on to the base of the cyclonic spray chamber and with the other hand holding the clip disconnect the clip to remove the spray chamber from the injector. See the following figure.

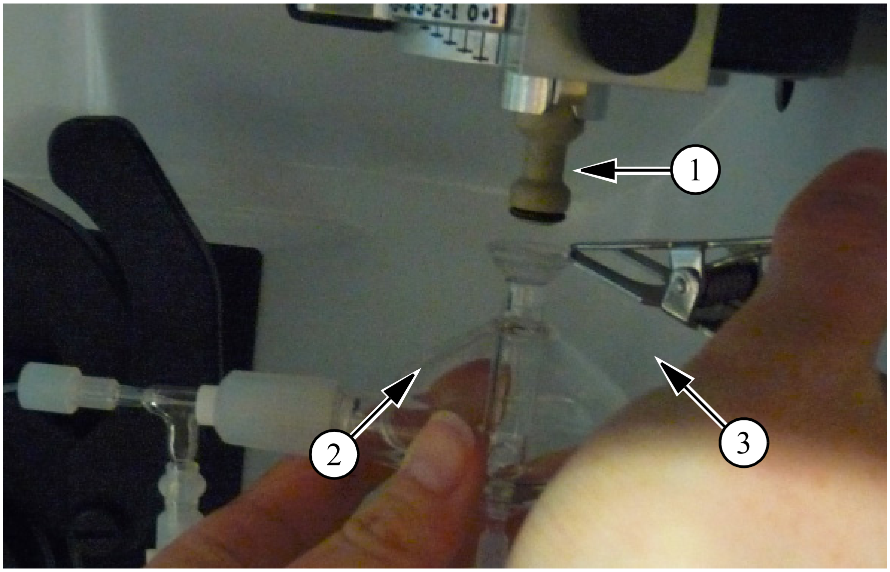



**Figure 5-11 Installing the Cyclonic Spray Chamber**

| Item | Description |
|---|---|
| 1 | Adaptor that Connects to the End of the Injector |
| 2 | Clip |
| 3 | Cyclonic Spray Chamber |

3. Inspect the cyclonic spray chamber and see if it needs to be etched or cleaned or replaced. See the following two procedures.

### Etching the Cyclonic Spray Chamber

Warning

**Hydrofluoric acid — toxic and corrosive.**
Hydrofluoric acid (HF) is toxic, **extremely** corrosive, and can cause severe burns. **Hydrofluoric acid will readily burn skin, and if the fumes are inhaled, lung tissue. Burns may not be immediately painful or visible. Contact with eyes could result in blindness.**

- When using hydrofluoric acid, always wear suitable protective clothing including a face mask, work in a fume hood, and observe the manufacturer's instructions and your local safety regulations.

Warning

**Avertissement: L'acide fluorhydrique - toxique et corrosif.**
L'acide fluorhydrique (HF) est toxique, extrêmement corrosif et peut causer des brûlures graves. **L'acide fluorhydrique sera facilement brûler la peau, et si les vapeurs sont inhalées, les tissus pulmonaires. Les brûlures peuvent ne pas être immédiatement douloureuses ou visibles. Contact avec les yeux peut entraîner la cécité**.

- Lors de l'utilisation de l'acide fluorhydrique, toujours porter des vêtements de protection appropriés, y compris un masque, le travail dans une hotte, et observer les instructions du fabricant et vos règles de sécurité locales.

The cyclonic spray chamber can be etched in order to improve drainage using the following procedure. However, if you will be using the cyclonic spray chamber in determinations of silicon, this procedure should ***not*** be used.

1. Prepare a 0.5% solution of hydrofluoric acid (HF), observing the precautions listed above.

2. Ignite the plasma.

3. Aspirate the HF solution for between 1 and a maximum of 2 minutes.

4. At first, you will see beads of water inside the cyclonic spray chamber, then after approximately 30 seconds, the beads will begin to disappear.

5. Aspirate a rinse solution for several minutes.

### Cleaning the Cyclonic Spray Chamber

If you have been analyzing aqueous solutions, the spray chamber should be cleaned in an acid bath. An ultrasonic bath may be used. Start with a solution of 5% nitric acid or aqua regia and, if deposits persist, increase the acid concentration, up to 20% if necessary. Acid solutions must be used with care. Observe all of the manufacturer's safety recommendations. These recommendations are normally provided in a material safety data sheet (MSDS) supplied with the chemical.

If you have been analyzing organic solutions, the spray chamber can be cleaned using a solvent or diluted soap solution.

**Caution** **Do not use solvents that will attack quartz or glass. The cyclonic spray chamber is not HF resistant.**

**Attention** **Ne pas utiliser de solvants qui attaquent le quartz ou le verre. La chambre de nébulisation cyclonique est pas HF résistant.**

O-rings may be cleaned with soap and water. An ultrasonic bath may be used.

### Installing the Cyclonic Spray Chamber

See the procedure on *Connecting the Cyclonic Spray Chamber* on page 138.

**Table 5-2. Replacement Parts: Spray Chambers**

| Part No. | Description |
|---|---|
| N0791499 | Ryton Double-Pass Scott-Type Spray Chamber |
| N0791352 | Cyclonic Spray Chamber for Aqueous Solutions and Most Organics |
| N0777497 | Cyclonic Spray Chamber for Highly Volatile Organic Solutions |

# Replacing the Plasma Induction Plates

### Plasma Induction Plates

Regularly inspect the plasma induction plates. They should not show any signs of deforming or pitting.

If your lab has high humidity, check the plasma induction plates to make sure they are dry. Use a soft dry cloth to dry the plasma induction plates if necessary. Contact your PerkinElmer Service Representative to replace and adjust the plasma induction plates.

### Replacing the Plasma Induction Plates

The plasma induction plates may need to be replaced occasionally as a result of overheating, pitting, or arcing. Contact your Perkin Elmer Service Representative to replace the plasma induction plates.

**Table 5-3. Replacement Parts: Torch Module**

| Part No. | Description |
|---|---|
| B0810377 | Long radial purge tube |
| N0690672 | Short radial purge tube |
| 09992731 | Axial Window |
| N0790131 | Quartz Torch (standard single slot torch) |
| N0790606 | Dual View Torch Module (includes Torch, Glassware, Injector (Alumina Injector, 2.0mm ID), Scott-type Spray Chamber & GemTip Cross-Flow Nebulizer) |
| N0790607 | Dual View Torch Module (includes Torch, Glassware, Injector (Alumina Injector, 2.0mm ID), Cyclonic Spray Chamber & Meinhard Type K1 Nebulizer) |
| N0791180 | Alumina Injector 0.85mm |
| N0791181 | Alumina Injector 1.2 mm |

**Table 5-3. Replacement Parts: Torch Module (Continued)**

| | |
|---|---|
| N0791182 | Alumina Injector Straight 1.2 mm |
| N0791183 | Alumina Injector, 2.0 mm ID, 150 mm LG (standard injector) |
| N0791184 | Sapphire Injector, 2.0 mm ID, 150 mm LG |
| N0791185 | Quartz Injector 0.8 mm ID |
| N0791186 | Quartz Injector 1.2 mm ID |
| N0791187 | Quartz Injector Straight 1.2 mm ID |
| N0791188 | Quartz Injector 1.6 mm ID |
| N0791189 | Quartz Injector, 2.0 mm ID, 150 mm LG |
| N0776027 | Knurled Nut for Torch Glassware |

# Windows

## Removing and Cleaning the Windows

Warning

**If the plasma has been on, the torch will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur, la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

Gradually, deposits may accumulate on the windows, for example, metallic oxides, and the windows may become etched. You must remove the windows to clean or replace them.

If you notice a drop in UV performance, the purge windows may needed to be cleaned or replaced even if the windows still look clear. Clean the windows first; if the UV performance does not improve replace the windows.

The axial window mount is also the purge outlet for the spectrometer. The radial window is a cylinder with one closed end; this end being the actual window.

## Removing and Replacing the Windows

**Caution** These windows are important parts of the optical system. Handle them carefully, as you would any sensitive optical component. Do **not** directly touch the windows. Always remove the axial window before the radial window and refit the radial window before the axial window. This will help avoid objects or contamination falling into the radial snout.

**Attention** Ces fenêtres sont des éléments importants du système optique. Manipulez-les avec soin, comme vous le feriez pour tout composant optique sensible. Ne touchez pas directement les fenêtres. Retirez toujours la fenêtre axiale avant que la fenêtre radiale et remonter la fenêtre radiale devant la fenêtre axiale. Cela permettra d'éviter des objets ou la contamination de tomber dans le museau radial.

Normally you should remove the axial window before you remove the radial window. This releases the pressure in the spectrometer and helps avoid objects or contamination falling into the radial snout.

### Removing and Returning the Axial Purge Window

**Caution** Wear cotton gloves when you handle the torch glassware**.**

**Attention** Porter des gants de coton lorsque vous manipulez la verrerie de la torche.

**Tool Needed:**

- Purge window aluminum ring removal tool (Part No. N0790448)

1. Turn off the plasma.
2. In order to gain access to the Axial Purge window, you must remove the Shear Gas Nozzle. See *Removing the Shear Gas Nozzle* on page 207.

Warning

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

3. Locate the axial purge window in the torch compartment.

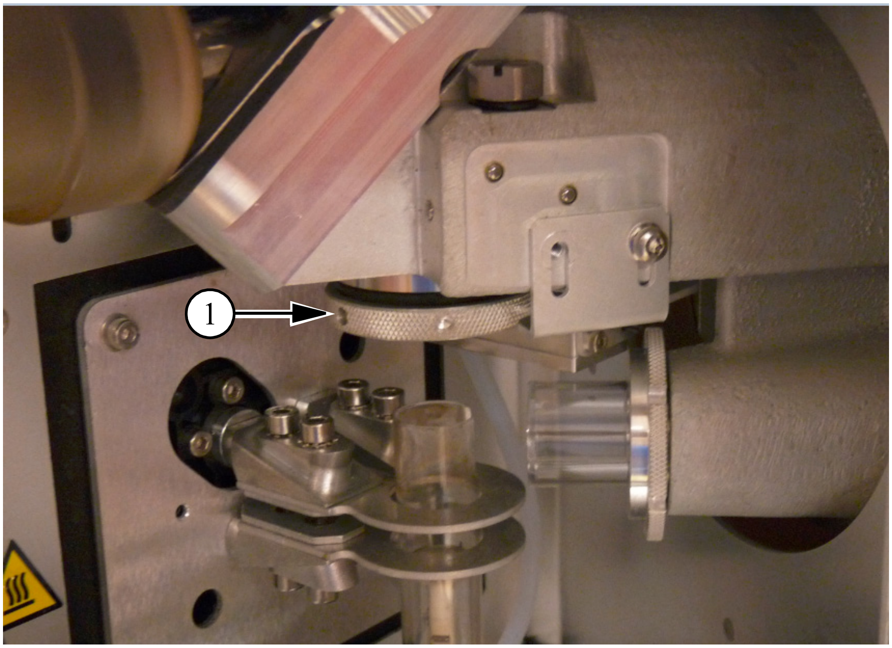



**Figure 5-12 Location of Axial Purge**

| Item | Description |
|---|---|
| 1 | Axial Purge Window Stainless Steel Ring |

4. Use the special removal tool to grip the sides of the ring that holds the axial purge window in place.

5. With the tool in place rotate the tool to the left to loosen the stainless steel ring.

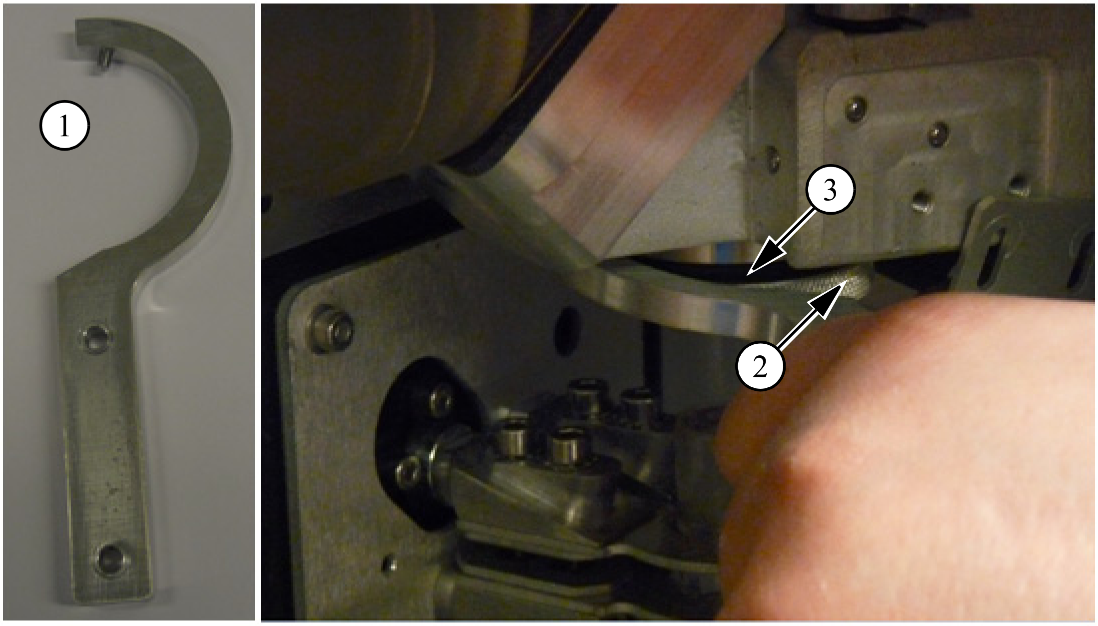



**Figure 5-13 Removing the Axial Purge Window**

| Item | Description |
|---|---|
| 1 | Purge Window Stainless Steel Ring Removal Tool |
| 2 | Axial Purge Window Stainless Steel Ring |
| 3 | Axial Purge Window |

6. With the ring now loosened carefully unscrew the axial purge window mount the rest of the way by hand.

7. Remove the ring that holds the axial purge window in the mount.

8. Lift the axial window and ring out of the mount — take care if the spectrometer purge is set to high and you have not removed the axial window — the pressure inside the spectrometer may force out the axial window.

9. If the window is dirty clean it by following the procedure *Cleaning the Windows* on page 206.

10. If the window is damaged replace with a new axial purge window (Part No. 09992731).

11. Return the new axial purge window in the stainless steel ring to the instrument.

12. Carefully screw it into place.

13. Use the tool to tighten down the stainless steel ring and axial purge window into place.

14. Return the Shear Gas Nozzle. See *Returning the Shear Gas Nozzle* on page 209.

15. Turn on the plasma.

### Removing and Returning the Radial Purge Window

---

**Caution** **Do not leave finger marks on the window.** Use an optical cloth to handle the window. Normally you should install the radial window before the axial window. This helps avoid objects or contamination falling into the radial snout. If the axial window is already installed and the spectrometer purge is set to high, the pressure inside the spectrometer may lift the radial purge window unless you hold it in place until you have tightened the retaining ring.

**Attention** **Ne pas laisser de traces de doigts sur la fenêtre.** Utilisez un chiffon optique pour gérer la fenêtre. Normalement, vous devez installer la fenêtre radiale avant que la fenêtre axiale. Cela permet d'éviter la contamination des objets ou de tomber dans le museau radial. Si la fenêtre axiale est déjà installé et la purge du spectromètre est réglé à haute, la pression à l'intérieur du spectromètre peut soulever la fenêtre de purge radiale, sauf si vous le tenez en place jusqu'à ce que vous avez serré la bague de retenue.

---

**Tool Required:**

- Purge window aluminum ring removal tool (Part No. N0790448)

1. Turn off the plasma.
2. In order to gain access to the Radial Purge window you must remove the Shear Gas Nozzle. See *Removing the Shear Gas Nozzle* on page 207.

**Warning**

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

3. Locate the radial purge window in the torch compartment.

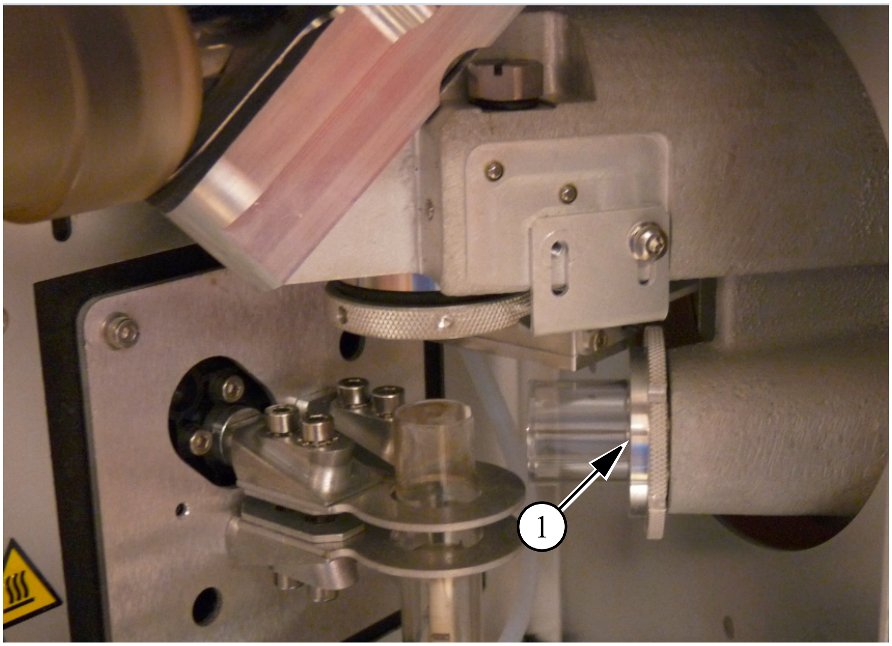



**Figure 5-14 Location of Radial Purge Windows**

| Item | Description |
|---|---|
| 1 | Radial Purge Window (Long Radial Purge Window B0810377 Short Radial Purge Window N0690672) |

4. Use the special removal tool to grip the sides of the ring that holds the radial purge window in place.

5. With the tool in place rotate the tool to loosen the stainless steel ring.

6. With the ring now loosened carefully unscrew the radial purge window mount the rest of the way by hand.

7. Remove the ring that holds the radial purge window in the mount

8. Lift the radial window and ring out of the mount — take care if the spectrometer purge is set to high and you have not removed the radial window, the pressure inside the spectrometer may force out the radial window.

9. If the window is dirty clean it by following the procedure *Cleaning the Windows* on page 206.

10. If the window is damaged, replace with a new radial purge window (Long Radial Purge Window B0810377 or Short Radial Purge Window N0690672).

11. Return the new radial purge window in the stainless steel ring to the instrument.

12. Carefully screw it into place.

13. Use the tool to tighten down the stainless steel ring and radial purge window into place.

14. Return the Shear Gas Nozzle. See *Returning the Shear Gas Nozzle* on page 209.

15. Turn on the plasma.

## *Cleaning the Windows*

**Note** Do **not** rub the surfaces of the windows before you have cleaned them as described below. The more you rub the surface of the windows, the more chance there is of scratching them. You must discard scratched windows. Allow to dry completely before reinstalling. If there is any moisture on the inside of the window, it can degrade the UV performance and/or damage the optics.

