TSQ Duo

Mass Spectrometer

Hardware Manual

1R120587-0003 Revision B December 2015

Thermo
SCIENTIFIC

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Software version: Thermo Foundation 3.1 SP1; Thermo Scientific Dionex Chromeleon 7 (release 7.2 SR3 MUa or later).

For Research Use Only. Not for use in diagnostic procedures.

Contents

Declaration

Manufacturer: Thermo Fisher Scientific

Thermo Fisher Scientific is the manufacturer of the instrument described in this manual and, as such, is responsible for the instrument safety, reliability and performance only if:

- installation,
- recalibration, and
- changes and repairs

have been carried out by authorized personnel and if:

- the local installation complies with local law regulations,
- the instrument is used according to the instructions provided, and
- if its operation is only entrusted to qualified trained personnel.

Thermo Fisher Scientific is not liable for any damages derived from the non-compliance with the aforementioned recommendations.

Regulatory Compliance

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations. When the system is delivered to you, it meets all pertinent electromagnetic compatibility (EMC) and safety standards as described in the next section or sections by product name.

Changes that you make to your system may void compliance with one or more of these EMC and safety standards. Changes to your system include replacing a part or adding components, options, or peripherals not specifically authorized and qualified by Thermo Fisher Scientific. To ensure continued compliance with EMC and safety standards, replacement parts and additional components, options, and peripherals must be ordered from Thermo Fisher Scientific or one of its authorized representatives.

EMC and Safety Standards

- ITQ, and Ion Trap Series standards: EMC: EN 61326-1:2006. Safety: IEC 61010-1:2001, IEC 61010-2-081:2001
- Direct Probe Controller (DPC) standards: EMC: EN 61326-1:2013. Safety: IEC 61010-1:2001, IEC 61010-2-081:2001
- ISQ Series standards: EMC: EN 61326-1:2013. Safety: IEC 61010-1:2010 (ed. 3); IEC 61010-2-081:2015 (ed. 2); IEC 61010-2-010:2014 (ed. 3); IECEE CB SCHEME CERT NO. DE 3-30000
- TSQ 8000 Evo and TSQ Duo standards: EMC: EN 61326-1:2013. Safety: IEC 61010-1:2010 (ed. 3); IEC 61010-2-081:2015 (ed. 2); IEC 61010-2-010:2014 (ed. 3); IECEE CB SCHEME CERT NO. DE 3-30034

Low Voltage Safety Compliance

This device complies with Low Voltage Directive 2011/95/EC.

FCC Compliance Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

CAUTION Read and understand the various precautionary notes, signs, and symbols contained inside this manual pertaining to the safe use and operation of this product before using the device.

Notice on Lifting and Handling of Thermo Scientific Instruments

For your safety, and in compliance with international regulations, the physical handling of this Thermo Fisher Scientific instrument ***requires a team effort*** to lift and/or move the instrument. This instrument is too heavy and/or bulky for one person alone to handle safely.

Notice on the Proper Use of Thermo Scientific Instruments

In compliance with international regulations: Use of this instrument in a manner not specified by Thermo Fisher Scientific could impair any protection provided by the instrument.

Notice on the Susceptibility to Electromagnetic Transmissions

Your instrument is designed to work in a controlled electromagnetic environment. Do not use radio frequency transmitters, such as mobile phones, in close proximity to the instrument.

For manufacturing location, see the label on the instrument.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling or disposal companies in each European Union (EU) Member State, and these companies should dispose of or recycle this product. See www.thermoscientific.com/rohsweee for further information on Thermo Fisher Scientific's compliance with these Directives and the recyclers in your country.

WEEE Konformität

Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96/EC erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet:

Thermo Fisher Scientific hat Vereinbarungen mit Verwertungs-/Entsorgungsfirmen in allen EU-Mitgliedsstaaten getroffen, damit dieses Produkt durch diese Firmen wiederverwertet oder entsorgt werden kann. Mehr Information über die Einhaltung dieser Anweisungen durch Thermo Fisher Scientific, über die Verwerter, und weitere Hinweise, die nützlich sind, um die Produkte zu identifizieren, die unter diese RoHS Anweisung fallen, finden sie unter www.thermoscientific.com/rohsweee.

Conformité DEEE

Ce produit doit être conforme à la directive européenne (2002/96/EC) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est marqué par le symbole suivant:

Thermo Fisher Scientific s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devrait être collecté ou recyclé par celles-ci. Davantage d'informations sur la conformité de Thermo Fisher Scientific à ces directives, les recycleurs dans votre pays et les informations sur les produits Thermo Fisher Scientific qui peuvent aider la détection des substances sujettes à la directive RoHS sont disponibles sur www.thermoscientific.com/rohsweee.

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Preface

This guide contains detailed information about maintaining and troubleshooting the Thermo Scientific™ TSQ™ Duo triple-quadrupole GC-MS system.

Contents

About Your System

Thermo Scientific systems provide the highest caliber gas chromatography/mass spectrometry (GC/MS) instrumentation available on today's market.

GC/MS represents a combination of two powerful analytical techniques: GC, which acts as a separation technique, and MS, which acts as a detection technique. Complex mixtures of individual compounds can be injected into the GC, either manually or by an autosampler and then separated for presentation to the MS. The MS will generate a mass spectrum of the GC eluate and its components. The mass spectrum can then be used for qualitative identification as well as accurate and precise quantification of the individual compounds present in the sample.

A triple-quadrupole GC/MS/MS system provides the extra selectivity required for trace analysis of compounds in complex matrices.

WARNING Thermo Scientific systems operate safely and reliably under carefully controlled environmental conditions. If the equipment is used in a manner not specified by the manufacturer, the protections provided by the equipment might be impaired. If you maintain a system outside the specifications listed in this guide, failures of many types, including personal injury or death, might occur. The repair of instrument failures caused by operation in a manner not specified by the manufacturer is specifically excluded from the standard warranty and service contract coverage.

Related Documentation

The TSQ Duo system includes Help and these manuals as PDF files:

- *TSQ Duo Preinstallation Guide*, PN 1R120587-0001
- *TSQ Duo User Guide*, PN 1R120587-0002
- *TSQ Duo Hardware Manual*, PN 1R120587-0003
- *TSQ Duo Spare Parts Guide*, PN 1R120587-0004
- *TSQ Series AutoSRM User Guide*, PN 1R120587-0005

❖ To view product manuals

Go to the desktop and then choose **Manuals > TSQ Duo**.

❖ To open Help

- From the TSQ Series window, choose **Help > TSQ Series Help**.
- If available for a specific window or dialog box, click **Help** or press the F1 key for information about setting parameters.

For more information, visit www.thermoscientific.com.

System Requirements

Your data system must meet these minimum requirements.

System	Requirements
Hardware	• 4.6 GHz processor with 16GB RAM • DVD/CD-ROM drive • Video card and monitor capable of 1680 × 1050 resolution • 1000 GB hard drive • Quad core processor
Software	• Microsoft™ Windows™ 7 SP1 Operating System (64-bit) • Thermo Foundation[1] • Thermo Scientific™ Dionex™ Chromeleon™ 7 (release 7.2 SR3 MUa or later)[2]

[1]Check release notes for compatibility with TSQ Series instrument control software.
[2]Check release notes for compatibility with Thermo Foundation and TSQ Series instrument control software.

Safety and Special Notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear in boxes.

Special Notices

Special notices include the following:

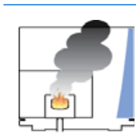
IMPORTANT Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

Note Highlights information of general interest.

Tip Highlights helpful information that can make a task easier.

Safety Symbols and Signal Words

All safety symbols are followed by **WARNING** or **CAUTION**, which indicates the degree of risk for personal injury, instrument damage, or both. Cautions and warnings are following by a descriptor. A **WARNING** is intended to prevent improper actions that *could* cause personal injury. A **CAUTION** is intended to prevent improper actions that *might* cause personal injury or instrument damage. You can find the following safety symbols on your instrument or in this guide.

	**BIOHAZARD:** Indicates that a biohazard *will*, *could*, or *might* occur.
	**BURN HAZARD:** Alerts you to the presence of a hot surface that *could* or *might* cause burn injuries.
	**ELECTRICAL SHOCK HAZARD:** Indicates that an electrical shock *could* or *might* occur.
	**FIRE HAZARD:** Indicates a risk of fire or flammability *could* or *might* occur.
	**FLAMMABLE GAS HAZARD:** Alerts you to gases that are compressed, liquefied or dissolved under pressure and can ignite on contact with an ignition source. This symbol indicates this risk *could* or *might* cause physical injury.
	**GLOVES REQUIRED:** Indicates that you must wear gloves when performing a task or physical injury *could* or *might* occur.
	**HAND AND CHEMICAL HAZARD:** Indicates that chemical damage or physical injury *could* or *might* occur.
	**INSTRUMENT DAMAGE:** Indicates that damage to the instrument or component *might* occur. This damage might not be covered under the standard warranty.
	**LIFTING HAZARD:** Indicates that a physical injury *could* or *might* occur if two or more people do not lift an object.
	**MATERIAL AND EYE HAZARD:** Indicates that eye damage *could* or *might* occur.
	**RADIOACTIVE HAZARD:** Indicates that exposure to radioactive material *could* or *might* occur.

READ MANUAL: Alerts you to carefully read your instrument's documentation to ensure your safety and the instrument's operational ability. Failing to carefully read the documentation *could* or *might* put you at risk for a physical injury.

TOXIC SUBSTANCES HAZARD: Indicates that exposure to a toxic substance could occur and that exposure *could* or *might* cause personal injury or death.

For the prevention of personal injury, this general warning symbol precedes the **WARNING** safety alert word and meets the ISO 3864-2 standard. In the vocabulary of ANSI Z535 signs, this symbol indicates a possible personal injury hazard exists if the instrument is improperly used or if unsafe actions occur. This symbol and another appropriate safety symbol alerts you to an imminent or potential hazard that *could cause personal injury.*

Hydrogen Safety Precautions

Hydrogen is a colorless, odorless, highly flammable gas with the molecular formula H_2 and an atomic weight of 1.00794, making it the lightest element. Hydrogen gas presents a hazard as it is combustible over a wide range of concentrations: at ambient temperature and pressure, this ranges from about 4% to 74.2% by volume.

Hydrogen has a flash point of - 423 °F (- 253 °C) and an auto-ignition temperature of 1,040 °F (560 °C). It has a very low ignition energy and the highest burning velocity of any gas. If hydrogen is allowed to expand rapidly from high pressure, it can self-ignite. Hydrogen burns with a flame that can be invisible in bright light.

WARNING FIRE HAZARD: The use of hydrogen as a carrier gas is dangerous. Hydrogen is potentially explosive and must be used with extreme care. Any use of hydrogen gas must be reviewed by appropriate health and safety staff and all installations of hydrogen systems must be performed to applicable codes and standards. Thermo Fisher Scientific assumes no liability for the improper use of hydrogen as a carrier gas.

Before you begin using hydrogen, you should conduct a risk assessment based on the quantity of hydrogen to be used and the conditions of your laboratory. You should ask yourself:

> "What hydrogen hazards associated with this project are most likely to occur?"
>
> "What hydrogen hazards associated with this project have the potential to result in the worst consequences?"

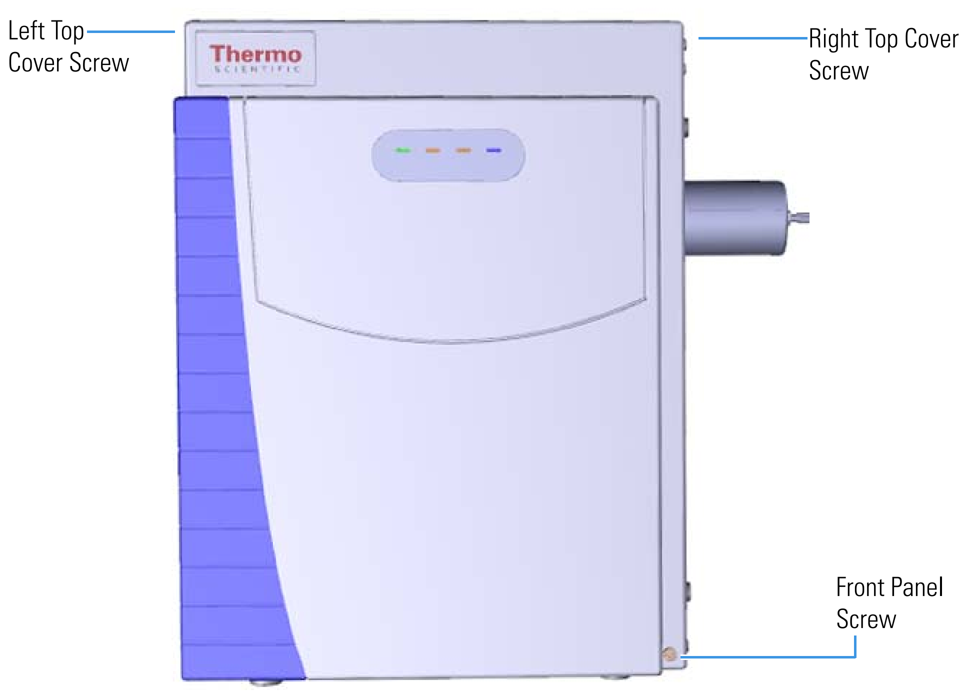
- Try to reduce or eliminate the higher risks by using the proper ventilation to remove hydrogen gas before an ignitable concentration can accumulate. You should also consider purging the hydrogen to further reduce hazards and ensure anyone who will be working with hydrogen has basic hydrogen safety training.

- As with laboratory safety in general, be sure to wear safety glasses, laboratory coats, gloves, etc. Typically there are no specific requirements for gaseous hydrogen, other than eye protection when working with a compressed gas. If working with liquid (cryogenic) hydrogen, insulated gloves and protective shoes should be worn in addition to eye protection.
- You should post “No Smoking” and “No Open Flames” signs to identify hydrogen sources and cylinders. Maintain, inspect and leak-test all hydrogen sources regularly.
- All hydrogen shutoff valves should be clearly marked and permanent hydrogen piping should be labeled as such at the supply or discharge point and at regular intervals along its length. Where hydrogen gas piping passes through a wall, the piping should be labeled on both sides of the wall.
- There should also be contingency plans in place should an incident occur.
- The site emergency response team, as well as the local fire department, should know the location of all hydrogen storage tanks.

Using Hydrogen with TSQ Duo

To use hydrogen with the TSQ Duo, you must always shut off the GC carrier gas before venting or turning off the TSQ Duo. There are three hydrogen safety screws on the TSQ Duo that **must** be in place. These are attached to your instrument at the factory.

Figure 1. Hydrogen Safety Screws on the TSQ Duo



Before powering on the TSQ Duo system, ensure that:

- All the covers and panels of the TSQ Duo system are firmly attached.
- The vent valve is tightly closed if you vented the system.
- All fittings, ferrules, and o-rings are sealed.

Hydrogen Connection Guidelines

Use the following guidelines to safely connect hydrogen to your system:

- **Piping—**Hydrogen must be delivered to equipment using appropriate piping and be done in such a way as to pose essentially no hazard to end-users. Piping systems for the delivery of hydrogen should be designed and installed by a person qualified by specific training and experience with hydrogen piping systems.

  Stainless steel is usually recommended because it is a safe, cost-effective material. Piping of *black iron* or copper must not be used, as the pipe can become brittle with age. Elastomeric/plastic tubing of various plastics and polymers should not be used, unless the tubing is approved for use with hydrogen. If elastomeric/plastic tubing is used for hydrogen gas delivery, the tubing should be tested for hydrogen permeability to minimize leakage.

