



# **Ion Max NG and EASY-Max NG**

## **Ion Sources User Guide**

For H-ESI, APCI, and APPI Modes

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# Preface

The *Ion Max NG and EASY-Max NG Ion Sources User Guide* describes how to install, remove, and maintain the Thermo Scientific™ Ion Max NG™ and EASY-Max NG™ atmospheric pressure ionization (API) sources.

**Note** The [Glossary](#) defines some of the terms used in this guide.

## Contents

- [Accessing Documentation](#)
- [Compatible Mass Spectrometers](#)
- [Special Notices, Symbols, and Cautions](#)
- [Safety Precautions](#)
- [Contacting Us](#)

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Complete a brief survey about this document by clicking the button below.  
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## Accessing Documentation

In addition to this guide, you can also access the Preinstallation Requirements Guide, Getting Connected Guide, Getting Started Guide, and Hardware Manual for your specific Thermo Scientific mass spectrometer as PDF files from the data system computer.

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4. From the results list, click the title to open the document in your web browser, save it, or print it.

To return to the document list, click the browser **Back** button.

## Compatible Mass Spectrometers

Install the Ion Max NG and EASY-Max NG ion sources on the appropriate Thermo Scientific mass spectrometers, some of which are listed in [Table 1](#). If you have instrument compatibility questions, contact Thermo Fisher Scientific Customer Service (see [page xiii](#)).



**CAUTION** The Ion Max NG and EASY-Max NG ion sources must connect to a certified Thermo Scientific mass spectrometer, which supplies high voltage capable of delivering a maximum of 8 kV and 100  $\mu$ A.

If you connect either API source to another type of mass spectrometer, you might impair the protection provided by the equipment.









**Table 1.** Ion sources and compatible mass spectrometers

Ion source model	Thermo Scientific mass spectrometer
EASY-Max NG	<ul style="list-style-type: none"> <li>• Orbitrap Fusion™ Series</li> <li>• TSQ Endura™ and Endura MD™</li> </ul>
Ion Max NG	<ul style="list-style-type: none"> <li>• TSQ Quantiva™</li> </ul>

## Special Notices, Symbols, and Cautions

Make sure you understand the special notices, symbols, and caution labels in this guide. Most of the special notices and cautions appear in boxes; those pertaining to safety also have corresponding symbols. Some symbols are also marked on the API source itself and can appear in color or in black and white. For complete definitions, see [Table 2](#).

**Table 2.** Notices, symbols, labels, and their meanings

Notice, symbol, or label	Meaning
<b>IMPORTANT</b>	Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the product.
<b>Note</b>	Highlights information of general interest.
<b>Tip</b>	Highlights helpful information that can make a task easier.
	<b>Caution:</b> Read the cautionary information associated with this task.
	<b>Chemical hazard:</b> Observe safe laboratory practices and procedures when handling chemicals. Only work with volatile chemicals under a fume or exhaust hood. Wear gloves and other protective equipment, as appropriate, when handling toxic, carcinogenic, mutagenic, corrosive, or irritant chemicals. Use approved containers and proper procedures to dispose of waste oil and when handling wetted parts of the instrument.
	<b>Hot surface:</b> Before touching the API source assembly, allow heated components to cool.
	<b>Risk of electric shock:</b> This instrument uses voltages that can cause electric shock and personal injury. Before servicing the instrument, shut it down and disconnect it from line power. While operating the instrument, keep covers on.
	<b>Risk of eye injury:</b> Eye injury can occur from splattered chemicals, airborne particles, or sharp objects. Wear safety glasses when handling chemicals or servicing the instrument.
	<b>Sharp object:</b> Avoid handling the tip of the syringe needle.
	<b>Trip obstacle:</b> Be aware of cords, hoses, or other objects located on the floor.
	<b>Ultraviolet light hazard:</b> For the APPI-configured ion source (APPI source), do not look directly at the ultraviolet (UV) light or into the UV source, or risk eye damage. Wear UV eye protection.

## Safety Precautions

Observe the following safety precautions when you operate or perform service on the API source.



**CAUTION Do not perform any servicing other than that contained in this manual.** To avoid personal injury or damage to the instrument, do not perform any servicing other than that contained in this manual or related manuals unless you are qualified to do so.



**CAUTION Respect heated zones.** Treat heated zones with respect. Allow heated components to cool to room temperature before you service them. The API source housing, its components, and the mass spectrometer's ion transfer tube can be very hot and cause severe burns if touched.



**CAUTION Risk of eye damage.** Do not look in the API source window at the ultraviolet (UV) light during APPI mode operation. If you must do so, wear UV eye protection.








**CAUTION Handle the APCI corona discharge needle with care.** The corona discharge needle is very sharp and can puncture your skin.



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	(U.S.) 1 (561) 688-8731	(U.S.) 1 (561) 688-8736
	<a href="mailto:us.customer-support.analyze@thermofisher.com">us.customer-support.analyze@thermofisher.com</a> 	<a href="mailto:us.techsupport.analyze@thermofisher.com">us.techsupport.analyze@thermofisher.com</a> 



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# Introduction

This chapter provides general information about the [atmospheric pressure ionization \(API\)](#) techniques (modes) available for use with the Ion Max NG and EASY-Max NG ion sources. The ionization mode is the specific process used to ionize the sample. You can configure the Ion Max NG and EASY-Max NG ion sources to operate in the following modes:

- [heated-electrospray \(H-ESI\)](#)
- [atmospheric pressure chemical ionization \(APCI\)](#)
- [atmospheric pressure photoionization \(APPI\)](#)
- Combined H-ESI/APPI
- Combined APCI/APPI

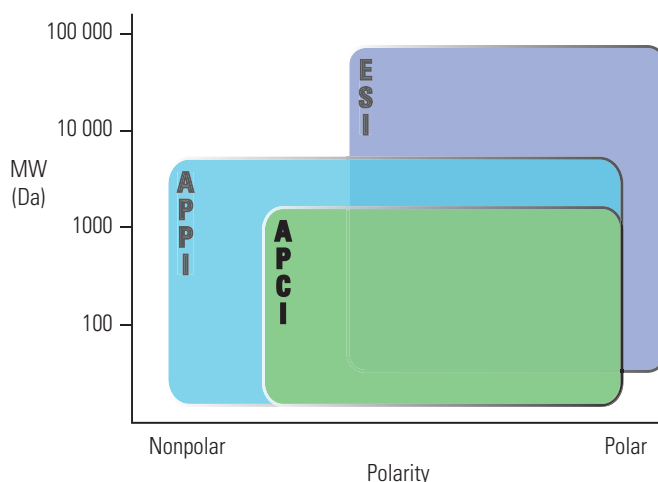
The mass spectrometer keeps the pressure in the API source housing at atmospheric levels, which reduces the chemical noise that nebulized gases can cause when they are not properly evacuated from the API source. The mass spectrometer's ion guides transmit the ions produced in the API source into the mass analyzer, where the instrument analyzes them according to their mass-to-charge ratio ( $m/z$ ). For information about ion analysis, refer to the mass spectrometer manuals.

## Contents

- [H-ESI Mode](#)
- [APCI Mode](#)
- [APPI Mode](#)

Typically, H-ESI is the preferred ionization mode for polar compounds, APCI is the preferred ionization mode for medium polarity compounds, and APPI is typically the preferred ionization mode for certain polar and nonpolar compounds. See [Figure 1](#).

**Figure 1.** Polarity ranges for ESI, APCI, and APPI versus molecular weights



## H-ESI Mode

Heated electrospray (H-ESI) transforms ions in solution into ions in the gas phase by using electrospray (ESI) in combination with heated [auxiliary gas](#). With H-ESI, a mass spectrometer can analyze a range of molecular weights greater than 100 000 Da, due to multiple charging. H-ESI is especially useful for the mass analysis of polar compounds that make a preformed ion in solution, which include biological polymers (for example, proteins, peptides, glycoproteins, and nucleotides), pharmaceuticals and their metabolites, and industrial polymers (for example, polyethylene glycols).

Droplet size, surface charge, liquid surface tension, solvent volatility, and ion solvation strength are factors that affect the H-ESI process. Large droplets with high surface tension, low volatility, strong ion solvation, low surface charge, and high conductivity prevent good electrospray. The H-ESI source produces charged aerosol droplets that contain sample ions. The H-ESI source accommodates liquid flow rates of 1  $\mu\text{L}/\text{min}$  to 1  $\text{mL}/\text{min}$  without splitting.

Organic solvents, such as methanol, acetonitrile, and isopropyl alcohol, are superior to water for H-ESI. Volatile acids and bases are good, but salts above 10 mM concentration and strong acids and bases are extremely detrimental.

## Guidelines

For achieving a good electrospray, use these guidelines:

- Refrain from using nonvolatile salts and buffers in the solvent system. For example, avoid the use of phosphates and salts that contain sodium or potassium. If necessary, use ammonium salts instead.
- Use organic-aqueous solvent systems.
- Use volatile acids and bases.
- If possible, optimize the pH of the solvent system for the analyte of interest. For example, if the analyte of interest contains a primary or secondary amine, use an acidic mobile phase (pH 2–5). The acidic pH tends to keep positive ions in solution.

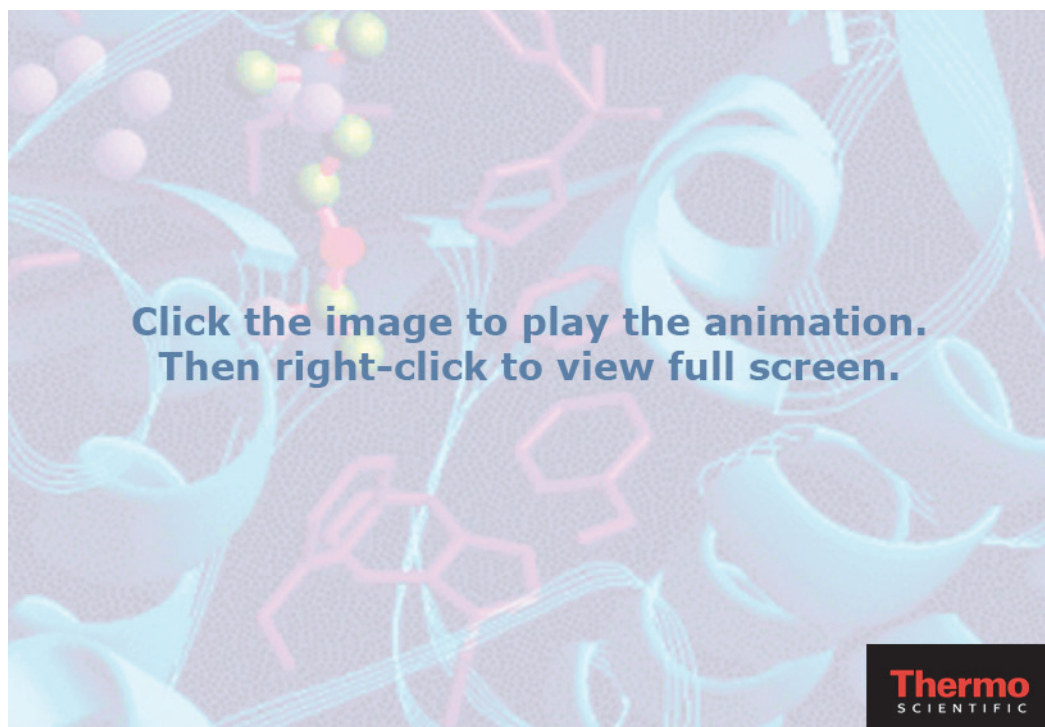
For LC applications that require nonvolatile buffers, use these guidelines:

- Install the [ion sweep cone](#) on the mass spectrometer.
- Optimize the spray insert position.
- Reduce the concentration of buffers to an absolute minimum.

## Demonstration Animation

### ❖ To view H-ESI in operation

Click the image below. When you want to close the animation, right-click it and choose **Disable Content** from the shortcut menu.



## APCI Mode

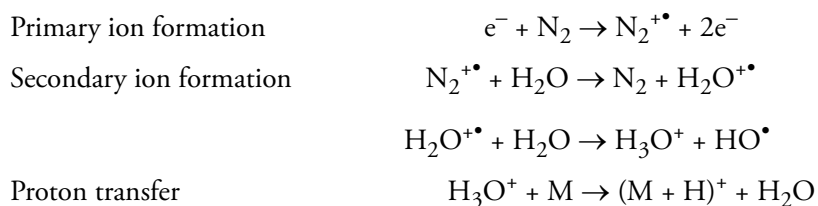
Atmospheric pressure chemical ionization (APCI) is a soft ionization technique, but not as soft as H-ESI. APCI is used to analyze compounds of medium polarity that have some volatility.

Figure 2 shows the APCI process for positive adduct ion formation. In APCI, the mass spectrometer produces and analyzes ions as follows:

1. The **nozzle** sprays the sample solution into a fine mist of droplets.
2. The **APCI vaporizer** (high temperature tube) vaporizes the droplets.
3. The mass spectrometer applies a high voltage to a needle located near the exit end of the tube. The high voltage creates a **corona discharge** that forms reagent ions through a series of chemical reactions with solvent molecules and nitrogen sheath gas.
4. The reagent ions react with sample molecules to form sample ions.
5. The sample ions enter the mass spectrometer and are analyzed.

APCI is a gas phase ionization technique. Therefore, the gas phase acidities and basicities of the analyte and solvent vapor play an important role in the APCI process.

In the positive-ion mode, sample ionization occurs in a series of reactions that start with the electron-initiated cation formation. Typical examples of primary, secondary, and adduct ion formation are shown below:



In negative-ion mode,  $(M - H)^-$  is typically formed by the abstraction of a proton by  $OH^-$ .

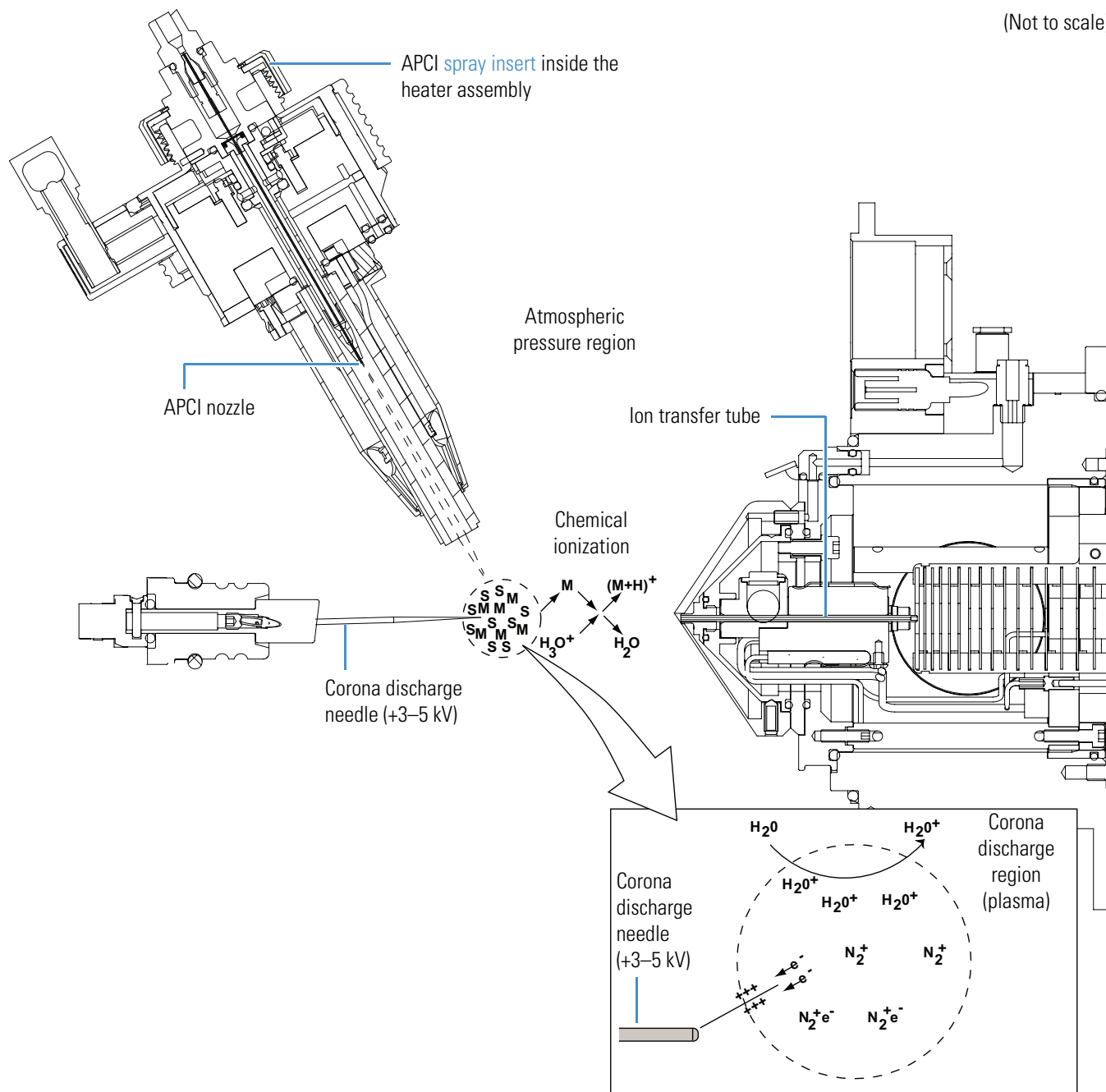
APCI is typically used to analyze small molecules with molecular weights up to about 1500 Da. A very robust ionization technique, APCI is not affected by minor changes in most variables, such as changes in buffers or buffer strength.