1. Rinse the windows thoroughly with deionized water.

2. To remove more stubborn marks:
   Soak the windows in warm, 40°C, 10-20% nitric acid for one hour.
   Rinse the windows thoroughly with deionized water.

3. Dry them with an optical-quality cloth.

4. If the windows are scratched or badly etched, discard them and install new ones.

# Replacing and Adjusting the Shear Gas Nozzle

**Caution** Risk of heat damage to the axial window. **Never** set the nozzle slit behind the front edge of the axial window mount.

**Attention** Risque de dommages de la chaleur à la fenêtre axiale. **Ne jamais** régler la fente de la buse derrière le bord avant de la fenêtre axiale de montage.

The basic shear gas nozzle position is with a 1 to 2 mm gap between the nozzle slit and the front edge of the axial window mount. For some special analyses you may want to move the nozzle, for example, for samples containing organics or salts, set the nozzle slit 4 mm in front of the front edge of the axial window mount.

**Tools Needed:**

- T20 Torx screwdriver

## Removing the Shear Gas Nozzle

1. Turn off the plasma.

**Warning**

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

2. Use a T20 Torx screwdriver to remove the two screws that secure the shear gas nozzle in place. See the following figure.

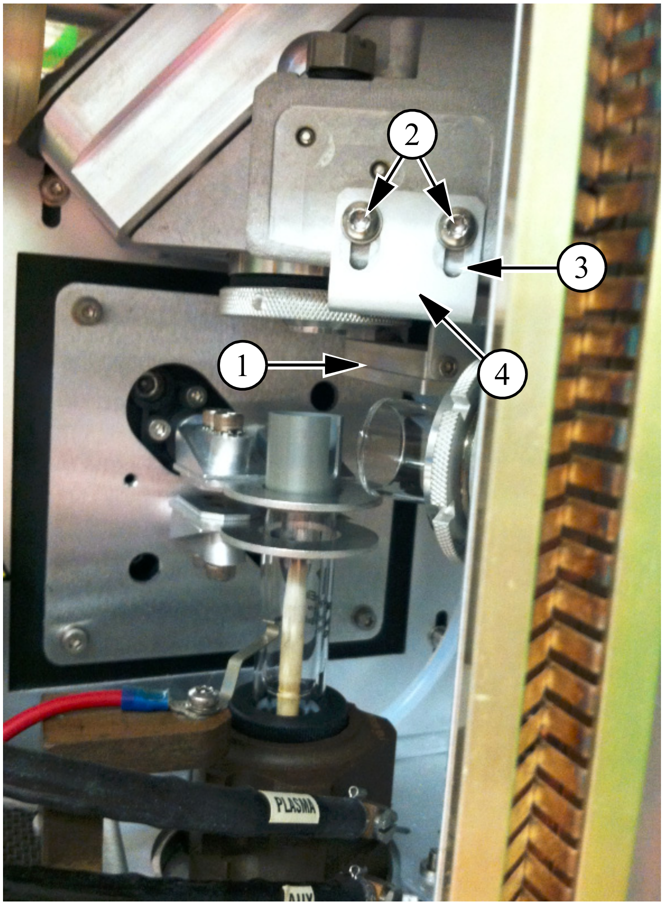



**Figure 5-15 Location of Shear Gas Nozzle**

| Item | Description |
|---|---|
| 1 | Shear Gas Nozzle |
| 2 | Screw Location |
| 3 | Slot |
| 4 | Bracket |

3. See the following procedure on installing a new shear gas nozzle or replacing the existing shear gas nozzle.

### *Returning the Shear Gas Nozzle*

Use this procedure to install a new shear gas nozzle or returning the existing shear gas nozzle if you had to remove it in order to replace either the axial or radial purge window.

1. Place the shear gas assembly back into position. Insert the two screws into the slots on the bracket. Make sure the screws are located at the top of the slot before tightening with the T20 Torx screwdriver (*see Figure 5-15*).
2. Reinstall the torch assembly; see the section *Replacing the Torch* on page 185 earlier in this chapter.
3. Align the torch and perform an axial and radial alignment; refer to the procedure *Setting the Torch Viewing Position* on page 151.

---

**Note** Before you perform an analysis at wavelengths below 190 nm, purge the optics overnight on high purge. For other analyses, purge the system until you obtain a steady signal.

---

**Table 5-4. Replacement Parts: Purge Components**

| Part No. | Description |
|---|---|
| 09921036 | O-Ring (for Dual View Radial Purge Tube) |
| 09921057 | Purge Outlet O-Ring |
| 09992731 | Axial Purge Window |
| N0690672 | Short Radial Purge Window |
| B0810377 | Long Radial Purge Window |

### Adjusting the Position of the Shear Gas Nozzle

**Caution** Risk of heat damage to the axial window. **Never** set the nozzle slit behind the front edge of the axial window mount.

**Attention** Risque de dommages de la chaleur à la fenêtre axiale. Ne jamais régler la fente de la buse derrière le bord avant de la fenêtre axiale de montage.

The basic shear gas nozzle position is with a 1 to 2 mm gap between the nozzle slit and the front edge of the radial window mount. For some special analyses you may want to move the nozzle, for example, for samples containing organics or salts, set the nozzle slit 4 mm in front of the front edge of the axial window mount.

1. Loosen the two Torque screws that hold the shear gas nozzle assembly in position.

2. Slide the assembly to the position you require, then tighten the screws.

## Remove and Replacing the Axial Heat Sink Cooling Tube

1. Turn off the plasma.

**Warning**

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

2. Locate the Axial Heat Sink Cooling Tube in the torch compartment.

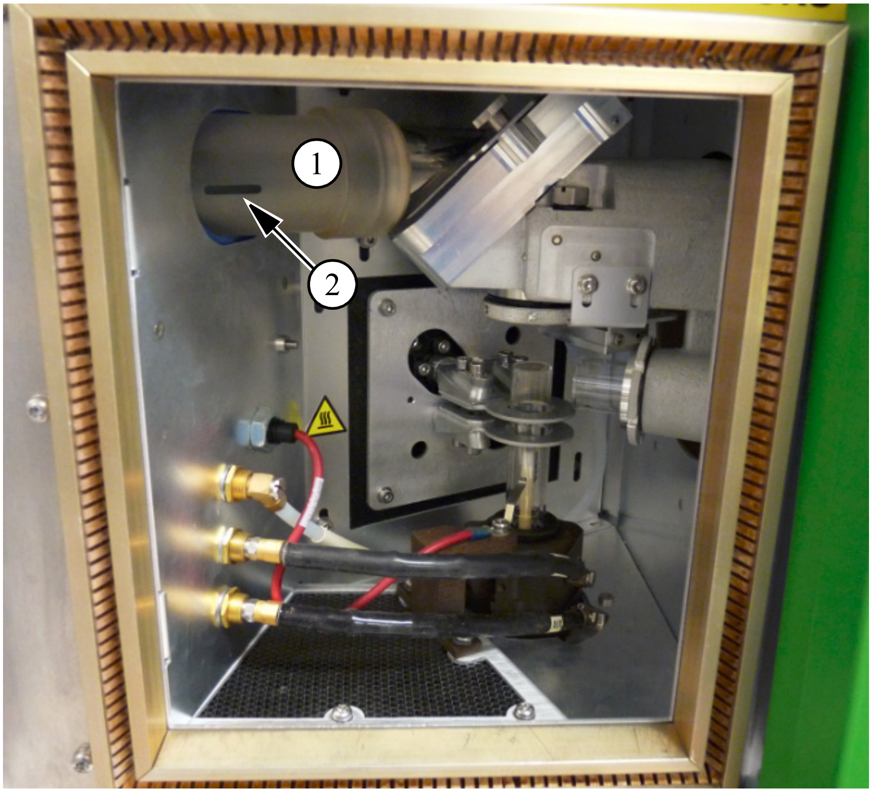



**Figure 5-16 Location of Axial Heat Sink Cooling Tube**

| Item | Description |
|---|---|
| 1 | Axial Heat Sink Cooling Tube |
| 2 | Black Line on the Axial Heat Sink Cooling Tube |

3. Slowly and carefully twist out towards the front of the instrument the Axial Heat Sink Cooling Tube.
4. Slowly and carefully twist in the new Axial Heat Sink Cooling Tube.
5. The Axial Heat Sink Cooling Tube is in the correct position when you can see the black line facing you. See the previous figure.

# Removing and Replacing the Axial Flat Optic

You may need to remove and replace the Axial Flat Optic if you notice reduced Axial sensitivity or counts.

**Tools Needed:**

- 6mm Hex Mini Ratchet

1. Turn of the plasma.

---

Warning

**If the plasma has been on, the torch glass will be very hot and can cause serious burns.** Wait five minutes after turning off the plasma before you begin these maintenance procedures.

**Avertissement: Si le plasma a été mis sur le verre de la torche sera très chaude et peut causer des brûlures graves.** Attendez cinq minutes après avoir éteint le plasma avant de commencer ces procédures d'entretien.

---

2. Remove the Axial Heat Sink Cooling Tube. See *Remove and Replacing the Axial Heat Sink Cooling Tube* on page 210.

3. Remove the thumbscrew on the heat sink cover.

4. Disconnect the Axial Flat Optic Temperature Sensor from the instrument.

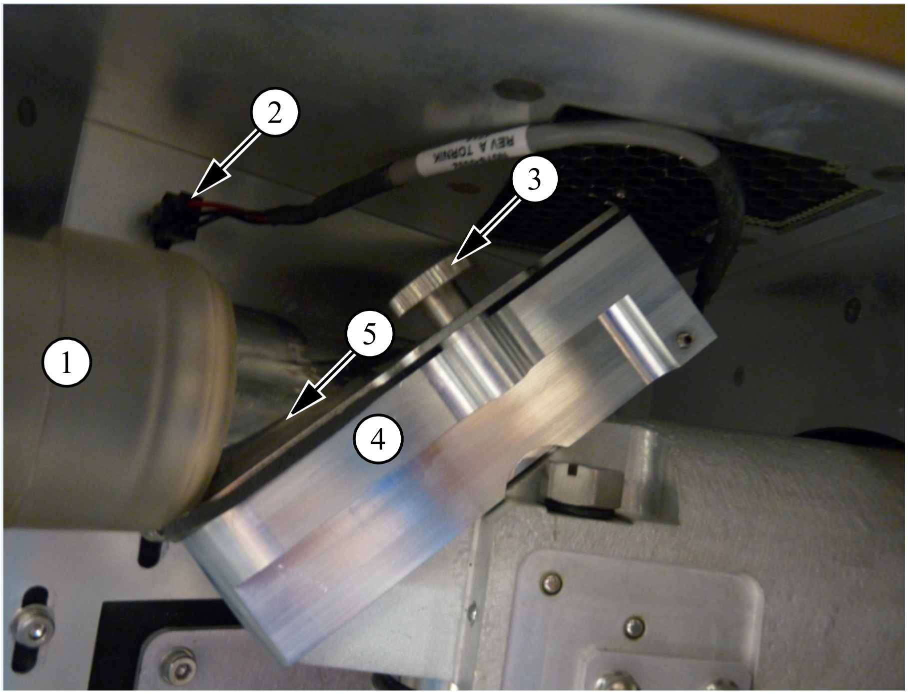



**Figure 5-17 Location of Axial Flat Optic**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Axial Heat Sink Cooling Tube | 3 | Thumbscrew |
| 2 | Axial Flat Optic Temperature Sensor | 4 | Heat Sink |
| 5 | Heat Sink Cover | | |

5. Unhook the cover from the back and slide the cover up and forward to remove.

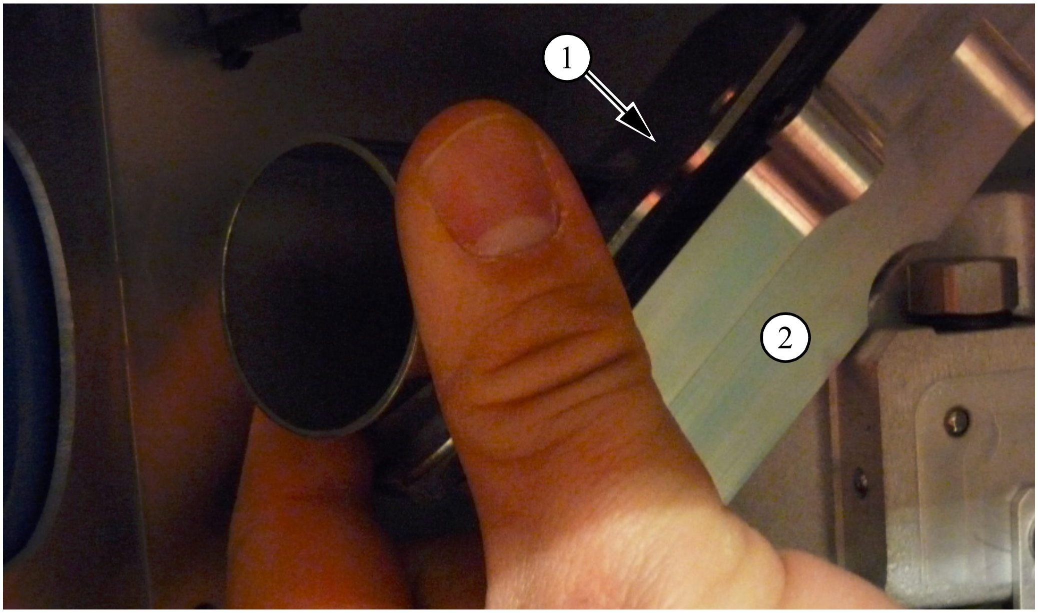



**Figure 5-18 Removing Heat Sink Cover**

| Item | Description |
|---|---|
| 1 | Heat Sink Cover |
| 2 | Heat Sink |

6. Use the 6mm Hex Mini Ratchet to remove the three screws that secure the Axial Flat Optic in place.

**Caution** Wear powder free gloves to avoid contaminating the optics.

**Attention** Porter des gants sans poudre pour éviter de contaminer l'optique.

7. Install the new Axial Flat optic and secure with the three screws with the 6mm Hex Mini Ratchet.

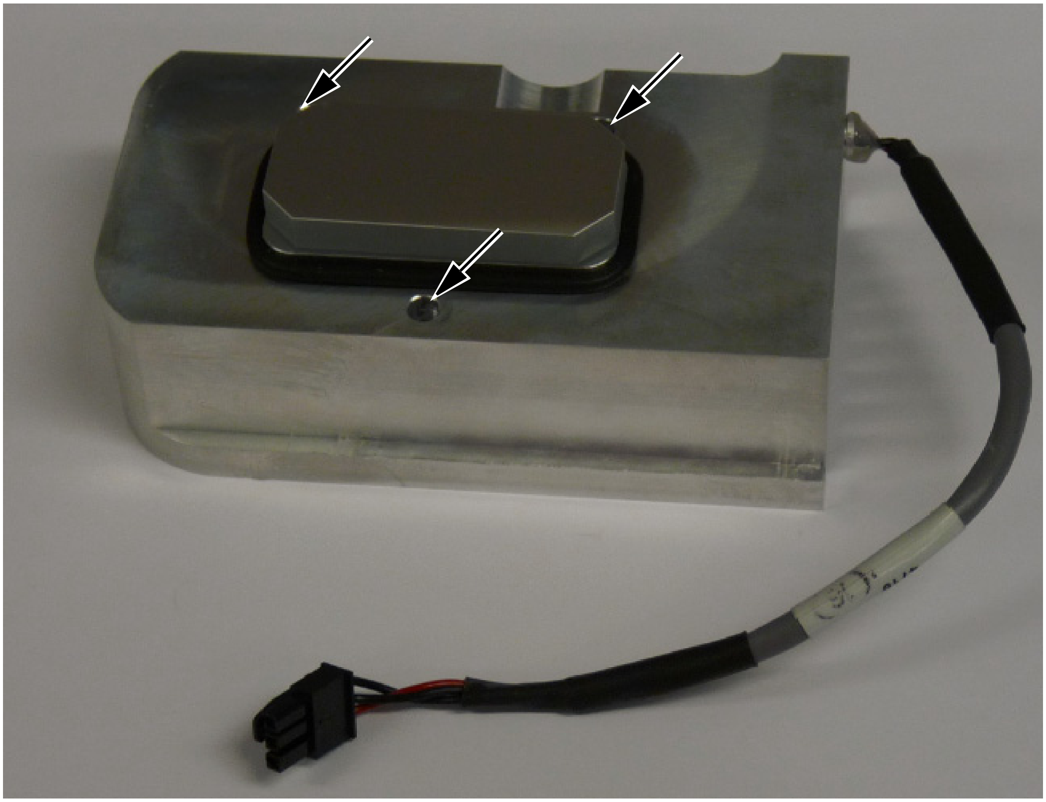


**Figure 5-19 Location of three screws**

8. Replace the cover and return the assembly to the instrument.

9. Reattach the Axial Flat Optic Temperature Sensor to the instrument.

10. Return the thumbscrew on the heat sink cover.

11. Return the Axial Heat Sink Cooling Tube. See *Remove and Replacing the Axial Heat Sink Cooling Tube* on page 210.

# Nebulizers

PerkinElmer offers different types of nebulizers for a wide variety of applications. For descriptions of the nebulizers and their different uses and advantages, refer to Chapter 3, System Description. Part numbers and replacement parts for the different types of nebulizers are listed on the next page.

Recommended flow rates for the nebulizers are given in the table below. If you find that a flow rate is insufficient, this often indicates that the nebulizer has clogged and requires cleaning. On GemTip and GemCone nebulizers, you should also check that the argon gas fitting is properly tightened. If a space collar is used, tighten the fitting with a wrench until you can no longer turn the knurled space collar. If a space collar is not used, finger-tighten the fitting, then using a wrench, turn clockwise 1/8-turn.