  The hydrogen piping system must be flexible enough to endure routine thermal expansion and contraction. The system should also include considerations for the most severe condition of temperature and pressure expected during service. Piping and supports must be able to withstand static loading introduced by such things as ice and snow; and dynamic loading from high wind and earthquake.

  Caution should be used if burying hydrogen piping. Proper controls should be used to protect against damage and corrosion, and also to prevent Hydrogen from entering a building if there is any leakage.

- **Fittings—**All fittings must be of the proper type approved or designed for use with hydrogen gas. Use as few fittings as possible to minimize the potential for leaks. After installation, ensure that leak testing is carried out prior to system use, and on a regular basis.

  There must be no PTFE tape or other things like *plumber's putty* used to enhance a seal, as this actually is a detriment to a good seal. Ideally the best installation would use stainless steel tubing with appropriate gas-tight fittings.

  Welding is usually preferred for joints in hydrogen piping systems since welding provides a better connection and reduces the potential for leaks compared to mechanical fittings. Soft solder joints are not permitted for hydrogen systems (due to the low melting point of soft solder and its potential for brittle failure at cryogenic temperatures). Brazed joints are permitted, but such joints should be protected against the possibility of external fire.

  Tubing connections should be clamped to barbed or press-fit type connections. Hose clamps or *jubilee clamps* must not be used.

- **Valves—**All valves must be suitable for hydrogen service and for the specific operating conditions. Valves, including regulators, must not be used for hydrogen, unless they are designed and identified for such a use. Ball valves are often chosen because of their superior leak tightness through the valve seat. Pneumatic operators are usually chosen for remotely operated valves so that potential ignition sources (electricity) are remote from the valve.

  Manual shutoff valves should be provided near each point of use, within immediate reach. If a hydrogen cylinder or hydrogen generation system is located within immediate reach, a separate point-of-use shutoff valve is usually not necessary.

  Line regulators that have their source away from the point of use should have a manual shutoff valve near the point of use.

  An emergency gas shutoff device in an accessible location outside the use area should be provided in addition to the manual point-of-use valve in each educational and instructional laboratory space that has a piped gas supply system.

  If necessary, the piping system should have uninterruptible pressure relief. The pressure relief system should be designed to provide a discharge rate sufficient to avoid further pressure increase and should vent to a safe location outside or to a ventilation system exhaust.

Purchasing Hydrogen

Use the following guidelines when purchasing hydrogen:

- Hydrogen Generator—Because it minimizes the amount of hydrogen present and reduces the degree of hazard, a hydrogen generator (also called an electrolyzer) is the safest way to purchase hydrogen in the quantity used in GC/MS.

  However, to minimize the degree of hazard, the hydrogen generator must only be operated in a non-explosive environment because hydrogen buildup can be ignitable. This means that your ventilation system for the room or lab hood must maintain an air exchange rate that is at least two orders of magnitude greater than the maximum hydrogen production rate of the hydrogen generator. Be sure to follow the manufacturers' directions about proper use and maintenance of the regulator.

  To prevent the possibility of releasing hydrogen, the hydrogen generator should be set to shut down if:

  – There is a loss of flow to the ventilation system

  – A hydrogen detector alarms at 25% of the lower flammable limit of hydrogen in air.

  The oxygen exhausted by the electrolyzer should be vented to the outside as well.

- Hydrogen Cylinder—Hydrogen can be delivered in standard laboratory gas bottles or cylinders. These cylinders have a limited amount of hydrogen in them and are a safe way to transport and store hydrogen. However, compressed hydrogen gas cylinders, like all compressed gas cylinders, must be secured in an upright position, ideally with a non-combustible chain or cable. If the cylinder falls over, the valve can be knocked off and the pressurized cylinder can take off like a rocket, which leads to the release of hydrogen and possibly an explosion, severe injury, or death. Never crack a hydrogen cylinder valve to remove dust or dirt from fittings prior to attaching a regulator, as there is a risk of self-ignition.

Properly Storing Hydrogen

Storing and handling compressed hydrogen gas and cryogenic liquid hydrogen present potential health and safety hazards. Using proper storage and handling techniques is essential to maintaining a safe work environment.

Use the following guidelines when storing hydrogen:

- Store spare hydrogen gas cylinders outside and away from doors, windows, building air intake vents, structures, and vehicle routes. This precaution applies when the hydrogen is or is not in use. Indoor storage of spare hydrogen cylinders has special requirements, which is beyond the scope of this document. Documentation for each vessel should include a description of the vessel, a list of available drawings or other documents, the most recent inspection results, and the responsible person's name.
- Prevent spare cylinders from toppling by wrapping them with chains. The chains should also be protected against corrosion and excessive heat.
- Separate spare hydrogen cylinders from oxidizing gases (such as oxygen) with a 5 ft (1.5 m) tall fire barrier with a half-hour fire rating or place the cylinders at least 20 ft (6 m) apart.
- When moving hydrogen cylinders:
  – Remove the regulator and replace the cylinder valve cap before moving.
  – Move cylinders on cylinder carts or with other appropriate transport devices.
  – Never roll or drop a cylinder and never lift a cylinder by its protective cap.
- Bulk hydrogen systems include either gaseous or liquid hydrogen in fixed installations; in some gas systems a semi-permanent trailer (tube trailer) can be used. Storage vessels for compressed hydrogen gas or liquid hydrogen should be designed, constructed, tested, and maintained in accordance with applicable codes and standards. Bulk hydrogen systems represent a level of complexity again which is beyond the scope of this document; however some general guidelines are provided.

- The bulk hydrogen storage system should not be located beneath electric power lines, close to other flammable gases/liquids, or close to public areas. It should be readily accessible to authorized personnel and delivery equipment, but protected from physical damage or tampering.
- As liquid hydrogen systems also have a cryogenic hazard, additional safety considerations for the use of cryogenic liquids might be necessary.

Hydrogen Safety Codes, Standards and References

The following list of safety codes, standards and references is in no way an exhaustive list. In fact, there might be federal, state or local codes that apply to your specific location. Check with all appropriate agencies with jurisdiction before installing or using a hydrogen system.

- Air Products Safetygram #4 Gaseous Hydrogen
- ANSI/AIAA standard for hydrogen safety guidelines is AIAA G-095-2004, Guide to Safety of Hydrogen and Hydrogen Systems
- ASME B31.1, Power Piping Code
- ASME B31.3, Process Piping Code
- ASME B31.8, Gas Transmission and Distribution Systems
- BCGA Code Of Practice CP4 Industrial Gas Cylinder Manifolds and Gas Distribution Pipework
- BCGA Code Of Practice CP33 The Bulk Storage of Gaseous Hydrogen at Users' Premises
- CGA G-5, Hydrogen
- CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations
- CGA G-5.5, Hydrogen Vent Systems
- CGA G-5.6, Hydrogen Pipeline Systems
- CGA G-5.8, High Pressure Hydrogen Piping Systems at Consumer Locations.
- FM Global Property Loss Prevention Data Sheets 7-50: Compressed Gases in Cylinders
- FM Global Property Loss Prevention Data Sheets 7-91: Hydrogen
- IGC Doc 121/04/E, Hydrogen Transportation Pipelines System Design Features
- NASA
- NSS 1740.16 Safety Standard For Hydrogen And Hydrogen Systems Guidelines for Hydrogen System Design, Materials Selection, Operations, Storage, and Transportation
- NFPA 52, Vehicular Fuel Systems Code
- NFPA 55, Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks, 2005 Edition
- NFPA 68, Standard on Explosion Protection by Deflagration Venting
- NFPA 70, National Electrical Code

- NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 55, Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks
- NFPA 68, 2007 Standard on Explosion Protection by Deflagration Venting
- NFPA 69, Standard on Explosion Prevention Systems
- NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors
- NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
- OSHA 29CFR1910.103 1910.103 Hydrogen

Hazardous Substances Precautions

WARNING Before using hazardous substances (toxic, harmful, and so on), please read the hazard indications and information reported in the applicable Material Safety Data Sheet (MSDS). Use personal protective equipment according to the safety requirements.

Biological Hazard Warning Note

In laboratories where samples with potential biological hazards are handled, the user must label any equipment or parts which might become contaminated with biohazardous material.

The appropriate warning labels are included with the shipment of the instrument. It is the user's responsibility to label the relevant parts of the equipment.

When working with biohazardous materials, you are responsible for fulfilling the following mandatory requirements:

- Providing instructions on how to safely handle biohazardous material.
- Training operators must to be aware of potential hazards.

- Providing personal protective equipment.
- Providing instructions for what to do if operators are exposed to aerosols or vapors during normal operation (within the intended use of the equipment) or in case of single fault situations such as a broken vial. The protective measures must consider potential contact with the skin, mouth, nose (respiratory organs), and eyes.
- Providing instructions for decontamination and safe disposal of relevant parts.

WARNING The user or operator is responsible for the safe handling of hazardous chemicals or biological compounds including (but not limited to) bacterial or viral samples and the associated waste, according to international and local regulations.

Venting Toxic Gases

When analyzing toxic compounds, be aware that during the normal operation of the GC some of the sample might be vented outside the instrument through the split and purge flow vents; therefore, be sure to vent the exhaust gases to a fume hood. Consult local environmental and safety regulations for instructions in exhausting fumes from your system.

Contacting Us

There are several ways to contact Thermo Fisher Scientific for the information you need.

❖ **To find out more about our products**

Go to www.thermo.com/ms for information about our products.

❖ **To get local contact information for sales or service**

Go to www.thermoscientific.com/wps/portal/ts/contactus.

❖ **To suggest changes to documentation or to Help**

- Fill out a reader survey online at www.surveymonkey.com/s/PQM6P62.
- Send an e-mail message to the Technical Publications Editor at techpubs-austin@thermofisher.com.

1

Performing Routine Maintenance

This chapter describes how to perform routine maintenance on the TSQ Duo system. Keeping your system in good working condition increases laboratory productivity and helps you get the most out of the instrument.

Contents

There are only a few components on your TSQ Duo system that require routine maintenance, depending on the quantity and types of samples you are running. A frequently used instrument will, of course, require more maintenance than an instrument that is rarely used.

Note For routine maintenance information about your GC or autosampler, refer to the appropriate product documentation.

- **Column**—You may need to replace the column when your performance degrades and troubleshooting indicates that the column needs maintenance. That may mean that end of the column needs to be trimmed or the column needs to be replaced.
- **Ion source cartridge**—The ion cartridge needs to be cleaned when it gets dirty.
- **Filament**—The filament needs to be replaced when it wears out from use.
- **Calibration gas reservoir**—The calibration gas reservoir needs to be refilled when it gets empty. Typically, it will need to be refilled every year or two.
- **Electron multiplier**—The electron multiplier needs to be replaced when the detector gain tune sets the electron multiplier to a voltage higher than 2000 V. This component can not be cleaned.
- **Foreline pump**—The foreline (rough) pump needs an oil change periodically, as indicated in the pump's documentation. The foreline pump must be replaced if it seizes up.

There are many more components of the TSQ Duo system that do not require routine maintenance, but may need to be replaced if there is a problem with the instrument. To replace components not listed in this chapter, refer to Chapter 3: Advanced Troubleshooting.

Maintenance Supplies and Tools

To perform routine maintenance on the TSQ Duo instrument, you will need the supplies and tools listed in the following table. The supplies in the MS Toolkit are included in the toolkit shipped with your instrument.

Item	Included in the MS Toolkit	Not Included in the MS Toolkit
Cloth or paper, lint-free		✓
Column measuring tool	✓	
Small source exchange tool	✓	
Forceps	✓	
Gas, clean and dry		✓
Gloves, clean, lint-free		✓
Protective eye wear		✓
Torx® T10 screwdriver	✓	
Torx® T20 screwdriver	✓	
Torx® T30 screwdriver	✓	
Wrenches, open-ended, 1/4-in., 5/16-in., 3/8 in., 7/16-in.	✓	

Note The tools in the MS Toolkit are shipped in a black plastic case with the instrument. Each tool in the kit can be ordered separately or you can order an additional toolkit. See the *TSQ Duo Spare Parts Manual* for ordering information.

IMPORTANT Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information

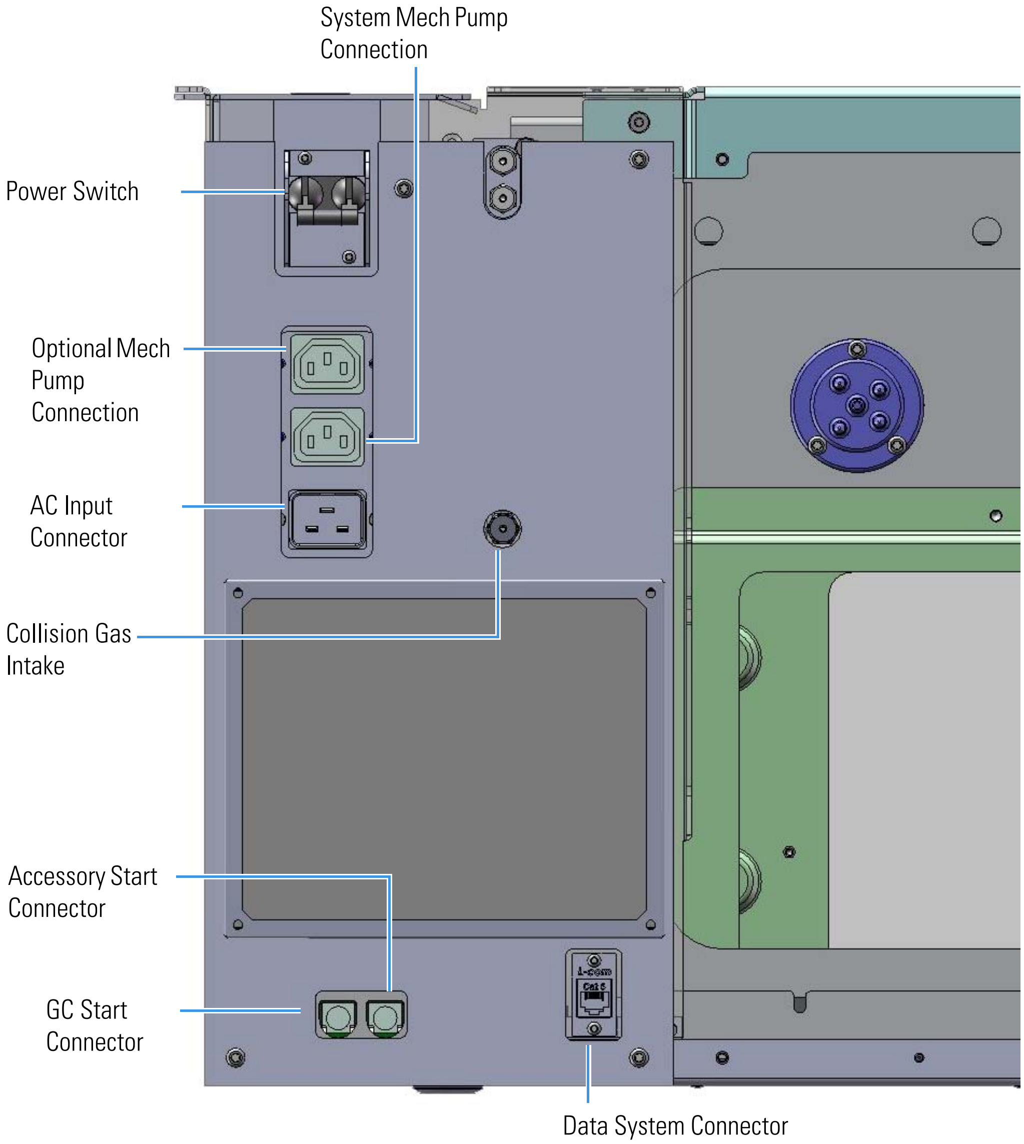
In addition to the MS Toolkit, you can also purchase a TSQ Duo Screw Kit, which includes extra screws, nuts, and standoffs. Refer to the *TSQ Duo Spare Parts Manual* for ordering information.