You can use APCI in positive or negative ion polarity mode. For most molecules, the positive-ion mode produces a stronger ion **current**. This is especially true for molecules with one or more basic nitrogen (or other basic) atoms. An exception to the general rule is that molecules with acidic sites, such as carboxylic acids and acid alcohols, produce more negative ions than positive ions.

Although, in general, APCI produces fewer negative ions than positive ions, negative ion polarity is sometimes the mode of choice. Because the negative ion polarity mode sometimes generates less chemical noise than in the positive mode, selectivity might be better in the negative ion mode.

**Figure 2.** APCI process in the positive ion polarity mode (cross-sectional components)

(Not to scale)

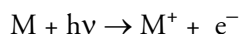


## APPI Mode

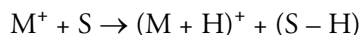
Atmospheric pressure photoionization (APPI) is also a soft ionization technique. In APPI an ion is generated from a molecule when it interacts with a photon from a light source, such as the Syagen™ Technology PhotoMate™ APPI™ light source. APPI generates molecular ions for molecules that have an ionization potential below the photon energy of the light being emitted by the light source.

In APPI, the mass spectrometer produces and analyzes ions as follows:

1. The H-ESI or APCI nozzle sprays the sample solution into a fine mist of droplets.
2. The vaporizer (high temperature tube) vaporizes the droplets.
3. The analyte molecule interacts with the light from the PhotoMate light source. The analyte molecule M is ionized to a molecular ion  $M^+$  if the ionization potential of the analyte is less than the photon energy  $h\nu$ :



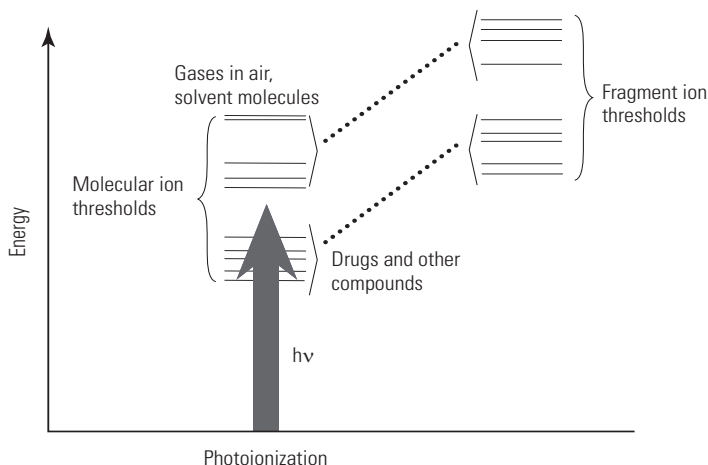
4. In the presence of protic solvents, the analyte ion may extract a hydrogen to form an  $(M + H)^+$  ion:



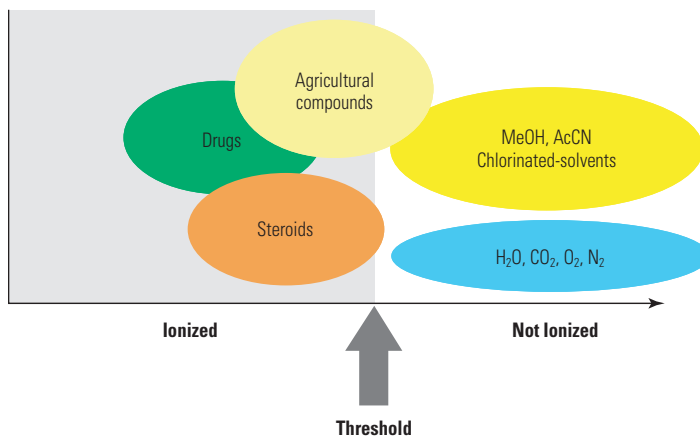
5. The analyte ions pass through the [API ion transfer tube](#), enter the mass spectrometer, and are analyzed.

Molecules including steroids, basic-drug entities, and pesticides have ionization potentials below the threshold, and protonated molecules are generated in the LC/MS experiment. APPI reduces fragmentation because only a small amount of energy is deposited in the molecule. Molecules such as the nitrogen sheath and auxiliary gas and the simple solvents used for LC/MS are not ionized because their ionization potentials are greater than the photon energy. The result is selective ionization of an analyte versus the background. See [Figure 3](#) and [Figure 4](#).

**Figure 3.** Energetics of photoionization





**Figure 4.** Illustration of selective photoionization

## APPI Light Source

The PhotoMate APPI light source uses a krypton, vacuum ultraviolet (VUV) lamp that emits photons with energies of 10.0 and 10.6 eV. Molecules with ionization potentials less than 10 eV ionize to form  $M^+$  or  $(M + H)^+$ , while those with greater ionization potentials do not. [Figure 5](#) shows ionization potentials of typical compounds and solvents.

**Figure 5.** Ionization potentials of typical compounds and solvents

Krypton 10.0 eV, 10.6 eV			
Ionization Potentials (IP)		Solvent Ionization Potentials (IP)	
Anthracene	7.4 eV	Toluene	8.82 eV
Fluoranthene	7.8 eV	Acetone	9.70 eV
Caffeine	8.0 eV		
4-Nitrotoluene	9.5 eV		
10.0 eV -----			
		Methanol	10.85 eV
		Acetonitrile	12.19 eV
		Water	12.61 eV

## API Spray Insert Selection

For APPI mode, you can use either the [APCI Spray Insert](#) (default) or the [H-ESI Spray Insert](#). When you install the APCI spray insert, you can switch between three ionization modes: APCI only, APPI only, and APCI/APPI. When you install the H-ESI spray insert, you can switch between three ionization modes: H-ESI only, APPI only, and H-ESI/APPI.

Select the spray inset that is best suited for your compounds of interest. If the main analysis mode is APPI, use the APCI spray insert. However, if your analysis requires that you switch between ionization modes, use the H-ESI spray insert for polar compounds and the APCI spray insert for nonpolar compounds. If you need additional information, contact Thermo Fisher Scientific Technical Support (see [Contacting Us](#)).

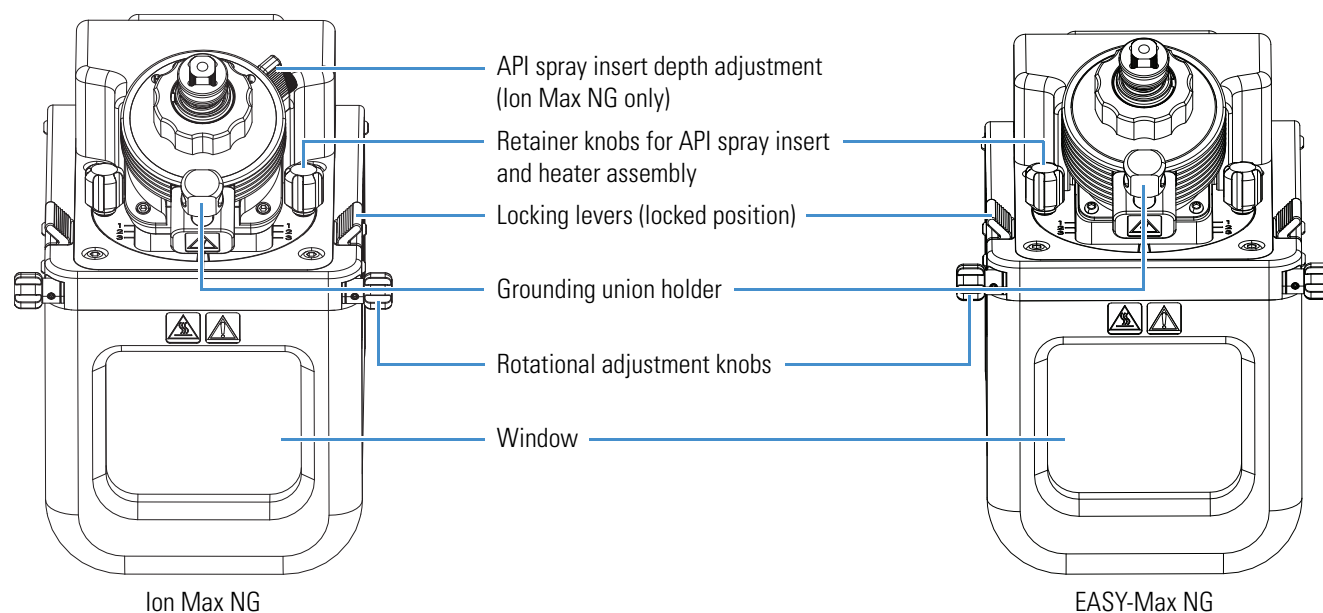
## API Source

This chapter provides general information about the Ion Max NG and EASY-Max NG ion sources (Figure 6), and describes how to remove and install the API source housing.

### Contents

- API Source Features
- Solvent Waste System
- API Spray Inserts
- Removing and Installing the API Spray Insert
- Removing and Installing the API Source

**Figure 6.** Ion Max NG and EASY-Max NG ion sources



## API Source Features

The API source includes these features:

- Heater assembly—Mounts on top of the API source housing, and used for H-ESI, APCI, and APPI modes. In H-ESI mode the heater heats the auxiliary gas, which aids desolvation. In APCI and APPI modes, the heater vaporizes the sample before it reaches the [APCI corona discharge needle](#) (APCI mode) or the PhotoMate light source (APPI mode). For information about the ionization modes, see [Chapter 1, “Introduction.”](#)
- Adjustable API spray insert mount—Move the API spray insert and heater assembly front-to-back or rotate them slightly to increase sensitivity or robustness. You can also adjust the spray insert depth on the Ion Max NG ion source, which is the only difference between the two API source models. See [“Adjusting the Spray Direction.”](#)
- Mounting angle of the API spray insert—Fixed at the optimum angle for signal intensity and API source robustness. You can view the spray insert through the API source window while positioning it.
- Interchangeable ionization modes—Change the ionization mode by installing a different spray insert and reconfiguring the housing. See [Chapter 3, “Changing the Ionization Mode.”](#)
- Safety interlock system—Prevents contact with high voltages. The API source housing has high voltage safety interlock switches that turn off the following voltages:
  - Electrospray needle voltage or APCI corona discharge voltage
  - All API source and lens voltages, including the ion transfer tube offset voltage
  - The voltages on the mass spectrometer ion guides

The following actions turn off these voltages:

- Removing the API spray insert from the API source
- Removing the API source from the mass spectrometer
- Internal wiring and gas plumbing—Requires no removal of the LC or gas plumbing when you want to remove the API source or change the ionization mode.
- Internal drain tube—Requires no removal of an external drain tube when you want to remove the API source. The API source contains an internal drain insert that connects to the drain tube located inside the mass spectrometer.
- Cooling vents—During operation, the external surface of the API source can become hot. The ventilation holes in the housing aid cooling. Before you touch the housing or its components, allow the system to cool for a minimum of 20 minutes.

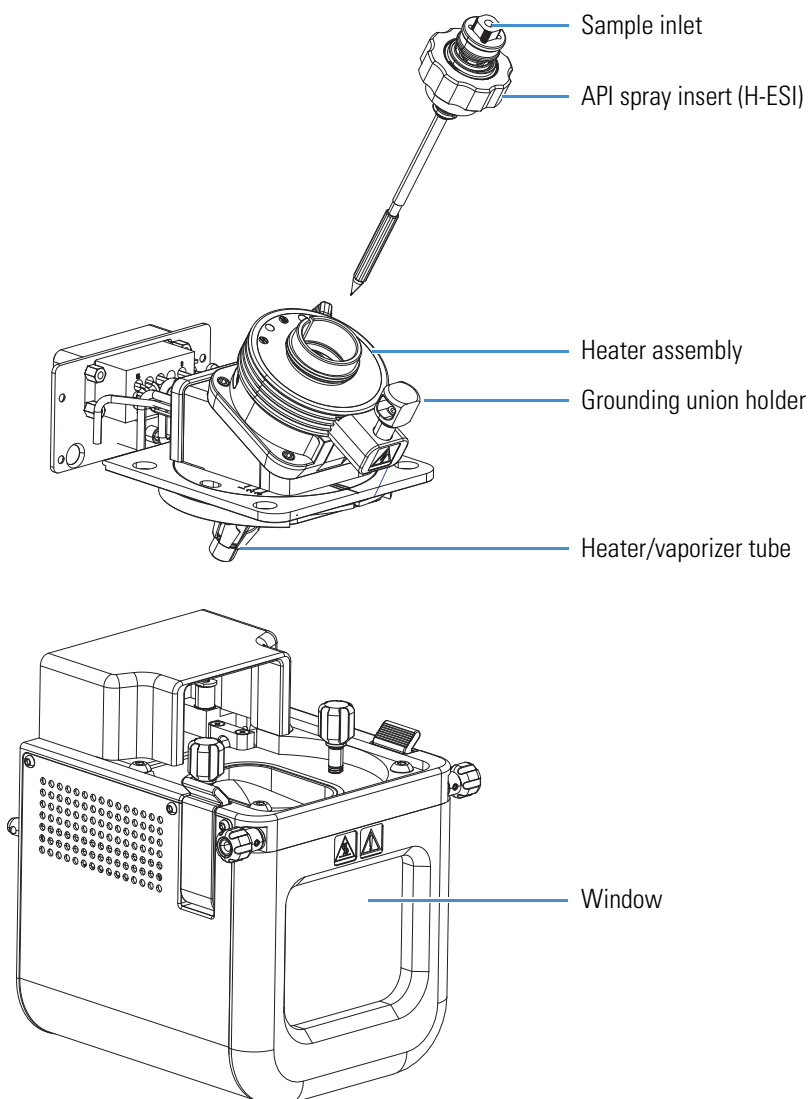


**CAUTION Avoid burns.** Avoid touching the API source housing when the mass spectrometer is in operation. The external surface of the housing can become hot enough to burn your skin.