**Table 5-5. Nebulizer Flow Rates**

| | Argon Flow Rate | |
|---|---|---|
| **Nebulizer** | **Typical Value** | **Operating Range** |
| GemTip Cross-Flow | 0.6 L/min | 0.4 - 1.3 L/min |
| Low-Flow GemCone | 0.6 L/min | 0.4 - 0.95 L/min |
| High Flow GemCone | 1.0 L/min | 0.7 - 1.0 L/min |
| Concentric Glass (MEINHARD) Type A | 0.70 L/min | 0.4 - 1.3 L/min |
| Concentric Glass (MEINHARD) Type C | 0.70 L/min | 0.4 - 1.3 L/min |
| Concentric Glass (MEINHARD) Type K1 | 0.70 L/min | 0.4 - 0.95 L/min |
| Concentric Glass (MEINHARD) Type K3 | 0.70 L/min | 2.5 - 3.5 mL/min |
| Ultrasonic | 0.5 L/min | n/a |
| Mira Mist | 0.70 L/min | 0.6-1.0 L/min |

**Table 5-6. Replacement Parts: Nebulizers and End Caps**

| Part No. | Description |
|---|---|
| 00472020 | MEINHARD Nebulizer (Type A, General purpose) |
| 00473194 | O-Ring (for Nebulizer Seal on End Cap) |
| 09902033 | O-Ring for Cross Flow Nebulizer End Cap |
| N0680504 | End Cap for GemCone Nebulizers |
| N0681574 | MEINHARD Type K3 |
| N0690670 | High Solids GemCone Nebulizer |
| N0691709 | CETAC U-6000AT$^{+}$ Ultrasonic Nebulizer System, 115 V, 50/60 Hz |
| N0691710 | CETAC U-6000AT$^{+}$ Ultrasonic Nebulizer System, 230 V, 50/60 Hz |
| N0775330 | PEEK Mira Mist Nebulizer |
| N0777707 | MEINHARD Nebulizer (Type K1) Note: This is the standard nebulizer for the Cyclonic/Meinhard systems. |
| N0780546 | GemTip Cross-Flow II Nebulizer |
| N0780676 | GemTip Replacement Nebulizer Tips for GemTip Cross-Flow Nebulizer |

# GemTip Cross-Flow Nebulizer

The following procedures cover the maintenance of the GemTip Cross-Flow nebulizer supplied with the instrument.

To check the performance of the nebulizer, aspirate a standard and note the intensity reading. If the intensity is significantly lower than it should be, first check that:

- The pump tubing is in good condition (has no flat spots).
- The sample capillary is in good condition (has no kinks) and is clean.
- The plasma viewing position is set properly (using the software's alignment function).

Also try flushing out the nebulizer by aspirating for several minutes using either:

- a 1% acid solution, if you have been analyzing aqueous solutions, or
- a solvent, if you have been analyzing organic solutions.

Recheck the intensity of the standard. If the intensity is still too low, you should check the nebulizer spray pattern. Before removing the nebulizer/end cap to check the spray pattern, be sure to pump deionized water for several minutes to thoroughly flush it out.

**Warning**

When checking the spray pattern of the nebulizer pump only use deionized water. Do **not** use any other solution.

**Avertissement:** Lors de la vérification du motif de pulvérisation de la pompe nébuliseur utiliser uniquement de l'eau déminéralisée. **Ne pas** utiliser toute autre solution.

### Removing the Nebulizer/End Cap

To remove the nebulizer/end cap assembly:

1. Turn off the plasma if it is on.

---

**Warning**

If the plasma has been on, allow one minute for the Quick-Change Adjustable Torch Module to cool and an additional two minutes for the torch to cool before handling.

Avertissement: If the plasma has been on, allow one minute for the Quick-Change Adjustable Torch Module to cool and an additional two minutes for the torch to cool before handling.

---

2. Open the door on the left side to the sample compartment.

3. Loosen, but do not remove, the two knurled screws in the nebulizer end cap. Support the spray chamber with one hand as you twist the end cap and end cap ring, together, off the spray chamber.

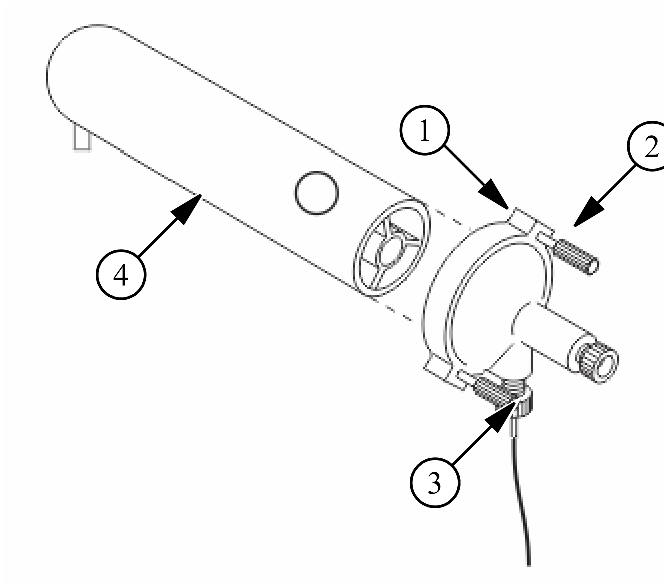



**Figure 5-20 The nebulizer/end cap assembly removed from the spray chamber. Illustration shows cross-flow nebulizer end cap assembly.**

| Item | Description |
|---|---|
| 1 | Cross-Flow GemTip Nebulizer End Cap Assembly (Part No. N0780546) |
| 2 | Knurled Screw (Part No. 00473539) |
| 3 | Knurled Screw (Part No. 00473539) |
| 4 | Spray Chamber (Part No. N0791499) |

4. To check the spray pattern, leave the sample capillary tubing and the nebulizer argon tubing connected. Then refer to the next procedure.

### Checking the Spray Pattern

Once you have thoroughly flushed out the nebulizer with deionized water and removed the nebulizer/end cap, you can follow these steps to check the nebulizer spray pattern:

**Warning**

When checking the spray pattern of the nebulizer, pump only use deionized water. Do **not** use any other solution.

**Avertissement:** Lors de la vérification du motif de pulvérisation du nébuliseur, pompe utiliser uniquement de l'eau déminéralisée. Ne pas utiliser toute autre solution.

1. Set the nebulizer argon flow to 0.6 L/min.

2. Place the sample capillary tubing in a beaker of deionized water and start the pump at a rate of 1.5 mL/min.

3. Check the spray pattern on a paper towel. You should see a fine, even spray of uniform sample droplets.

If the spray pattern is not even or the nebulizer is sputtering, the nebulizer tips should be inspected for clogging and cleaned or replaced as necessary. See the following procedure.

Complete replacement of the nebulizer/end cap assembly may be necessary if the GemTips are not seated properly inside the cap (see the next figure) or if the end cap does not fit properly on the spray chamber.

### *Disassembling the Cross-Flow Nebulizer*

Disassemble the nebulizer if it is necessary to clean or replace the GemTips. The Cross-Flow nebulizer has two GemTips. The sample tip is a clear sapphire and the argon tip is a red ruby. *These tips are **not** interchangeable.* For this reason, we recommend that you first remove one GemTip, clean or replace it, then remove the other.

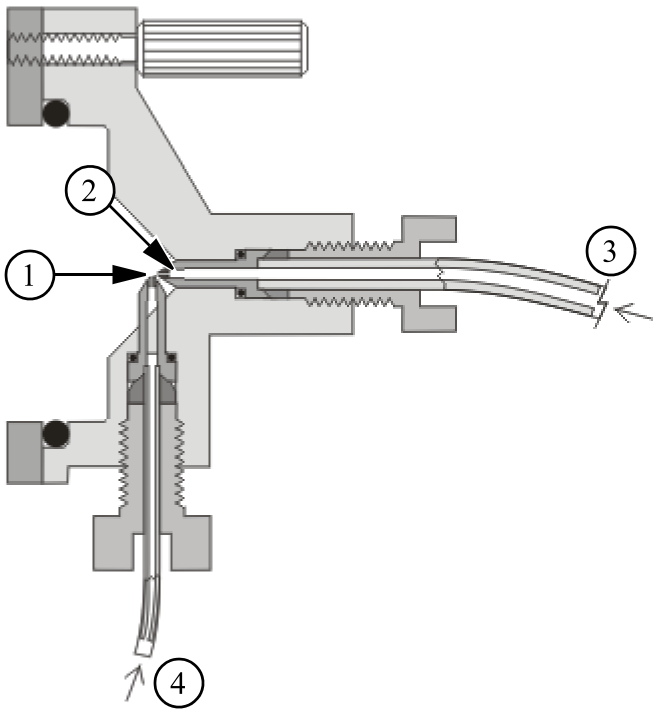



**Figure 5-21 Cross-section of GemTip Cross-Flow Nebulizer shown with Cross-Flow End Cap, Part No. N0780546.**

| Item | Description |
| --- | --- |
| 1 | Clear GemTip |
| 2 | Red GemTip |
| 3 | Argon Inlet |
| 4 | Sample Inlet |

To begin disassembling the nebulizer:

1. If you have not already done so, remove the nebulizer/end cap assembly from the spray chamber.

2. Disconnect the sample capillary tubing by removing it from the pump tube.

3. Disconnect the nebulizer argon tubing at the gas fitting. Do **not** disconnect nebulizer argon tubing from the end cap because the GemTip could fall out.

4. Inspect the inside of the end cap. If metal or salt deposits are found, clean the cap using a dilute acid solution.

### *Removing the Sample Tip from the End Cap, N0780546*

1. Loosen the nut on the sample inlet. Remove the nut along with the tubing piece and ferrule. See the next figure.

2. Using your fingers, push the sample tip out from the inside of the end cap, being careful not to damage it. Do ***not*** use any metal tools to remove the nebulizer tips because this may damage the tips or end cap.

3. Inspect the sample tip. Clean the tip using soap and water or a dilute solution of nitric acid. An ultrasonic bath may be used.

   If you need to replace the sample tip, be sure to replace it with a clear GemTip. GemTips must be purchased in a set (Part No. N0780676). They are not available separately.

4. Inspect the O-ring (Part No. 09921045), replace if it is worn or cracked.

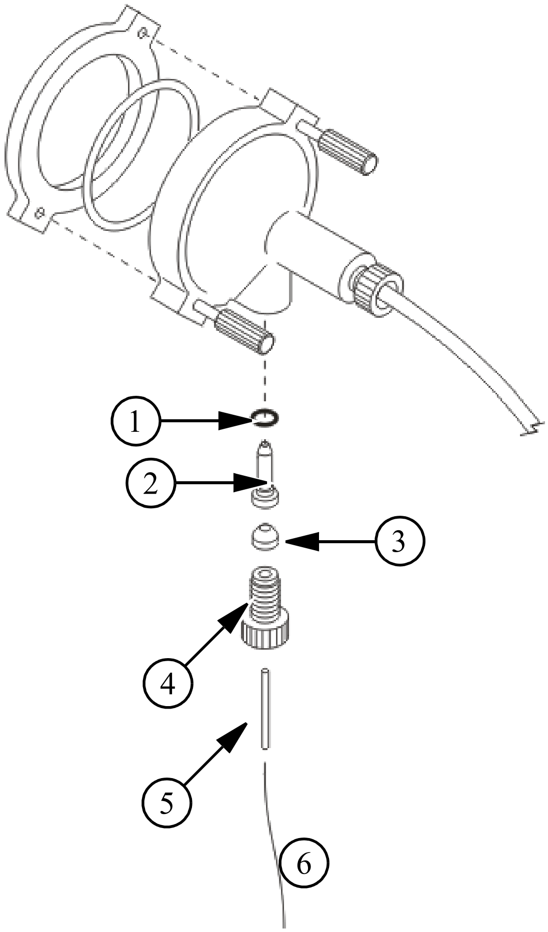



**Figure 5-22 Clear GemTip for sample inlet and associated parts for Cross-Flow End Cap, Part No. N0780546.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | O-Ring (Part No. 09921045) | 4 | Nut (Part No. 09920546) |
| 2 | Clear GemTip Nebulizer (Sample Inlet Available in GemTip Kit Part No. N0780676) | 5 | 1/16 inch O.D. Teflon Tubing Piece (Part No. 09985708) |
| 3 | Ferrule (Part No. 09920518) | 6 | Sample Capillary Tubing |

5. Check the condition of the tubing piece (Part No. 09985708). If the tubing is worn, replace it as follows:

    - Obtain a new piece of 1/16-in. O.D. Teflon tubing (Part No. 09985708).
    - Using a razor blade, make a straight cut on one end of the tubing.
    - Insert a nut (Part No. 09920546) and ferrule (Part No. 09920518) on the newly cut end of the tubing with the ferrule oriented as shown in the figure below.

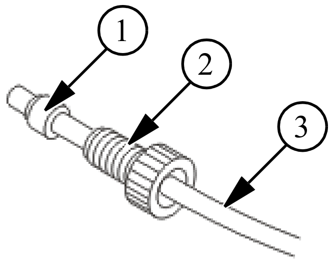



**Figure 5-23 Installing new tubing for the sample inlet. Cross-Flow End Cap, N0780546.**

| Item | Description |
|---|---|
| 1 | Ferrule (Part No. 09920515) |
| 2 | Nut (Part No. 09920545) |
| 3 | 1/8 inch O.D. Tubing (Part No. 09985723) |

6. To reassemble the nebulizer make sure that the O-ring is completely seated on the base of the sample tip, then insert the sample tip into the sample inlet.

7. With the tubing and ferrule assembled as shown in the previous figure, screw the nut into the sample inlet making a finger-tight connection. **Do not use any tools to tighten the nut.**

8. Examine the two GemTips in the end cap. These tips should almost butt up to each other at an angle of 90 °.

9. If you have installed new 1/16-in. tubing, cut the tubing so that it extends approximately 1/2 in. beyond the nut.

10. For the sample capillary tubing, use a piece of 0.023 in. (inner diameter) polyethylene tubing (Part No. 09908265). Using a razor blade, bevel the tubing by cutting it at an angle. Insert the sample capillary tubing into the tubing piece.

### *Removing the Argon Tip from the End Cap, N0780546*

1. Loosen the nut on the argon inlet. Remove the nut along with the tubing and ferrule. See the next figure.

2. Using your fingers, push the argon tip out from the inside of the end cap, being careful not to damage it. Do **not** use any metal tools to remove the nebulizer tips because this may damage the tips or end cap.

3. Inspect the argon tip. Clean the tip using soap and water or a dilute solution of nitric acid. An ultrasonic bath may be used.

   If you need to replace the tip, be sure to replace it with a *red* GemTip. GemTips must be purchased in a set (Part No. N0780676). They are **not** available separately.

4. Inspect the O-ring (Part No. N09921045), replace if it is worn or cracked.

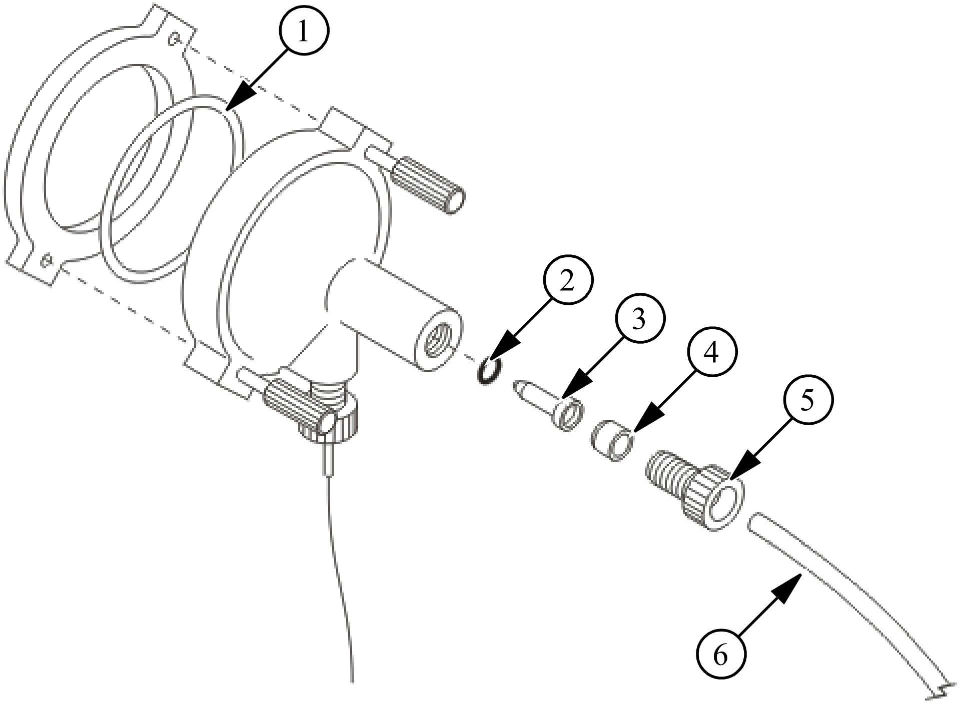



**Figure 5-24 Red GemTip for argon inlet and associated parts for Cross-Flow End Cap (Part No. N0780546).**

| Item | Description |
|---|---|
| 1 | End Cap O-Ring (par No. 09902033) |
| 2 | O-Ring (Part No. 09921045) |
| 3 | Red GemTip Nebulizer -Argon Inlet (Part No. N0780676) |
| 4 | Ferrule (Part No. 09920515) |
| 5 | Nut (Part No. 09920545) |
| 6 | 1/8 inch O.D. Tubing (Part No. 09985723) |

5. To reassemble the nebulizer make sure that the O-ring is completely seated on the base of the argon tip, then insert the argon tip into the argon inlet.

6. Check the condition of the argon inlet tubing (Part No. 09985723). If the tubing is worn, replace it as follows. See the next figure.

a. Obtain a new piece of 1/8-in. O.D. Teflon tubing (Part No. 09985723).

b. Using a razor blade, make a straight cut on one end of the tubing. Wire cutters or scissors do not make acceptable cuts.

c. Insert a nut (Part No. 09920545) and ferrule (Part No. 09920515) on the newly cut end of the tubing, with the ferrule oriented as shown in the figure below.

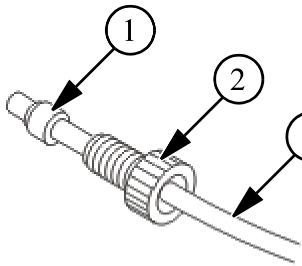



**Figure 5-25 Installing new tubing for the argon inlet. Cross-Flow End Cap, Part No. N0780546.**

| Item | Description |
| --- | --- |
| 1 | Ferrule (Part No. 09920515) |
| 2 | Nut (Part No. 09920545) |
| 3 | 1/8 inch O.D. Tubing (Part No. 09985723) |

7. With the tubing and ferrule assembled as shown in the figure above, screw the nut into the argon inlet making a finger-tight connection. Do **not** use any tools to tighten the nut.

8. Examine the two GemTips in the end cap. These tips should almost butt up to each other at an angle of 90 °.

### Connecting the Nebulizer Argon Tubing (Cross-Flow End Cap, N0780546)

1. Pass the tubing (Part No. 09985723) through the nut (Part No. 09920545) and attach the ferrule (Part No. 09920515) on the end of the tubing. See the following figure.

2. Insert the ferrule with the tubing and nut to the Male Quick Disconnect (Part No. N0775206). Connect the entire Quick Disconnect to the sample introduction system. See the following figure.

### Replacing the Nebulizer Argon Tubing (Cross-Flow End Cap, N0780546)

If you replace the argon tubing with new tubing, you will need to replace the Swagelok nut as follows. See the previous figure.

1. Using a razor blade, make a straight cut on one end of the tubing. Wire cutters or scissors do not make acceptable cuts.