Configuring the TSQ Duo System

When you receive your TSQ Duo system, a Field Service Engineer will configure the system for you. However, if you need to reconfigure your system, follow these steps:

1. Place the TSQ Duo instrument, GC, computer, monitor, and keyboard on a work table and the foreline pump on the floor underneath.

Figure 1. Configuring the TSQ Duo System



Note Leave at least 46 cm (18 in.) of free space on the left side of the instrument to provide easy access to the power switch and other appliance inlets.

2. Connect all the cables to the computer, keyboard, mouse, monitor, and printer (if applicable).
3. Connect the handshaking cable to the GC and to the TSQ Duo instrument's GC Start connector.
4. Connect the computer and monitor electrical cables to the wall outlet.
5. Connect the GC communication cable to the COM1 or LAN port on the back of the computer.
6. Connect the Ethernet cable to the Data System connector on the TSQ Duo instrument and to the bottom Ethernet port on the back of the computer.
7. Power-on the computer, monitor, and printer.
8. Set the time, date, and passwords.
9. Install print drivers and test the printer.
10. Connect the foreline vacuum hose to the foreline pump input using the o-ring screen seal and clamp.

CAUTION - INSTRUMENT DAMAGE: Be sure to connect the foreline vacuum hose to the foreline pump inlet on the roughing pump. If you attach the hose to the wrong inlet on the roughing pump, pump oil will flood the manifold.

11. Connect the exit of the foreline pump to a suitable exhaust or oil mist filter.
12. Connect the foreline pump's power cable to the pump and to the System Mech Pump connector on the TSQ Duo instrument.

CAUTION INSTRUMENT DAMAGE: Make sure the voltage on the pump matches the AC voltage that is powering the TSQ Duo system.

13. Turn the foreline pump power switch to the **On** position. The foreline pump will not power on until the TSQ Duo instrument is powered on.
14. Connect the GC electrical cable to the wall outlet.
15. Power-on the GC.
16. Perform a leak check on the GC.
17. Install and condition the column, as described in Replacing a Column.

Note Condition the column before installing it on the mass spectrometer.

18. Make sure the TSQ Duo instrument's power switch is in the Off (down) position.

19. Connect the TSQ Duo instrument's electrical cable to the AC Input connector on the mass spectrometer and to the wall outlet.

20. Follow the instructions in Powering On the TSQ Duo System to power on the instrument.

Powering On the TSQ Duo System

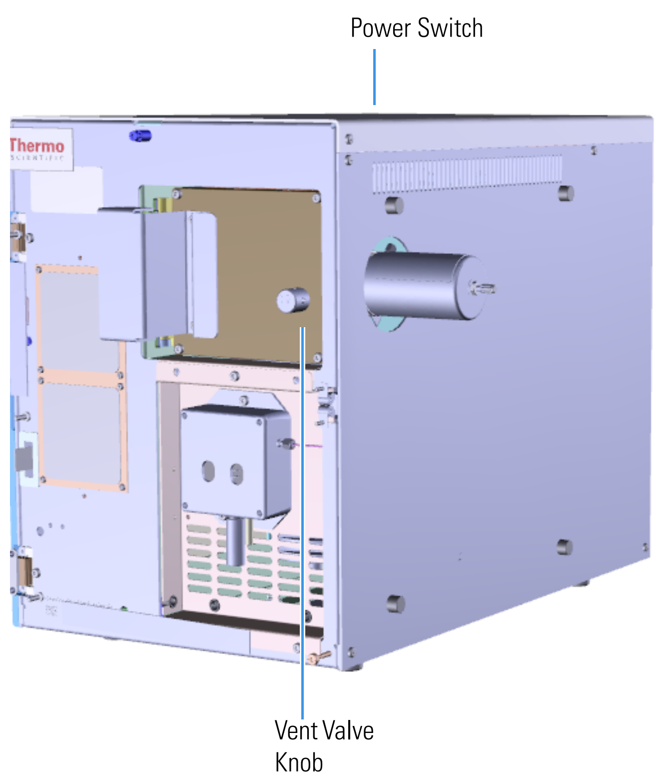
To power-on the TSQ Duo system:

1. Install the GC column if you have not already done so (see Replacing a Column).
2. Be sure the GC is powered on and there is carrier gas flowing through the column into the TSQ Duo system.

CAUTION INSTRUMENT DAMAGE: If you power-on the mass spectrometer without column flow, air is drawn through the column, which could damage the instrument. This large air leak may also require that you clean the ion source.

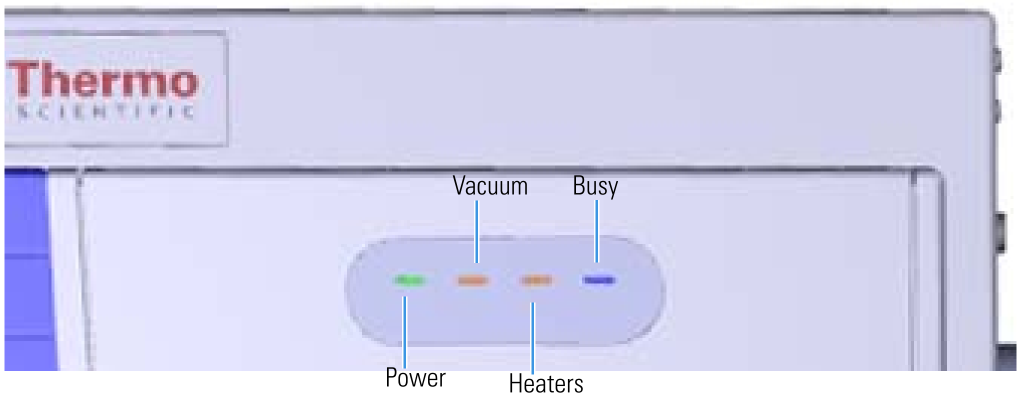
3. Open the front door of the instrument and tighten the vent valve knob. Then close the front door of the instrument.
4. Reach over to the left side of the instrument and pull up on the power switch to power-on the TSQ Duo mass spectrometer.

Figure 2. Powering On the TSQ Duo System



5. Check the lights on the front of the instrument to make sure it is ready for use.

Figure 3. Using the Lights on the TSQ Duo Instrument



- **Power**—If the Power light is a solid green, the instrument is powered on. When the light is not lit, the instrument is not powered on.
- **Vacuum**—After the instrument is powered on, it can take up to 10 minutes to achieve proper vacuum. During this initial power-up, the vacuum light will slowly blink orange. If the vacuum light begins blinking orange quickly, you have a large leak that is preventing the instrument from achieving vacuum. If this occurs, turn the power off, find and fix the leak, and power-on the instrument. The Vacuum light also blinks orange quickly when the vacuum pumps are turned off and the system is safe to vent, during instrument shut down, or if the foreline pump has failed. When the Vacuum light is a solid green, the instrument is under high vacuum.

Tip The mostly likely causes of not achieving vacuum are the vent valve needs to be closed, the column nut needs to be tightened, or the column was not installed correctly.

- **Heaters**—To check the temperature, look at the Heaters light on the front door. When the Heaters light is a solid green, the instrument is at temperature. If it is blinking orange, the ion source and/or transfer line are not at temperature. If the light is not lit, the heaters are not turned on.

Note Until the Vacuum light is a solid green (high vacuum is achieved), the heaters will not power on, and the Heaters light will not be lit. The heaters will turn on for about 30 seconds on initial power-up. If the Vacuum light is not a solid green at that time, the heaters will turn off until the Vacuum light is green.

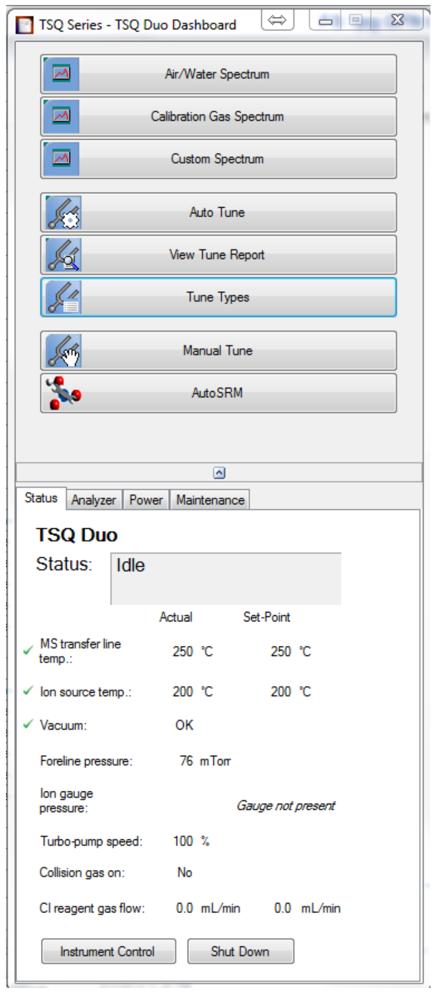
- **Busy**—If the Busy light is a solid blue, the instrument is actively scanning. When the light is not lit, the instrument is not scanning. The Busy light is also lit when establishing communication with the computer or when the filament or electron multiplier is on.

6. Open the TSQ Duo Dashboard by clicking on the desktop icon.

7. Check the status of the vacuum on the TSQ Duo Dashboard. Within 10 minutes of powering on the instrument, the vacuum should read OK.

8. Check the heater status on the TSQ Duo Dashboard. If the ion source is not set to the desired temperature, click the **Instrument Control** button and change the temperature.The temperature set point will change when the send button is pressed.

Figure 4. Checking the Status of TSQ Duo System



9. Allow the TSQ Duo system to stabilize for at least 4 hours before tuning the instrument or running samples.

Note You can run the instrument without stabilizing it, but you may have changes in the masses and intensities as the system equilibrates at the final temperature.

Powering Off the TSQ Duo System

To power-off the TSQ Duo system:

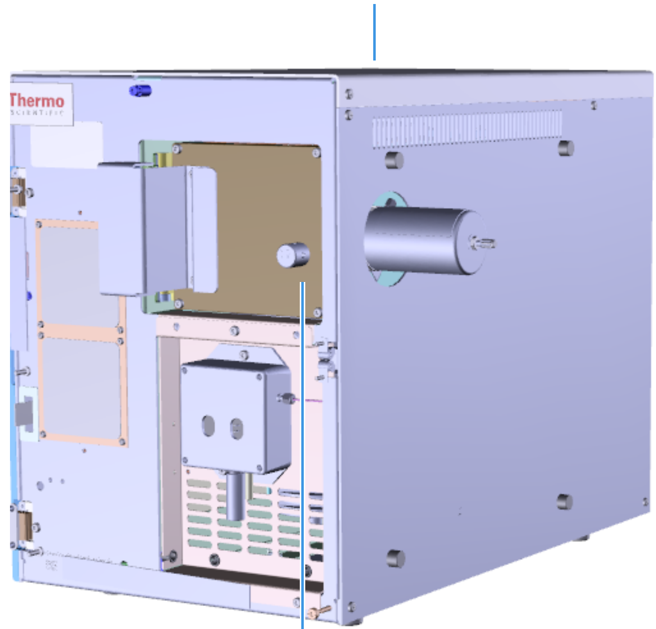
Note If you are running samples, stop the acquisition before powering off the system.

1. Cool down the GC. If you do not plan to replace the column or perform maintenance on the GC, you do not have to lower the injector temperature.

   Note If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold.

2. Open the TSQ Duo Dashboard and click the **Shut Down** button.
3. Click the **Yes** button to continue the shutdown process. The heaters and turbomolecular pump power off. Once the turbomolecular pump reaches 50% rpm, the foreline pump powers off, and you may vent the system.
4. When the TSQ Duo system's temperatures and pumps are ready for shutdown, the vacuum light on the front of the instrument will start blinking rapidly.
5. Reach over to the left side of the instrument and push down on the power switch to power-off the TSQ Duo mass spectrometer.

Figure 5. Powering Off the TSQ Duo System



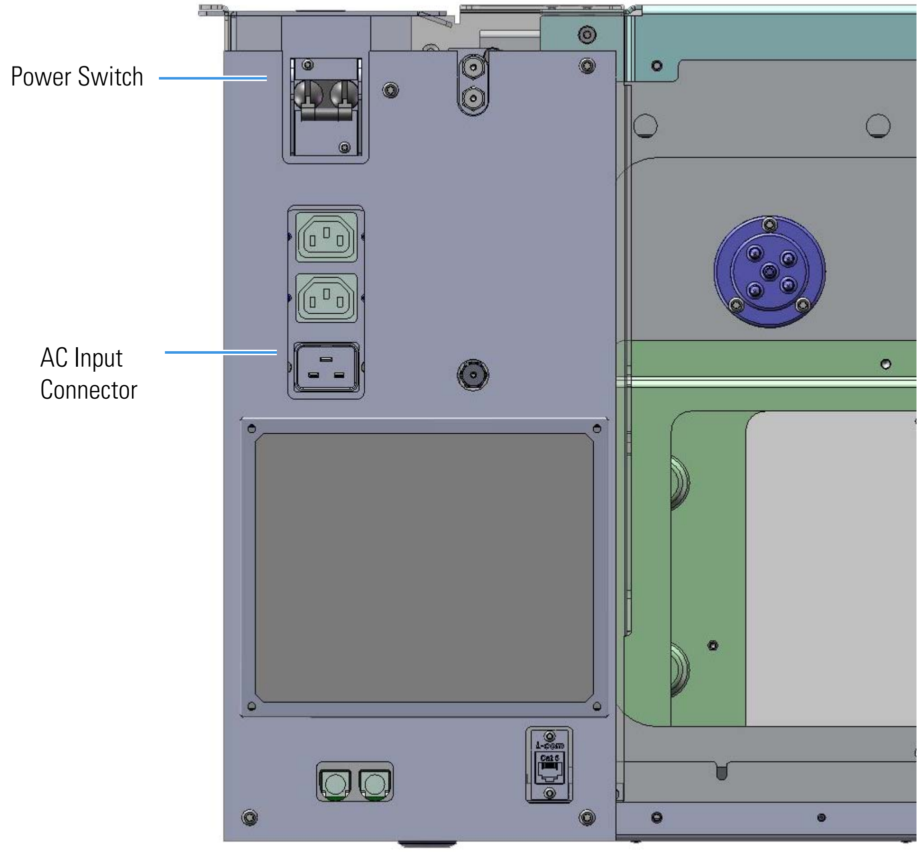
6. Open the front door of the instrument.
7. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent. Wait five minutes for venting to complete.

> **IMPORTANT** The process ends here if you are planning to perform system maintenance on the TSQ Duo mass spectrometer alone (for example, to replace the filament). You don't need to turn off the GC, data system, and autosampler.

8. Power-off all the remaining instruments. Refer to their user documentation for specific instructions.

> **CAUTION** If you need to work inside the TSQ Duo instrument, disconnect it from the electrical outlet. Be sure to reconnect it to the AC Input connector on the back of the instrument after finishing your work and closing the instrument.