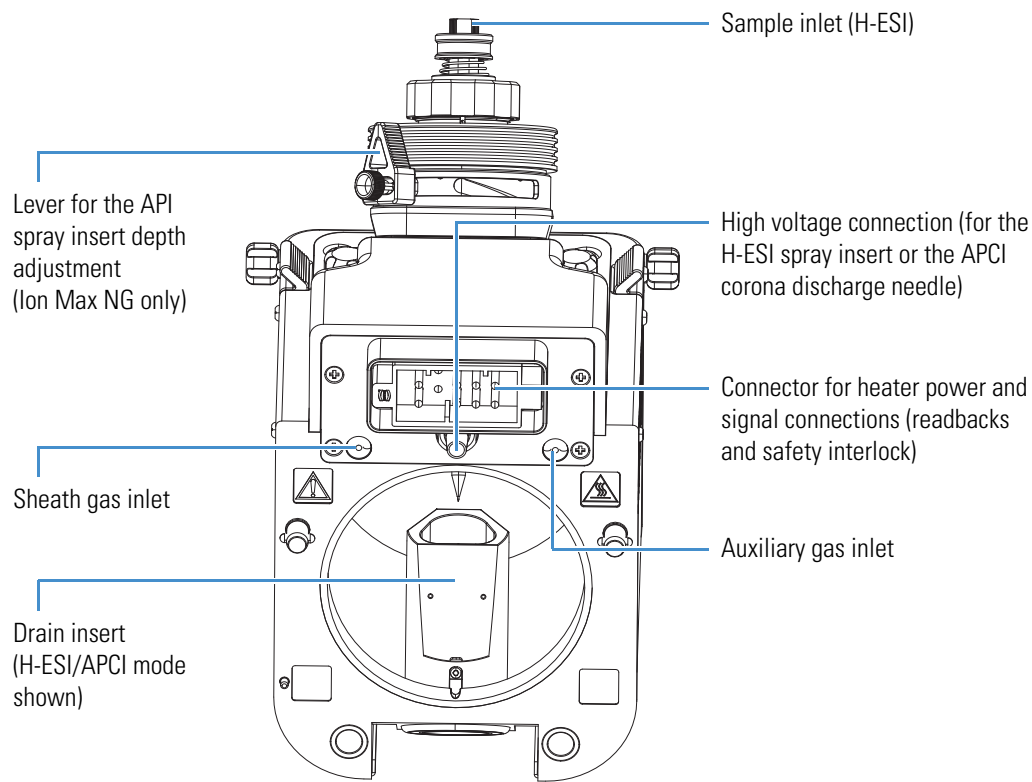
To prevent corrosion caused by liquid leaks or poor drainage, the API source includes these features:

- Zero dead volume (ZDV) grounding union—(Required for H-ESI mode only) Connects the solvent flow from the LC instrument or the syringe pump to the API spray insert's sample inlet. The grounding union's position is offset to prevent liquid leaks from dripping into the API source housing (Figure 7).
- Drain insert—Allows eluants to flow directly from the API spray insert into the drain. (Figure 8).

**Figure 7.** Ion Max NG ion source showing the API spray insert, heater assembly, and housing



**Figure 8.** Ion Max NG ion source (back and top view)



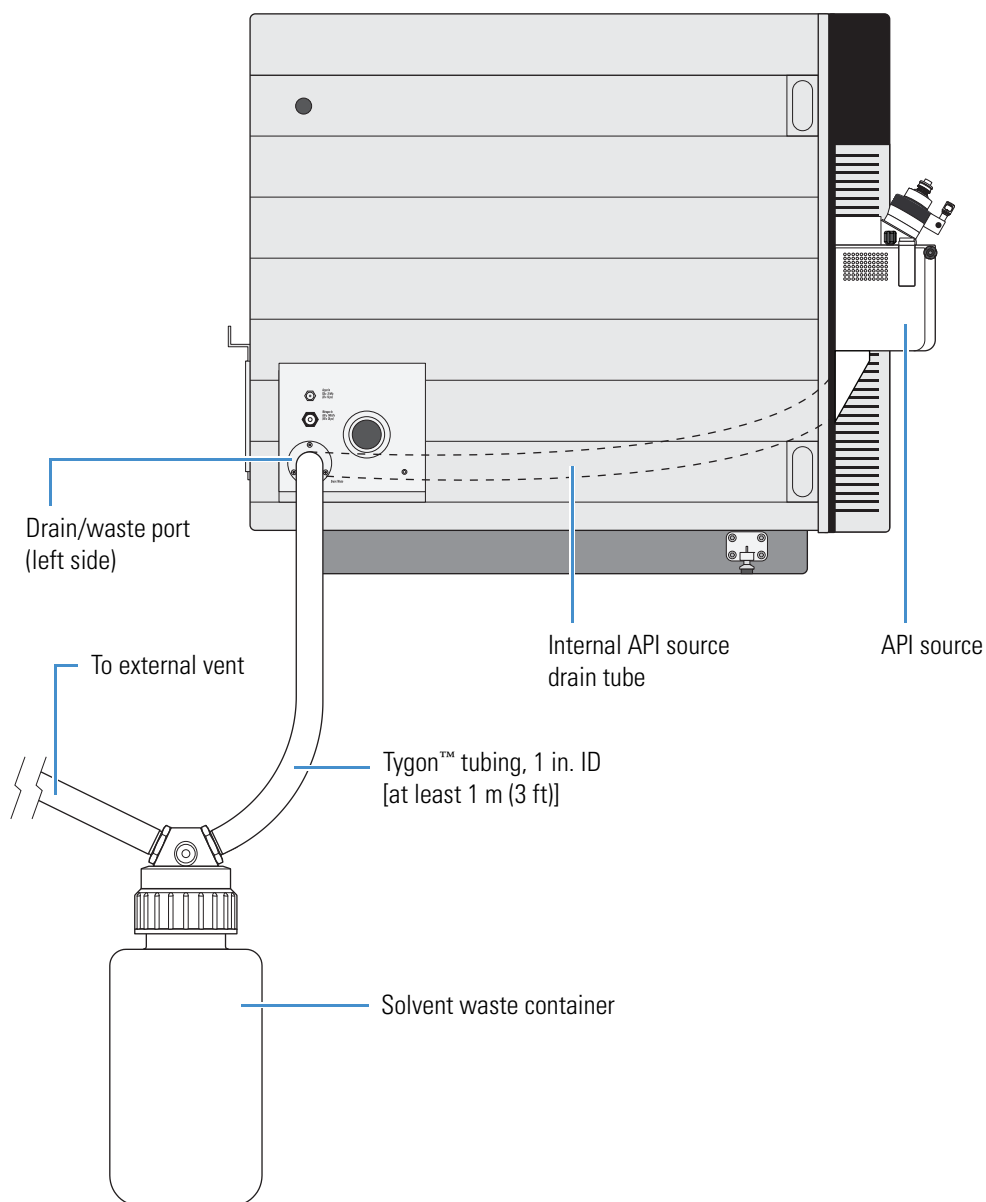
## Solvent Waste System

Solvent waste from the drain insert in the API source travels through a fully enclosed drain tube inside the mass spectrometer and exits the instrument at either the left side or back, depending on the mass spectrometer model. [Figure 9](#) shows the solvent waste system for the TSQ Quantiva and TSQ Endura mass spectrometers.

**IMPORTANT** Equip your laboratory with at least two fume exhaust systems. The analyzer optics can become contaminated if the API source drain tube and the exhaust tubing from the forepumps connect to the same fume exhaust system. Route the exhaust tubing from the forepumps to a dedicated fume exhaust system.

For additional information, refer to the mass spectrometer's Preinstallation Requirements Guide.

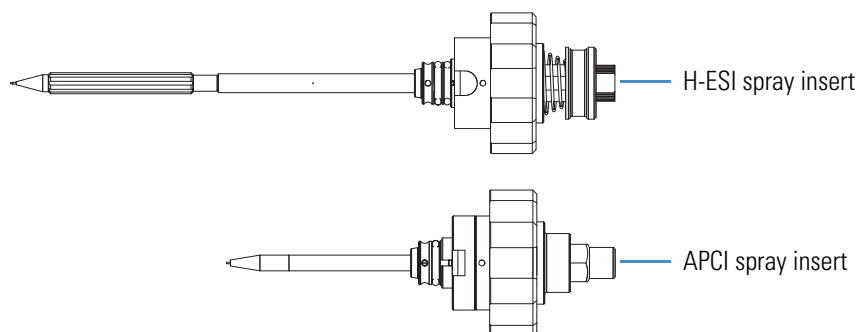
**Figure 9.** Example solvent waste system (TSQ Quantiva and TSQ Endura mass spectrometers)



## API Spray Inserts

This section describes the API spray insert that you insert into the heater assembly through the top of the API source ([Figure 7](#)). The default spray insert provided with your API source is for H-ESI mode, and the optional spray insert is for APCI mode. For ordering information, see [Chapter 5, “Replaceable Parts.”](#)

**Figure 10.** H-ESI (top) and APCI (bottom) API spray inserts

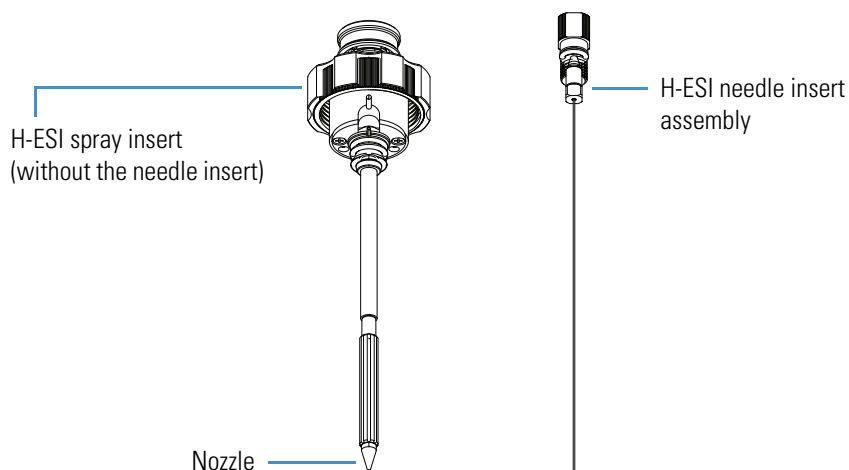


### H-ESI Spray Insert

The H-ESI spray insert includes a metal electrospray needle insert, a H-ESI [nozzle](#), and the [sheath gas](#) and auxiliary gas plumbing. Sample and solvent enter the nozzle through one of two H-ESI needle inserts: one is for low flow (less than 10  $\mu\text{L}/\text{min}$ ) and the other, for high flow (greater than 10  $\mu\text{L}/\text{min}$ ). To change the needle insert, see [“Replacing the H-ESI Metal Needle Insert.”](#)

The H-ESI needle insert includes a stainless steel needle that extends from the sample inlet to approximately 1.2 mm (0.05 in.) past the end of the spray insert nozzle. [Figure 11](#) shows the H-ESI needle insert removed from the H-ESI spray insert.

**Figure 11.** H-ESI spray insert and its metal needle insert

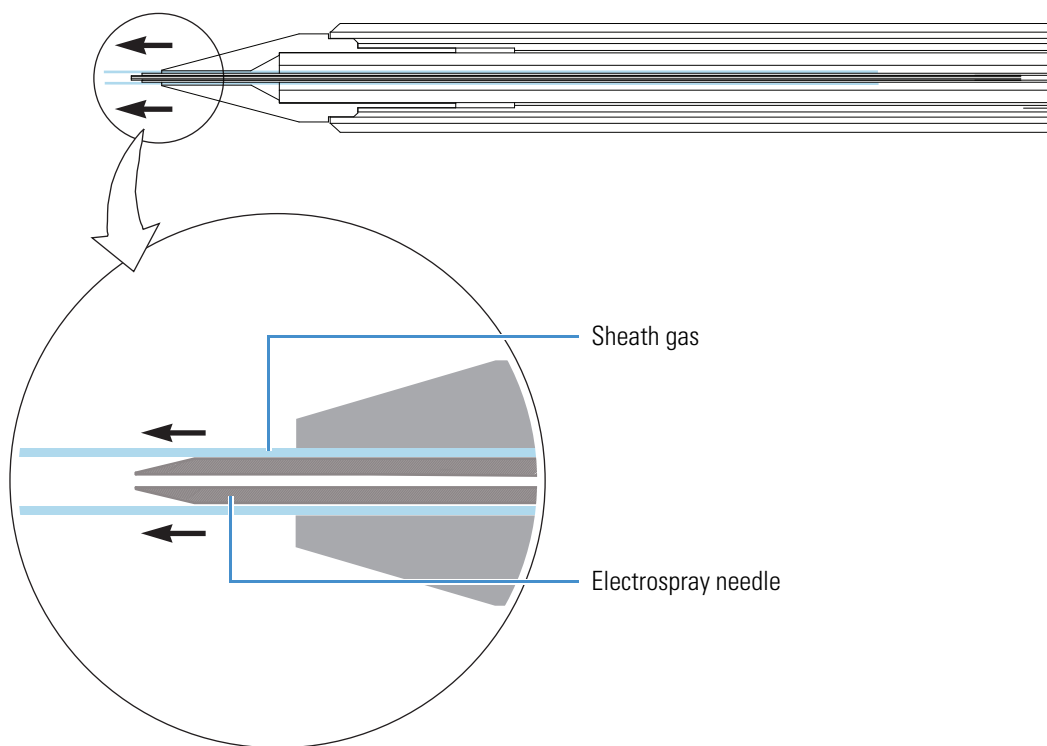




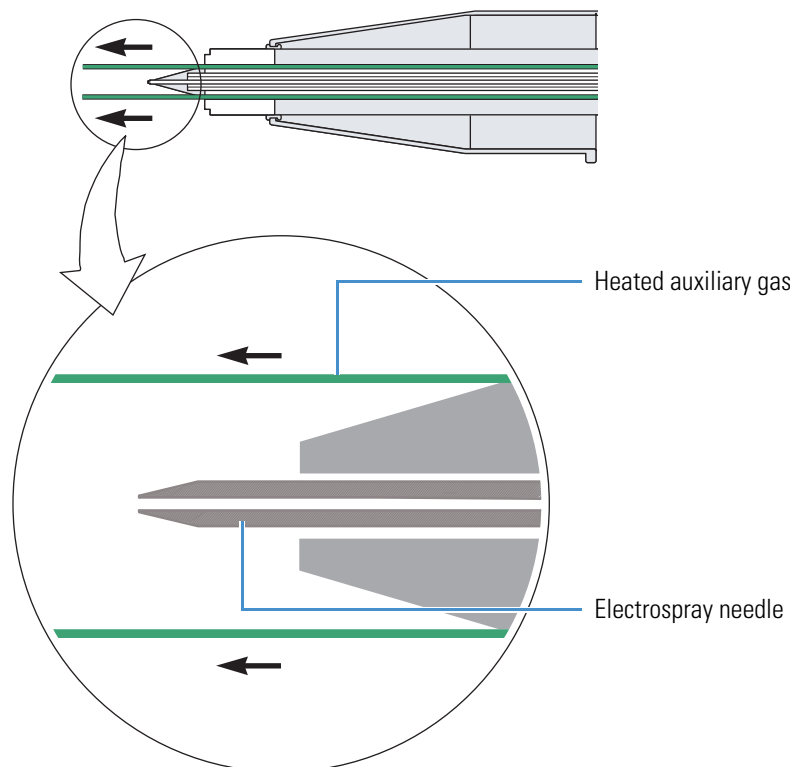
The mass spectrometer applies a large negative or positive voltage (typically  $\pm 3$  to  $\pm 5$  kV) to the metal electrospray needle, which sprays the sample solution into a fine mist of charged droplets. The H-ESI spray insert delivers the sheath gas and auxiliary gas to the nozzle. The sheath gas is the inner coaxial nitrogen gas that sprays (nebulizes) the sample solution into a fine mist as it exits the electrospray needle (see the light blue lines in [Figure 12](#)). The heated auxiliary gas is the outer coaxial nitrogen gas that assists the sheath gas in the desolvation of sample solutions (see the green lines in [Figure 13](#)).

The auxiliary gas heats as it passes through the heater/vaporizer tube. The heater/vaporizer tube ([Figure 7](#)) is thermally insulated from the metal electrospray needle to prevent direct heating of the sample solution. You can control the heater/vaporizer temperature from the Thermo Scientific Tune or Method Editor application. The temperature range is from ambient room temperature to 550 °C. For the recommended initial operating settings, see “[Setting the Initial Ion Source Parameters.](#)”

**Figure 12.** Sheath gas flow (blue lines)



**Figure 13.** Auxiliary gas flow (green lines)

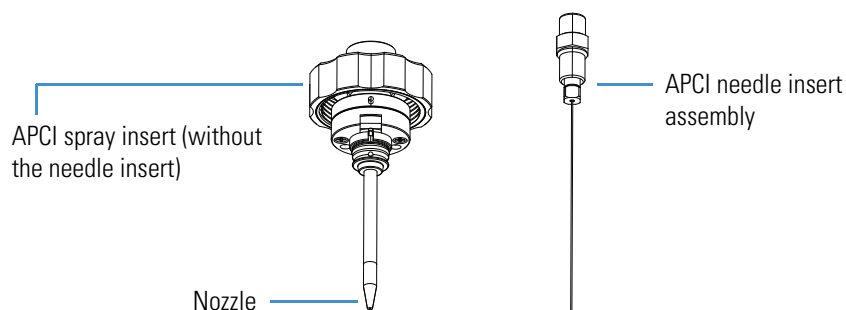


## APCI Spray Insert

The APCI spray insert, which is shorter than the H-ESI spray insert, includes a fused-silica capillary ([APCI sample tube](#)) insert, an APCI [nozzle](#), and the sheath gas and auxiliary gas plumbing. Sample and solvent enter the nozzle through the fused-silica capillary insert. To change the fused-silica sample tube, see [“Replacing the APCI Fused-Silica Sample Tube.”](#)

The APCI fused-silica insert is a short section of 0.15 mm (0.59 in.) ID fused-silica tubing that extends from the sample inlet to 1 mm (0.04 in.) past the end of the spray insert nozzle. [Figure 14](#) shows the APCI needle insert removed from the APCI spray insert.