2. Put the 1/8-in. Swagelok nut (Part No. 09903128), rear ferrule, front ferrule, and tubing insert onto the tubing as shown in the figure below.

3. Finger-tighten the nut on the Brass Reducer Fitting.

4. Connect the nebulizer argon tubing to the NEB connection with the quick disconnect.

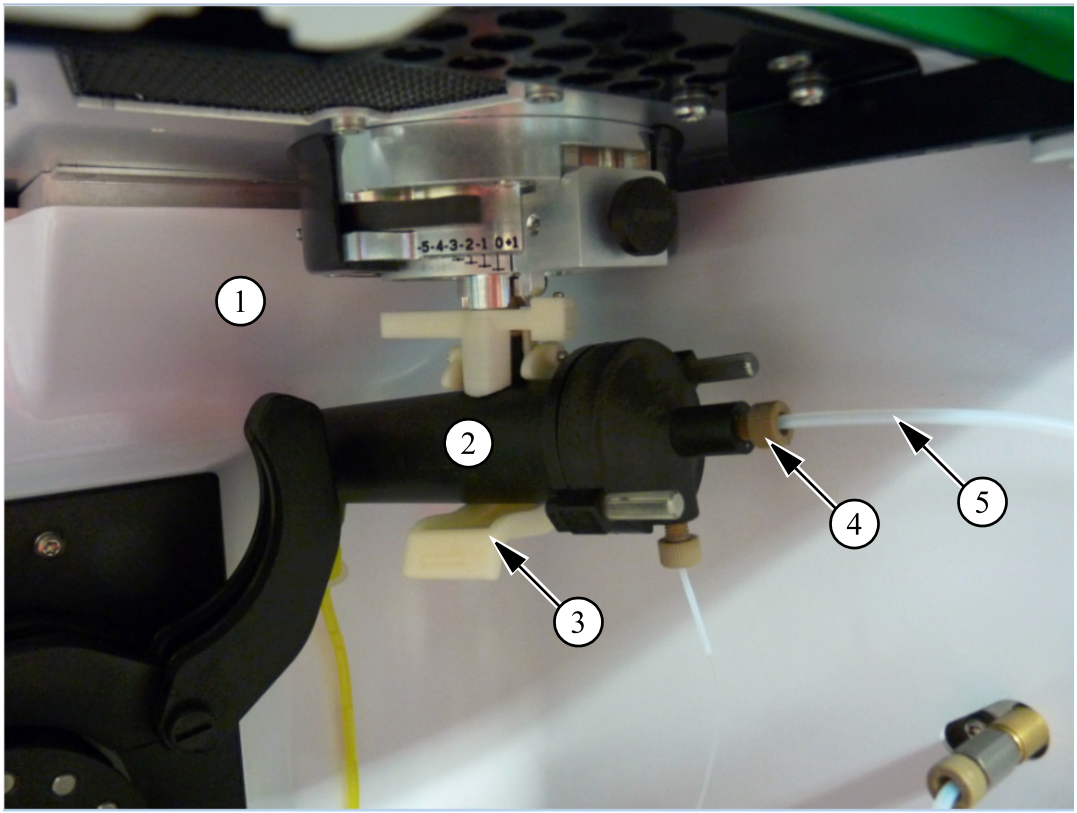



**Figure 5-26 Connecting the tubing.**

| Item | Description |
|---|---|
| 1 | Sample Compartment |
| 2 | Scott Spay Chamber |
| 3 | Clip |
| 4 | Nut (Part No. 09920545) |
| 5 | 1/8 inch O.D. Tubing (Part No. 09985723) |

## Replacing the Nebulizer/End Cap

*Before* replacing the end cap:

- Check the end cap O-ring (Part No. 09902033) for nicks or cracks. If you need to replace the O-ring, remove the two knurled screws and the end cap ring. When placing the end cap ring back on the end cap, install it with the flat side against the O-ring and the molding marks (small circular indentations) against the end cap.

- If you have just replaced the nebulizer tips, connect the sample capillary tubing and the nebulizer argon tubing to the nebulizer and check the spray pattern to make sure it is even. See *Checking the Spray Pattern* on page 220.

To replace the end cap:

1. Moisten the O-ring to make replacing the end cap easier. Make sure that the two knurled screws that hold the end cap and the ring together are loose.

2. With one hand supporting the far end of the spray chamber, push and twist the nebulizer/end cap onto the spray chamber so that the end cap seats firmly onto the spray chamber.

3. Alternately hand-tighten the two knurled screws until the end cap ring is pulled snug against the end cap.

4. If you have not already done so, connect the sample capillary tubing and nebulizer argon tubing.

# GemCone Nebulizer

## Daily Cleaning of the Low-Flow GemCone Nebulizer

Each day after use, the low-flow GemCone nebulizer should be rinsed out by pumping deionized water to the nebulizer for several minutes. This should be done with both the plasma on and the nebulizer gas on. This helps prevent the formation of salt crystals near the exit of the nebulizer gas orifice. The plasma should be on to prevent aerosol from condensing on the purge window.

## Daily Cleaning of the High Solids GemCone Nebulizer

It is important to rinse the high solids nebulizer after use, particularly when working with solutions containing high levels of solids. You do this by pumping deionized water for several minutes to wash out any solid material that may have crystallized on the inside surface of the nebulizer. If a stronger cleaning solution is required, a solution of 1% acid in deionized water may be used in place of the deionized water. The plasma should be on to prevent aerosol from condensing on the purge window.

To rinse the argon orifice:

1. Place the sample capillary tube in deionized water or 1% acid in deionized water and operate the pump.

2. Momentarily shut off the nebulizer gas flow for about 30 seconds.

3. Turn the nebulizer gas back on.

   This procedure can be performed more than once a day in cases where very high levels of dissolved solids are aspirated through the nebulizer for prolonged periods of time.

## *Installing the GemCone Nebulizer on the Scott-Type Spray Chamber*

To install the GemCone nebulizer on the Scott-type spray chamber, the end cap assembly (Part No. N0680504) and the tubing assembly (Part No. N0770336) must be used.

1. Remove the existing nebulizer/end cap assembly (if the wrong one is installed) by loosening the knurled nuts on the end cap. Use a gentle twisting action to remove the assembly from the spray chamber.

2. Assemble the correct end cap (Part No. N0680504) to the spray chamber with a twisting action.Alternately hand-tighten the knurled screws until the end cap ring is pulled snugly against the end cap.

3. Before inserting the GemCone nebulizer into the cap, connect the argon gas fitting to the threads on the nebulizer where shown in the next figure. First, tighten the gas fitting by hand. Tighten the fitting another 1/8 of a turn using a 9/16-in. open-end wrench. Support the nebulizer with a back-up wrench when tightening or loosening fittings. Do **not** overtighten the fitting as this may cause leaking and poor ICP performance.

4. Connect the capillary tubing to the nebulizer. Be sure not to crimp or bend the tubing as you insert it. Crimps may reduce flow to the tip of the nebulizer or may cause air to enter the liquid stream during operation.

5. Insert the nebulizer as far as it will go through the opening in the end cap.

6. Tighten the nut on the end cap so that it is finger-tight.

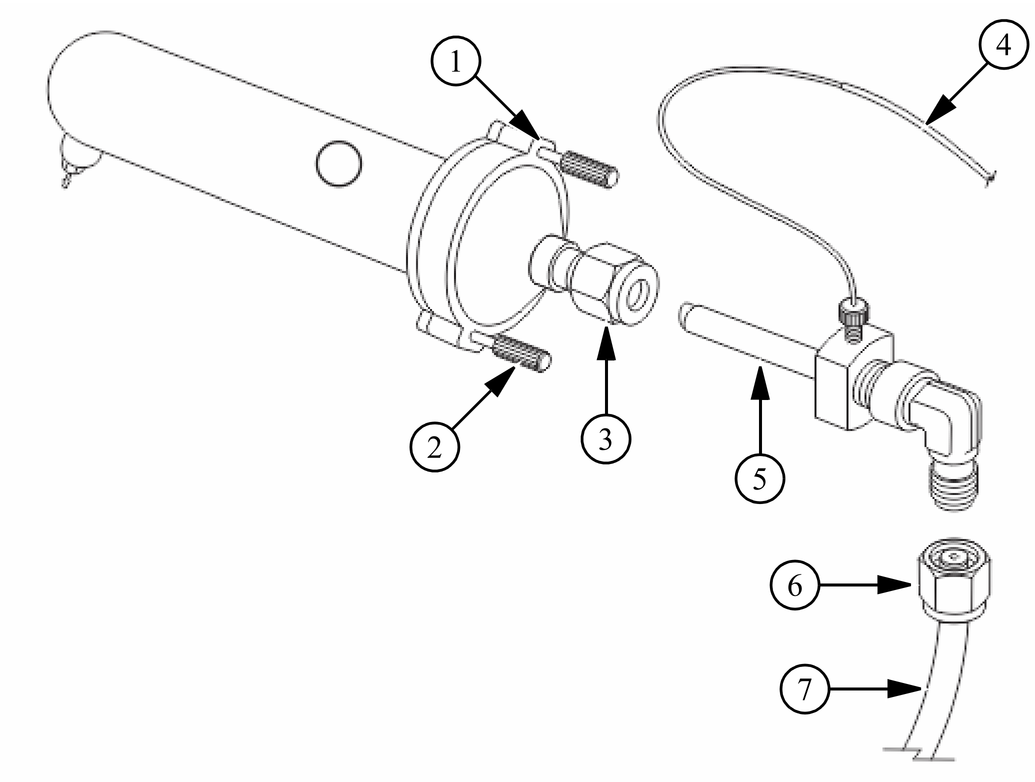



**Figure 5-27** **Installing the GemCone nebulizer to a Scott-type spray chamber.**

| Item | Description |
|---|---|
| 1 | End Cap Assembly (Part No. N0680504) |
| 2 | Knurled Nut-2 (Part No. 00473539) |
| 3 | Nut |
| 4 | Capillary Tubing (Part No. 09908265) |
| 5 | GemCone Nebulizer Assembly |
| 6 | Argon Gas Fitting |
| 7 | Tubing Assembly (Part No. N0770336) |

### Installing the GemCone Nebulizer on the Cyclonic Spray Chamber

1. Before inserting the GemCone nebulizer into the chamber, connect the argon gas fitting to the nebulizer threads. First, tighten the gas fitting by hand. Tighten the fitting another 1/8 of a turn using a 9/16-in. open-end wrench. Support the nebulizer with a back-up wrench when tightening or loosening fittings. Do **not** overtighten the fitting as this may cause leaking and poor ICP performance.

2. Connect the capillary tubing to the nebulizer. Be sure not to crimp or bend the tubing as you insert it. Crimps may reduce flow to the tip of the nebulizer or may cause air to enter the liquid stream during operation.

3. Insert the nebulizer into the cyclonic spray chamber as shown in the next figure. The nebulizer may be inserted to its fullest extent.

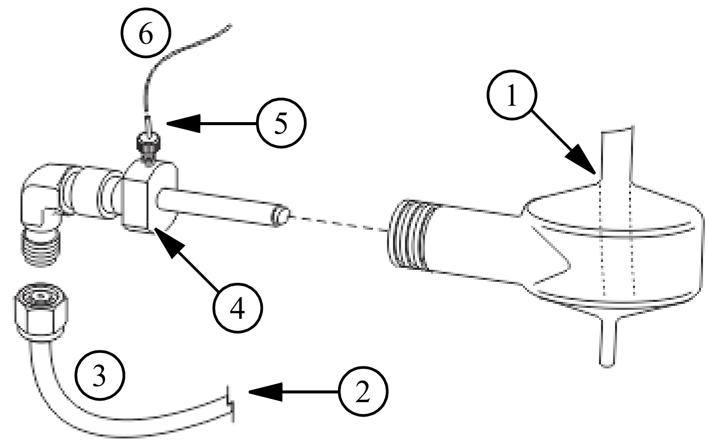



**Figure 5-28 Connecting the GemCone nebulizer to the cyclonic spray chamber.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Cyclonic Spray Chamber | 4 | GemCone Nebulizer Assembly |
| 2 | Tubing Assembly for the GemCone Nebulizer (Part No. N0770336) | 5 | Teflon Tubing-1 inch (Part No. 09985708) |
| 3 | Argon Gas Fitting | 6 | Capillary Tubing (Part No. 09908265) |

## Cleaning the GemCone Nebulizer

With routine use it may become necessary to perform a thorough cleaning.

1. Remove the nebulizer from the end cap (loosen both thumbscrews).

2. Disconnect the argon gas fitting and the capillary tube connection from the nebulizer.

3. Immerse the nebulizer in a solution of liquid laboratory cleaner (such as "Microcleaning" solution, Cole-Parmer). Use the recommended concentration of cleaning solution.

4. Apply ultra-sonication to the solution containing the nebulizer for about five minutes.

5. Rinse the nebulizer thoroughly using deionized water.

6. Dry the gas passages of the conespray nebulizer by connecting the argon gas fitting and turning on the argon flow to 1 L/min. Allow the argon flow to dry the internal passages for several minutes.

## GemCone Liquid Fitting Maintenance

It is possible to remove the liquid inlet fitting to the nebulizer. The clear plastic fitting has a knurled head and can be unscrewed by hand. Before reconnecting the fitting, make sure that about 1-2 mm of tubing protrudes out from the sealing side of the fitting. Screw the fitting back into the nebulizer and snug to hand tightness.

# Concentric Glass Nebulizer

## Installing the Concentric Nebulizer on the Cyclonic Spray Chamber

Warning

**Handle the concentric nebulizer carefully to avoid breaking the glassware and possible injury.**

**Avertissement:** Manipuler avec soin le nébuliseur concentrique pour éviter de casser la verrerie et des blessures.

1. The spacer must be installed on the concentric glass nebulizer assembly.

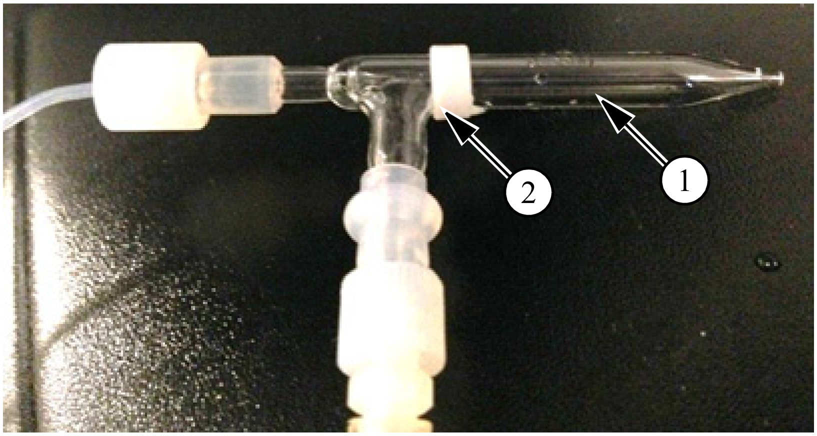



**Figure 5-29 Concentric Glass Nebulizer Assembly**

| Item | Description |
|---|---|
| 1 | Concentric Glass Nebuizer Assembly |
| 2 | Spacer |

2. Install the concentric glass nebulizer assembly into the spray chamber.

3. The nebulizer should be pushed flush against the spacer, which will sit flush against the knurled nut on the spray chamber. However, the nebulizer may be moved slightly out to optimize intensities and RSDs.

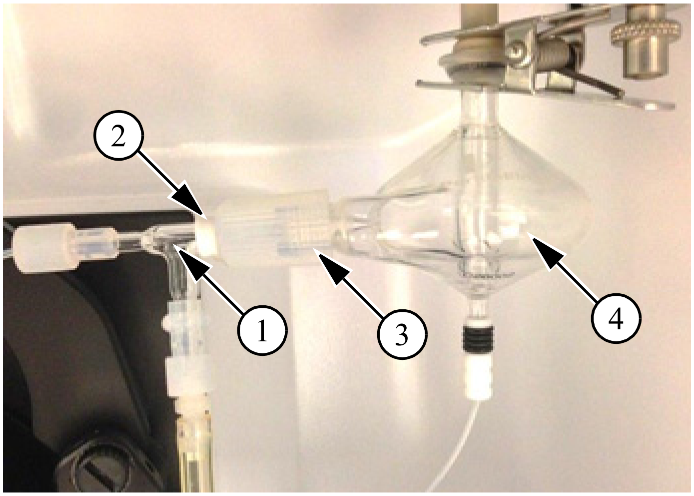



**Figure 5-30 Concentric Glass Nebulizer Assembly Attached to the Spray Chamber**

| Item | Description |
|---|---|
| 1 | Concentric Glass Nebuizer Assembly |
| 2 | Spacer |
| 3 | Knurled Nut |
| 4 | Cyclonic Spray Chamber |

## *Installing the Concentric Nebulizer on the Scott's Spray Chamber*

1. The spacer must be installed on the concentric glass nebulizer assembly. See Figure 5-29.

2. Insert the Concentric Glass nebulizer, as far as it will go, through the opening in the end cap of the Scott's spray chamber. See the next figure.

3. Tighten the nut on the end cap so that it is finger-tight.

**Note** Alternative fittings for connecting sample tubing to the concentric nebulizer and pump sample tubing can be purchased as an option. Purchase part number N8122258 - Pump Tubing Adapter

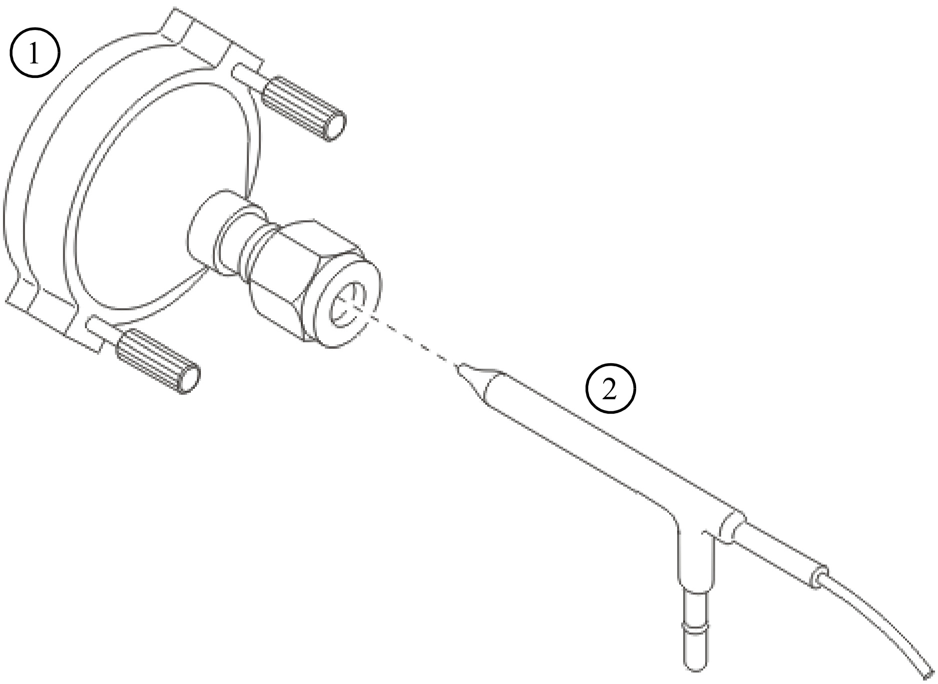



**Figure 5-31** **Installation of the Concentric Glass Nebulizer in the End Cap.**

| Item | Description |
|---|---|
| 1 | End Cap (Part No. N0680504) |
| 2 | Meinhard Concentric Nebulizer |

## Cleaning the Concentric Glass Nebulizer

For detailed information on cleaning MEINHARD Concentric Glass nebulizer, see *Maintenance Tips for Users of the MEINHARD Concentric Glass Nebulizer* (PerkinElmer Part No. 099936334), which is also available upon request from J.E. Meinhard Associates, Inc.