Figure 6. Connecting the TSQ Duo Instrument to the Electrical Power



Replacing a Column

To replace a column:

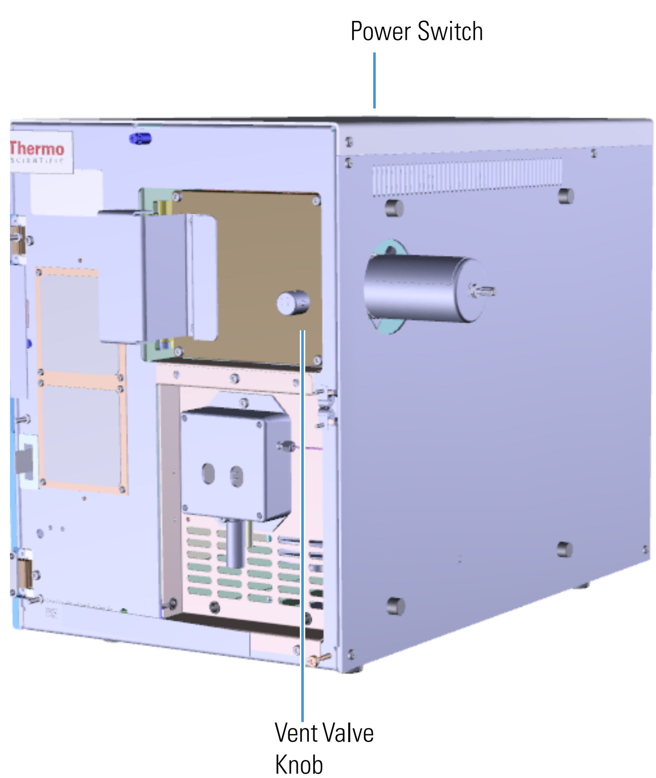
Note If you are running samples, stop the acquisition before powering off the system.

1. Cool down the GC oven and injector. See the GC documentation for information.
2. Open the TSQ Duo Dashboard and click **Shut Down**.

   During the shutdown procedure the vacuum and heaters lights will remain off. Once the procedure is complete and the instrument is ready to be powered off, the power light will turn orange and start blinking rapidly. At this point it is safe to power off the TSQ Duo system

3. On the left side of the instrument, push down on the power switch to power-off the TSQ Duo system.

   Figure 7. Powering Off the TSQ Duo System



4. Open the front door of the instrument.
5. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent. Wait five minutes for venting to complete
6. Remove the current column:

a. Make sure the heated zones of the GC are cooled down. Refer to the GC documentation for instructions.

b. Turn off the carrier gas and if used, the detector gas. See the GC documentation for information about using detector gases.

c. Open the front door of the GC.

> **WARNING BURN HAZARD:** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

d. Unscrew the transfer line nut and remove the column from the transfer line.

e. Unscrew the injector and detector nuts and remove the column.

f. Remove the column from the column rack and from the GC.

7. Connect the new column to the injector inside the GC.

> **Note** Wear clean, lint- and powder-free gloves when you handle the column and injector ferrule.

a. Unwind the column enough to easily connect its ends to the injector and detector.

b. Wipe about 100 mm (4 in.) of the column with a tissue soaked in methanol.

c. Insert the column through the injector retaining nut and ferrule (larger end up). If the M4 retaining nut is used, slide it on the column through the side cut. Wipe the column again with a tissue soaked in methanol.

> **Tip** Slide a notched septum on the column before the injector retaining nut to make it easier to measure the proper distance between the nut and end of the column.

d. Use a scoring wafer to score and break the column about 1 cm (0.4 in.) from the end. Use a magnifying glass to check for an even, flat cut. Repeat if necessary.

e. Insert a notched septum on the column to hold the retaining nut at this position. Thread the retaining nut into the injector but do not tighten.

f. Ensure that the end of the column is the proper distance (splitless = 5 mm, split = 10 mm, PTV and PTVBKF = 30 mm) from the back of the injector nut.

g. Adjust the column position so that the septum contacts the bottom of the retaining nut. Use your fingers to tighten the retaining nut until it starts to grip the column.

h. Tighten the column nut finger-tight until it starts to grip the column plus a quarter turn.

i. Remove the notched septum from the column.

8. Set up the GC parameters:

a. Set the oven and injector temperature to 50 °C (122 °F).

b. Set the carrier gas flow to 1.0 mL/min.

c. Turn off vacuum compensation, which is located on the Carrier menu of the GC.

d. Use the column flowmeter connector to verify that there is flow through the column. If you do not have a flowmeter, dip the column outlet in a small vial of methanol. Bubbles indicate there is flow through the column. If there is no flow, check that the carrier gas is on, the GC inlet is pressurized, and the column is not plugged. If there is still no flow, consult the GC documentation or contact Technical Support.

e. Allow the column to purge for at least 10 minutes. If you used methanol to detect column flow, remove column from methanol during purge time.

f. Insert the column into the fitting of the column flowmeter connector that blocks the column flow.

9. Perform a column leak check:

a. On the TRACE 1310, select the **Leak Check** icon in the **Maintenance** menu. Otherwise, perform the leak check through the Chromatography Data System. Refer to the *TRACE 1300 and TRACE 1310 Series GC User Guide* for instructions.

b. Start the leak check.

The split and purge valves of the selected channel are automatically closed, and the channel is pressurized with carrier gas to the leak check setpoint.

The system monitors the pressure for one minute. If the pressure does not drop more than the maximum allowed sensitivity value, then the leak check will pass. If the leak check does not pass, use the leak detector to find and fix any leaks.

Tip Leaks can be caused by not tightening the fitting on the column flowmeter connector. Check the fitting before looking for the leak elsewhere.

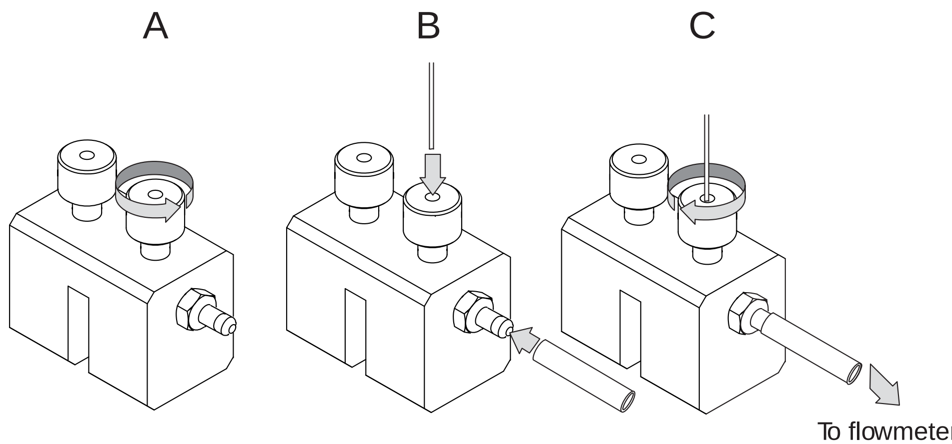
CAUTION INSTRUMENT DAMAGE: Do not allow the column flowmeter connector to exceed 80 °C (176 °F). Otherwise, it will melt and damage the instrument.

c. Repeat the leak check until no leaks are indicated.

10. Calibrate the carrier gas flow (column evaluation):

a. Carefully push the capillary column end into the flowmeter section of the column flowmeter connector.

Figure 8. Column Flowmeter Connector



b. Connect the flowmeter to the dedicated fitting on the column flowmeter connector.

c. If you have a TRACE 1310, select the **Back** or **Front Column** icon in the **Configuration** menu. Otherwise, perform the column evaluation through the Chromatography Data System. See the *TRACE 1300 and TRACE 1310 User Guide* for instructions.

d. Select **Column** and input the column's physical characteristics.

e. If a pre-/post column is present, set the length and nominal internal diameter of the pre-/post column in the same valid ranges for the column. The following two lines are added to the menu.

> **Note** For the most reproducible results, you should conduct a more detailed column evaluation. However, the following steps, while recommended, are not required.

f. Start the column evaluation. According to the physical characteristics of the column, the system calculates and displays the relevant column K-factor. At the end of the routine, a message will indicate that the evaluation was successful.

g. Expect a K-factor of approximately 0.7 – 0.9 for a 15 m, 0.25 mm i.d. column (1.3 – 2.0 for a 30 m, 0.25 mm i.d. column). If the column does not report a K-factor within this range or within 0.1 units of the previous stored value, check for a leak or broken column using the leak detector. The K-factor is a measured resistance for the column. A K-factor that is too low may indicate a leak in the system, while a K-factor that is too high may indicate a blockage.

   Fix any issues found and rerun column evaluation until an appropriate K-factor is achieved.e a leak in the system, while a K-factor that is too high might indicate a blockage.

11. Disconnect the column flowmeter:

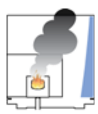
   a. Disconnect the column from the column flowmeter connector.

b. Remove the clear plastic component, including its fittings, from the oven and set them aside.

c. Close the GC door.

12. Condition the column before inserting it into the TSQ Duo system. Column conditioning consists of passing a carrier gas flow through the column heated to a programmed temperature as described in the column manufacturer's instructions.

a. If there are no conditioning instructions, perform the column conditioning by setting a final temperature 10 °C–20 °C below the column's recommended maximum temperature.



CAUTION INSTRUMENT DAMAGE: The material released from the column (column bleed) during conditioning may contaminate the ion source if the column is inserted into the transfer line during the high-temperature stage of conditioning.

WARNING FIRE HAZARD: Do not use hydrogen as the carrier gas for conditioning your column. It could vent into the oven and present an explosion hazard.

b. Run the slow temperature program that is recommended by the manufacturer. A typical program would hold the column at 40 °C (104 °F) for 15 minutes, and then ramp at 10 °C/min (50 °F/min) up to 10–20 °C below the maximum allowed column temperature. Hold the column at this temperature for two hours.

CAUTION INSTRUMENT DAMAGE: Never exceed the column manufacturer's maximum operating temperature.

13. Connect the column to the transfer line:

a. Lower the oven temperature and allow it to cool.

b. If the TSQ Duo system is running, shut down and vent it. See Powering Off the TSQ Duo System for instructions.

CAUTION BURN HAZARD: The injector, detectors, oven, and transfer line may be hot. Allow them to cool before touching them.

c. Unwind about one turn of the column from the column outlet end.

Note Wear clean, lint- and powder-free gloves when you handle the column and transfer line ferrule.

d. Wipe approximately 300 mm (12 in.) of the column with a tissue soaked in methanol.

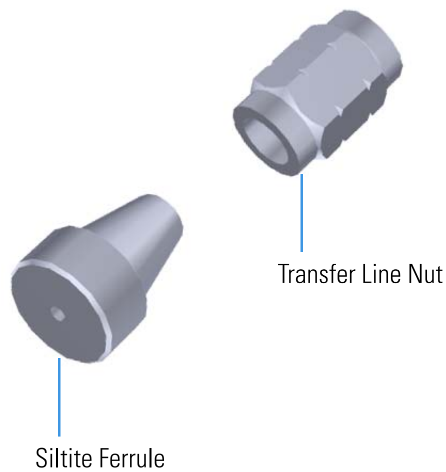
e. Lay the column on the oven floor. It is a flat surface and will improve handling.

f. Choose an appropriate ferrule for the outer diameter of your column.

> **Note** If the maximum oven temperature in your method is ≥ 290 °C (554 °F), Thermo Fisher Scientific recommends using a Siltite™ ferrule. By cycling the oven at and above this temperature, expansion and contraction of the graphite/vespel material can cause leaks in the transfer line.

g. Insert the column through the transfer line nut and ferrule, using the tapered end of the ferrule. Wipe the column again with a tissue soaked in methanol.

Figure 9. Transfer Line Nut and Siltite Ferrule Orientation



h. Insert the column into the measuring tool, which is in the MS Toolkit (See Figure 10), so that it is even with the lines at the end of the column. Figure 11 indicates proper positioning of the column in the tool for accurate measuring.

i. Use a scoring wafer to score and break the column. Use a magnifying glass to check for an even, flat cut. Repeat if necessary.

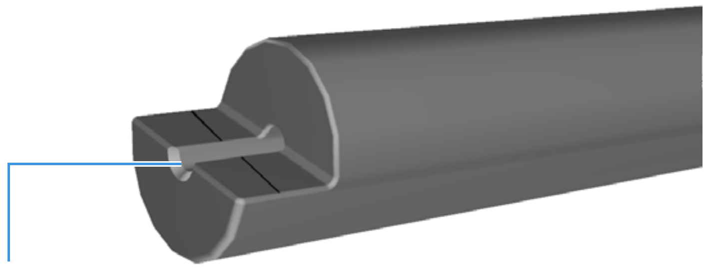
j. Use a 5/16 in. wrench to hold the column measuring tool steady.

k. Using your fingers or a 1/4" wrench, tighten the transfer line nut until the column is held in place lightly.

l. Using your fingers or a 1/4 in. wrench, tighten the transfer line nut until the column is held in place lightly.

Figure 10. Column Measuring Tool

Figure 11. Breaking the Column



m. Line up the outlet of the column with the arrows on the end of the column measuring tool.

n. While holding the column measuring tool steady, tighten the transfer line nut with a 1/4” wrench until the column stops moving in the ferrule.

o. Loosen the transfer line nut from the column measuring tool. Remove the column, transfer line nut and ferrule from the column measuring tool, making sure the ferrule does not move from its tightened position in the column. Placing a septum with a cut in it on the column behind the nut will help keep the ferrule in place.

p. Insert the column into the transfer line.

q. Tighten the nut finger tight plus a quarter turn.

> **Note** If you are using a Siltite ferrule, follow the instructions that come with Siltite ferrules. If you are using a graphite/vespel ferrule, they require conditioning to ensure a leak-tight seal. See the *TSQ Duo Spare Parts Guide* for information about ordering these ferrules.

r. Condition the graphite/vespel ferrule:

   i. Raise the oven temperature to the maximum temperature you will operate the GC.

   ii. Wait 10 minutes.

   iii. Lower the oven temperature to 40 °C (104 °F) and allow it to cool before continuing.

   > **WARNING BURN HAZARD:** The oven may be hot. Allow it to cool to room temperature before opening it. The injector will still be hot, so do not touch it.

   iv. Re tighten the transfer line nut.

   v. View air water spectra and look for evidence of leaks with a large *m/z* 28 signal. If you observe a leak, stop scanning and gently tighten the nut in small increments until no leaks appear when scanning.

14. Close the front door of the GC.

15. Restore working conditions.

    a. Raise the oven temperature to the initial temperature that you will use.

    b. Turn on vacuum compensation on the GC.

    c. Power on the TSQ Duo instrument. See Powering On the TSQ Duo System for instructions.