**Figure 14.** APCI spray insert and its fused-silica needle insert



The APCI spray insert sprays the sample solution into a fine mist that enters the APCI vaporizer tube, which is ceramic and heated by the heater assembly. The vaporizer tube vaporizes the mist droplets at temperatures up to 550 °C (typically 350–450 °C for flow rates of 0.1–2 mL/min). The APCI spray insert delivers the sheath gas and auxiliary gas to the nozzle. The flow of the nitrogen sheath and auxiliary gases move the sample vapor toward the corona discharge needle.


During APCI operation, the tip of the corona discharge needle, which is mounted inside the API source housing, is positioned near the vaporizer. The mass spectrometer applies a high [APCI corona discharge voltage](#) (typically  $\pm 3$  to  $\pm 5$  kV) to the corona discharge needle to produce a steady [APCI corona discharge current](#) of up to 100  $\mu\text{A}$  (typically 5  $\mu\text{A}$ ). The corona discharge from the needle produces reagent ion [plasma](#) primarily from the solvent vapor. Ion-molecule reactions with the reagent ions in the plasma ionize the sample vapor.


The APCI source can accommodate liquid flows of 100  $\mu\text{L}/\text{min}$  to 2 mL/min without splitting.

## Removing and Installing the API Spray Insert

Use the following procedures when you want to change the ionization configuration (mode) of the API source or perform the maintenance tasks in [Chapter 4, “Maintenance.”](#)

### ❖ To remove the API spray insert

1. Complete all data acquisition, if any.
2. Place the mass spectrometer in Standby mode as follows:
  - a. From the Windows taskbar, open the Tune application by choosing **Start > All Programs > Thermo Instruments > *model* > *model* Tune**, where *model* is your specific mass spectrometer.
  - b. Click the **Standby** icon, .

The center of the selected icon changes from white to green, . You can leave the power on for the mass spectrometer, the LC components, and the data system.



**CAUTION Hot surface.** Accidental contact with the part of the API spray insert located inside the housing can severely burn you, as this area of the insert can reach 350 °C (662 °F). In addition, although the housing's exterior surface and the exposed part of the spray insert fall below the limit of 70 °C (158 °F) for accessible metal surfaces, they too pose a burn hazard. Therefore, handle ALL heated components with extreme caution.

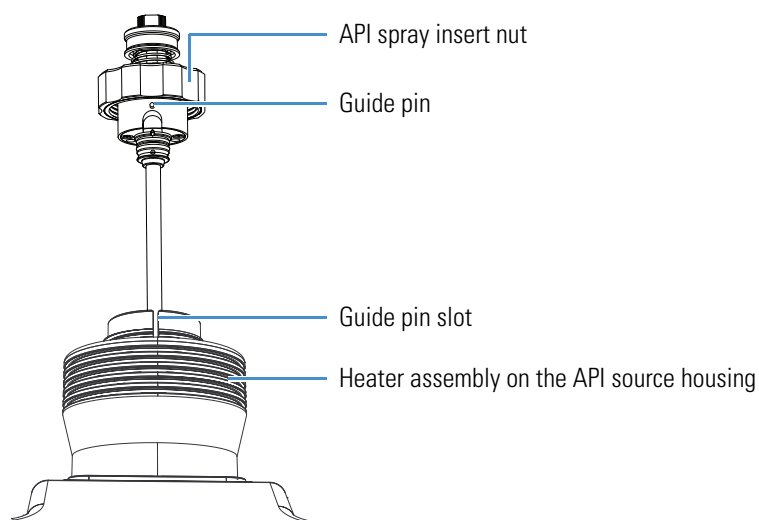
- Before removing the API spray insert or housing, allow the part to cool to room temperature (approximately 20 minutes) before you touch it.
- If the mass spectrometer connects to an LC system, leave the solvent flow from the LC pump on while the API spray insert cools to room temperature. Then turn off the solvent flow to the API source.

3. Disconnect the sample line from the spray insert's sample inlet (Figure 8).
4. After the spray insert cools to room temperature, loosen the spray insert nut (Figure 15).
5. Lift up and remove the spray insert from the heater assembly.

#### ❖ To install the API spray insert

1. Align the guide pin on the API spray insert with the guide pin slot in the heater assembly (Figure 15).

**Figure 15.** Guide pin and guide pin slot locations



2. Slowly place the spray insert into the heater assembly on the source.
3. With your hand, tighten the spray insert nut.

## Removing and Installing the API Source

This section describes how to remove and install the Ion Max NG or EASY-Max NG ion source. If any other source is installed, refer to its documentation for how to remove it from the mass spectrometer after it has cooled to room temperature.

- [Removing the API Source from the Mass Spectrometer](#)
- [Installing the API Source onto the Mass Spectrometer](#)

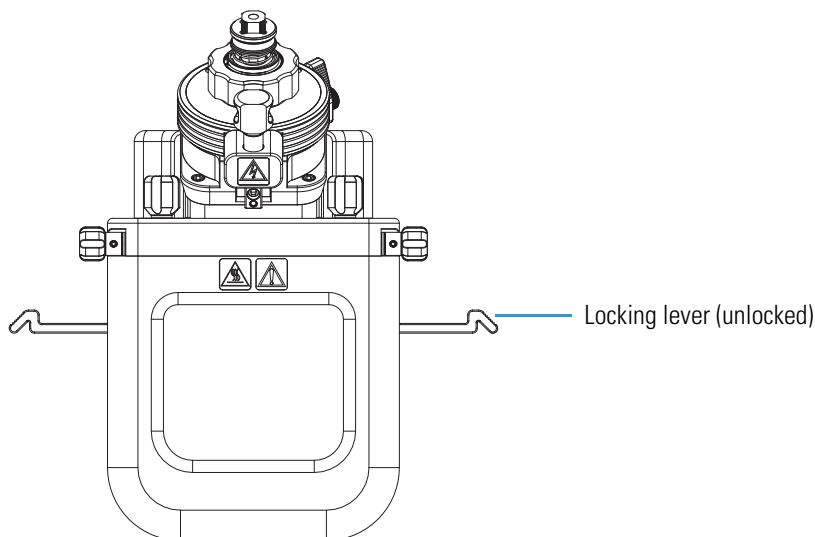
### Removing the API Source from the Mass Spectrometer

You must remove the API source to access the mass spectrometer's ion sweep cone, ion transfer tube, and ion source interface, and to access the optional APCI corona discharge needle and the optional APPI lamp inside the API source housing. Always place the mass spectrometer in standby mode before you remove any components. When the instrument is in standby mode, the API gases, the high voltage, and the syringe pump are off.

#### ❖ To remove the API source

1. Place the mass spectrometer in **Standby** mode (see [page 17](#)).
2. Disconnect the sample line from the grounding union (H-ESI mode) or the spray insert's sample inlet (APCI or APPI mode). See [Figure 29](#).
3. Rotate the locking levers to the unlocked position ([Figure 16](#)).

**Figure 16.** Ion Max NG ion source with unlocked levers (front view)



4. Grasp the source housing with both hands and slowly pull it away from the mass spectrometer.

**Note** If you plan to store the API source, rotate the locking levers to the locked position.

## Installing the API Source onto the Mass Spectrometer

Before installing the API source, you must prepare the mass spectrometer.

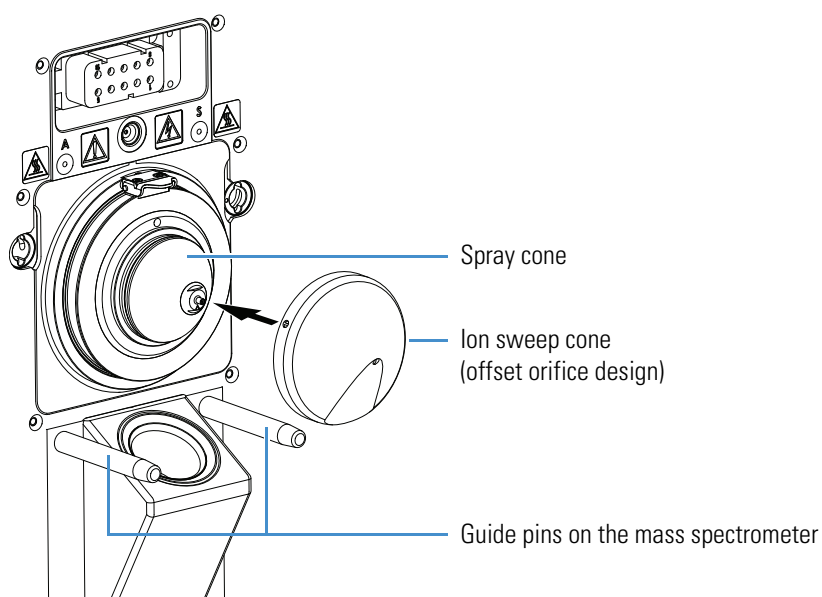
### ❖ To prepare the mass spectrometer

1. If any other source is installed, remove it from the mass spectrometer after it has cooled to room temperature.

For instructions, refer to the mass spectrometer's documentation.

2. Make sure that the ion sweep cone is installed over the spray cone (Figure 17).

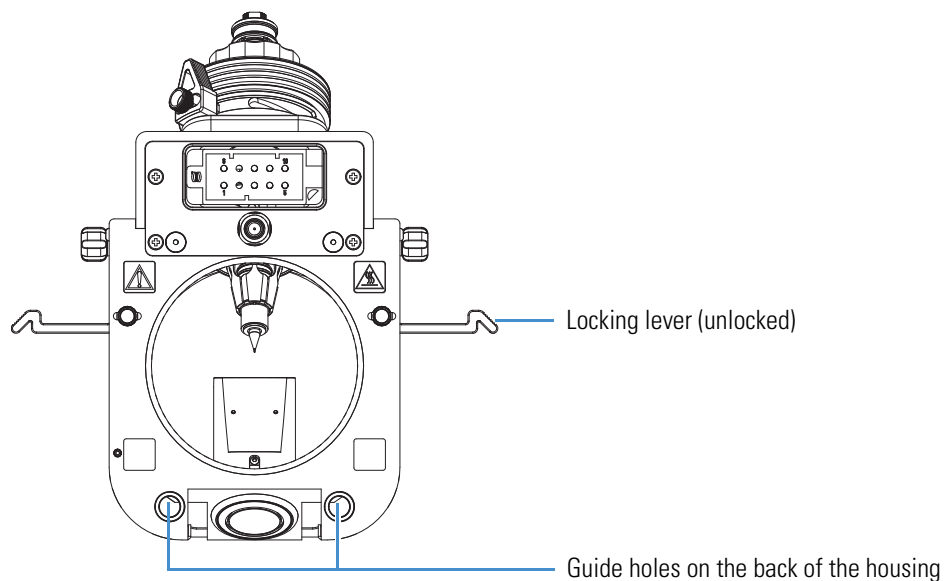
**Figure 17.** Mass spectrometer mount assembly with detached ion sweep cone



### ❖ To install the API source

1. Follow the procedure “To prepare the mass spectrometer.”
2. Make sure that the locking levers are in the unlocked position (Figure 16).
3. Align the two guide pin holes on the back of the source (Figure 18) with the guide pins on the front of the mass spectrometer (Figure 17).

**Figure 18.** Ion Max NG ion source with unlocked levers (back view)



4. Carefully press the source onto the mass spectrometer.
5. Lock the locking levers.
6. Reconnect the sample line to the grounding union (H-ESI mode) or the spray insert's sample inlet (APCI and APPI modes).

## **2 API Source**

Removing and Installing the API Source



## Changing the Ionization Mode

This chapter describes how to identify the current ionization configuration (mode) for the API source and how to reconfigure it between H-ESI, APCI, and APPI modes.

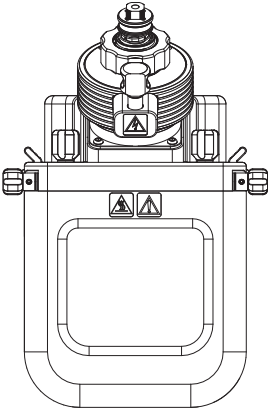
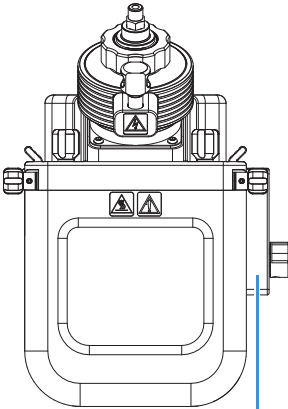
### Contents

- [Identifying the Ionization Configuration](#)
- [Changing the Ionization Configuration](#)
- [Setting the Initial Ion Source Parameters](#)
- [Adjusting the Spray Direction](#)

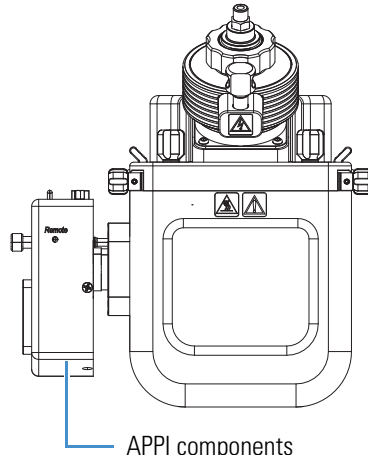
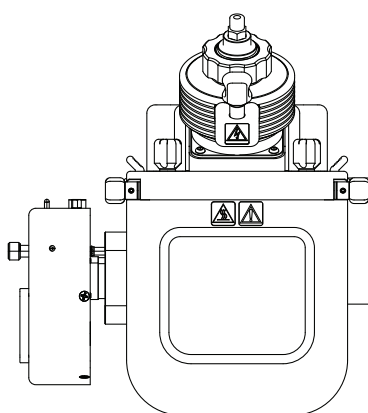
## Identifying the Ionization Configuration

To identify the current ionization configuration, compare your API source housing to the images shown in [Table 3](#). These images show the API source housing configured for H-ESI mode only; H-ESI and APCI modes; and H-ESI, APCI, and APPI modes.

**Table 3.** Images showing the possible API source housing configurations (Sheet 1 of 2)

API source housing image	Configured ionization mode
	H-ESI mode (default)
	Shows the default API source housing configuration.
 <p>APCI components</p>	H-ESI and APCI modes
	Shows the APCI corona needle adapter installed on the right side of the API source housing (shown with the APCI spray insert).

**Table 3.** Images showing the possible API source housing configurations (Sheet 2 of 2)

API source housing image	Configured ionization mode
 <p>APPI components</p>	<p>H-ESI and APPI modes</p> <p>Shows the PhotoMate APPI light source installed on the left side of the API source housing (shown with the APCI spray insert).</p>
	<p>H-ESI, APCI, and APPI modes</p> <p>Shows the API source housing configured for both APCI (right side) and APPI (left side).</p> <p>Depending on the intended ionization mode, one of two different spray inserts (H-ESI or APCI) and drain inserts (H-ESI/APCI or APPI) are installed in the housing.</p>

## Changing the Ionization Configuration

The procedures in [Table 4](#) show you how to configure the API source housing between H-ESI, APCI, and APPI modes. Before you continue, make sure you know the current ionization configuration (mode) for the API source housing (see [Table 3](#) on [page 24](#)).