J.E. Meinhard Associates, Inc.
700 Corporate Circle, Suite L
Golden, CO 80401-5636
Telephone: 303-277-9776
FAX: 303-279-5156
Toll Free Telephone:800-MEINHARD (800-634-6427)
Internet address: http://www.meinhard.com

The following table summarizes the cleaning procedures for the MEINHARD Concentric Glass nebulizer.

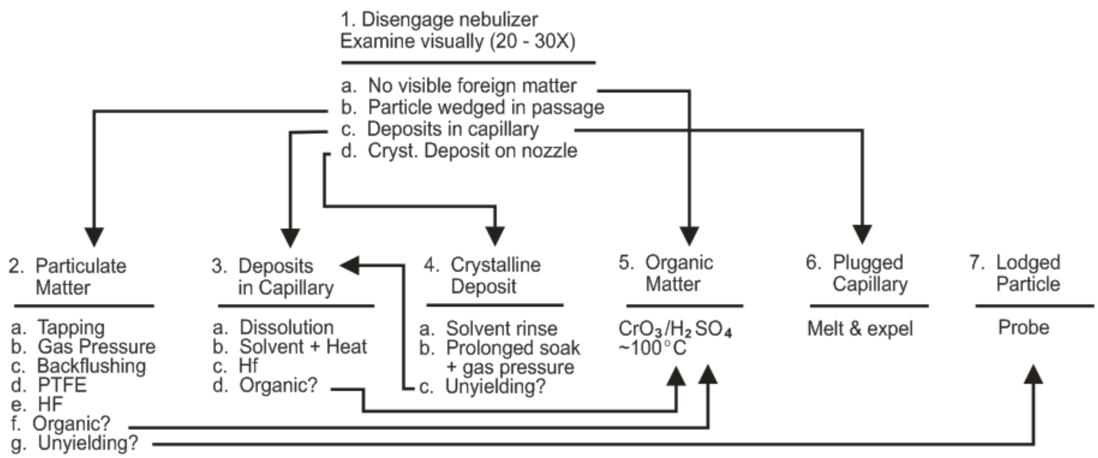



**Figure 5-32 Cleaning Strategy for the MEINHARD Nebulizer. (Reprinted with the permission of JE Meinhard Assoc., Inc.)**

**Caution** When cleaning the concentric glass nebulizer, do **not** use ultrasonic cleaning. This can adversely affect nebulizer performance.
Do **not** attempt to clean out the concentric nebulizer with any wire instrument. This can cause irreparable damage to the nebulizer.

**Attention** Lors du nettoyage du nébuliseur en verre concentriques, ne pas utiliser le nettoyage par ultrasons. Cela peut nuire à la performance nébuliseur.
**Ne pas** essayer de nettoyer le nébuliseur concentrique avec tout instrument de fil. Cela peut causer des dommages irréparables au nébuliseur.

## *Mira Mist Nebulizer*

**Warning**

**This device operates on compressed gases.** Appropriate care must be taken. If in doubt about correct operating procedures, call an experienced operator. Burgener Mira Mist Nebulizers require 45 - 55 psi to have a 1 liter per minute of Argon gas flow, so the operating pressures are in the range of 25 - 45 psi, depending on the torch optimum flow rate.

Mira Mist nebulizers will pulse if the pump cannot deliver constant sample flow: Change your pump tubing often, or use a surgeless pump if possible.

Warning

**Avertissement: Cet appareil fonctionne sur les gaz comprimés.** Des soins appropriés doivent être prises. En cas de doute sur les procédures de fonctionnement, appeler un opérateur expérimenté. Burgener Mira Mist nébuliseurs nécessitent 45 - 55 psi d'avoir un 1 litre par minute d'écoulement du gaz argon, de sorte que les pressions de fonctionnement sont de l'ordre de 25 - 45 psi, en fonction du débit optimal de la torche.
Mira Mist nébuliseurs flashe si la pompe ne peut pas fournir un débit d'échantillon constant: Changez votre tuyau de pompe souvent, ou utiliser une pompe surgeless si possible.

**Caution** The gas orifice is at the very tip of the nebulizer. It is made of Teflon which is **VERY SOFT**. This tip is very easily damaged and should **NEVER** be touched with fingers, tissues, or anything else. If the tip is accidentally touched and the nebulizer continues to operate, then it is still functional, and its use can be safely continued.

**Attention** L'orifice de gaz est à la pointe du nébuliseur. Il est fait de téflon qui est très doux. Cette astuce est très facilement endommagé et ne doit **JAMAIS** être touché avec les doigts, les tissus, ou toute autre chose. Si la pointe est accidentellement touché et le nébuliseur continue à fonctionner, alors il est encore fonctionnel, et son utilisation peut se poursuivre en toute sécurité.

### *Sample Capillary Tubing*

**Note** The PEEK Mira Mist body has 10/32 threads for the gas and capillary fittings. Gently tighten until snug for the sample line. For the gas line, if there seems to be any leakage, then tighten **HARD**. PEEK is very strong.

The capillary tubing  is attached with UpChurch® 10/32 chromatographic fittings. We supply 0.043 OD X 0.017 ID Poly Capillary tubing (Part No. N0777111), but you may use any other tubing that fits an UpChurch 10/32 fitting. We recommend that you use a 0.017" ID or smaller ID capillary tube for the sample feed. This should catch any particles before they get into the nebulizer. It is much safer & easier to replace the capillary tubing than to clean the nebulizer.

The Mira Mist Nebulizer body is PEEK, and the inner capillaries are Teflon. Generally it will not break. If it is dropped such that the tip is deformed, then it will be irreparably damaged. If it continues to operate after being dropped, then it has not been affected, and its use can be safely continued.

## Gas Line

The gas line is attached with UpChurch® 10/32 chromatographic fittings (Part No. N0777113). We supply 2 mm OD X 0.039 ID Teflon tubing. A gas line filter is **NOT** included in the nebulizer. Any particles from the gas line will destroy the nebulizer. We have found this is one of the main causes of blockage of the nebulizers, so please ensure that the gas line to the nebulizer is clean of any particles.

The gas line terminates in the Avio 200 quick disconnect. It is a direct replacement for typical concentric nebulizers.

## Sample Introduction / Maximizing Stability

The Mira Mist does not have any suction, so it requires a pump to supply the sample solution. The pump speed and the quality of the pump tubing have a large effect on the performance of the nebulizer. Try to select a pump tubing size that allows running the pump at a higher speed (If you use the standard black-black tubing, you may need to use a higher pump rate: for example 1.5 mL/min). So for low sample flow, use orange green or orange blue pump tubing. Generally the pump tubing should be changed every day for maximum stability and lowest %RSD.

### Cleaning the Nebulizer

**Caution** The gas orifice is at the very tip of the nebulizer. It is made of Teflon which is **VERY SOFT**. This tip is very easily damaged and should **NEVER** be touched with fingers, tissues, or anything else. If the tip is accidentally touched and the nebulizer continues to operate, then it is still functional, and its use can be safely continued.

**Attention** L'orifice de gaz est à la pointe du nébuliseur. Il est fait de téflon qui est très doux. Cette astuce est très facilement endommagé et ne doit **JAMAIS** être touché avec les doigts, les tissus, ou toute autre chose. Si la pointe est accidentellement touché et le nébuliseur continue à fonctionner, alors il est encore fonctionnel, et son utilisation peut se poursuivre en toute sécurité.

For the longest life and best performance, wash your nebulizer by simply running water as a sample for 10 minutes at the end of the day before shutting down the plasma. Any other form of washing is usually unnecessary. **DO NOT** wash your nebulizer in acid or solvents to "prevent salt build up". **DO NOT** use surfactants as they will destroy the surface tension at the tip and performance.

## Peristaltic Pump

The peristaltic pump requires routine maintenance to ensure that the system will run properly. The pump tubing should be replaced when flat spots develop (on a daily basis or after approximately eight hours of use). When replacing the pump tubing, the drain tubing should be replaced at the same time since uneven wear can cause the spray chamber to back up.

### Replacement Pump Tubing

Replace the pump tubing when flat spots develop (after approximately eight hours of use). When replacing the pump tubing, both the sample and drain tubing should be replaced at the same time since uneven wear can cause the spray chamber to back up.The following table gives part numbers for pump tubing for the sample and drain.

**Table 5-7. Pump Tubing**

| Pump Tubing | Solvent Type | Inner Diameter | Part No. |
|---|---|---|---|
| Standard | Inorganic | Sample: 0.76 mm (0.030 in.)<br>Drain: 1.14 mm (0.045 in.) | 09908587<br>09908585 |
| Solvent Flex | Kerosene or xylene | Sample: 0.76 mm (0.030 in.)<br>Drain: 1.14 mm (0.045 in.) | 00473550<br>09923037 |
| Silicone | Organic solvents, including MIBK, but not kerosene or xylene | Sample: 0.76 mm (0.030 in.)<br>Drain: 1.14 mm (0.045 in.) | 00473552<br>N0691595 |
| Viton | Kerosene or xylene, but **not MIBK**. | Sample: Orange-Orange 0.89 mm (0.035 in.)<br>Drain: Yellow-Yellow 1.40 mm (0.056 in.) | 09923511<br>09923512 |

## Installing the Sample and Drain Tubing

The peristaltic pump is used to pump sample into the nebulizer and pump the waste out of the spray chamber. Tighten the adjustment screw (turn clockwise) up to three turns so that moving bubbles are visible in the drain tubing. Then adding three more turns of the adjustment screws.

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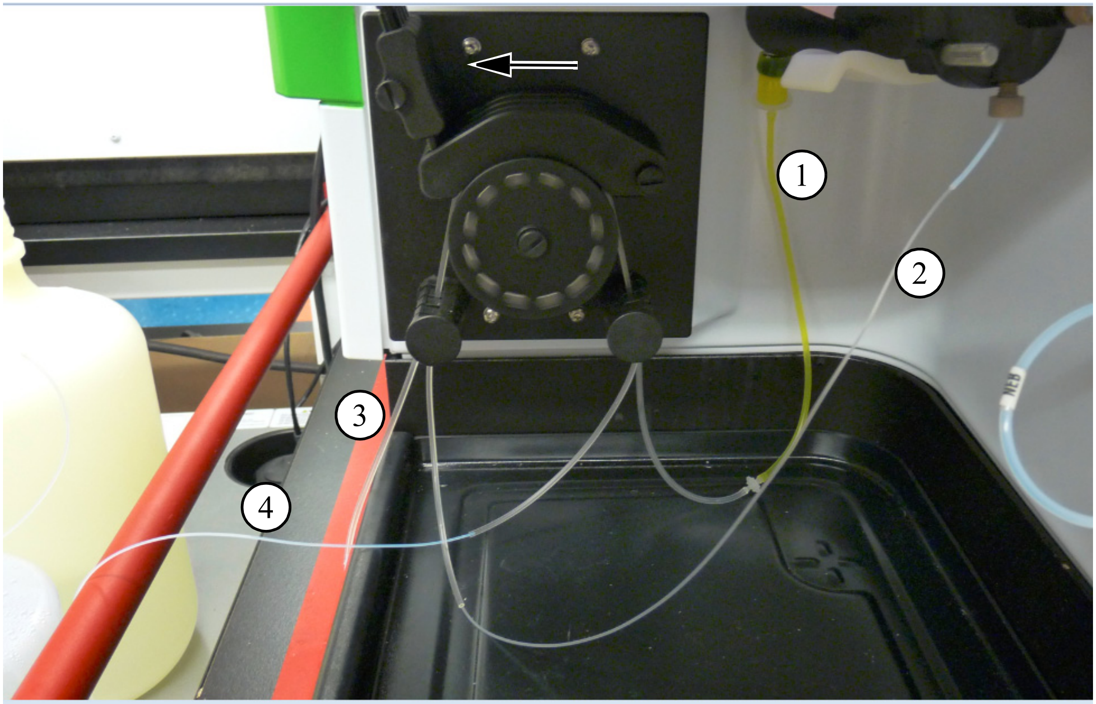


**Figure 5-33 Tubing installed on pump for sample and drain**

| Item | Description |
|---|---|
| 1 | From Spray Chamber Drain |
| 2 | To Nebulizer |
| 3 | To Drain Bottle |
| 4 | From Sample Container |

### *Installing the Sample Tubing*

To install the sample tubing refer to the instructions below and the next two figures:

1. Turn off the peristaltic pump using the software control.

2. Take a piece of 0.76 mm (0.030 in.) pump sample tubing. New pump tubing will work better if it is pre-stretched, and analytical precision will be improved. Grasp the tubing, with one clip in each hand, and stretch the tubing gently a few times.

3. Install the pump tubing on an open channel of the pump. To do this, carefully stretch the new tubing around the pump head and place the clips on the pump tubing into the slots, using the slots in the same position on each side of the pump head. Carefully thread the pump tubing through the lip of the cover (see the next figure). Be careful not to twist or kink the pump tubing during this process.

4. Take two pieces of 0.58 mm i.d. (0.023 in.) polyethylene tubing (Part No. 09908265), one for the sample capillary and one for the nebulizer capillary. Using a razor blade, bevel one end of each piece of capillary tubing by cutting it at an angle. See the next figure.

5. Insert the beveled end of the sample capillary tubing into one end of the pump tubing. Lead the capillary tubing to the sample bottle.

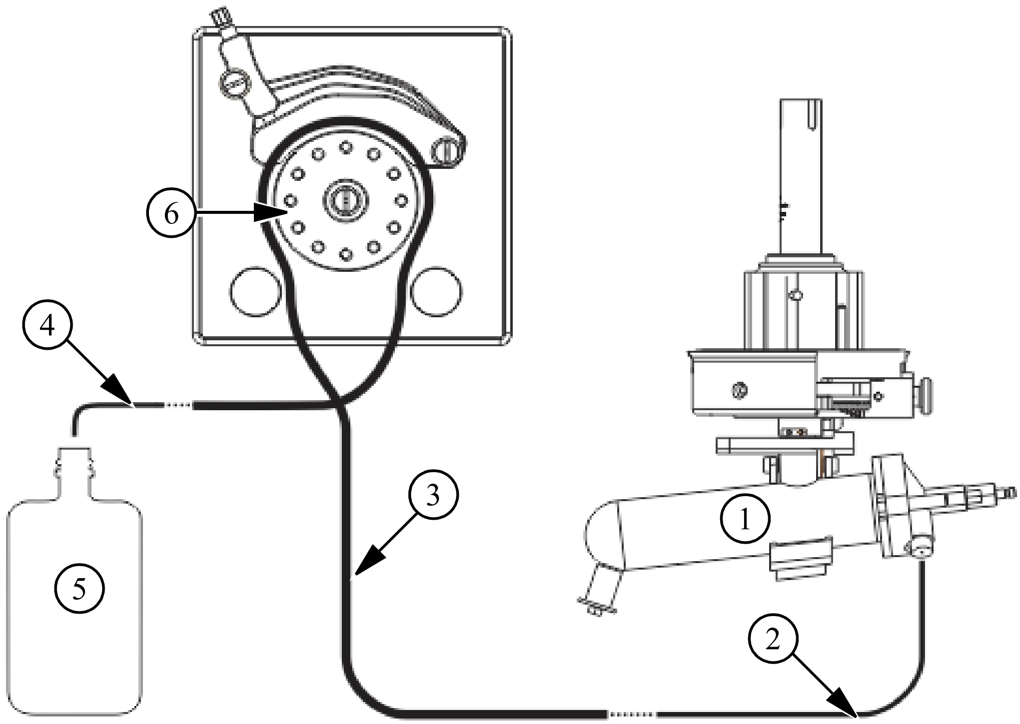


**Figure 5-34 Tubing assembly for sample.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Scott Spray Chamber | 4 | Polyethylene tubing (including with the Nebulizer, 0.58 mm i.d. Part No. 09908265) |
| 2 | Polyethylene tubing (including with the Nebulizer, 0.58 mm i.d. Part No. 09908265) | 5 | Sample Bottle |
| 3 | Pump Tubing 0.76 mm i.d. (different part numbers available) | 6 | Peristaltic Pump |

6. Insert the beveled end of the nebulizer capillary tubing into the other end of the pump tubing.

7. Attach the capillary tubing to the sample inlet of the nebulizer.

## Connecting the Drain Tubing Assembly

**Table 5-8. Spray Chamber Drain Spare Parts**

| Part No. | Drain Spare Part |
|---|---|
| 09920186 | Barb Fitting Coupler 3/32 Tubing |
| 09920267 | Barb Fitting Male 10-32 UNF |
| 09985708 | PTFE Tubing 0.031 x 0.016 |
| 09985735 | Solvent Flex Tubing, 0.11 inches ID |
| N0695414 | Drain Adapter |
| N0695415 | Drain Coupling |

To connect the drain tubing assembly, use the following steps and refer to the next figure.

1. Connect the sleeve (Part No. N0695415) and adapter (Part No. N0695414) to the spray chamber drain. Thread the barbed fitting (Part No. 09920267) into the coupler and adapter.

2. Attach the Solvent Flex (PVC) tubing (Part No. 09985735) to the barbed fitting. Attach the other end of the Solvent Flex (PVC) tubing to the tubing coupler (Part No. 09920186).

3. Use the other end of the tubing coupler (Part No. 09920186) to connect the drain tubing to the peristaltic pump.

Drain tubing with 1 mm i.d. (0.04 in.) can also be used by following these steps:

1. Attach a small piece of 1.5 mm (0.06 in.) i.d. PVC tubing (Part No. 09985729) to the barbed fitting (Part No. 09920267).