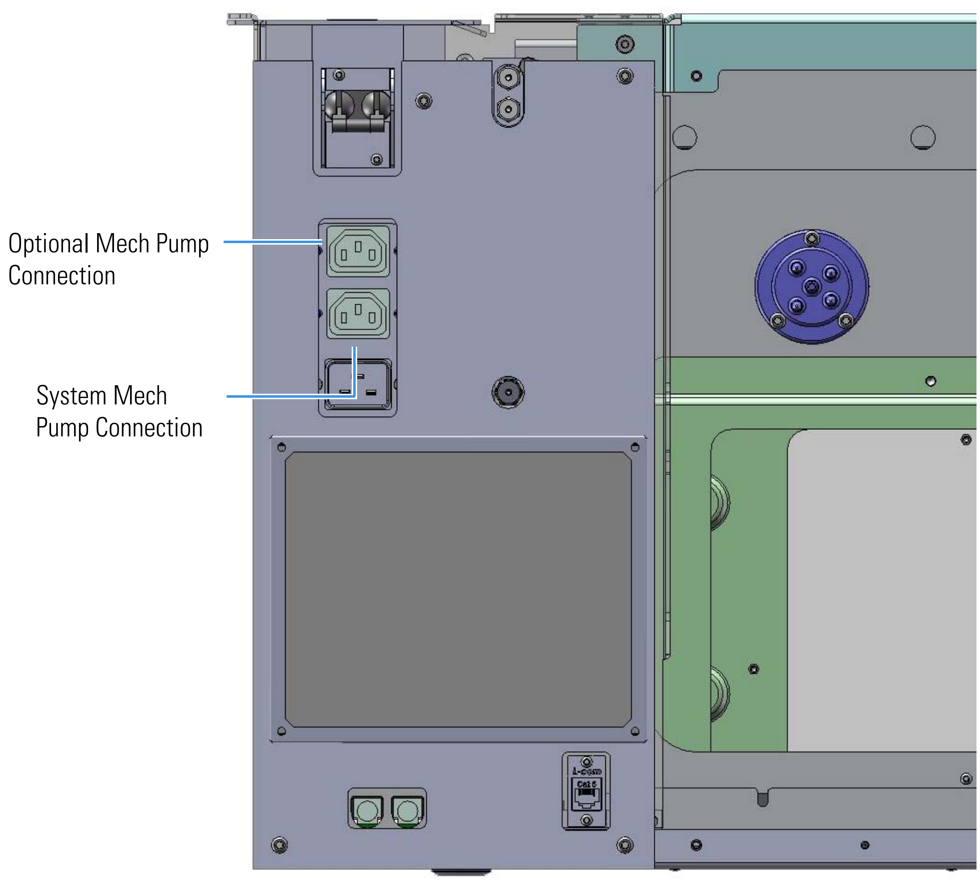
Maintaining the Foreline Pump

The foreline (roughing) pump is usually located on the floor behind the TSQ Duo instrument and occasionally requires maintenance. It establishes the vacuum needed to run the turbomolecular pump inside the instrument. Typically, the foreline pump oil needs to be replaced every four months. However, depending on your sample type and frequency of use, your maintenance interval will be different. Refer to the foreline pump documentation for information.

The foreline pump connects to the turbomolecular pump with a piece of 0.75 in. i.d. tubing. The pump's power cable connects to the System Mech Pump connector near the back of the TSQ Duo instrument.

CAUTION INSTRUMENT DAMAGE: The foreline pump must be set to the line voltage used at your location. Always plug the foreline pump power cable into the System Mech Pump connector on the rear of the TSQ Duo instrument and never into a wall outlet. This prevents the foreline pump from operating when the instrument is powered off.

Figure 12. Connecting the TSQ Duo System to the Foreline Pump



Checking the Oil in the Foreline Pump

To check the oil level of the foreline pump:

1. Ensure the pump is on a level surface.
2. Look in the oil-level sight-glass to see if the oil level is between the MIN and MAX marks.
3. If the oil level is below the MIN mark, add oil, as described in Adding Oil to the Foreline Pump.
4. Look for oil that is clear or light orange in color.
   a. If the oil is cloudy or discolored, purge the oil to decontaminate dissolved solvents, as described in Purging Gas from the Oil in the Foreline Pump.
   b. If the pump oil is still discolored, change it, as described in Changing the Oil in a Foreline Pump.

Adding Oil to the Foreline Pump

To add oil to the foreline pump:.

Note If you are running samples, stop the acquisition before powering off the system.

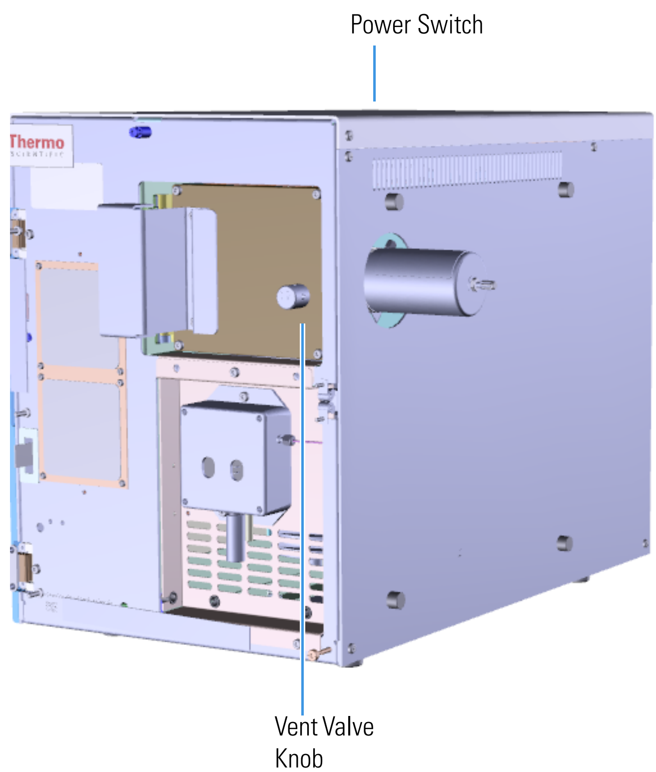
WARNING BURN HAZARD: The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

WARNING BURN HAZARD: If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold.

1. Click the **Shut Down** button on the TSQ Duo Dashboard.
2. Click the **Yes** button to continue the shutdown process. The heaters and turbomolecular pump power off. Once the turbomolecular pump reaches 50% rpm, the foreline pump powers off, and you may vent the system. At this point, the vacuum light blinks orange rapidly, and the system is ready to shut down.

3. Reach over to the left side of the instrument and push down on the power switch to power-off the TSQ Duo system.

Figure 13. Powering Off the TSQ Duo System



4. Open the front door of the instrument.
5. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent. Wait five minutes for venting to complete
6. Allow the system to vent for five minutes.
7. Unplug the optional mechanical pump (if used) to avoid accidentally turning on the system.
8. Disconnect the foreline pump power cable from the System Mech Pump connector on the back of the instrument.
9. Remove one of the oil filler plugs from the foreline pump.

Note The pump oil level must be between the MIN and MAX marks on the oil-level sight-glass for the pump to operate properly.

10. Add fresh oil to the reservoir until the oil is halfway between the MIN and MAX level marks.

CAUTION INSTRUMENT DAMAGE: Use only factory-approved foreline pump oil to avoid damaging the instrument or causing a fire.

11. If the oil level goes above the MAX level mark, remove the drain plug and drain the excess oil into a suitable container.
12. Reattach the oil filler plug.
13. Twist the vent valve one and a half times in a clockwise direction.
14. Close the front door of the instrument.
15. Reconnect the foreline pump power cable to the System Mech Pump connector on the back of the instrument.
16. Reconnect the optional mechanical pump to the instrument.
17. Power-on the TSQ Duo system.
18. Purge the foreline pump for 10 minutes using the gas ballast to remove excess gases from the new oil.

Purging Gas from the Oil in the Foreline Pump

Purging (or decontaminating) the oil in the foreline pump removes dissolved gases and low-boiling-point liquids from the oil. Purge the oil if it is cloudy or discolored. You can purge the oil without interrupting system operation.

Set the gas-ballast control to the closed position (0 means closed) to purge the oil.

CAUTION INSTRUMENT DAMAGE: Properly vent the foreline pump exhaust. While the gas is being purged, more oil vapor is being generated. If you leave the purge open for an excessive amount of time, the pump oil will turn into mist, which could damage the pump. Never purge your pump for more than 10 minutes at a time.

Changing the Oil in a Foreline Pump

You should change the foreline pump oil every four months or after 3,000 hours of operation.

Note For best results, change the oil while the foreline pump is still warm. Be careful, as the oil can be very hot if the pump has been used recently.

To change the oil in the foreline pump:.

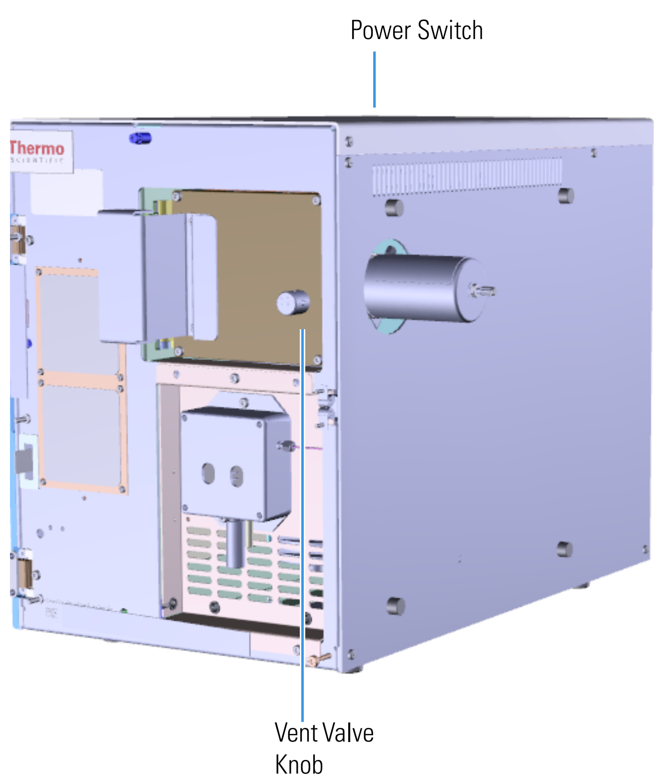
Note If you are running samples, stop the acquisition before powering off the system.

WARNING BURN HAZARD: The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

WARNING If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold

1. Click the **Shut Down** button on the TSQ Duo Dashboard.
2. Click the **Yes** button to continue the shutdown process.The heaters and turbomolecular pump power off. Once the turbomolecular pump reaches 50% rpm, the foreline pump powers off, and you may vent the system. At this point, the vacuum light blinks orange rapidly, and the system is ready to shut down.
3. Reach over to the left side of the instrument and push down on the power switch to power-off the TSQ Duo system.

Figure 14. Powering Off the TSQ Duo System



4. Open the front door of the instrument.
5. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent. Wait five minutes for venting to complete
6. Allow the system to vent for five minutes.
7. Unplug the optional mechanical pump (if used) to avoid accidentally turning on the system.
8. Disconnect the foreline pump power cable from the System Mech Pump connector on the back of the instrument.
9. Disconnect the foreline vacuum hose from the foreline pump.
10. Place the foreline pump on a bench.

WARNING LIFTING HAZARD: Use a proper lifting technique with the foreline pump because it weighs approximately 22 kg (50 lbs).

11. Drain the old oil.


WARNING HAND, CHEMICAL, AND EYE HAZARD Wear impermeable laboratory gloves and eye protection when changing oil.

   a. Remove one of the oil filler plugs.
   b. Remove the drain plug and allow the oil to drain into a suitable container.
   c. Dispose of the spent oil according to local environmental regulations.
   d. Replace the drain plug.

12. Add fresh oil to the reservoir until the oil is halfway between the MIN and MAX level marks.

CAUTION INSTRUMENT DAMAGE: Use only factory-approved foreline pump oil to avoid damaging the instrument or causing a fire.

13. If the oil level goes above the MAX level mark, remove the drain plug and drain the excess oil into a suitable container.
14. Reattach the oil filler plug.
15. Reattach the oil filler plug.
16. Place the foreline pump on the floor.
17. Reconnect the foreline vacuum hose.

18. Reconnect the foreline pump power cable into the System Mech Pump connector on the back of the TSQ Duo instrument.

19. Reconnect the optional mechanical pump to the instrument.

20. Twist the vent valve one and a half times in a clockwise direction or until the o-ring is fully engaged.

21. Close the front door of the instrument.

22. Power-on the TSQ Duo system.

23. Purge the foreline pump for 10 minutes by using the gas ballast to remove excess gases from the new oil. See Purging Gas from the Oil in the Foreline Pump for more information.

Removing the Ion Source Cartridge for Cleaning

The ion source should be removed and cleaned according to your laboratory's schedule. Also clean it if you notice deterioration in the performance of your instrument. The frequency of cleaning is determined by the number of samples you run, as well as the types of samples you run. Since the ion source is the component closest to the sample, it needs to be cleaned more often.

The goal of cleaning the ion source cartridge is to remove any contamination from its surfaces, which restores its electrostatic properties and reduces active sites that may hold on to the GC effluent. You can clean the ion source cartridge using abrasive, sonic, or electropolishing methods, but we recommend using abrasives.

To clean the ion source you will need the following items:

- Source removal tool
- Tweezers
- Source holder
- Clean work surface
- Gloves

Note Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended when handling the ion source. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information.

The following instructions will tell you how to clean the ion source cartridge using abrasives, ultrasonication, and electropolishing.

Removing the Ion Source Cartridge

1. Click **Shut Down** on the TSQ Series Duo Dashboard.
2. Click **Yes** to continue the shutdown process. The high voltages, heaters, and turbomolecular pump power off. Once the turbomolecular pump reaches 50% speed, or five minutes elapses, the foreline pump powers off and you may vent the system.

Note The amber vacuum light on the front of the instrument starts blinking rapidly, indicating the mechanical pump has powered off after a five minute period with the turbomolecular pump off (such as when the instrument is shut down), or due to a sustained vacuum fault lasting five minutes. When the turbomolecular pump spins down below 50% speed due to the shut down process, the vacuum light turns off.

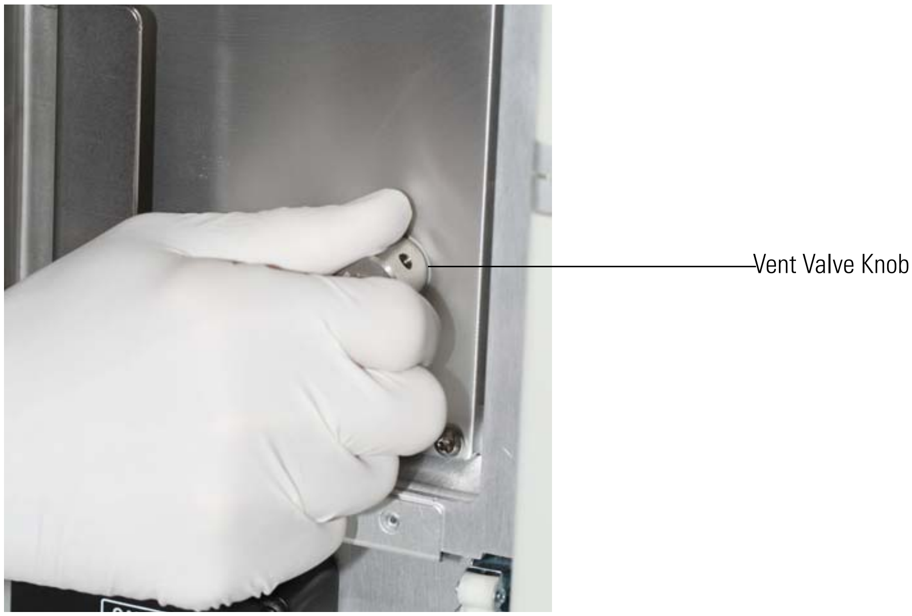
3. Reach around the left side to the back of the instrument and push down on the power switch to power-off the instrument.

4. Open the front door of the TSQ Duo mass spectrometer.

5. Open the front door of the instrument.

6. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent.