You need the following supplies:

- Hex key, 2 mm
- Lint- and powder-free gloves
- Phillips #2 (small) screwdriver
- Pliers



**CAUTION Hot surface.** Avoid touching the API source housing or the API spray insert when the mass spectrometer is in operation. These components can become hot enough to burn your skin. Allow the components to cool (minimum 20 minutes) before you touch them.

**Table 4.** Summary procedures for configuring the API source housing (Sheet 1 of 3)

Current mode	New mode	Procedure
H-ESI	APCI	<ol style="list-style-type: none"> <li>1. Remove the H-ESI spray insert (see <a href="#">page 17</a>), and place it in a safe place.</li> <li>2. If the API source is not already configured for APCI, do the following: <ol style="list-style-type: none"> <li>a. Remove the API source from the mass spectrometer (see <a href="#">page 19</a>).</li> <li>b. Configure the API source for APCI mode (see <a href="#">page 29</a>).</li> <li>c. Install the API source onto the mass spectrometer (see <a href="#">page 20</a>).</li> </ol> </li> <li>3. Install the APCI spray insert (see <a href="#">page 18</a>) and the LC plumbing.</li> <li>4. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>
	APPI	<ol style="list-style-type: none"> <li>1. Remove the H-ESI spray insert (see <a href="#">page 17</a>), and place it in a safe place.</li> <li>2. If the API source is not already configured for APPI, do the following: <ol style="list-style-type: none"> <li>a. Remove the API source from the mass spectrometer (see <a href="#">page 19</a>).</li> <li>b. Configure the API source for APPI mode (see <a href="#">page 33</a>).</li> <li>c. Install the API source onto the mass spectrometer (see <a href="#">page 20</a>).</li> </ol> </li> <li>3. Install the H-ESI or APCI spray insert (see <a href="#">page 18</a>) and the LC plumbing. For guidelines, see “<a href="#">API Spray Insert Selection.</a>”</li> <li>4. Turn on the left-side power switch for the APPI (VUV) lamp.</li> <li>5. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>

**Table 4.** Summary procedures for configuring the API source housing (Sheet 2 of 3)

Current mode	New mode	Procedure
APCI	H-ESI	<ol style="list-style-type: none"> <li>1. Remove the APCI spray insert (see <a href="#">page 17</a>), and place it in a safe place.</li> <li>2. Do one of the following: <ul style="list-style-type: none"> <li>• Place the corona discharge needle in the Off (0) position away from the spray insert (see <a href="#">page 32</a>).</li> <li>• Remove the corona discharge needle (see <a href="#">page 32</a>), and then install the API source onto the mass spectrometer (see <a href="#">page 20</a>).</li> </ul> </li> <li>3. If it is not already installed, install the grounding union and its holder onto the API source (<a href="#">Figure 29</a>).</li> <li>4. Install the H-ESI spray insert (see <a href="#">page 18</a>) and the LC plumbing.</li> <li>5. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>
	APPI	<ol style="list-style-type: none"> <li>1. Remove the APCI spray insert (see <a href="#">page 17</a>), and place it in a safe place.</li> <li>2. If the API source is not already configured for APPI, do the following: <ol style="list-style-type: none"> <li>a. Remove the API source from the mass spectrometer (see <a href="#">page 19</a>).</li> <li>b. Configure the API source for APPI mode (see <a href="#">page 33</a>).</li> </ol> </li> <li>3. Do one of the following: <ul style="list-style-type: none"> <li>• Place the corona discharge needle in the Off (0) position away from the spray insert (see <a href="#">page 32</a>).</li> <li>• Remove the corona discharge needle (see <a href="#">page 32</a>).</li> </ul> </li> <li>4. If you removed the API source, install it onto the mass spectrometer (see <a href="#">page 20</a>).</li> <li>5. Install the H-ESI or APCI spray insert (see <a href="#">page 18</a>) and the LC plumbing. For guidelines, see “<a href="#">API Spray Insert Selection.</a>”</li> <li>6. Turn on the left-side power switch for the APPI (VUV) lamp.</li> <li>7. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>

**Note** The APCI components can remain in the housing when the system operates in H-ESI or APPI mode.

**Table 4.** Summary procedures for configuring the API source housing (Sheet 3 of 3)

Current mode	New mode	Procedure
APPI	H-ESI	<ol style="list-style-type: none"> <li>1. If the APCI spray insert is installed, remove it (see <a href="#">page 17</a>) and place it in a safe place.</li> <li>2. If it is not already done, install the grounding union and its holder onto the ion source (<a href="#">Figure 29</a>).</li> <li>3. Install the H-ESI spray insert (see <a href="#">page 18</a>) and the LC plumbing.</li> <li>4. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>
	APCI	<ol style="list-style-type: none"> <li>1. If the H-ESI spray insert is installed, remove it (see <a href="#">page 17</a>) and place it in a safe place.</li> <li>2. If the API source is not already configured for APCI, do the following: <ol style="list-style-type: none"> <li>a. Remove the API source from the mass spectrometer (see <a href="#">page 19</a>).</li> <li>b. Configure the API source for APCI mode (see <a href="#">page 29</a>).</li> <li>c. Install the API source onto the mass spectrometer (see <a href="#">page 20</a>).</li> </ol> </li> <li>3. Install the APCI spray insert (see <a href="#">page 18</a>) and the LC plumbing.</li> <li>4. Follow the procedure “<a href="#">Setting the Initial Ion Source Parameters.</a>”</li> </ol>

**Note** The APPI components can remain in the housing when the system operates in H-ESI or APCI mode.

If you configure the API source housing for all three ionization modes (see the last image in [Table 3](#) on [page 24](#)), set the APCI corona discharge needle and the PhotoMate APPI light source as listed in [Table 5](#).

**Table 5.** Light source and corona discharge needle settings for the ionization modes

Ionization mode	Corona discharge needle	PhotoMate light source
H-ESI	Off	Off
APCI	On	Off
APPI	Off	On
Combined H-ESI/APPI	Off	On
Combined APCI/APPI	On	On

## Configuring the API Source Housing for APCI Mode

Use the following procedures to install the right-side APCI components (see [APCI Parts](#)).

1. To remove the right-side H-ESI components from the API source
2. To install the APCI installation kit

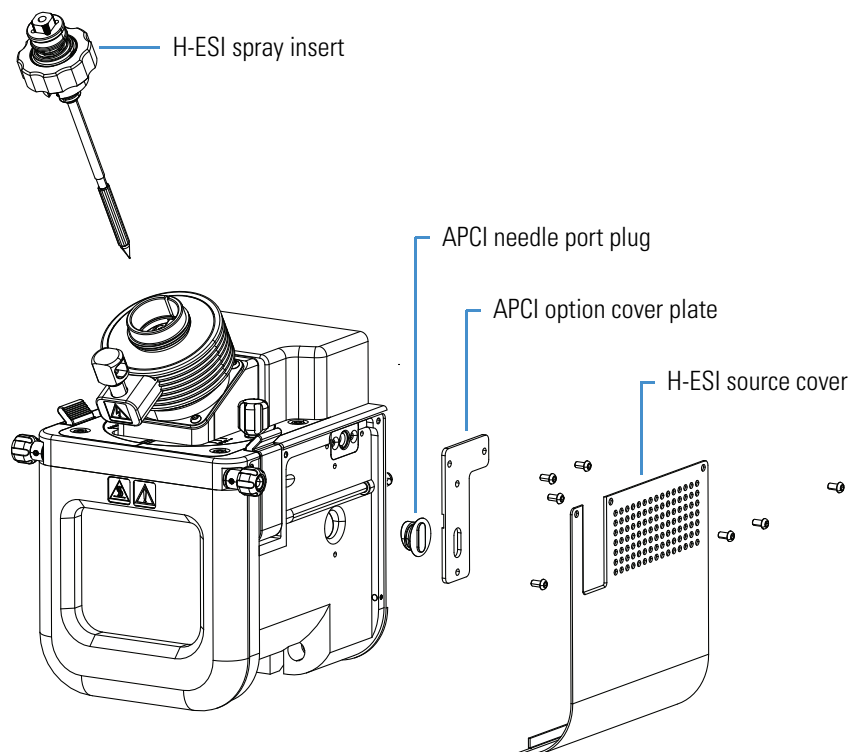
**Note** If you already installed the right-side APCI components, you only need to install the APCI spray insert and place the APCI corona needle in the On position (see [page 32](#)).

### ❖ To remove the right-side H-ESI components from the API source

1. After the API source cools to room temperature, remove it from the mass spectrometer (see [page 19](#)).
2. Remove the H-ESI spray insert (see [page 17](#)).
3. Using the hex key and the screwdriver, remove from the source the right-side cover of the H-ESI source, the APCI option cover plate, and the APCI needle port plug ([Figure 19](#)).

You might need to use your fingers to push the APCI needle port plug out of the housing.

**Figure 19.** API source showing the right-side H-ESI components (exploded view)

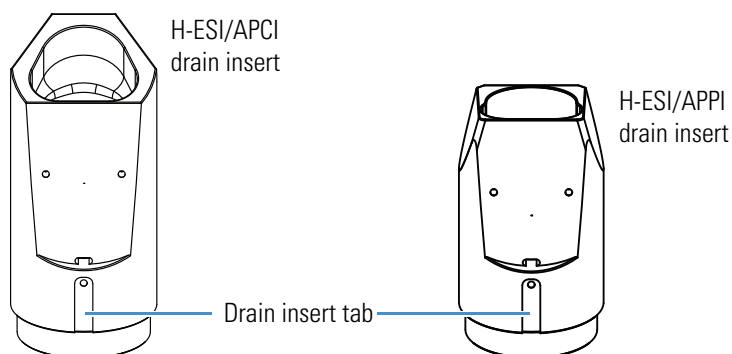


4. Store the H-ESI spray insert, H-ESI source cover, APCI option cover plate, APCI needle port plug, and screws in a safe place.

❖ **To install the APCI installation kit**

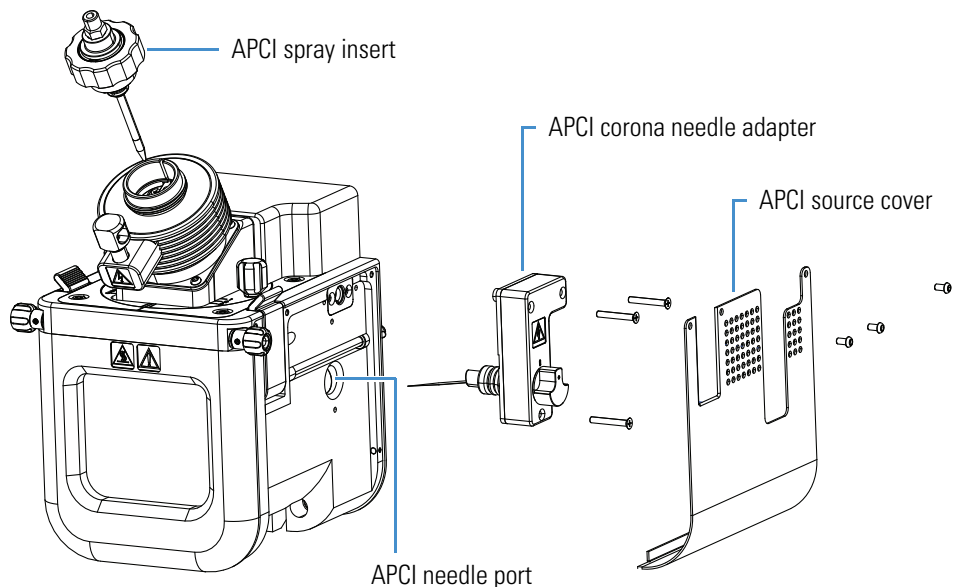
1. Follow the procedure “To remove the right-side H-ESI components from the API source.”
2. If the longer H-ESI/APCI drain insert (Figure 20) is not already installed in the API source housing, do the following:
  - a. Using a small slotted screwdriver, press the bottom tab of the installed shorter APPI drain insert, and then remove it.
  - b. Rinse the H-ESI/APCI drain insert with methanol and store it in a safe place.
  - c. Align the H-ESI/APCI drain insert with the tab facing the back of the housing, press the screwdriver on the drain tab, and then insert the drain into the housing.

**Figure 20.** Drain insert types



3. Using the screwdriver, secure the APCI corona needle adapter into the APCI needle port located on the right-side of the housing (Figure 21).

**Figure 21.** API source showing the right-side APCI components (exploded view)





4. Using the screwdriver, secure the APCI source cover onto the source's right side.
5. Put on a new pair of lint- and powder-free gloves.
6. Using the pliers, insert the base of the corona discharge needle into the needle socket.



**CAUTION** To prevent damage, avoid touching the corona discharge needle with the pliers.



**CAUTION Sharp object.** The corona discharge needle can puncture your skin. Handle it with care.

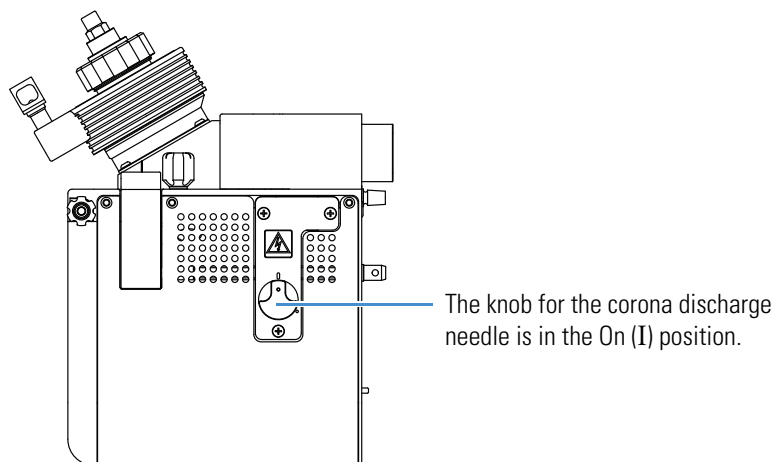
7. Install the APCI spray insert (see [page 18](#)).

The APCI spray insert is shorter than the H-ESI spray insert.

8. Place the corona discharge needle in the On (I) position (see [page 32](#)).

[Figure 22](#) shows the completed API source housing for APCI mode.

**Figure 22.** Right side of the assembled APCI source



You can now install the API source onto the mass spectrometer and connect the LC plumbing.

## Changing the Position of the APCI Corona Discharge Needle

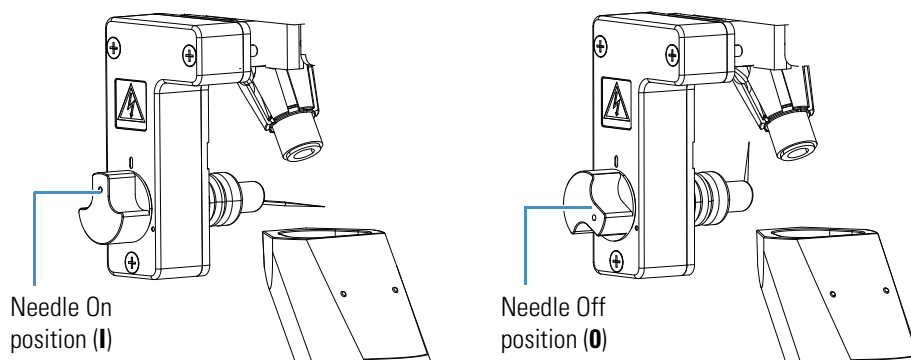
Use the following procedure when you want to use the corona discharge needle (On position) or move it out of the way of the API spray insert (Off position).

### ❖ To change the position of the corona discharge needle

Do the following to adjust the corona discharge needle position (Figure 23):

- To use the needle (APCI mode), turn the right-side knob to the On (I) position.
- To not use the needle and move it away from the API spray insert (H-ESI and APPI modes), turn the right-side knob to the Off (0) position.

**Figure 23.** Corona discharge needle adapter showing the On and Off knob positions



## Removing the APCI Corona Discharge Needle

If you do not plan to use APCI mode for awhile, you can remove the corona discharge needle.

### ❖ To remove the corona discharge needle

1. Remove the API source from the mass spectrometer (see [page 19](#)).
2. Put on a new pair of lint- and powder-free gloves.
3. Using the pliers, grasp the base of the corona discharge needle and slowly pull it straight out of the socket (Figure 24).