2. Cut the 1 mm i.d. tubing at an angle and insert it into the 1.5 mm tubing.

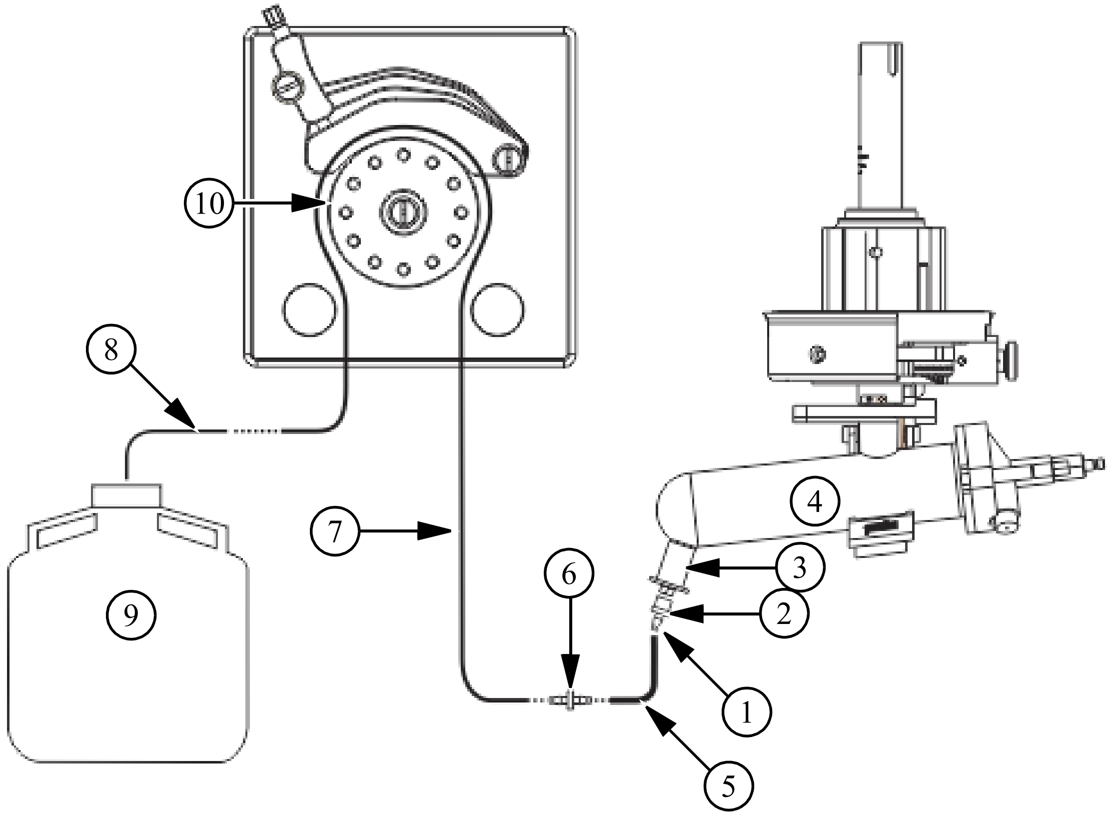


**Figure 5-35 Drain tubing assembly.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Barbed Fitting (Part No. 09920267) | 6 | Coupler (Part No. 09920186) |
| 2 | Adapter (Part No. N0695414) | 7 | Pump Tube 1.14 mm i.d |
| 3 | Sleeve (Part No. N0695415) | 8 | Teflon Tubing 1 mm i.d. (Part No. 09985708) |
| 4 | Spray Chamber | 9 | Drain bottle |
| 5 | PVC Tubing 1.5 mm i.d. (Part No. 09985735) | 10 | Peristaltic Pump |

### *Installing the Drain Tubing*

Install the drain tubing on an open channel of the peristaltic pump as follows:

1. Pre-stretch a piece of 1.14 mm (0.045 in.) pump drain tubing.

2. Carefully stretch the new tubing around the pump head and place the clips on the pump tubing into the slots, using the slots in the same position on each side of the pump head. Be careful not to twist or kink the pump tubing during this process.

3. Attach the Teflon tubing to the pump tubing for the drain.

   **Make sure you install the tubing on the pump so that the waste liquid is pumped *out* of the spray chamber. See Figure 5-36.** If the tubing is installed in the wrong direction, the spray chamber will flood.

4. For the tubing that leads to the drain bottle, use one piece of 1.07 mm i.d. (0.042 in.) Teflon tubing (Part No. 09985708). Bevel one end by cutting it at an angle.

5. Insert the Teflon tubing into the other side of the pump tubing. Lead this tubing to the drain bottle. Refer to Figure 5-36.

6. Adjust the tubing as described in the next procedure.

## Adjusting the Pump Tubing

Adjust the tension on the sample and drain tubing, one at a time, using deionized water as follows:

**Adjusting the Sample Tubing**

1. Make sure the sample tubing is centered in the channel, then place the clamp around the tubing and lower the clamp arm on onto the pump. Turn the adjustment screws until locked in place.

2. Place the sample capillary (SAMPLE IN side) in a container of deionized water.

3. Set the pump speed to 1.0 mL/min and start the pump.

4. Dip the tubing in DI water a few times to let air gaps form. As you watch the air gaps form loosen the adjustment screw in a counterclockwise direction until the air gaps stop or do not flow smoothly.

5. Tighten the adjustment screw *slowly* (turn clockwise) until droplets just start forming at the end of the SAMPLE OUT side of the sample tubing.

6. Tighten the adjustment screw until you see a smooth flow of bubbles (3 turns on the peristaltic pump). Add an additional three more turns.

7. Turn off the pump. The tension is now correctly set. No bubbles should be seen in the sample tubing once the sample tube is kept in the solution.

**Adjusting the Drain Tubing**

1. Make sure the drain tubing is centered in the channel without disturbing the sample tubing, then place the clamp around the drain tubing and lower the clamp arm.

2. Loosen the adjustment screw (turn counterclockwise) for the drain tubing channel so that the lever can be easily opened and closed with little resistance.

3. Set the pump speed to 1.0 mL/min and start the pump.

4. Dip the tubing in DI water a few times to let bubbles form. As you watch the bubbles form loosen the adjustment screw in a counterclockwise direction until the bubbles stop or do not flow smoothly.

5. Tighten the adjustment screw *slowly* (turn clockwise) until droplets just start forming at the end of the SAMPLE OUT side of the sample tubing.

6. Tighten the adjustment screw until you see a smooth flow of bubbles (3 turns on the peristaltic pump). Add an additional three more turns.

7. Turn off the pump. The tension is now correctly set. No bubbles should be seen in the sample tubing once the sample tube is kept in the solution.

## Cleaning the Pump

Periodically inspect the peristaltic pump rollers to make sure they are clean and move freely. Clean the exterior of the pump with a cloth moistened with water.

The pump head on the peristaltic pump can be removed and cleaned if necessary. A replacement pump head is available (Part No. 09220266).

---

**Caution** **If a spill occurs on the pump, immediately clean it up.** A corrosive spill could damage the pump.

**Attention** **Si un déversement se produit sur la pompe, nettoyer immédiatement vers le haut.** Un déversement corrosif pourrait endommager la pompe.

---

## Removing the Pump Head on the Peristaltic Pump

To remove the pump head on the peristaltic pump:

1. Remove the pump tubing.

2. Unscrew the large screw in the center of the pump head. Place the screw and washer in a secure place.

3. Lift the pump head off. To clean the pump head, use water or a mild solvent and dry thoroughly.

4. Return the pump head to the pump. Orient the pump head by aligning the notch on the bottom of the pump head with the pin on the shaft. The pump head must click in this slot for a proper fit. Replace the washer and tighten the screw.

## Drain

One drain is used on the Avio 200. This pumped drain leads from the spray chamber.

To connect the drain to the drain bottle, refer to the next figure and follow the steps below:

1. Connect the drain tubing leading from below the sample compartment to one of the large fittings on the drain bottle.

2. Insert the drain tubing from the pump into the 1.6 mm (0.0625 in.) i.d. tubing piece on the drain bottle shown in the next figure.

**Table 5-9. Replacement Parts: Peristaltic Pump**

| Part No. | Description |
|---|---|
| 09220266 | Peristaltic Pump Head |

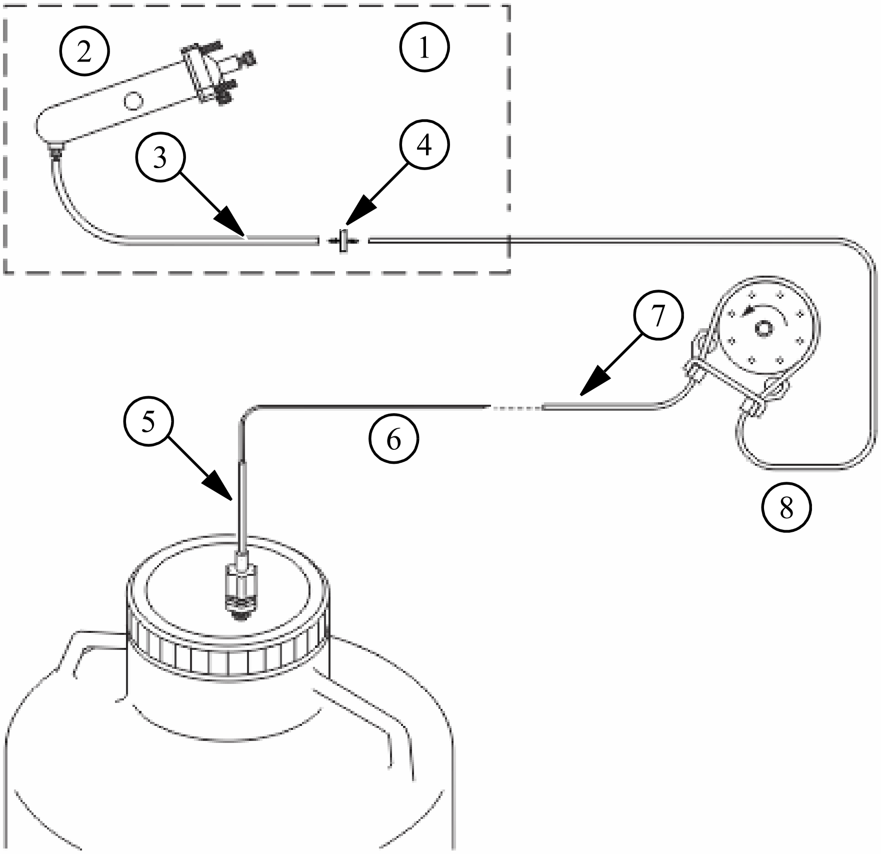


**Figure 5-36 Tubing connections to the drain bottle.**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Sample Compartment | 5 | Drain Tubing Piece 1.6 mm i.d. (Part No. 02506241) |
| 2 | Spray Chamber | 6 | Teflon Tubing 1 mm i.d. (Part No. 09985708) |
| 3 | PVC Tubing 1.5 mm i.d. (Part No. 09985735) | 7 | Pump Tubing 1.14 mm i.d. |
| 4 | Coupler (Part No. 09920186) | 8 | Peristaltic Pump |

# General System Maintenance

## Cleaning the Instrument

Exterior surfaces may be cleaned with a soft cloth, dampened with a mild detergent and water solution. Do not use abrasive cleaners or solvents.

## Air Filters

To ensure that the electrical components in the spectrometer and the RF generator are properly cooled, check the air filters regularly to see if they are clogged or dirty. There are two air filters on the instrument as shown in Figure 5-37. The one filter is for the RF generator and the other for the spectrometer.

## Changing the Air Filters

The air filters are located inside the snap-on plastic grid. Refer to the following figure.

1. Shut down and switch off the spectrometer.

2. Carefully pull off the plastic grid on the ventilator.

3. Remove the filter and insert a new one (Part No. 09995098).

4. Carefully push the plastic grid onto the ventilator.

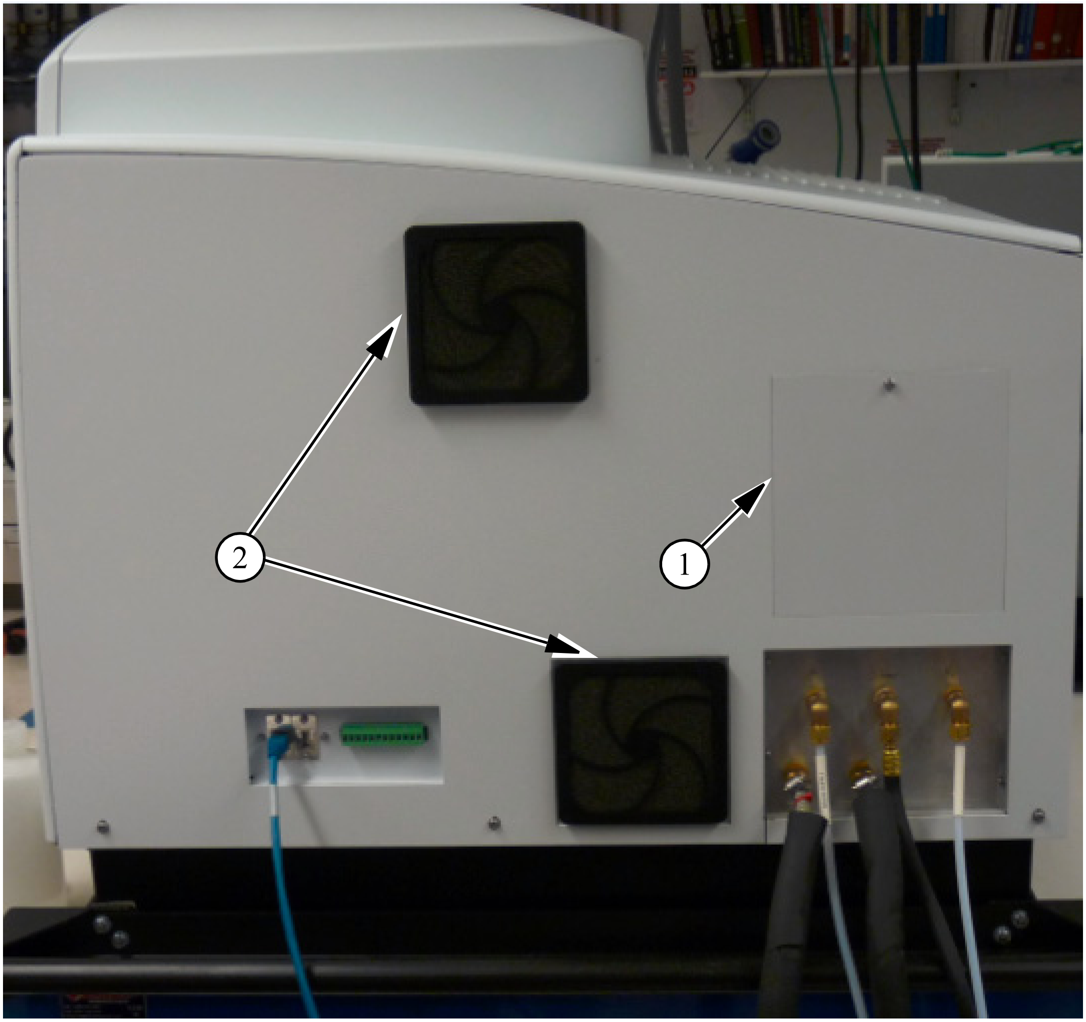


**Figure 5-37 Location of the air filters on the right side of the instrument.**

| Item | Description |
|---|---|
| 1 | Access Panel for Neon Lamp |
| 2 | Air Filters (Part No. 09995098) |

## Changing the Neon Lamp Assembly

**Tools Required:**

T20 Torx driver

The neon lamp (Part No. B0810144) is in an assembly that plugs into a connector on the right-hand side of the optics tub. A panel in the side of the spectrometer housing gives access to the neon lamp. Refer to Figure 5-37.

---

**Warning**

**Always turn off the instrument power before this box is plugged in or removed.**

**Avertissement: Couper toujours l'alimnetation de l'instrument avant que sette caisse soit branchée ou retirée.**

---

1. Shut down and switch off the spectrometer.
2. Use the T20 Torx driver to remove the screw that secures the access panel on the right-hand side of the spectrometer and remove the panel. Place the screw in a secure location.
3. The neon lamp assembly is the metal box that is visible inside the access hole. Loosen the large screw on the metal box inside the access panel and pull the metal box off the side of the optics tub.
4. Carefully slide a new neon lamp assembly (Part No. B0810144) onto the tub using the metal plates on the tub as guides. Tighten the large screw securely.
5. Replace the access panel and secure it with the screw.

## Chiller and Filters

Inspect the metal strainer (Part No. N0776075) that is suspended inside the chiller reservoir; this should be removed and rinsed clean when the system is flushed or if dirty. Flush out the chiller every 6 months.

Fill the chiller reservoir with the coolant fluid with corrosion inhibitor (Part No. N0776200). The chiller reservoir has a capacity of 4.2 liters (1.1 US gallons). Refer to *Connecting the PolyScience Chiller* on page 104 for more information on filling the chiller.

**Caution** **Do not use deionized or tap water in the chiller. Only use the coolant fluid with corrosion inhibitor (Part No. N0776200) recommended above.**

**Attention** **Ne pas utiliser déminéralisée ou l'eau du robinet dans le refroidisseur. Utiliser uniquement le liquide de refroidissement avec un inhibiteur de corrosion (N0776200) recommandée ci-dessus.**

For additional information on the chiller, refer to the manufacturer's maintenance guidelines.

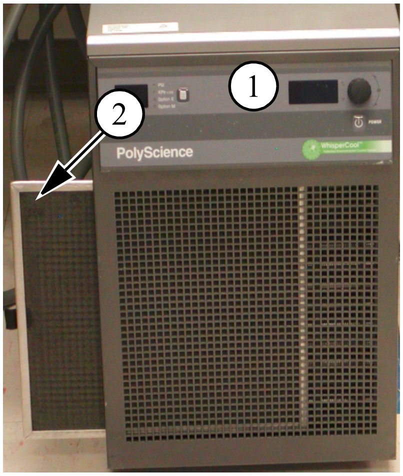


**Figure 5-38 Location of the filter on the chiller.**

| Item | Description |
|---|---|
| 1 | Chiller |
| 2 | Air Filter (remove in this direction) (PolyScience Part No. 750-855) |

## *Fuses*

Fuses may only be replaced by a PerkinElmer service engineer.

# Replacement Parts: General

Every day you count on PerkinElmer to provide you with solutions that deliver reliable performance, control operating costs and maximize operational time. Our complete portfolio of consumables, parts, supplies, training and service helps you meet both routine and demanding measurement challenges. We invest heavily in testing and validating our products to ensure you receive guaranteed compatibility and performance - on-time, every time, for every instrument in your laboratory.

The following replacement parts are required for general system maintenance. For other replacement parts, refer to the appropriate sections earlier in this chapter.