Figure 15. Venting the TSQ Duo Mass Spectrometer



7. Wait five minutes for venting to complete.

CAUTION - INSTRUMENT DAMAGE Do not proceed until the instrument is vented, or pieces of the column or ferrule might blow into the instrument. To ensure that the instrument is vented, check how much the glass cover compresses the top cover o-ring in the manifold. Once the o-ring surface touching the glass is about 1 mm, it is safe to open the instrument and remove the column.

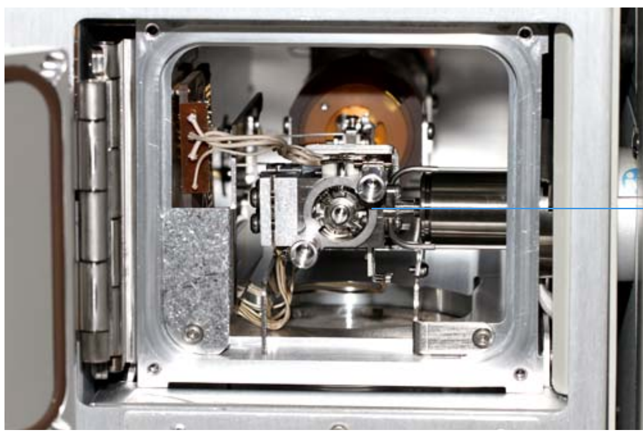
8. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door. See Figure 16.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

Figure 16. Removing the Manifold Door Screws

9. Open the manifold door. You can now see the ion source block.

Figure 17. Locating the Ion Source Block

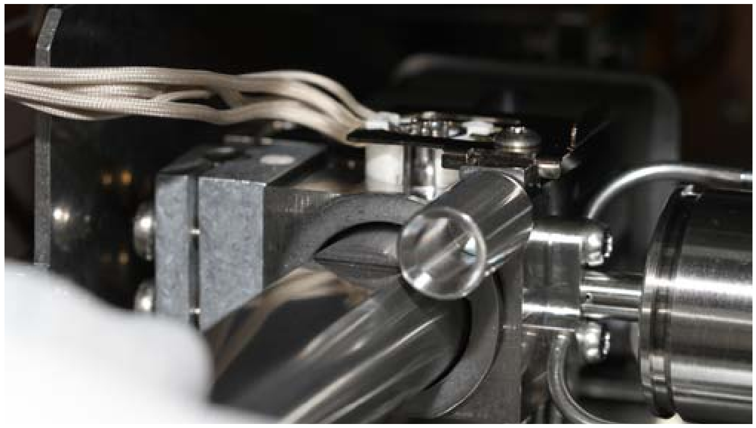


10. With the flat side of the small source removal tool twisted slightly to the right, insert the tool into the ion source block as shown in Figure 18.

Figure 18. Inserting the Small Source Removal Tool

11. Twist the tool to the left so that the flat side faces up. The ion source cartridge should now be connected to the small source removal tool. See Figure 19.

Figure 19. Twisting the Small Source Removal Tool



12. Slowly remove the ion source cartridge from the instrument.

Figure 20. Removing the Ion Source Cartridge

CAUTION - BURN HAZARD The ion source cartridge may be hot.

13. Let the ion source cartridge cool down before removing the components from the source holder.

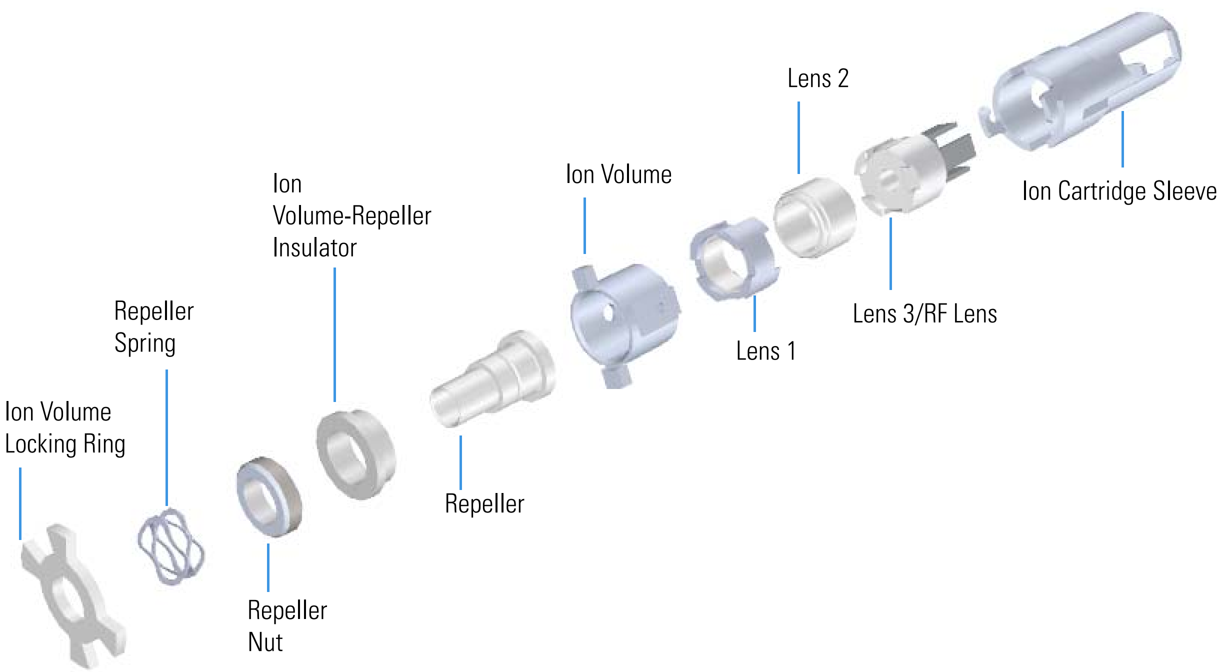
14. Set the ion source cartridge and holder on a clean surface

Disassembling the Ion Source Cartridge

1. Disassemble the ion source cartridge by removing the locking ring first, then the repeller spring, then the nut, insulator, and repeller (which comes out in one piece), ion volume, lens 1, lens 2, and lens 3/RF lens.

   IMPORTANT Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended when handling the ion source cartridge. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information.

Figure 21. Ion Source Cartridge Components



2. Set the components on a clean work surface.

3. Separate the repeller nut, ion volume-repeller insulator, and repeller.

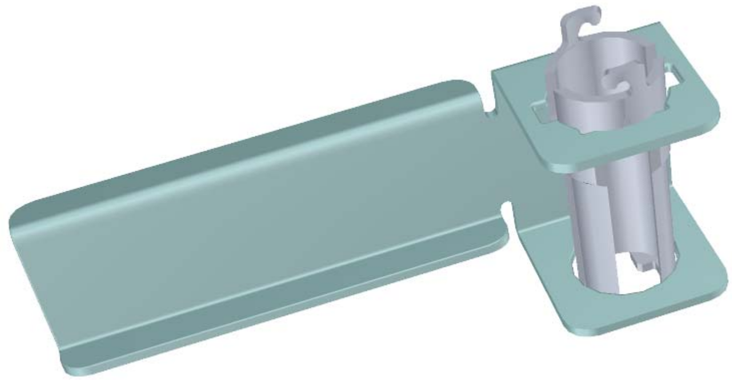
4. Clean the ion source cartridge as instructed in Cleaning Durable Components.

Reassembling the Ion Source Cartridge

1. Place the ion volume-repeller insulator on the repeller and hold it in place with the repeller nut. Set it aside for now.

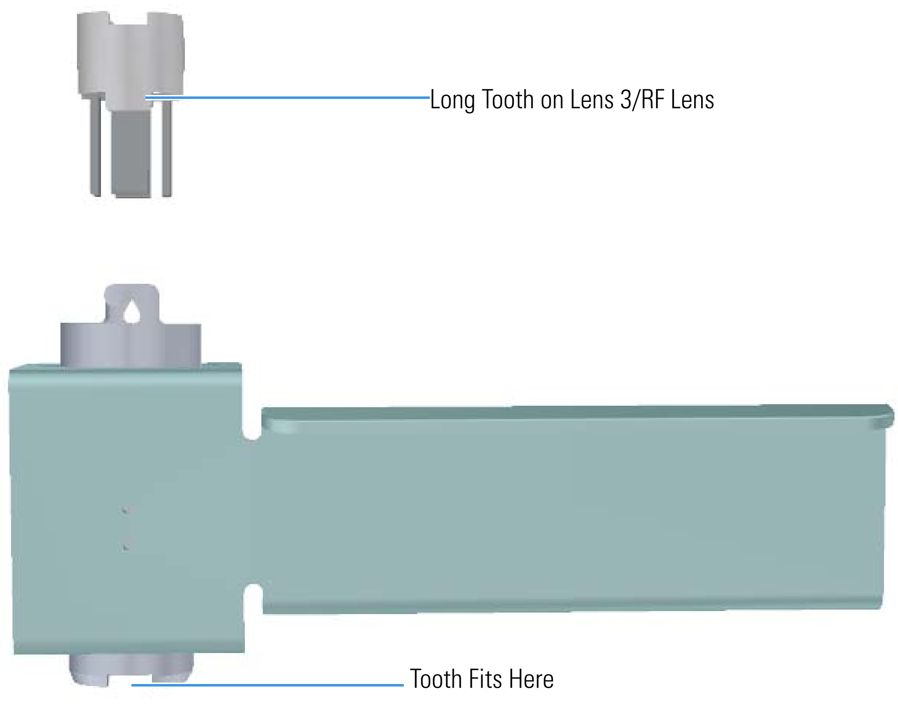
2. Insert the ion cartridge sleeve into the source holder.

Figure 22. Inserting the Sleeve into the Source Holder



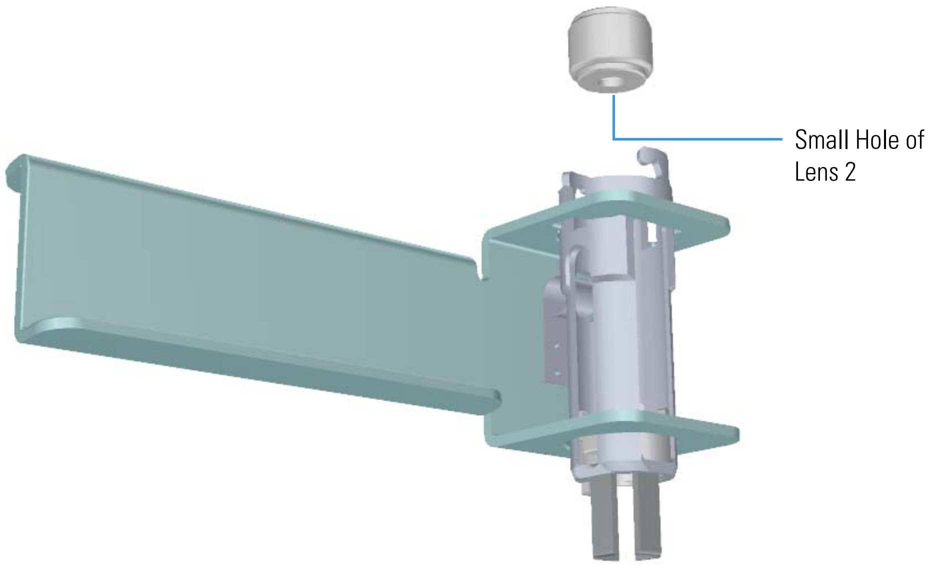
3. Align the long tooth of lens 3/RF lens with the notch on the bottom of the sleeve and drop the lens into the sleeve.

Figure 23. Inserting Lens 3/RF Lens into the Source Sleeve



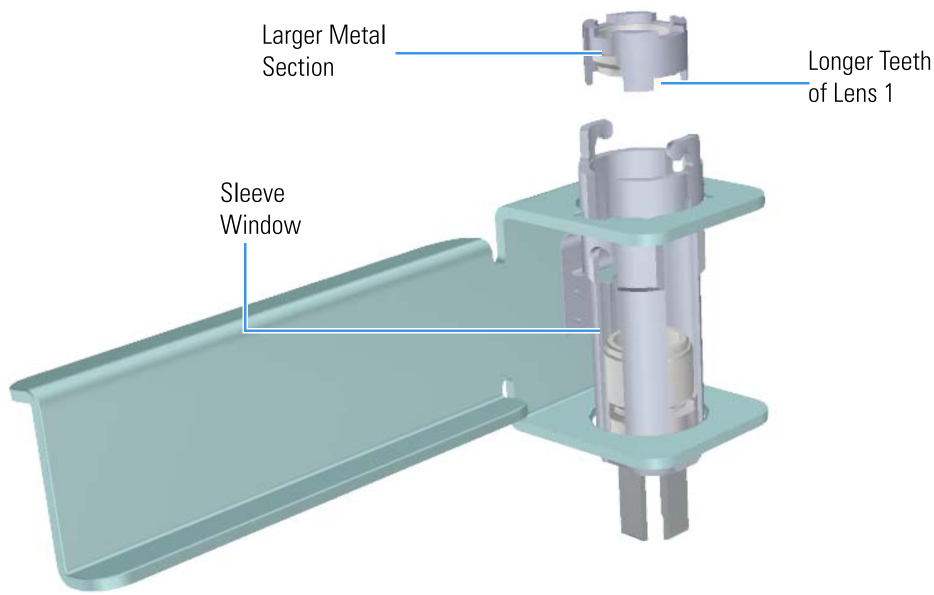
4. Place lens 2 on top of lens 3/RF lens with the small hole facing down. It should fit snugly and sit evenly on top of lens 3/RF lens.

Figure 24. Inserting Lens 2 into the Source Sleeve



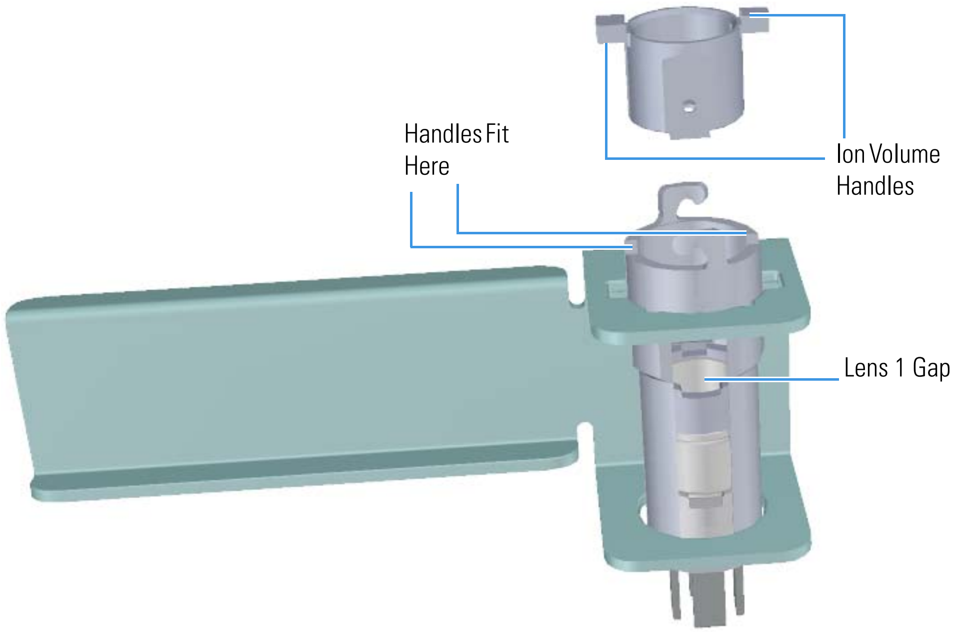
5. With the longer teeth of lens 1 facing down toward lens 2, align the larger metal section of lens 1 with the sleeve window and let it fall into place.