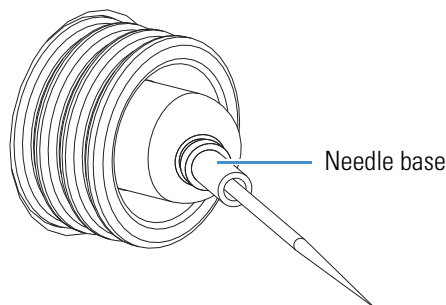


**CAUTION** To prevent damage to the corona needle, avoid touching it with the pliers.



**CAUTION Sharp object.** The corona discharge needle can puncture your skin. Handle it with care.

**Figure 24.** Corona discharge needle (close-up view)



4. Rinse the needle with solvents compatible with your compounds, and then store the needle in a safe place.

## Configuring the API Source Housing for APPI Mode

Use the following procedures to install the left-side APPI components (see [APPI Parts](#)).

1. [To remove the left-side H-ESI components from the API source](#)
2. [To install the APPI installation kit](#)

**Note** If you already installed the left-side APPI components, you only need to install the APPI drain insert and one of the spray inserts. For guidelines, see “[API Spray Insert Selection](#).”

### ❖ To remove the left-side H-ESI components from the API source

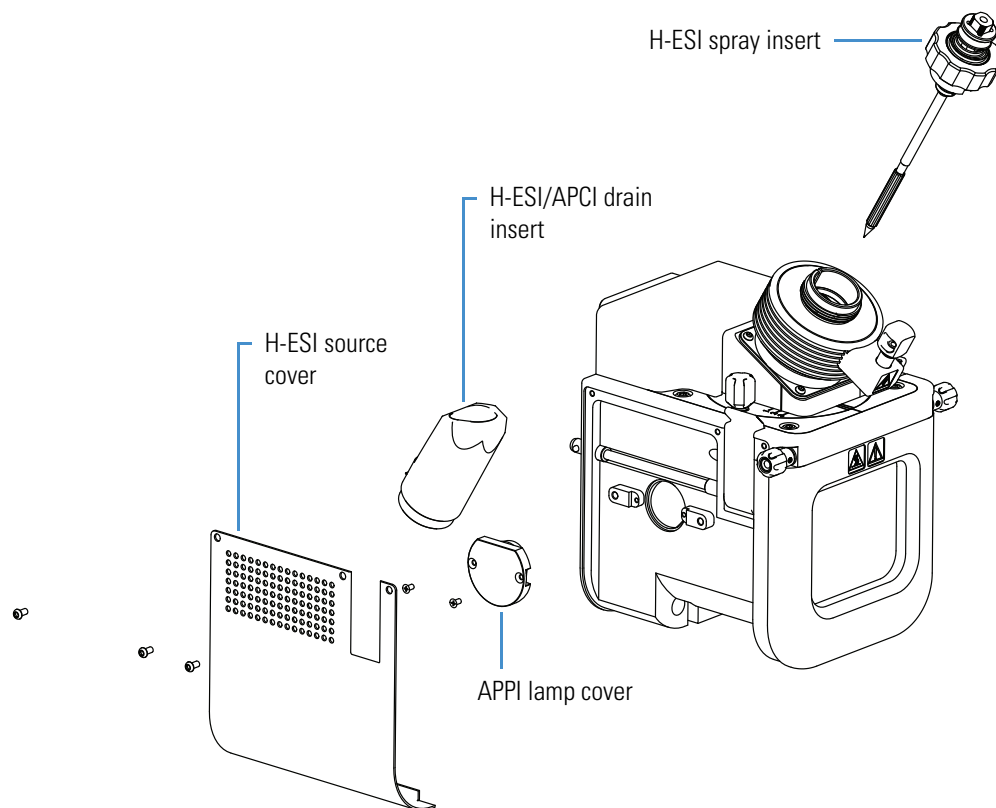
1. After the API source cools to room temperature, remove it from the mass spectrometer (see [page 19](#)).
2. Remove the H-ESI spray insert (see [page 17](#)).
3. If you installed the APCI components, place the corona discharge needle in the Off (0) position.
4. Using the hex key and the screwdriver, remove from the source the left-side H-ESI source cover and the APPI lamp cover ([Figure 25](#)).

You might need to use your fingers to push the APPI lamp cover out of the housing.



**CAUTION Sharp object.** An installed APCI corona discharge needle can puncture your skin. Be careful when you place your fingers inside the API source housing.

**Figure 25.** API source showing the left-side H-ESI components (exploded view)

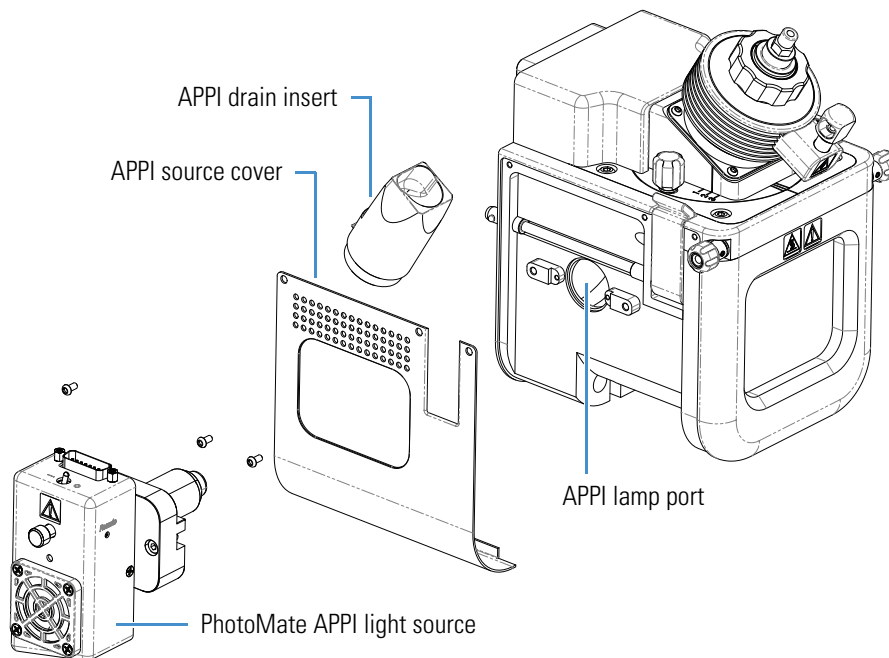


❖ **To install the APPI installation kit**

1. Follow the procedure “[To remove the left-side H-ESI components from the API source.](#)”
2. Using a small slotted screwdriver, press the bottom tab on the H-ESI/APCI drain insert ([Figure 20](#)), and then remove it.
3. Rinse the H-ESI/APCI drain insert with methanol and store it in a safe place.
4. Align the APPI drain insert with the tab facing the back of the housing, press the screwdriver on the drain tab, and then carefully insert the drain into the housing.

- Using the screwdriver, secure the APPI source cover onto the left side (Figure 26).

**Figure 26.** API source showing the left-side APPI components (exploded view)



- Using the hex key, secure the APPI light source into the left-side APPI lamp port.

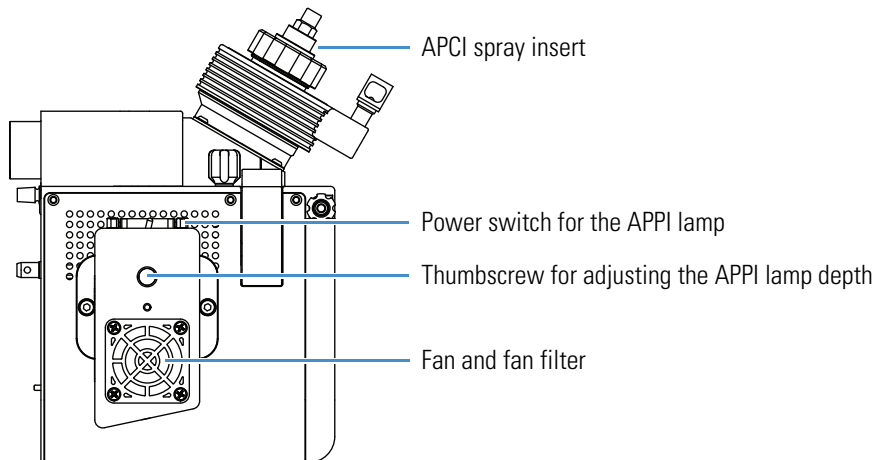


**CAUTION** To prevent damage to the APPI lamp, make sure that it does not touch the APCI corona discharge needle (if installed).

- Install either the H-ESI or APCI spray insert (see page 18).

For guidelines, see “API Spray Insert Selection.” Figure 27 shows the completed API source housing for APPI mode.

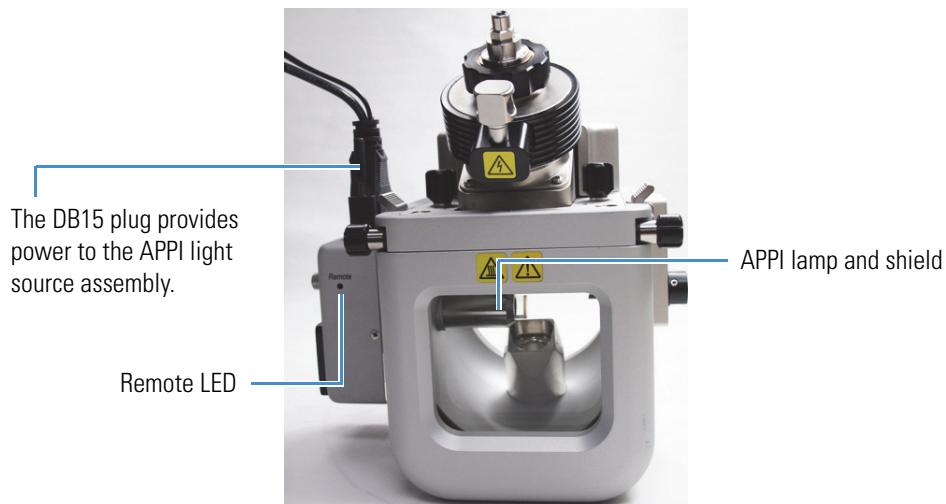
**Figure 27.** Left side of the assembled APPI source with the APCI spray insert



8. Connect the APPI power supply unit as follows:
  - a. If it is not already connected, connect the detachable power supply cord to the power supply unit, and then plug the power cord into a wall outlet.
  - b. Connect the DB15 plug to the top of the APPI light source (Figure 28).

The DB15 plug has two cables: one for power and the other for a USB connection to the mass spectrometer.

**Figure 28.** Power connection to the APPI light source



- c. Connect the USB cable to an open USB port on the mass spectrometer. If both ports are occupied, install the provided USB splitter into either USB port.

The USB ports are on the right or left side of the mass spectrometer, depending on which model you own. The Remote LED on the APPI light source indicates that the USB connection is on.

**Note** For troubleshooting purposes, you might want to record which devices connect to which USB ports on the mass spectrometer.



**CAUTION** After completing the power supply connections, route the cords so that they are not a trip hazard.

9. Using your fingers, turn the thumbscrew (Figure 27) on the APPI light source clockwise until it is fingertight (the default lamp depth position).

The thumbscrew controls the APPI lamp's depth position inside the API source housing.

10. Place the power switch for the APPI lamp in the On (I) position.

You can now install the API source onto the mass spectrometer and connect the LC plumbing.

## Configuring the API Source Housing for H-ESI Mode

Use the following procedure to configure the API source for H-ESI mode.

**Note** If you did not install the APCI or the APPI installation kit (see [page 24](#)), you do not need to make any changes to the API source housing—skip the following procedure. If you installed the APCI or the APPI installation kit, or both of these kits, you do not need to remove the housing components from the API source.

### ❖ To configure the API source for H-ESI mode

1. If you installed the APCI installation kit, do the following:
  - Make sure that the H-ESI spray insert is installed ([Figure 10](#)).
  - Place the APCI corona needle in the Off (0) position (see [page 32](#)).
2. If you installed the APPI installation kit, do the following:
  - a. Place the power switch for the APPI light source in the Off (0) position.
  - b. Disconnect the APPI power supply unit's input and output cords.
  - c. Make sure that the H-ESI spray insert is installed ([Figure 10](#)).
  - d. After the API source cools to room temperature, remove it from the mass spectrometer (see [page 19](#)).
  - e. Remove the APPI drain insert, and then install the H-ESI/APCI drain insert ([Figure 20](#)).

Store the APPI power supply unit and APPI drain insert in a safe place.

3. If it is not already installed, install the H-ESI grounding union ([Figure 29](#)).

You can now install the API source onto the mass spectrometer and connect the LC plumbing.

**IMPORTANT** Avoid operating the API source in H-ESI mode at elevated temperatures without solvent flow. Running the source dry at elevated temperatures can cause blockage of the replaceable metal needle.

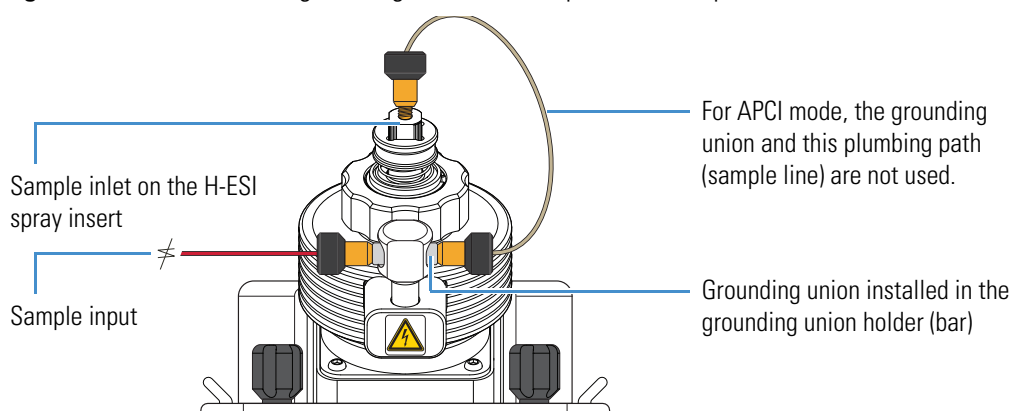
## Installing the H-ESI Grounding Union onto the API Source

Install the stainless steel grounding union in the LC liquid flow path when you want to use the API source for H-ESI mode. You can optionally leave this plumbing installed when you use APCI mode; the plumbing path is not used for APCI mode. Refer to the mass spectrometer manual for how to install the grounding union, its holder, and the sample line (Figure 29).



**CAUTION** To prevent electric shock, verify that the grounding union is made of stainless steel. A grounding union made of a nonconductive material, such as PEEK, creates an electric shock hazard.

**Figure 29.** Installed H-ESI grounding union and sample line (example)



## Setting the Initial Ion Source Parameters

After you configure the API source for H-ESI, APCI, or APPI mode and install the API source onto the mass spectrometer, use the Tune application to set the initial ion source parameters for the experiment's LC flow rate. For example, the ion source parameters for H-ESI mode include the spray voltage, the three API gas pressures, the ion transfer tube temperature, and the vaporizer temperature. For the auxiliary gas flow with vaporizer temperatures up to 100 °C, the allowable range is 0–60 units. For vaporizer temperatures above 100 °C, the minimum is 5 units (recommended).

The initial settings provide a starting point for optimizing system performance. The optimal settings for your experiment depend on the compound of interest, the solvent matrix, and the chromatographic conditions. For information on how to optimize the ion source settings, refer to the mass spectrometer's Getting Started Guide.

**IMPORTANT** For best results in H-ESI mode, avoid operating the API source at elevated temperatures without solvent flow from the LC system or the syringe pump. Allowing the API spray insert to run dry at elevated temperatures can cause blockage of the replaceable metal needle, which you would then need to replace.



❖ **To set the initial ion source parameters**

1. Open the Tune application, and then open the Ion Source pane.
2. In the Current LC Flow ( $\mu\text{L}/\text{min}$ ) box, enter a value for the experiment.
3. Click **Get Defaults**, and then click **Apply**.

The Tune application sets the default parameters for the H-ESI, APCI, or APPI source.

❖ **To optimize the API source parameters**

For instructions on how to optimize the spray voltage, the API gas pressures, and the discharge current (APCI only), refer to the Getting Started Guide.