**Table 5-10. Filters**

| Part No. | Description |
|---|---|
| N0776075 | Reservoir Water Filter/Strainer |
| N0777095 | Polyscience Chiller Air Filter |
| 09995098 | Air Filter for Spectrometer |
| N0775325 | Air Dry Filter Assembly with R250 Regulator |
| N9306067 | Replacement Filter Element (for Air Dry Filter Assembly) |

**Table 5-11. Gas and Water Supply Connections**

| Part No. | Description |
|---|---|
| 09920125 | Space Collar for 1/4-in. Swagelok Fittings |
| 09995098 | Air Filter for Spectrometer |
| N0690274 | Argon Supply Hose |

**Table 5-11. Gas and Water Supply Connections**

| Part No. | Description |
|---|---|
| N0690275 | Nitrogen Supply Hose |
| N0770341 | Water Supply Hose |
| N0770342 | Water Drain Hose |
| N0770348 | Shear Gas Supply Hose |
| N0775325 | Air Dry Filter Assembly with R250 Regulator |
| N9306067 | Replacement Filter Element (for Air Dryer Filter Assembly) |

**Table 5-12. Miscellaneous**

| Part No. | Description |
|---|---|
| 09920044 | Clamp for RF Generator Exhaust Hose |
| N0691578 | Exhaust Hose Duct |
| N0791409 | Drip Tray for Nebulizer Compartment |
| N0790448 | Aluminum Ring Removal Tool |

**Table 5-13. Organic Sample Introduction Kit (Part No. N0780608)**

| Part No. | Description |
|---|---|
| N0770358 | GemTip™ Cross-Flow II Nebulizer |
| N0791181 | Alumina Injector 1.2mm |

**Table 5-14. Solutions**

| Part No. | Description |
|---|---|
| No. N0776200 | Chiller Coolant With the Inhibitor Mixed |
| N0691579 and N9300221 | Multielement Solutions |

**Table 5-15. All Replacement Parts by Part Number**

| Part No. | Description |
|---|---|
| 00473194 | O-Ring (for Nebulizer Seal on N0680504 End Cap) |
| 00473539 | Knurled Screw used on End Cap |
| 00473550 | Solvent Flex Pump Tubing, 0.76mm ID, Black/Black (Sample tubing) |
| 00473552 | Silicone Pump Tubing, 0.76mm ID, Black/Black (Sample tubing) |
| 02506241 | Micro Line Tube 0.125 x 0.0625 |
| 02506516 | Tygon Tubing 1/4 in. OD x 1/8 in. ID |
| 02506532 | Organic Drain Tubing |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| 09921036 | O-Ring (for Dual View Radial Purge Tube) |
| 09902033 | O-Ring for Cross Flow Nebulizer End Cap |
| 09921062 | O-Ring (for Dual View Axial Purge Window) |
| 09902207 | O-Ring (Injector Adapter - inside) |
| 09903730 | Nipple, 1/16 to 1/8 |
| 09908265 | Polyethylene Tubing, Sample Capillary |
| 09908585 | PVC Pump Tubing, 1.14mm ID, Red/Red (Drain tubing) |
| 09908587 | PVC Pump Tubing, 0.76mm ID, Black/Black (Sample tubing) |
| 09920044 | Clamp for RF Generator Exhaust Hose |
| 09200486 | Wide Mouth Bottle 15L HDPE |
| 09920125 | Space Collar for 1/4 in. Swagelock Fittings |
| 09920186 | Barb Fitting Coupler 3/32 Tubing |
| 09920267 | Barb Fitting Male 10-32 UNF |
| 09920410 | O-Ring Removal Tool |
| 09920865 | Coupler 3/32 Tubing |
| 09921028 | O-Ring - Metric (for seal Spray Chamber to Injector Adapter) |
| 09921036 | O-Ring 0.984 ID x 0.140 WD |
| 09921045 | O-Ring 0.126 ID x 0.040 WD (for Cross-Flow Nebulizer Gem Tips) |
| 09220266 | Peristaltic Pump Head |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| 09923037 | Solvent Flex Pump Tubing, 1.14mm ID, Red/Red (Drain Tubing) |
| 09923057 | O-Ring 1.484 ID x 0.139 WD |
| 09923383 | Cap Sleeve 0.406 in. Brown Vinyl |
| 09931178 | Unpacking Instructions Avio 200 |
| 09936225 | ICP-OES Instrument Maintenance Log Book |
| 09985708 | PTFE Tubing 0.031 x 0.016 |
| 09985723 | 1/8 in. OD Teflon Tubing |
| 09985729 | PVC Tubing 1.5mm ID |
| 09985730 | PVC Tubing 0.031mm ID, 10 FT. |
| 09985735 | Solvent Flex Tubing 0.11mm ID |
| 09992731 | Axial Purge Window |
| 09995098 | Air Filter for Spectrometer |
| B0810285 | Radial Purge Tube Holder |
| B0810377 | Long Radial Purge Tube |
| N0582325 | ICP Concepts Book |
| N0680504 | End Cap for GemCone Nebulizers |
| N0690271 | Drain Bottle Cap Assembly |
| N0690274 | Argon Supply Hose |
| N0690275 | Nitrogen Supply Hose |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| N0690672 | Short Radial Purge Tube |
| N0691595 | Silicone Pump Tubing, 1.14mm ID, Red/Red (Drain tubing) |
| N0691709 | CETAC U-6000AT+ Ultrasonic Nebulizer System, 115 V, 50/60 Hz |
| N0691710 | CETAC U-6000AT+ Ultrasonic Nebulizer System, 230 V, 50/60 Hz |
| N0695414 | Drain Adapter |
| N0695415 | Drain Coupling |
| N0770183 | Hose Kit (includes gas and cooling water hoses) |
| N0770336 | Quick Disconnect Tubing Assembly for GemCone Nebulizer |
| N0770341 | Water Supply Hose |
| N0770342 | Water Drain Hose |
| N0770348 | Shear Gas Supply Hose |
| N0770358 | GemTip™ Cross-Flow II Nebulizer |
| N0770425 | Receptacle - AC Power 250 Volt |
| N0777497 | Cyclonic Spray Chamber |
| N0770434 | Fresh Air Inlet Kit (which includes the Flex Hose and Hose Clamp) |
| N0770605 | Cyclonic Spray Chamber with Cap for Aqueous Solutions |
| N0770610 | Quick Disconnect Tubing Assembly for Concentric Nebulizer |
| N0773115 | Viton Pump Tubing, 1.14mm ID, Red/Red (Drain tubing) |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| N0773118 | Viton Pump Tubing, 0.76mm ID, Black/Black (Sample tubing) |
| N0777095 | Polyscience Chiller Air Filter |
| N0775325 | Air Dryer Filter Assembly with R250 Regulator |
| N0775330 | PEEK Mira Mist Nebulizer |
| N0775345 | SeaSpray Nebulizer (0.7 L/min. Ar flow rate, 2 mL/min. uptake rate) |
| N0775346 | MicroMist Nebulizer (0.7 L/min. Ar flow rate, 0.6 mL/min. uptake rate) |
| N0775347 | MicroMist Nebulizer (0.7 L/min. Ar flow rate, 0.2 mL/min. uptake rate) |
| N0775348 | MicroMist Nebulizer (0.7 L/min. Ar flow rate, 0.1 mL/min. uptake rate) |
| N0775349 | MicroMist Nebulizer (0.7 L/min. Ar flow rate, 0.05 mL/min. uptake rate) |
| N0775358 | Eluo Nebulizer Cleaner |
| N0776027 | Knurled Nut for Torch Glassware |
| N0776075 | Reservoir Water Filter/Strainer |
| N0776200 | Chiller Coolant with Inhibitor Mix |
| N0777111 | Sample capillary tubing with fitting |
| N0777112 | Sample capillary tubing with fitting (pack of 10) |
| N0777113 | Gas Line 2mm With UpChurch Fittings |
| N0777116 | Bulk sample tubing without the fittings (10 feet) |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| N0777117 | Bulk sample tubing without the fittings (100 feet) |
| N0777707 | MEINHARD Nebulizer (Type K1, Low Ar Flow nebulizer for routine aqueous samples) |
| N0780546 | Cross-Flow Nebulizer |
| N0780676 | GemTip Kit for Cross-Flow II Nebulizer |
| N0790131 | Quartz Torch (standard single slot torch) |
| N0790141 | Injector Adapter Kit-Cyclonic (includes o-rings) |
| N0790433 | Spares Kit |
| N0790154 | Injector Adapter Kit-Scott (includes o-rings) |
| N0790154 | Scott Injector Assembly |
| N0790432 | Installation Kit |
| N0790437 | O-Ring Kit for the Dual View Torch Periscope |
| N0790440 | O-ring Kit for Avio Scott Injector |
| N0790441 | O-ring Kit for Avio Cyclonic Injector |
| N0790448 | Aluminum Ring Removal Tool |
| N0790606 | Dual View Torch Module (includes Torch, Glassware, Injector(Alumina Injector, 2.0mm ID), Scott-type Spray Chamber and GemTip Cross-Flow Nebulizer) |
| N0790607 | Dual View Torch Module (includes Torch, Glassware, Injector (Alumina Injector, 2.0mm ID), Cyclonic Spray Chamber and Meinhard Type K1 Nebulizer) |
| N0791017 | DV Axial Window Holder |
| N0791180 | Alumina Injector 0.85mm |

**Table 5-15. All Replacement Parts by Part Number**

| | |
|---|---|
| N0791181 | Alumina Injector, 1.2mm ID entire length, 150mm LG |
| N0791182 | Alumina Injector Straight 1.2 mm |
| N0791183 | Alumina Injector, 2.0mm ID, 150mm LG |
| N0791184 | Sapphire Injector, 2.0mm ID, 150mm LG |
| N0791185 | Quartz Injector 0.8 mm ID |
| N0791186 | Quartz Injector 1.2 mm ID |
| N0791187 | Quartz Injector Straight 1.2 mm ID |
| N0791188 | Quartz Injector 1.6 mm ID |
| N0791189 | Quartz Injector, 2.0mm ID, 150mm LG |
| N0791352 | Standard Baffled Cyclonic Spray Chamber |
| N0791409 | Drip Tray for Nebulizer Compartment |
| N0791499 | Ryton Double-Pass Scott-Type Spray Chamber |
| N8120160 | O-Rings for Cyclonic Spray Chamber (PK/10) |
| N8122258 | Pump Tubing Adapter |
| N9302946 | VIS Wavecal Solution |
| N9306067 | Replacement Filter Element (for Air Dryer Filter Assembly) |

## Consumables and Supplies

PerkinElmer is the only supplier who develops, manufactures, supports and services every product it offers to provide a truly integrated system. This means one expert supplier - with best-in-class instruments and a world-class service and support organization - can address all of your applications and troubleshooting needs, from sample handling to data handling.

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- If you are located within the U.S., call toll free 1-800-762-4000, 8 a.m. to 8 p.m. EST. Your order will be shipped promptly, usually within 24 hours.
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# Troubleshooting 6

# A Word on Troubleshooting

We recommend that you consult the troubleshooting information included here before you call a PerkinElmer service engineer. The Troubleshooting chapter contains suggestions to help you determine systematically whether instrument problems are due to improper analytical techniques, improper selection of instrument parameters, or malfunction of the instrument.

If after using the troubleshooting techniques in this chapter your instrument is still not performing properly, fill out the form at the end of this chapter and contact PerkinElmer service.

Use the following table to guide you to the appropriate section or manual.

| Problem | Refer to section |
|---|---|
| You are not getting the desired results. | Optimizing and Verifying Performance in the Syngistix Software Guide on the Syngistix Document Pack CD or Performance Problems: Troubleshooting Table in this chapter. |
| You cannot ignite the plasma, or the plasma is unstable. | Plasma Ignition and Stability Problems in this chapter. |
| A red fault icon appears in the Status panel. It means that the system is not ready. | Operating Status Problems in the Syngistix Software Guide on the Syngistix Document Pack CD. |
| There is a software error. | Software Troubleshooting in the Syngistix Software Guide on the Syngistix Document Pack CD. |
| The printer is not working. | See *Printing Problems* on page 285 Problems in this chapter. |
| The pump is not working. | *Pump Problems* on page 286 in this chapter. |

# What the Performance Checks Measure

The tests in this section allow the operator to measure performance aspects of the instrument. If you are experiencing problems with your results, these tests can pinpoint the cause of the problem.

The tests include the following:

- **Sodium Bullet Test:** This test allows you to visualize the sample flow in the plasma so that you can check that the sample introduction system is working correctly.

- **Background Equivalent Concentration (BEC) Test:** The BEC value is the concentration of an element which would produce the same emission intensity as the plasma background measured at the analyte wavelength. The BEC serves as an indication of instrument sensitivity. It checks torch alignment, plasma viewing height, nebulizer gas flow rate, and incident RF power. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details.

- **Precision Test:** This test indicates the Relative Standard Deviation (RSD) of the instrument's analyte emission intensity or concentration measurements. The RSD may also be referred to as the CV (Coefficient of Variation). A high RSD or CV is usually indicative of a problem with the sample introduction system such as improper drainage, leaks, improper tension on the pump tubing, worn pump tubing, or nebulizer problems. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details.

- **Detection Limit Test:** This test measures the baseline signal for a blank solution to give an indication of the lowest concentration of an element which can be measured. The detection limit is calculated as three times the standard deviation of the blank. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details.

# *Sodium Bullet Test*

To run the sodium bullet test:

1. For aqueous analyses, aspirate a 1000 mg/L solution of sodium. For organic analyses, aspirate an appropriate organic blank.

2. Examine the plasma through the viewing window in the sample compartment door.

A yellow-orange bullet (or green, in the case of organic compounds) should be visible in the center of the discharge and should extend from the base of the discharge to just below the top induction plate. If the bullet height is unsatisfactory, adjust the nebulizer argon flow in the Method Editor or Plasma Control windows.

If no bullet appears or the bullet is faint:

- Check that your sample does contain sodium at the required concentration.
- Check that sample is being pumped to the nebulizer. Make sure that the pump lever is engaged and that the pump tubes are connected appropriately.
- Check that the drain is being pumped properly. You should see a segmented flow of bubbles through the tubing.

If the above checks fail to make an improvement, turn off the plasma, then check the following:

- Check that the nebulizer is connected tightly.
- Check the nebulizer spray pattern: run deionized water for several minutes, then remove the nebulizer. If the nebulizer spray is sputtering or uneven, inspect the nebulizer tips for clogging and clean or replace them as necessary.

**Note:** *For a clogged Meinhard K1 nebulizer, try soaking in low acid solution for several hours or over night. Alternatively, direct a flow of gas (air, nitrogen or argon) through the nebulizer tip (this can sometimes dislodge a clog in the Ar capillary).*

**Warning**

If the plasma has been on, allow one minute for the Quick-Change Torch Module to cool and an additional two minutes for the torch to cool before checking the following.

***Avertissement:*** *Si le plasma a été allumée, laissez une minute pour le changement rapide Module Torch refroidir et deux minutes supplémentaires pour la torche pour refroidir avant de vérifier le suivant.*

- Check that the injector is not clogged. You will need to remove the Quick-Change Torch Module and disassemble the torch as described in *Quick-Change Adjustable Torch Module* on page 173. Remove the spray chamber and either remove the torch and then the injector or remove the injector leaving the torch in place.

# Performance Problems

## Checking the Sample Introduction System

Many performance problems (such as poor precision or loss of signal) can be traced to the setup and condition of the sample introduction system.

The following list describes general checks for the sample introduction system, which should be done on a regular basis. Typical symptoms of problems are listed to help you determine whether maintenance is required.

If you have already done performance checks, refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details**.**

The sodium bullet test is also a good way of visually checking the sample flow in the plasma and, therefore, indicates problems in sample introduction. This test is described earlier in this chapter.

**Pump and Pump Tubing**

Is the tubing overstretched, or does it have flat spots, leaks, or discoloration?

Install new tubing, stretching it gently beforehand. If using organics, special tubing should be used. See the list of replacement parts at the end of *Replacement Parts: General* on page 260.

Is the flow of liquid irregular?

Refer to the adjustment procedure in *Adjusting the Pump Tubing* on page 252.

Do the pump rollers bind or not roll easily? Are there grooves in the pump rollers?

On the PerkinElmer pump, the pump head may be removed for cleaning. The pump head may also be replaced. See *Removing the Pump Head on the Peristaltic Pump* on page 253.

### Capillary Tubing

Are the nebulizer and sample capillary tubing properly connected? Is the tubing discolored or clogged? Is tubing crimped or pinched?

If the capillary tubing is not in good condition, replace it.

### Nebulizer and Spray Chamber

Is there leakage around the nebulizer? Is there leakage from the spray chamber drain? Is fluid accumulating in the torch?

Make sure the nebulizer is on securely. If you cannot get a secure fit, the nebulizer or knurled nut (for Meinhard K1) O-ring may need to be replaced. Check the drain fitting and tubing to be sure the spray chamber is being properly drained. Check that the waste is being pumped in the proper direction.

Check the nebulizer spray pattern: run deionized water for several minutes, then remove the nebulizer. Is the nebulizer spray sputtering or uneven?

Check the nebulizer spray pattern: run deionized water for several minutes, then remove the nebulizer. If the nebulizer spray is sputtering or uneven, inspect the nebulizer tips for clogging and clean or replace them as necessary.

Are there deposits inside the end cap or spray chamber?

Clean out deposits. See *Replacing the Torch* on page 185.

### Torch Assembly

Are the torch fittings for the gas inlets secure?

If needed tighten the fittings on the torch manifold. Do **not** overtighten them. See *Replacing the Torch* on page 185.

Is the quartz torch cloudy or dirty?

Check for deposits, particularly if running organics, alloys, or samples with high dissolved solids. See *Cleaning the Torch* on page 184.

Is the injector dirty? Is it deformed due to overheating?

The injector may be clogged and require cleaning. If you are running organics, check for carbon buildup. If running samples with high dissolved solids, check for deposits. See *Removing the Injector* on page 175.

If the torch requires disassembly, check the O-rings. Are they cracked or worn? Is the injector adapter discolored? See *Cleaning the Torch* on page 184.

Replace worn parts. *Replacement Parts: General* on page 260.

**Purge Window**

Is the purge window cloudy or dirty?

Rinse with deionized water and dry with a soft cloth. Or, replace if necessary. Do not touch the window. If oils from the skin are deposited on the window, this can cause inaccurate results. A 10% solution of hydrofluoric acid may be used to clean the window. Observe the following warning statement. Soak the window briefly, then rinse thoroughly.

Has UV performance dropped?

Even if the purge windows look clean, a drop in UV performance indicates that the windows should be cleaned or replaced. First rinse with deionized water and dry with a soft cloth. If the UV performance does not improve,

replace the purge windows. Do **not** touch the window. If oils from the skin are deposited on the window, this can cause inaccurate results. A 10% solution of methanol may be used to clean the window.