Figure 25. Inserting Lens 1 into the Source Sleeve



6. Insert the ion volume with the handles fitting into the notches of the sleeve. Make sure the ion volume is firmly seated into the gap on lens 1. You may need to rotate lens 1 slightly to make the ion volume fit correctly.

Figure 26. Inserting the Ion Volume into the Source Sleeve

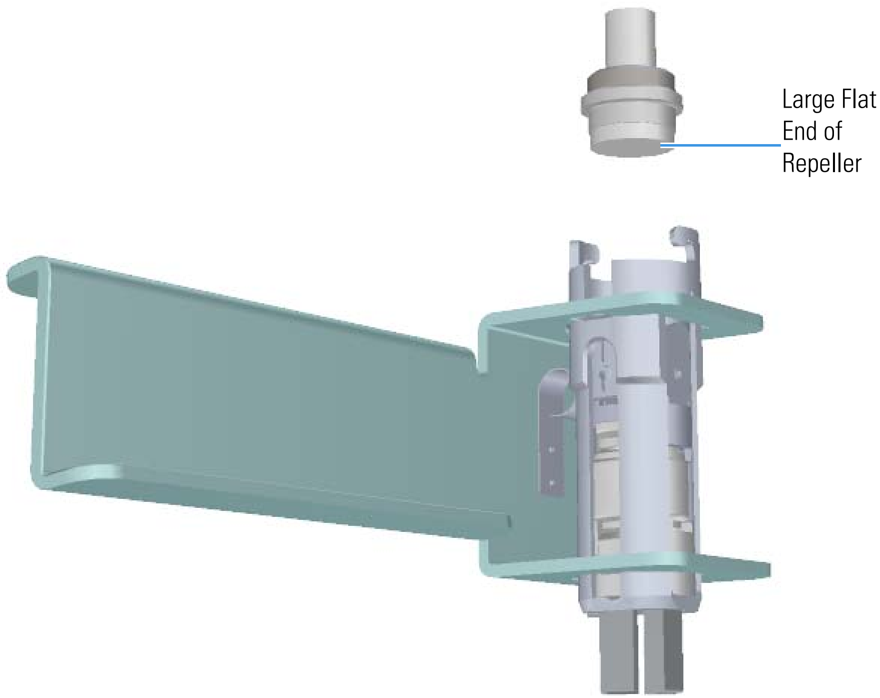


Note The ion volume handles are different sizes and will only fit into the sleeve one way.

7. Tighten the repeller nut.

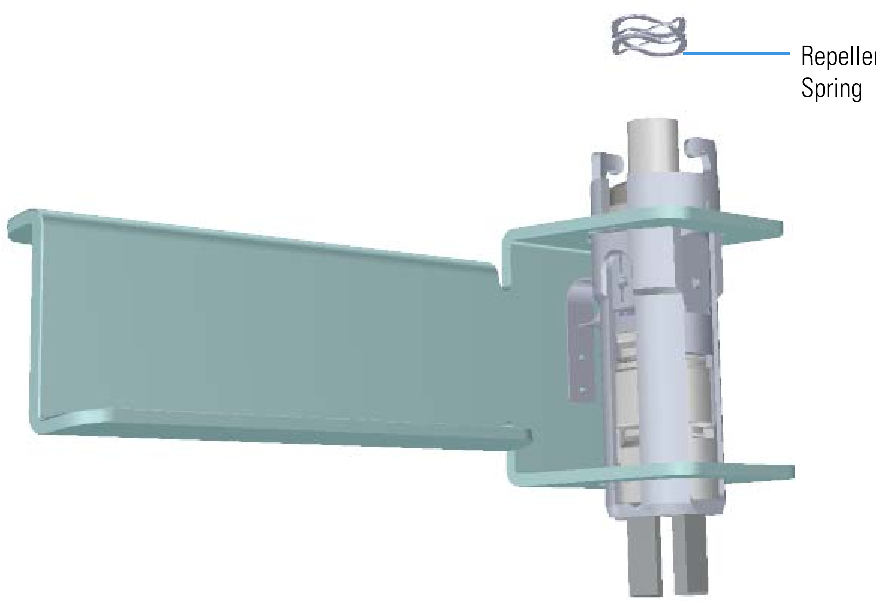
8. Insert the large flat end of the repeller so that it rests on top of the ion volume.

Figure 27. Inserting the Repeller into the Source Sleeve



9. Slide the repeller spring onto the repeller.

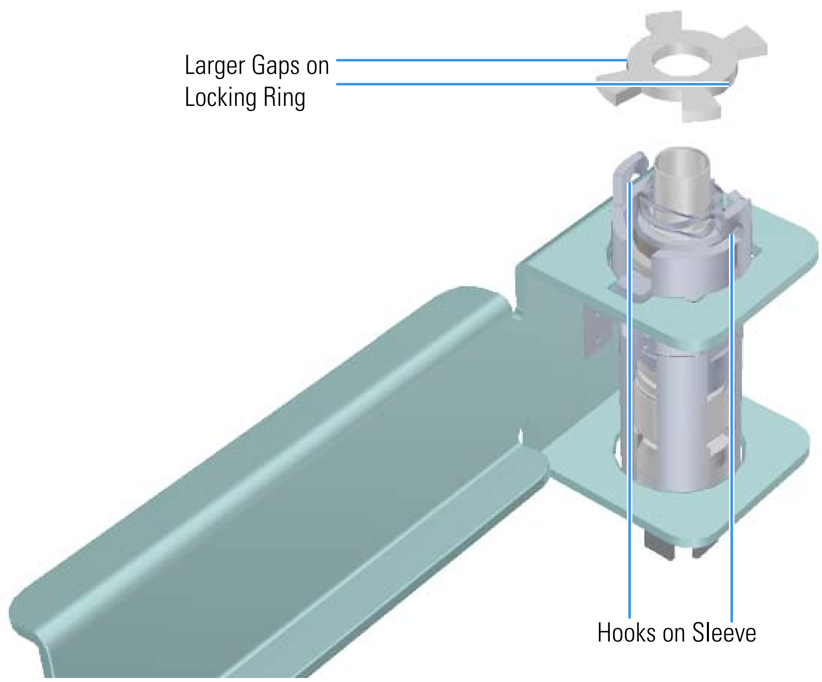
Figure 28. Inserting the Repeller Spring into the Sleeve



10. Place the locking ring on top of the repeller spring so that the repeller protrudes through the center hole on the locking ring. The hooks on the sleeve fit between the larger gaps on the locking ring.

Note Do not twist and lock the locking ring on the sleeve at this time.

Figure 29. Inserting the Locking Ring into the Sleeve



Reinserting the Ion Source Cartridge

IMPORTANT When inserting a cold ion source cartridge such as after cleaning, the ion source and lens stack will expand as the source cartridge heats, often pushing the ion volume and lenses away from the rear of the instrument where they are firmly held by the RF Lens spring contacts. To avoid intermittent electrical contacts to the lenses, you should insert the ion source cartridge, wait 30 minutes for it to get to temperature, then remove and reinsert it.

1. Attach the ion source cartridge to the end of the small source removal tool as shown in Figure 30.

Figure 30. Attaching the Ion Source Cartridge to the Small Source Removal Tool

2. With the source and the flat side of the tool facing straight up, insert the ion source cartridge into the instrument. See Figure 31.

Figure 31. Inserting the Ion Source Cartridge into the Instrument

3. Once the ion source cartridge is inserted into the ion source block, turn the small source tool to the right until you feel the ion source cartridge engage.

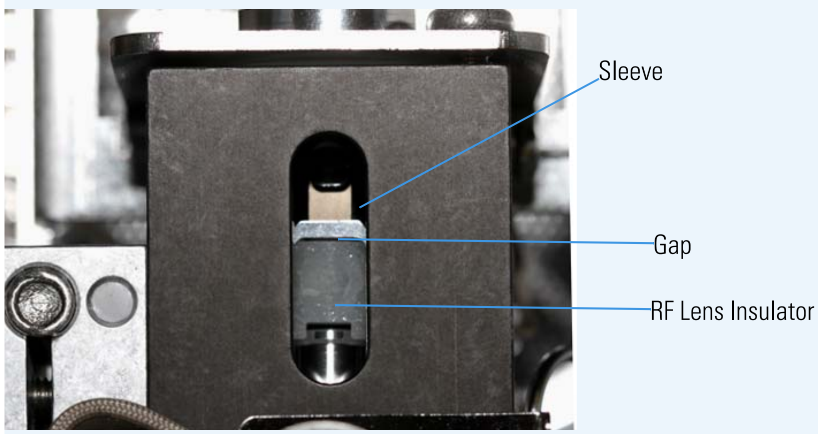
4. Remove the small source tool from the instrument.

Figure 32. Removing the Small Source Tool from the Instrument

5. Be sure that the source interface board wires do not touch anything metal in the manifold before closing the door.

Figure 33. Securing the Source Interface Board Wires

Tip At this point, you may want to remove the top cover and look at the position of the ion source cartridge through the manifold cover. There should be a small gap between the RF Lens insulator and the inside end of the sleeve. This helps to prevent thermal expansion of the sleeve from moving the optics.



6. Close the manifold door and slightly tighten the vent valve knob by turning it one half turn clockwise.
7. Flip the power switch on the back of the TSQ Duo instrument upwards to power on the instrument. This will help you achieve good vacuum.
8. Center the manifold door so that the screw holes are aligned with the manifold. And insert the four manifold screws, tightening each finger-tight such that the o-ring is engaged on every surface.
9. Tighten the four manifold screws using a T20 Torxhead screwdriver.
10. Tighten the vent valve knob completely by turning it approximately one turn clockwise.

11. Close the front door of the instrument.

12. For optimal performance, wait at least fifteen minutes for the ion source to heat up to the same temperature as the inside of the instrument. Otherwise, the masses or intensities may be different

IMPORTANT When inserting a cold ion source cartridge such as after cleaning, the ion source and lens stack will expand as the source cartridge heats, often pushing the ion volume and lenses away from the rear of the instrument where they are firmly held by the RF Lens spring contacts. Inserting the source with the gap shown in the tip above can help prevent contact issues.

Maintaining the Calibration Gas Module

The calibration gas module on the TSQ Duo mass spectrometer is very easy to maintain. It is inside the front door of the instrument, and you only refill the calibration gas reservoir every one to two years.

The calibration compound is a liquid whose vapor is introduced into the ion source by the calibration gas module and the associated tubing. When the calibration compound is ionized, it produces a rich spectrum of ions that are well distributed across the mass range of the instrument and which are used for tuning and calibrating the mass spectrometer. The TSQ Duo mass spectrometer uses FC 43, which contains perfluorotributylamine (PFTBA) as its calibration compound.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering calibration gas components.

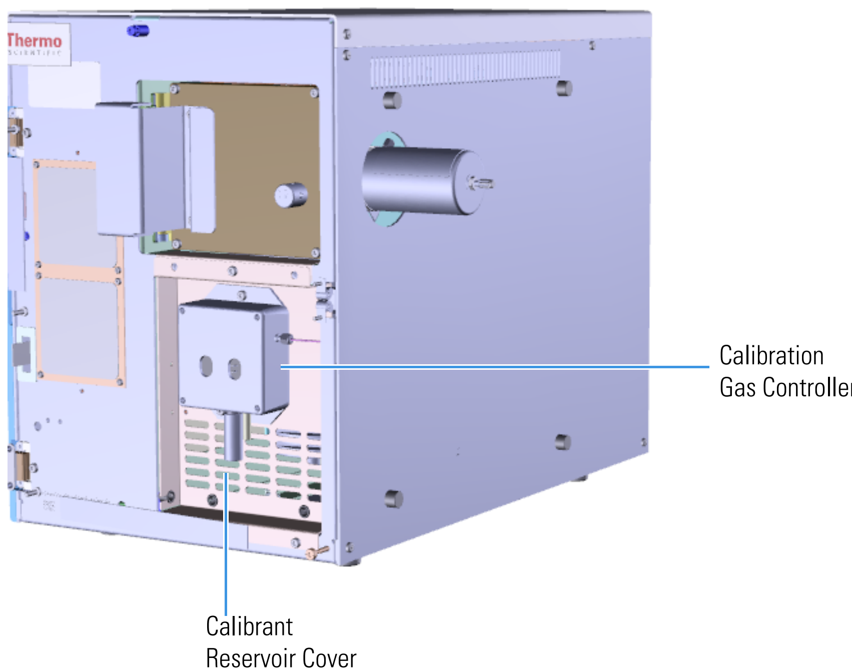
Refilling the Calibrant Reservoir

To refill the calibrant reservoir:

Note It is not necessary to vent the instrument to perform this operation

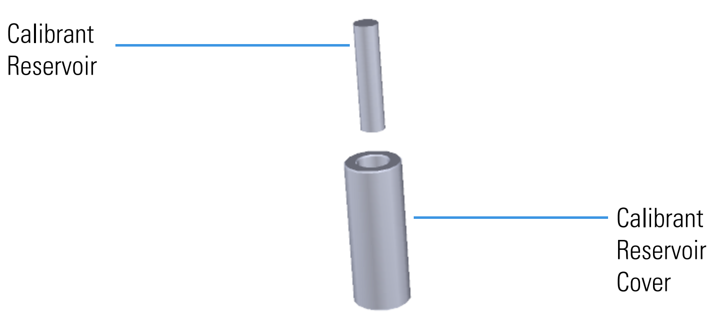
1. Open the front door of the TSQ Duo instrument.
2. Twist the calibrant reservoir cover counter-clockwise and remove it from the calibration gas controller.

Figure 34. Removing the Calibrant Reservoir Cover



3. Fill a syringe with 200 µL of the FC 43 calibration compound, which contains perfluorotributylamine (PFTBA), and insert it into the calibrant reservoir.

Figure 35. Removing the Calibrant Reservoir from the Cover



4. Inject the FC 43. If you see liquid pooled on top of the white frit, remove the excess liquid according to local environmental regulations.

CAUTION INSTRUMENT DAMAGE: Adding more than 300 µL of calibration compound can damage the calibration gas controller. Be sure liquid does not get into the controller when you reattach the reservoir.

5. Reattach the cover to the calibration gas controller.
6. Close the front door of the instrument.
7. If using hydrogen as a carrier gas, reattach they hydrogen safety screw.

Replacing a Dual Filament

The number of ions produced in the ion source is proportional to the filament emission current. If the measured emission current is substantially less than the set emission current value, or if the measured emission current is decreasing, you may need to replace the dual filament because it has failed or is failing. Also, if one of the filaments has burned out, it may be time to replace it.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering a new filament.

You can increase the life of your dual filament by:

- Setting the solvent delay so that the analyzer will not turn on while the solvent peak is eluting.
- Not overriding the solvent delay at the beginning of a run.
- Selecting a lower emission current.

Note Click the **Instrument Control** button in the Xcalibur Status panel to switch between filaments A and B.