## Adjusting the Spray Direction

To maximize sensitivity or robustness, you can adjust the spray direction by a few millimeters. Typically, you adjust the spray direction while optimizing the API source parameters for the analytes. For information about using the mass spectrometer's Tune application, refer to the mass spectrometer's Getting Started Guide and use the API source's adjustment guidelines that are listed in [Table 6](#).

**Note** The angle of the API spray insert and heater assembly is not adjustable. However, you can adjust the depth of the API spray insert on the Ion Max NG ion source only.

**Table 6.** Guidelines for adjusting the heater and API spray insert position (Sheet 1 of 2)

Adjustment control	Description
<b>Front-to-back position</b>	
1	For H-ESI mode, use position 1 for calibrating the mass spectrometer and for low liquid flow rates (less than $50 \mu\text{L}/\text{min}$ ). In position 1, the spray is closest to the entrance of the mass spectrometer.
2	Use position 2 (default) for liquid flow rates greater than $50 \mu\text{L}/\text{min}$ .
3	Use position 3 for enhanced robustness, for example, when you use a biological matrix. In position 3, the spray is farthest from the entrance of the mass spectrometer.
<b>Rotational position</b>	
Left, center, right (marks)	Use the center mark to position the spray closest to the entrance of the mass spectrometer.

**Table 6.** Guidelines for adjusting the heater and API spray insert position (Sheet 2 of 2)

Adjustment control	Description
<b>Spray insert depth (Ion Max NG ion source only)</b>	
Move the lever to the left.	Raises the spray insert.
Move the lever to the right.	Lowest the spray insert.

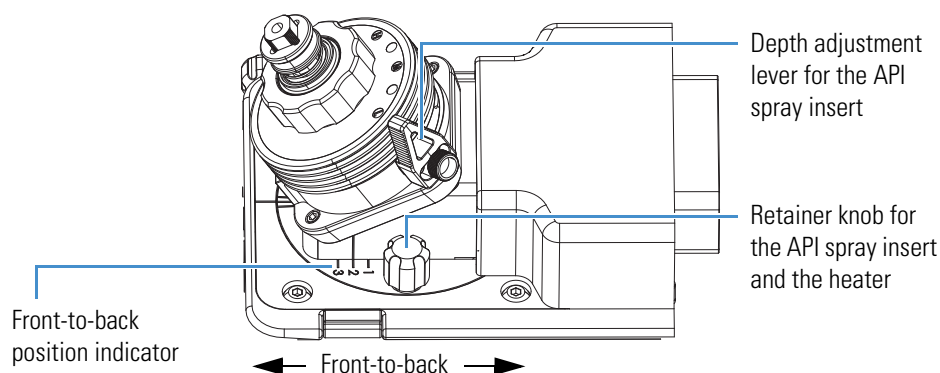
❖ **To adjust the spray direction**



**CAUTION Hot surface.** Avoid touching the API source housing when the mass spectrometer is in operation. The external surface of the housing can become hot enough to burn your skin. Allow the housing to cool before you touch it.

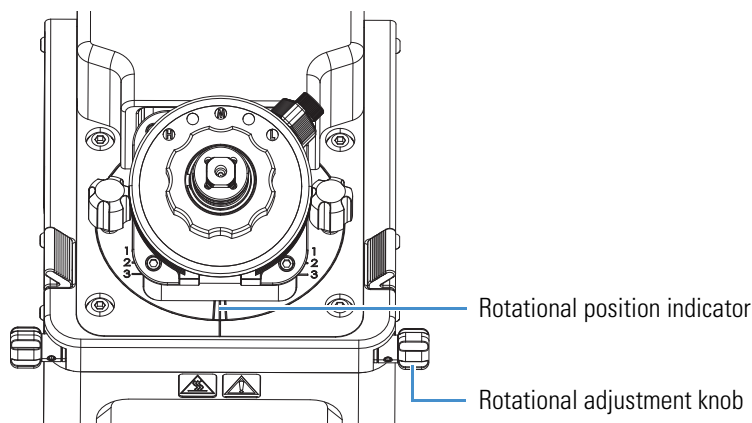
1. Loosen the top two retainer knobs that secure the heater assembly (Figure 30).
2. Do any of the following (see Table 6 on page 39):
  - Move the heater forward or backward to the desired position (Figure 30).

**Figure 30.** Front-to-back adjustment (in the Ion Max NG ion source)



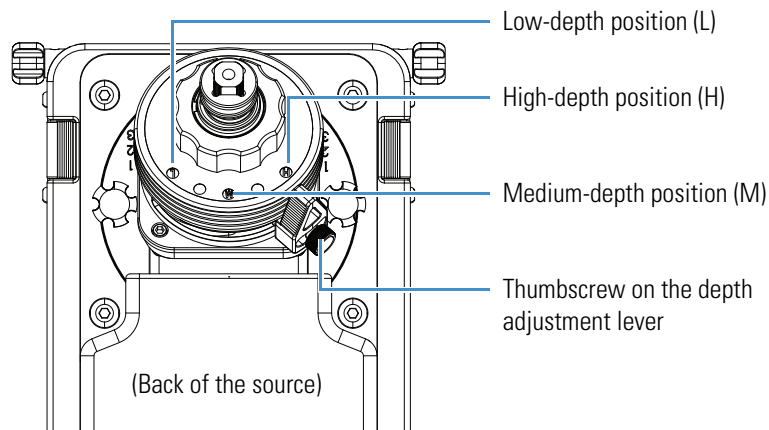
- Turn the side rotational adjustment knob to rotate the heater (Figure 31).

**Figure 31.** Rotational adjustment (in the Ion Max NG ion source)



- (Ion Max NG ion source only) To adjust the spray insert depth, do the following:
  - i. Loosen the thumbscrew on the depth adjustment lever (Figure 32).
  - ii. Move the lever to the left or right (left lowers the depth, right raises it), and then tighten the thumbscrew.

**Figure 32.** API spray insert for the Ion Max NG ion source in the high-depth position



3. Using your fingers, tighten the top two retainer knobs to secure the heater assembly in its new position.

### **3 Changing the Ionization Mode**

Adjusting the Spray Direction

# Maintenance

This chapter provides routine maintenance procedures that you must perform to ensure optimum performance of the Ion Max NG and EASY-Max NG ion sources. For a list of replaceable parts, see [Chapter 5, “Replaceable Parts.”](#)

## Contents

- [Maintenance Schedule](#)
- [Tools and Supplies](#)
- [Guidelines](#)
- [Flushing the Inlet Components](#)
- [Maintaining the API Spray Insert](#)
- [Maintaining the PhotoMate APPI Light Source](#)
- [Maintaining the API Source Housing](#)

## Maintenance Schedule

[Table 7](#) list the maintenance procedures and their recommended frequency.

**Table 7.** API source maintenance procedures and frequency

Recommended frequency	Procedure	Location
Daily (end of the work day)	Flush (clean) the sample transfer line, sample tube, and API spray insert.	<a href="#">page 45</a>
	Clean the APPI lamp window.	<a href="#">page 52</a>
As needed	Replace the H-ESI metal needle insert.	<a href="#">page 47</a>
	Replace the APCI fused-silica sample tube.	<a href="#">page 49</a>
	Replace the APPI lamp.	<a href="#">page 53</a>
	Clean the APPI fan filter.	<a href="#">page 53</a>
	Clean the API source housing.	<a href="#">page 54</a>

## Tools and Supplies

The API source requires very few tools to perform routine maintenance procedures. [Table 8](#) lists the necessary tools and supplies for maintaining the ion source.



### CAUTION Avoid exposure to potentially harmful materials.

By law, producers and suppliers of chemical compounds are required to provide their customers with the most current health and safety information in the form of Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDSs). The MSDSs and SDSs must be freely available to lab personnel to examine at any time. These data sheets describe the chemicals and summarize information on the hazard and toxicity of specific chemical compounds. They also provide information on the proper handling of compounds, first aid for accidental exposure, and procedures to remedy spills or leaks.

Read the MSDS or SDS for each chemical you use. Store and handle all chemicals in accordance with standard safety procedures. Always wear protective gloves and safety glasses when you use solvents or corrosives. Also, contain waste streams, use proper ventilation, and dispose of all laboratory reagents according to the directions in the MSDS or SDS.

**Table 8.** Chemicals, equipment, and tools (Sheet 1 of 2)

Item	Part number
<b>Chemicals</b>	
Aluminum oxide, polishing compound (5 micron powder)	Fisher Scientific™ 50-342-955
Detergent (for example, Liquinox™)	(Liquinox) Fisher Scientific: <ul style="list-style-type: none"> <li>• 50-821-299 (1 quart)</li> <li>• 50-821-298 (1 gallon)</li> </ul>
Isopropyl alcohol	Fisher Scientific A459-1
Methanol, LC/MS-grade	Fisher Scientific A456-1
Nitrogen gas, clean and dry	—
Water, LC/MS-grade	Fisher Scientific W6-1
Water, tap	—
<b>Equipment and tools</b>	
Cotton-tipped swabs, lint-free	Fisher Scientific NC9954124
Fused-silica cutting tool <sup>a</sup>	G10-0205

**Table 8.** Chemicals, equipment, and tools (Sheet 2 of 2)

Item	Part number
Gloves, lint-free and powder-free	Fisher Scientific 19-120-2947 <sup>b</sup>
	Unity Lab Services: <ul style="list-style-type: none"><li>• 23827-0008 (size medium)</li><li>• 23827-0009 (size large)</li></ul>
Magnification device	—
Screwdriver, Phillips #2	—
Wrench, 3/8 and 3/16 in.	—

<sup>a</sup> Provided in the APCI installation kit<sup>b</sup> Multiple sizes are available.

## Guidelines

For optimal results, follow these guidelines when performing the procedures in this chapter:

- Always wear a new pair of lint- and powder-free gloves when handling internal components. Never reuse gloves after you remove them because the surface contaminants on them recontaminate clean parts.
- Always place the components on a clean, lint-free work surface.
- Have nearby the necessary tools, supplies, and replacement parts (when applicable).
- Proceed methodically.

## Flushing the Inlet Components

At the end of each work day (or more often if you suspect contamination) flush the inlet components (sample transfer line, sample tube, and API spray insert) with a 50:50 methanol/water solution from the LC system through the API source to remove contamination.

**Tip** You do not need to flush the inlet components daily. However, if a mass spectrum shows unwanted contamination peaks, flush the inlet components.




**CAUTION** When the mass spectrometer's ion transfer tube is installed, do not flush it with cleaning solution, which flushes the residue into the mass spectrometer.

❖ **To flush the inlet components**

1. Complete all data acquisition, if any.
2. Set up and start a flow of 50:50 methanol/water solution at 200  $\mu\text{L}/\text{min}$  from the LC to the API source.


**Note** For the flushing solution, use a solvent bottle without buffers.

3. Open the Tune application, and then place the mass spectrometer in **On** mode.  
The center of the selected icon changes from white to green, .
4. Open the Ion Source page in the Ion Source pane, and set the following parameters based on the API source housing's configured mode (see the images in [Table 3](#) on [page 24](#)).

**Table 9.** Ion source parameters for flushing the inlet components

Parameter	H-ESI mode	APCI or APPI mode
Spray Voltage (V)	0	0
Sheath Gas (Arbitrary)	30	30
Auxiliary Gas (Arbitrary)	5	5
Vaporizer Temperature ( $^{\circ}\text{C}$ )	400	450

5. Click **Apply**.
6. Flush the solution through the inlet components for 15 minutes. Then, turn off the liquid flow from the LC.

7. Place the mass spectrometer in **Standby** mode, .

The API source turns off.

## Maintaining the API Spray Insert

The H-ESI and APCI spray inserts require minimum maintenance.

- [Replacing the H-ESI Metal Needle Insert](#)
- [Replacing the APCI Fused-Silica Sample Tube](#)



**CAUTION Hot surface.** Accidental contact with the part of the API spray insert located inside the housing can severely burn you, as this area of the insert can reach 350  $^{\circ}\text{C}$  (662  $^{\circ}\text{F}$ ). In addition, although the housing's exterior surface and the exposed part of the spray insert fall below the limit of 70  $^{\circ}\text{C}$  (158  $^{\circ}\text{F}$ ) for accessible metal surfaces, they too pose a burn hazard. Therefore, handle ALL heated components with extreme caution.



## Replacing the H-ESI Metal Needle Insert

If the H-ESI metal needle (sample tube) in the H-ESI spray insert becomes plugged, you must replace it. Replacing the metal needle requires that you partially disassemble the spray insert.

**IMPORTANT** For best results, wear clean gloves when you handle API spray insert components.

Follow these procedures:

1. To remove the needle insert from the H-ESI spray insert
2. To install the new needle insert into the H-ESI spray insert

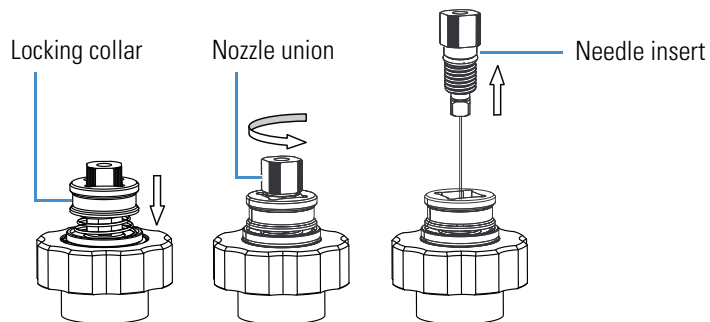
### ❖ To remove the needle insert from the H-ESI spray insert



**CAUTION** Before you begin, place the mass spectrometer in Standby mode (see page 17).

1. If your LC/MS system includes an LC pump, turn off the liquid flow to the API source.
2. After the API source cools to room temperature, remove the spray insert (see page 17).
3. Remove the needle insert from the spray insert as follows:
  - a. With one hand, depress the needle insert's locking collar (Figure 33).

**Figure 33.** Removing the needle insert from the H-ESI spray insert

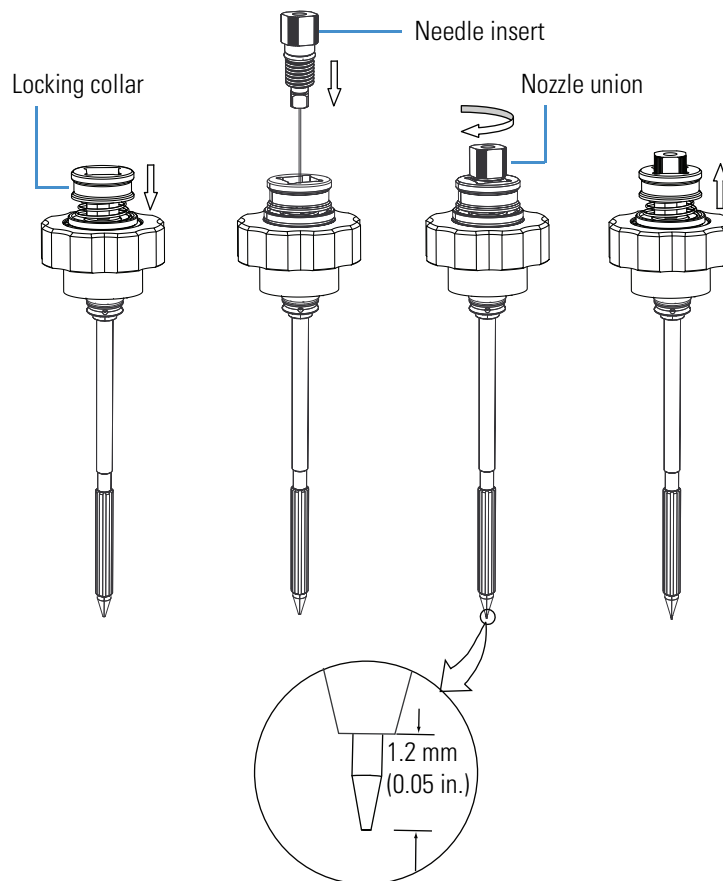


- b. Using the 3/8 in. wrench or your other hand, loosen the nozzle union.
- c. Slowly pull the needle insert out of the spray insert.
- d. Release the needle insert's locking collar.