# Performance Problems: Troubleshooting Table

**Table 6-1. Performance Problems: Troubleshooting Table**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| RSD (Relative Standard Deviation) greater than 1%. | The sample introduction system may not be set up correctly or may require maintenance. | Refer to *Cleaning the Sample Introduction System* on page 171. |
| | Does the sample have a high viscosity or high percentage of dissolved solids? | Try increasing the integration time. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details.<br>For high dissolved solids, try the GemCone spray nebulizer.<br>Add 0.05% surfactant to your samples, standards, and blanks.<br>Try running other samples with normal characteristics to determine if the sample matrix is really the problem.<br>The standard and blank may need to be matrix-matched. Or, internal standardization may be required. |
| | Look for carryover – check if concentrations of replicates increase from one to the next. | Increase the Read Delay to flush the sample introduction system completely. Increase the rinse time if using an autosampler. Prepare the rinse solution in the same acid matrix used for the standards, samples, and blank. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| | RF power and/or nebulizer argon flow may require adjustment. | Adjust as necessary. Also, check that you are using the recommended settings for your instrument. |

**Table 6-1. Performance Problems: Troubleshooting Table**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| Cannot obtain suggested BEC value | You may not be comparing the appropriate BEC value for the wavelength you are using. | Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| | The torch position may need adjustment. | Refer to the torch adjustment procedures for your instrument. |
| | The plasma viewing position may need to be optimized. | Refer to the Lateral (radial view mode) and X/Y (axial view mode) torch view procedures. See *Setting the Torch Viewing Position* on page 151 . |
| | RF power, nebulizer argon flow, and/or plasma viewing height may need adjustment. | Adjust as necessary. Also, check that you are using the recommended settings for your instrument. |
| | The purge windows may require cleaning. | Refer to the instructions for removing and cleaning the purge windows for your instrument. |
| Results erroneously high | Corrections may not have been made for the reagent blank. | Aspirate a blank and rerun standards and samples. |
| | Standard solutions may have deteriorated or may have been improperly made. | Restandardize with a proven standard. |
| | Background emission may be present. | Use background correction. |

**Table 6-1. Performance Problems: Troubleshooting Table**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| Results erroneously low | Standard solutions may have been improperly made. | Rerun proven standards. |
| | Blank solution may be contaminated or not matrix-matched to the standards. | Remake the blank solution. Acidify the blank if the sample matrix is acidified. |
| | Does the matrix composition of the samples vary from that of the blanks and standards? | If possible, prepare the standard and blank in the same acid matrix used for the samples. Or, internal standardization may be required. |
| | Is the concentration for the second standard lower than that for the first? | Increase the Read Delay to flush the sample introduction system completely. Alternatively, aspirate a blank between standards. |
| | Is background correction being used? | Check the placement of background correction points. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| | Are you analyzing aluminum at 167 nm? | Run a high nitrogen purge continuously. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| Undetectable emission signal | The sample introduction system may not be set up correctly, or may require maintenance. | Refer to *Cleaning the Sample Introduction System* on page 171. |
| | The shutter may be closed. | Check the shutter position set in the software. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| Memory effects | Spray chamber may not be being drained properly, or may need cleaning. | Check drain fittings and drain tubing. Clean the spray chamber if necessary. |

**Table 6-1. Performance Problems: Troubleshooting Table**

| | | |
|---|---|---|
| Cannot get suggested detection limits | The sample introduction system may not be set up correctly, or may require maintenance. | Refer to Chapter 4, Maintenance. |
| | The BEC may be high. | Run the BEC test. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| | Look for carryover – check if concentrations for the sample replicates increase from one to the next. | Increase the Read Delay to flush the sample introduction system completely. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| | The standard and blank may need to be matrix-matched. | Prepare the standard and blank in the same acid matrix used for the samples. |
| | The integration time may be too short. | Increase the minimum and maximum times for integration. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| Cannot get suggested detection limits (continued) | The standard may have too high a concentration. | Dilute the standard to approximate the anticipated concentration of samples. |
| | You may not be comparing the appropriate value for the wavelength you are using. | Confirm that you are using the appropriate wavelength and recheck the value. Refer to the Syngistix Software Guide on the Syngistix Document Pack CD for details. |
| General performance problems | Performance problems such as poor precision or loss of signal can often be traced to the setup and condition of the sample introduction system. | See the section *Checking the Sample Introduction System* on page 276. |

**Table 6-1. Performance Problems: Troubleshooting Table**

| | | |
|---|---|---|
| Unexplained background shift | The torch or injector may be coated with a deposit that reflects light, resulting in a periodic background shift. | Replace the torch and injector. |

# Plasma Ignition and Stability Problems

## Plasma Ignition Problems

Possible reasons for unsuccessful ignition follow. Correct the problem, if possible, and then try to ignite the plasma again.

- If the plasma will not light, check the **ignitor.** Open the door to the sample compartment. Check that the ignitor finger is making contact with the torch glassware. Also check that the ignitor finger is approximately 22 mm from the bottom flat plate
- **Torch:** Check that the torch is locked into place. If it is not, the torch can leak.
- **Torch and Injector Adapter O-rings:** Verify that all gas fittings to the torch are finger-tight. Leakage of air into any part of the torch, nebulizer or spray chamber will cause ignition problems. The torch should be clean and in good condition. **Do not over tighten the nebulizer fittings because they will get damaged**. The dark blue torch o-ring (Part No. N0791334) on the outside of the torch and the dark blue o-ring on the outside of the injector adapter (Part No. N0791333) should be replaced after 300 insertions
- If the plasma will not light, check the **plasma induction plates.** Check the plasma induction plates for condensation, particularly in labs with high humidity. Dry the plasma induction plates with a soft cloth if necessary.
- **Torch Glassware:** Check the condition of the torch glassware. If it is cloudy or dirty, clean it in a 5-20% nitric acid solution. See *Cleaning the Torch* on page 184.
- If the plasma is unstable, check the drain**.** Check the drain tubing for flat spots and replace the tubing if necessary. Check that the drain fitting on the spray chamber drain is secure. Be sure that the pump is properly draining the spray chamber and that the drain liquid is not backing up into the spray chamber or building up in the torch.

- **Argon:** Check that the argon supply is on. Check the argon hose connections. Make sure that they are not obstructed. Check that the pressure at the cylinder regulator is 550-825 kPa (80-120 psig).

- **Injector:** Check that the injector is not clogged. You will need to remove the injector and injector adaptor as described in *Removing the Injector* on page 175. In addition, try pumping solutions with the Nebulizer, Auxiliary, and Plasma gas flows on for approximately two minutes. Then turn off the pump and try to reignite the plasma again.

- **Nebulizer:** Check that it is tightly secured to the spray chamber.

- **Sample Capillary:** Check that it is attached to the nebulizer.

- **Organics:** If you analyzing organic solutions and cannot ignite the plasma, run the nebulizer argon for a couple of minutes with the pump *off* to purge the spray chamber.

- **Organic Vapors:** If these remain in the torch from an earlier analysis, they can sometimes cause ignition problems. If you suspect this, purge the sample introduction system with argon for several minutes.

- **Spray Chamber:** Remove the spray chamber and cap the injector. Now try to light the plasma. If the plasma now lights and is stable, the ignition problem is in the spray chamber, nebulizer or the sample introduction system. If the problem persists, check the torch O-rings and gas connections to the torch mount.

## Plasma Stability Problems

If periodic pulsations of the torch are observed:

- Poor sample drainage may be the problem. Make sure that waste drainage is not backing up into the spray chamber and that the waste is draining properly.
- Check the condition of the peristaltic pump tubing. If it is flattened, stretched, or damaged by abrasion, replace the tubing.
- Air leaks may be causing the pulsation. Check the O-rings on the torch assembly and ensure that the nut on the end of the torch is firmly in place. Do **not** use a tool to tighten. Make sure the nebulizer/end cap assembly fits tightly to the spray chamber.

If using organics, you may see an irregular pulsation:

- Be sure that the injector you are using is recommended for the types of solvents you are using. The quartz injector, 1.2 mm i.d., is recommended for typical organic analyses. The alumina injector, 0.80 mm i.d., should be used with volatile organic solvents, for example, methanol.
- Try increasing the RF power, using less solvent, slowing down the pump speed, or adjusting the torch height.

## Printing Problems

**Table 6-2. Printing Problems**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| Printer does not print | The correct printer driver may not be installed or selected in Windows. | Check the printer drivers in Windows. For more information, see the Syngistix Software installation Guide on the Syngistix Document Pack CD. |
| | The printer may have been disconnected. | Check the power cable and the cable connecting the printer to the computer. Make sure the power is on. |
| | The printer may be out of paper or off-line. | Check printer status. |
| | The pins on the printer cable connector may be broken. | Check the connector. If the pins are broken, order a replacement cable. |
| Printout is missing information | The printer may not be set to the correct emulation mode. | See the printer manufacturer's information or refer to the Syngistix Software Installtion Guide on the Syngistix Document Pack CD. |

## Pump Problems

**Table 6-3. Pump Problems**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| Pump rollers stick | A spill may have occurred or the pump head may be worn and may need to be replaced. *Note: It is normal for a small amount of roller lubricant to appear at the ends of the rollers*. | Clean the pump head, or replace if necessary. |
| Liquid is not flowing freely | The tension on the pump tubing is too high or low.<br><br>Tubing may not be installed correctly in the channel.<br><br>Tubing may be worn. | Use the adjustment screw to adjust the tension. See *Adjusting the Pump Tubing* on page 252.<br><br>Reinstall tubing.<br><br>Replace tubing. |
| Pump tubing is stretched on one end and slack on the other end | The tension on the pump tubing is too tight.<br><br>Rollers may be stuck.<br><br>Tubing may be worn. | Loosen the adjustment screw.<br><br>Check the rollers in the pump head to see if they roll freely.<br><br>Replace tubing. |
| Pump makes excessive noise | A mechanical problem may have occurred. | Call a PerkinElmer service engineer. |

## *Autosampler Problems*

**Table 6-4. Autosampler Problems**

| Problem | Possible Cause(s) | Corrective Action |
|---|---|---|
| Autosampler does not respond | There may be a communication problem. | Use the **Instrument Diagnostics** window to reset the autosampler. |
| | The software may not be configured for the autosampler you are using. | Select the **Instrument tab -> Devices** click on the **Autosampler** tab and check the autosampler configuration. If the wrong autosampler model is shown exit, Syngistix and run the **Syngistix Reconfiguration** program from the Windows start menu to change the autosampler model. |
| | One of the cables may have been disconnected or the autosampler may have been turned off. | Check the power cable and the cable connecting the autosampler to the computer. Make sure the power is on. |
| | For AS-93plus and other GPIB controlled autosamplers, the DIP switches may be set incorrectly. | Reference the appropriate autosampler hardware guide for the correct DIP switches. |
| | The pins on the autosampler cable connector may be broken. | Check the connector. If the pins are broken, order a replacement cable. |
| Autosampler does not go to the correct location. | The software may not be configured for the correct autosampler tray. | Autosampler tray is selected by going to **Instrument** tab and selecting **Devices** and then select the **Autosampler** tab. In the **Autosampler Setting** field in the **Autosampler** tab select the tray type from the browse window. |

# RF Generator/Sample Introduction System Troubleshooting Form

Fill out the following form before you contact PerkinElmer service.

## Troubleshooting Form

## General:

Instrument Serial Number:

Site:

Date:

## Sample Introduction Configuration:

Nebulizer Type:CROSS FLOW / LF GEMCONE / CONCENTRIC

Spray Chamber Type:SCOTT /BAFFLED CYCLONIC

Injector Type:QUARTZ / ALUMINA

Injector Bore (mm):0.8 / 1.2 / 1.6 / 2.0 / 3.0

Torch (number of slots):NO SLOT / ONE SLOT / THREE SLOT

Sample Type:AQUEOUS / ORGANICS / HIGH SOLIDS

## Operating Conditions:

RF Power:

Plasma Gas Flow:L/min

Aux Gas Flow:L/min

Nebulizer Gas Flow:L/min

Sample Uptake Rate:L/min

Torch Position:mm

Distance between Injector tip and Aux Tube:mm

### Instrument Environment:

Lab Temperature:°C± °C

Line Voltage:V

Line Frequency:Hz

Chiller Temperature Setting:°C

### Common Setup Problems:

Glassware bottomed out in torch body (Glassware Holder): Yes/No

Glassware aligned with notch in torch body (Glassware Holder): Yes/No

Igniter finger contacting torch glass: Yes/No

Torch position appropriate for sample type: Yes/No

Aqueous = -3, Organics = -3, High Solids = -2

Injector O-Rings not worn, cracked, or cut: Yes/No

Torch Body (Glassware Holder) O-Rings not worn, cracked, or cut: Yes/No

Injector Dry: Yes/No

Spray Chamber draining properly: Yes/No

Pump Tubing clamped: Yes/No

Pump Tubing not worn out: Yes/No

Pump Tubing pumping in proper direction: Yes/No

Radial and Axial windows installed and clean: Yes/No

## Troubleshooting Tasks Performed:

Did the plasma light: Yes/No

Did the plasma stay lit after ignition: Yes/No

Plasma went out after pump turned on: Yes/No

Plasma went out after how long of operation:

Plasma went out with Warm Wet Plasma (neb on, pump on, heat on): Yes/No

Plasma went out with Cold Wet Plasma (neb on, pump on, no heat): Yes/No

Plasma went out with Dry Plasma (neb on, no pump): Yes/No

Plasma went out when injector capped off: Yes/No

Referring to the figures on the following pages, the plasma looked like:

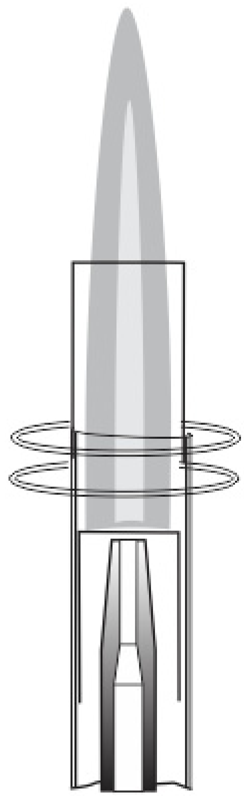

**Figure 6-1. Normal Plasma Conditions at 0 torch position**

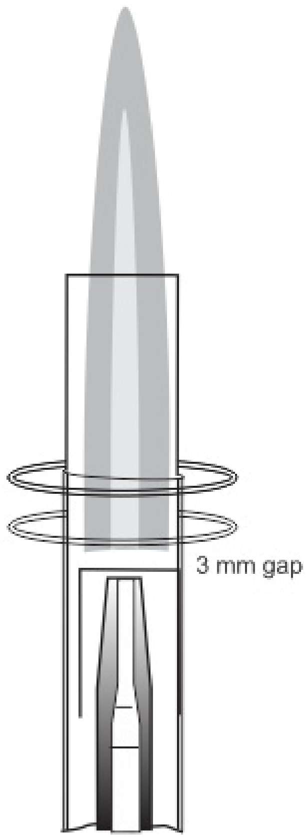


**Figure 6-2 Normal Plasma at -3mm position**

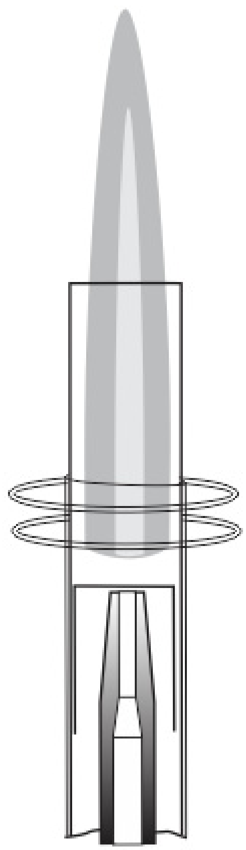

**Figure 6-3 Rounded Plasma due to sample or air getting around the outside (typically subtle air leak)**

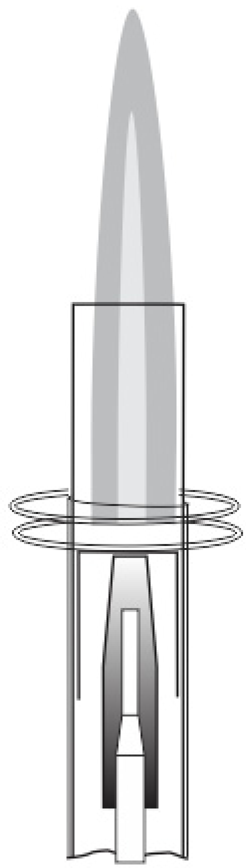

**Figure 6-4** **Aux Gas too high, Air Leak, or Spray Chamber Temperature too high**

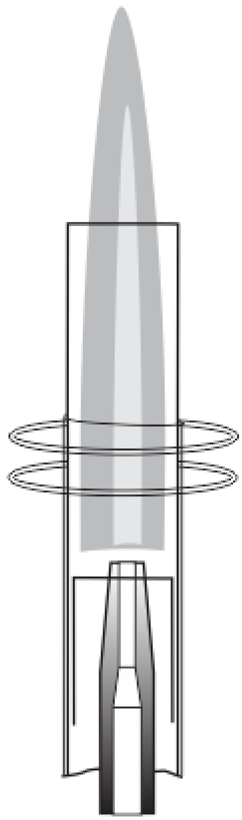

**Figure 6-5** **Injector too far forward**

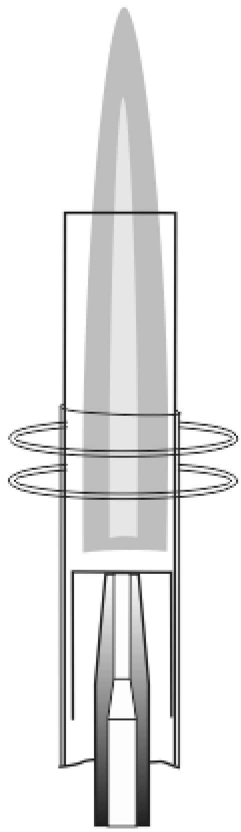

**Figure 6-6 No Aux Gas (Torch may be glowing)**

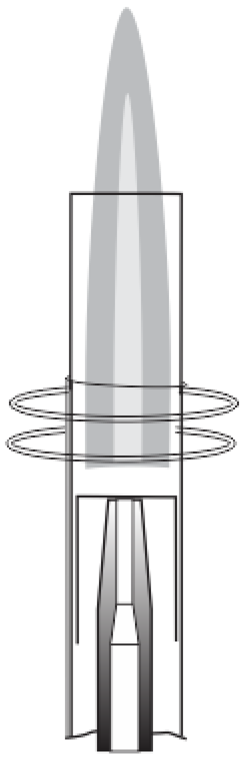

**Figure 6-7 Air Leak or Spray Chamber Temperature too high**

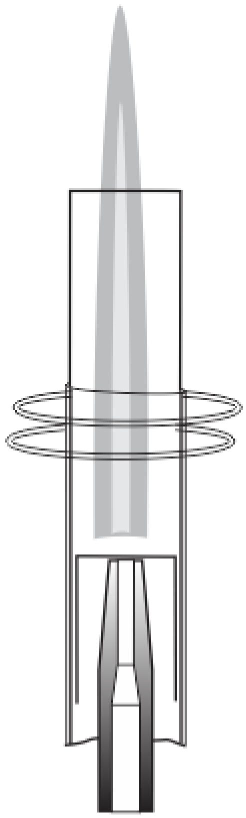

**Figure 6-8 Thin Plasma due to leak in Plasma Gas Line**

# Index

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