❖ **To install the new needle insert into the H-ESI spray insert**

1. With one hand, depress the needle insert's locking collar (Figure 34).

**Figure 34.** Installing the needle insert into the H-ESI spray insert



2. Slowly place the needle insert into the top of the spray insert until it extends approximately 1.2 mm (0.05 in.) beyond the end of the spray insert nozzle.
3. Using the 3/8 in. wrench or your other hand, tighten the nozzle union.
4. Release the needle insert's locking collar.

You can now reinstall the H-ESI spray insert into the API source.

## Replacing the APCI Fused-Silica Sample Tube

If the fused-silica sample tube (capillary) in the APCI spray insert becomes plugged, you must replace it. Replacing the sample tube requires that you partially disassemble the spray insert and then the fused-silica insert.

**IMPORTANT** For best results, wear clean gloves when you handle the API spray insert components.

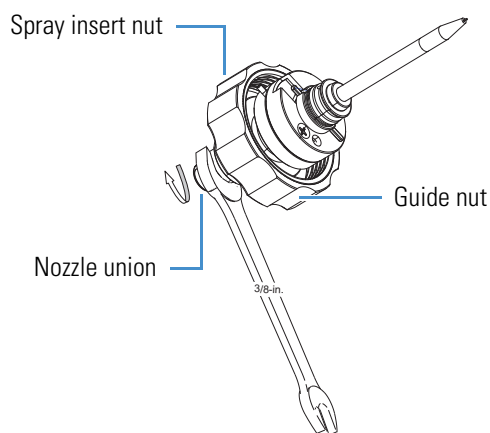
Follow these procedures:

1. To remove the fused-silica insert from the APCI spray insert
2. To remove the fused-silica tubing from the fused-silica insert assembly
3. To install the new fused-silica tubing into the insert assembly
4. To install the fused-silica insert into the APCI spray insert

❖ **To remove the fused-silica insert from the APCI spray insert**

1. Place the mass spectrometer in Standby mode (see [page 17](#)).
2. If your LC/MS system includes an LC pump, turn off the liquid flow to the API source.
3. After the API source cools to room temperature, remove the spray insert (see [page 17](#)).
4. Remove the fused-silica insert from the spray insert as follows:
  - a. With one hand, grasp the spray insert nut ([Figure 35](#)).

**Figure 35.** Removing the fused-silica insert from the APCI spray insert

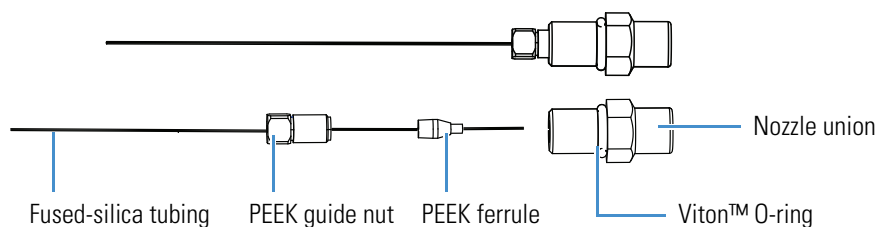


- b. Using the 3/8 in. wrench or your other hand, loosen the nozzle union.
- c. Slowly pull the fused-silica insert out of the spray insert.

❖ **To remove the fused-silica tubing from the fused-silica insert assembly**

1. Using the 3/8 in. and 3/16 in. wrenches, loosen and remove the nozzle union from the PEEK guide nut (Figure 36).

**Figure 36.** APCI fused-silica insert assembly (exploded view)



2. Remove the PEEK ferrule from inside the nozzle union.
3. Slide the ferrule and guide nut off of the fused-silica tubing, and then discard the tubing.

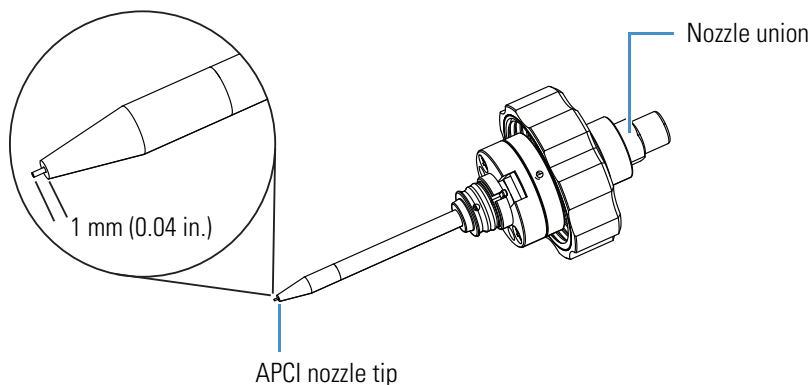
❖ **To install the new fused-silica tubing into the insert assembly**

1. If necessary, replace the nozzle union's Viton O-ring (Figure 36).
2. Using the fused-silica cutting tool, cut an approximate 13 cm (5 in.) length of fused-silica tubing, and then under magnification check that the end is squarely cut.
3. Connect the fused-silica tubing to the nozzle union as follows:
  - a. Slide the guide nut and the ferrule onto the tubing (Figure 36).
  - b. While you press the tubing into the externally threaded end of the APCI nozzle union, tighten the guide nut until the tubing is secure.

❖ **To install the fused-silica insert into the APCI spray insert**

1. Carefully insert the free end of the fused-silica tubing into the top of the spray insert and out of the nozzle tip. Then, fingertighten the APCI nozzle union.
2. Using the 3/8 in. wrench, tighten the nozzle union an additional quarter turn.
3. Using the fused-silica cutting tool, cut the tubing so that approximately 1 mm (0.04 in.) protrudes past the nozzle tip ([Figure 37](#)).

**Figure 37.** Exit end of the fused-silica tubing protrudes 1 mm (0.04 in.)

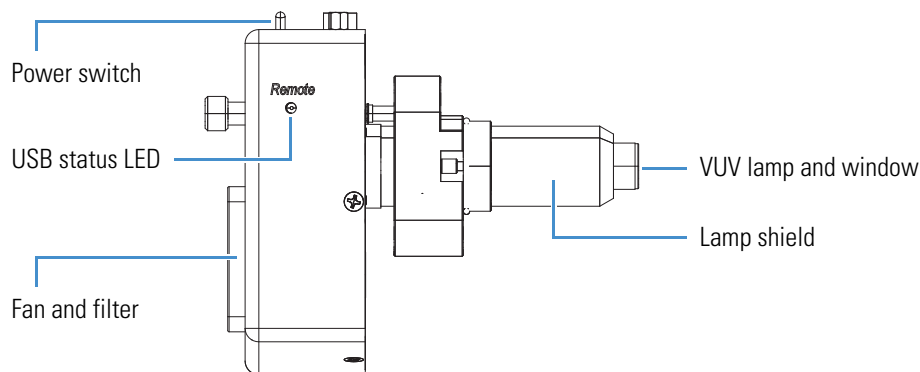


You can now reinstall the APCI spray insert into the API source.

## Maintaining the PhotoMate APPI Light Source

When you flush the mass spectrometer's inlet components at the end of the day, you also clean the APPI lamp window. Any time you notice a weak ion signal in APPI mode, you might want to clean or polish the APPI lamp window ([Figure 38](#)).

**Figure 38.** PhotoMate APPI light source



## Maintenance for the APPI Lamp

This section describes how to clean and polish the APPI lamp window (glass piece secured to the end of the lamp), and how to replace a damaged lamp.

- [To prepare the API source](#)
- [To clean the APPI lamp window](#)
- [To remove and polish the APPI lamp window](#)
- [To replace the APPI lamp](#)



**CAUTION** Minimize the chance of breaking the APPI lamp by doing the following:

- Always wear clean gloves when you handle the lamp. Fingerprints on the lamp can cause it to fail when in use.
- Do not spray solvent on the lamp while it is hot, as the lamp can crack.
- Never turn off the power to the PhotoMate light source while the vaporizer is hot. Without power, the fan stops running and the vaporizer heat can damage the light source's internal printed circuit board (PCB).
- Do not leave the LC or other liquid delivery device on while the mass spectrometer is in standby mode. The absence of sheath and auxiliary gas can cause the hot lamp to break upon contact with liquids.

### ❖ To prepare the API source

1. If your LC/MS system includes an LC pump, turn off the liquid flow to the source.
2. Place the mass spectrometer in Standby mode (see [page 17](#)).
3. Make sure that the APPI lamp and shield are at room temperature.



**CAUTION Hot surface.** The vaporizer heater can reach temperatures of 600 °C. Allow the vaporizer and APPI lamp/shield to cool to room temperature (approximately 15 minutes) before you touch them.

4. Configure the API source as follows:
  - a. Place the APPI power switch ([Figure 38](#)) in the Off position, and then disconnect the DB15 plug ([Figure 28](#)) from the APPI light source.
  - b. If you installed the APCI components, place the corona discharge needle in the Off (0) position.
5. Remove the API source from the mass spectrometer (see [page 19](#)).

❖ **To clean the APPI lamp window**

1. Follow the procedure [“To prepare the API source.”](#)
2. Put on a clean pair of lint- and powder-free gloves.
3. Soak a lint-free swab in the LC solvent, and then carefully wash the lamp window.

If you were unable to remove all material from the lamp window, follow the procedure [“To remove and polish the APPI lamp window.”](#)

❖ **To remove and polish the APPI lamp window**

1. While wearing clean gloves, carefully pull the lamp out of the lamp shield.
2. Soak a lint-free swab in isopropyl alcohol, and then dip the swab in aluminum oxide polishing compound (5 micron powder).
3. Carefully polish the lamp window with the swab until you remove the remaining material.
4. Soak another lint-free swab in isopropyl alcohol and remove the polishing compound from the window.
5. While wearing a new pair of clean gloves, carefully push the lamp into the lamp shield.

❖ **To replace the APPI lamp**

1. Follow the procedure [“To prepare the API source.”](#)
2. While wearing clean gloves, carefully pull the lamp out.
3. Push the new lamp into the light source.

You can now install the API source onto the mass spectrometer, reconnect the DB15 plug to the APPI light source, and turn on the APPI power switch.

## Maintenance for the APPI Fan Filter

This section describes how to clean the air filter for the APPI light source's fan.

❖ **To clean the APPI fan filter**

1. Follow steps 1–3 in the procedure [“To prepare the API source.”](#)
2. Place the APPI power switch in the Off position.
3. Using the screwdriver, remove the fan guard.
4. Remove the air filter.
5. Wash the filter in a solution of soap and tap water.

6. Rinse the filter with tap water, and then allow it to air dry.
7. Reinstall the filter and then the fan guard.

## Maintaining the API Source Housing

Only Thermo Fisher Scientific service engineers can service the API source housing, while user maintenance is limited to cleaning the housing as necessary. For any additional service, contact your local Thermo Fisher Scientific service engineer.

### ❖ To clean the API source housing

1. After the API source cools to room temperature, remove it from the mass spectrometer (see [page 19](#)).
2. Put on appropriate eye-wear and gloves.
3. Under an appropriate fume hood, rinse the interior of the housing with UHPLC/MS-grade methanol.
4. Allow the housing to dry before you install it on the mass spectrometer.



## Replaceable Parts

This chapter provides the part numbers for the Ion Max NG and EASY-Max NG ion sources' replaceable parts.

### Contents

- [API Source Housing](#)
- [APCI Parts](#)
- [APPI Parts](#)

## API Source Housing

API source housing (default H-ESI configuration) .....	80100-60315 <sup>1</sup>
H-ESI/APCI spray insert (high flow) .....	80000-60321 <sup>2</sup>
Needle insert, electrospray, low flow, black .....	OPTON-30139 <sup>3</sup>
Needle insert, H-ESI/APCI, high flow .....	80000-60317

## APCI Parts

APCI corona needle, stainless steel .....	70005-98033
APCI fused-silica capillary insert .....	80000-60164
<b>APCI fused-silica insert assembly .....</b>	<b>80000-60153</b>
Fused-silica sample tube (capillary), 150 µm ID, 390 µm OD,	
8.8 cm long .....	00106-10498-1
O-ring, Viton, 0.219 in. ID, 1/16 in. thick .....	00107-02600
<b>APCI source installation kit (see <a href="#">page 30</a>) .....</b>	<b>80000-62060</b>
APCI corona needle adapter (holds the needle) .....	80000-60167
APCI spray insert (nozzle) .....	80000-60525
Capillary (fused silica) cutting tool .....	G10-0205
Cover, APCI source (right side) .....	80000-10234

<sup>1</sup>Replaces P/N 80000-60315.

<sup>2</sup>Replaces P/N 80000-60320.

<sup>3</sup>Replaces P/N 80000-60152.

## APPI Parts

APPI VUV lamp . . . . .	00950-10002
<b>APPI Interface Kit (see <a href="#">page 35</a>) . . . . .</b>	<b>OPTON-30185</b>
APPI drain insert . . . . .	80000-60396
Cover, APPI source (left side) . . . . .	80000-10327
PhotoMate APPI light source and accessories . . . . .	00950-01-00235

# Glossary

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

## A

**APCI corona discharge current** The ion current carried by the charged particles in the APCI source. The voltage on the APCI corona discharge needle supplies the potential required to ionize the particles. The APCI corona discharge current is set; the [APCI corona discharge voltage](#) varies, as required, to maintain the set discharge current.

**APCI corona discharge voltage** The high voltage that is applied to the corona discharge needle in the APCI source to produce the APCI corona discharge. The corona discharge voltage varies, as required, to maintain the set APCI spray current.

**APCI corona discharge needle** A needle to which a sufficiently high voltage (typically  $\pm 3$  to  $\pm 5$  kV) is applied to produce a [chemical ionization \(CI\) plasma](#) by the [corona discharge](#) mechanism.

**APCI sample tube** A fused silica tube that delivers sample solution to the APCI [nozzle](#). The APCI sample tube extends from the sample inlet to the APCI nozzle.

**APCI vaporizer** A heated tube that vaporizes the sample solution as the solution exits the [APCI sample tube](#) and enters the atmospheric pressure region of the APCI-configured source.

**API ion transfer tube** A tube assembly that assists in desolvating ions that are produced by the ESI, APCI, or APPI nozzle.

**API source** The sample interface between the liquid chromatograph (LC) and the mass spectrometer (MS).

**APPI nozzle** The nozzle in the APPI spray insert that sprays the sample solution into a fine mist.

**atmospheric pressure chemical ionization (APCI)** A soft ionization technique done in an ion source operating at atmospheric pressure. Electrons from a [corona discharge](#) initiate the process by ionizing the mobile phase vapor molecules, forming a reagent gas.

**atmospheric pressure ionization (API)** Ionization performed at atmospheric pressure by using [electrospray \(ESI\)](#), [heated-electrospray \(H-ESI\)](#), [atmospheric pressure chemical ionization \(APCI\)](#), or [atmospheric pressure photoionization \(APPI\)](#).

**atmospheric pressure photoionization (APPI)** A soft ionization technique that shows an ion generated from a molecule when it interacts with a photon from a light source.

**auxiliary gas** The outer-coaxial gas (nitrogen) that assists the sheath (inner-coaxial) gas in dispersing and/or evaporating sample solution as the sample solution exits the ESI, APCI (optional), or APPI (optional) spray insert.

## C

**chemical ionization (CI) plasma** The collection of ions, electrons, and neutral species formed in the ion source during chemical ionization (CI).

**corona discharge** In the APCI source, an electrical discharge in the region around the corona discharge needle that ionizes gas molecules to form a [chemical ionization \(CI\) plasma](#), which contains CI reagent ions.

## E

**electrospray (ESI)** A type of atmospheric pressure ionization that is currently the softest ionization technique available to transform ions in solution into ions in the gas phase.

## H

**heated-electrospray (H-ESI)** A type of atmospheric pressure ionization that converts ions in solution into ions in the gas phase by using electrospray (ESI) in combination with heated auxiliary gas.

## I

**ion source** See [API source](#).

**ion sweep cone** A removable cone shaped metal cover that fits on top of the API ion transfer tube and acts as a physical barrier to protect the entrance of the tube.

## N

**nozzle** The nozzle in the spray insert that sprays the sample solution into a fine mist.

## S

**sheath gas** The inner coaxial gas (nitrogen), which is used in the [API ion transfer tube](#) to help nebulize the sample solution into a fine mist as the sample solution exits the H-ESI or APCI nozzle.

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