To replace the dual filament:

1. Open the TSQ Duo Dashboard and click the **Shut Down** button.

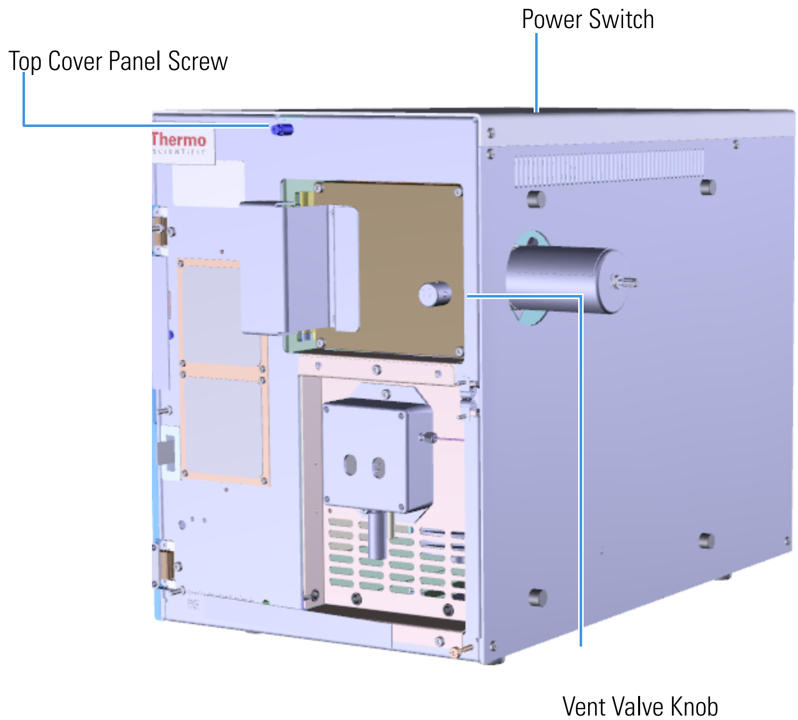
WARNING BURN HAZARD: The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

WARNING If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold.

2. Click the **Yes** button to continue the shutdown process. The heaters and turbomolecular pump power off. Once the turbomolecular pump reaches 50% rpm, the foreline pump powers off, and you may vent the system.
3. When the TSQ Duo system's temperatures and pumps are ready for shutdown, the vacuum light on the front of the instrument will start blinking rapidly.

4. Reach over to the left side of the instrument and push down on the power switch to power-off the TSQ Duo system.

Figure 36. Powering Off and Venting the TSQ Duo System



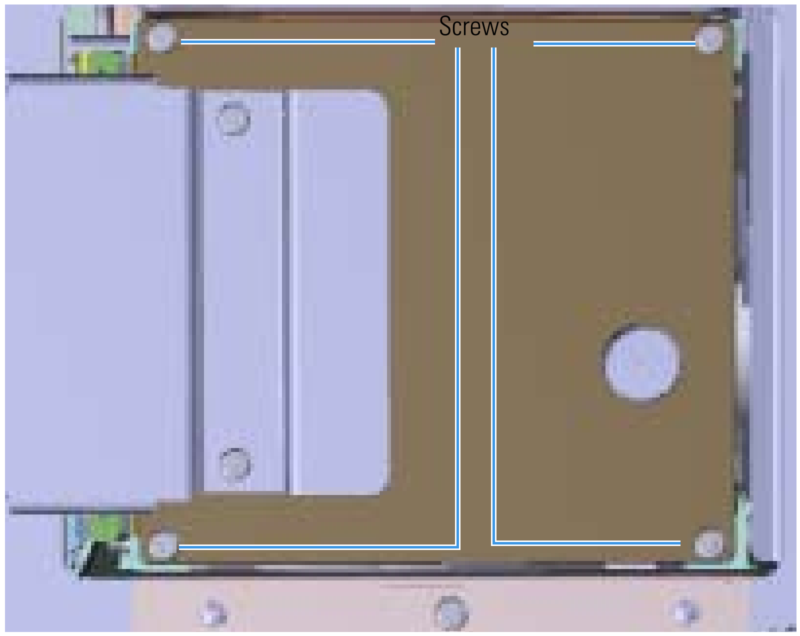
5. Open the front door of the instrument.
6. Twist the vent valve knob one and a half times in a clockwise direction to open the vent.
7. Wait five minutes for the system to vent.
8. Use a T20 Torxhead screwdriver to loosen the top cover panel from the interior front panel.

Note There are also two hydrogen safety screws in the top cover that are installed at top left and right. They must be removed before the top cover can be moved. The screw on the top right might be blocked by the GC, and you might have to move the GC out of the way.

9. Slide the top cover panel toward the back of the instrument and lift it off.

10. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

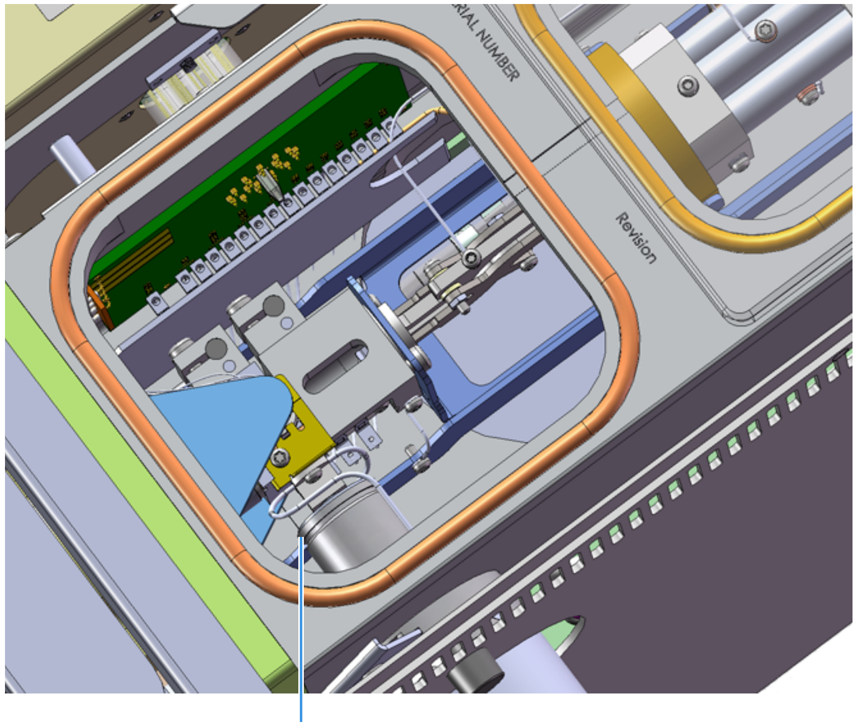
Figure 37. Opening the Manifold Door



11. Pull the manifold door out to open. Once the alignment pins are clear of the thumbscrews, swing the manifold door open.

12. Remove the small glass manifold cover from the top of the instrument.

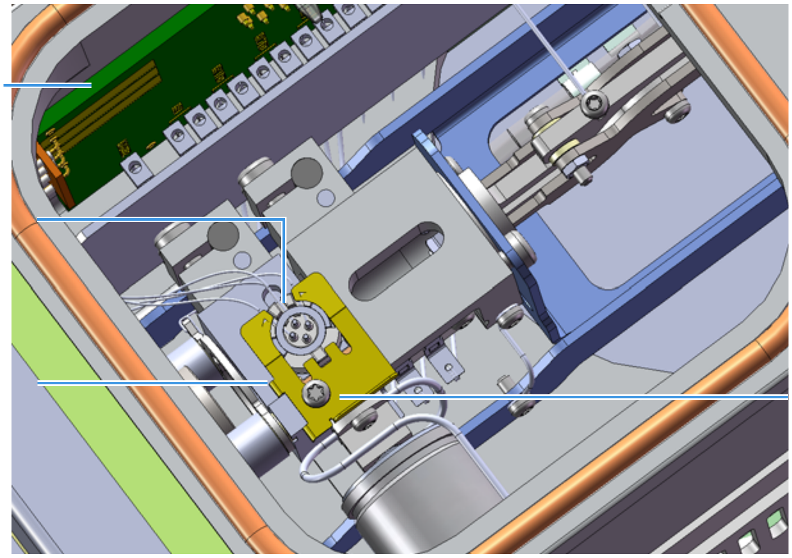
Figure 38. Removing the Small Glass Manifold Cover



> **CAUTION INSTRUMENT DAMAGE:** Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended when touching components inside the vacuum manifold. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information.

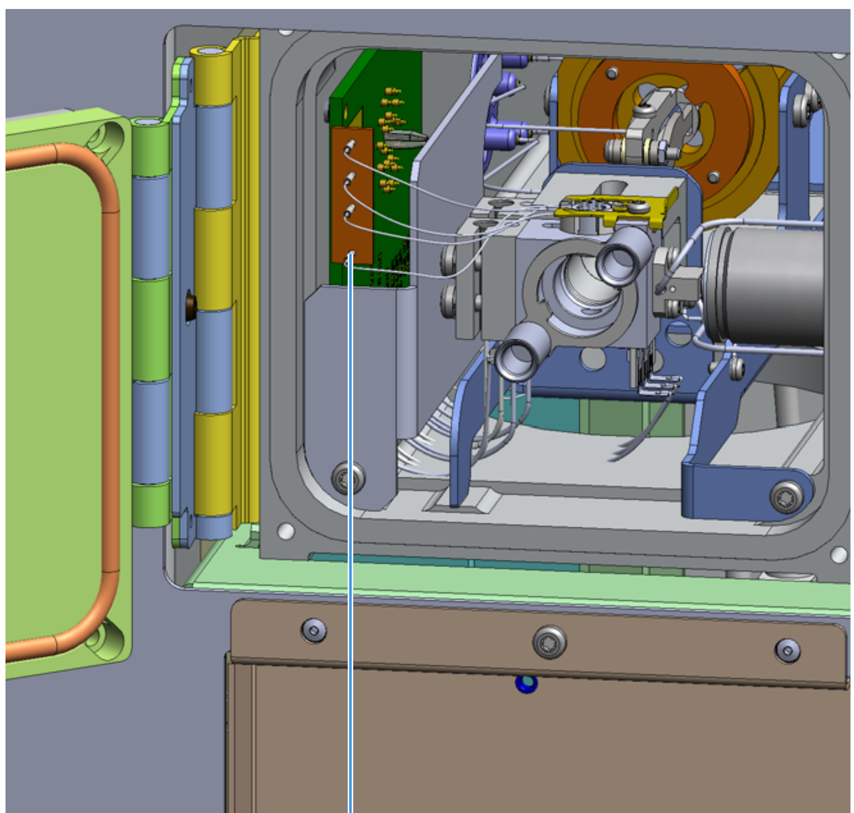
13. Look through the top of the instrument and use a clean T10 Torxhead screwdriver to loosen the screw holding the filament retaining clip in place. Then rotate the clip away from the filament.

Figure 39. Disconnecting the Filament



14. Disconnect the filament board and wires from the source interface board.

Figure 40. Disconnecting the Filament Board and Wires



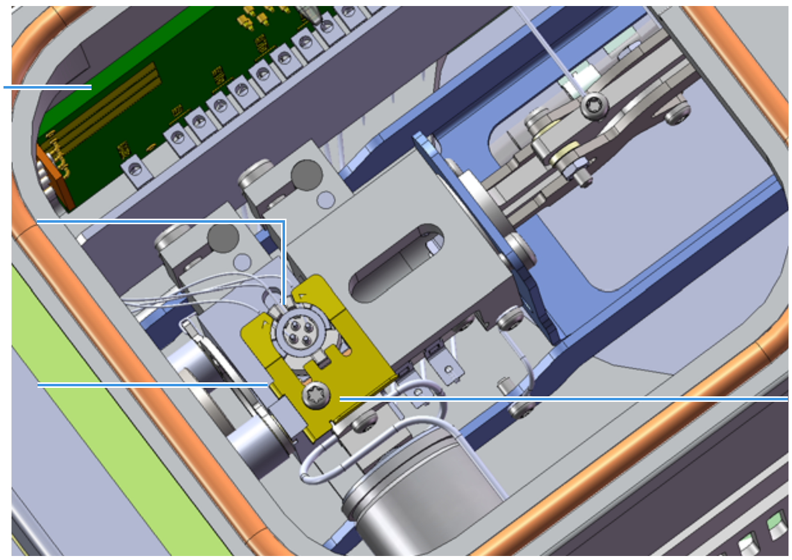
15. Remove the filament.

16. Insert the replacement filament into its slot, rotate the spring into position, and slightly tighten the screw holding the filament retaining clip in place.

17. Bend the filament wires so they do not touch any metal component. You may want the old filament as a model.

18. Attach the connector of the replacement filament to the source interface board.

Figure 41. Replacing the Filament



19. Return the glass manifold cover to the top of the instrument.

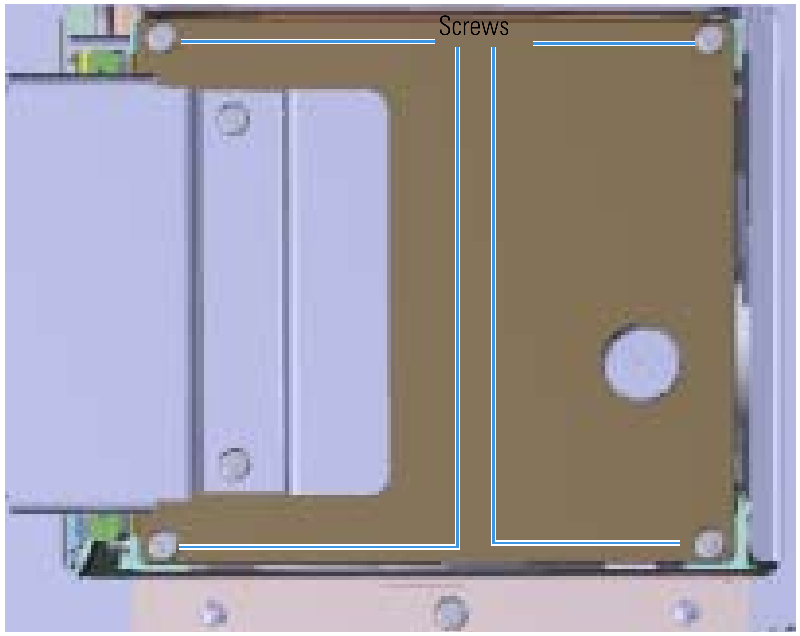
20. Swing the manifold door so that it is parallel to the opening. Guide the alignment pins into the thumbscrews.

Note The manifold door will not swing closed. There will be a 1 cm gap. You must push the door to close it completely. Do not apply excess force to the thumbscrews or components may be damaged.

Note Once the manifold door is closed, ensure the filament wires do not contact the metal surface of the door.

21. Use a T20 Torxhead screwdriver to replace the four screws around the manifold door.

Figure 42. Opening the Manifold Door



22. Reattach the top cover panel and tighten the screw holding it in place.

> **Note** If you are using hydrogen as a carrier gas, reinstall the two hydrogen safety screws.

23. Close the front door of the instrument. If you are using hydrogen as a carrier gas, fasten the hydrogen safety screw on the front door.
24. Twist the vent valve one and a half times in a clockwise direction to close it or until tight.
25. Reach over to the left side of the instrument and pull up on the power switch to power-on the TSQ Duo system.

Replacing the Electron Multiplier

The lifetime of the electron multiplier is directly related to the current that flows through it and the amount of contamination or condensation it receives. The electron multiplier will last longer if you:

- Maintain the best possible vacuum.
- After pumping down, allow the instrument enough time to equilibrate before you start running samples again.
- Monitor the GC/MS for background contamination and immediately repair leaks.
- Keep tuning and detector calibration to a minimum.

To replace the electron multiplier:

Note To order a new electron multiplier, refer to the *TSQ Duo Spare Parts Guide*.

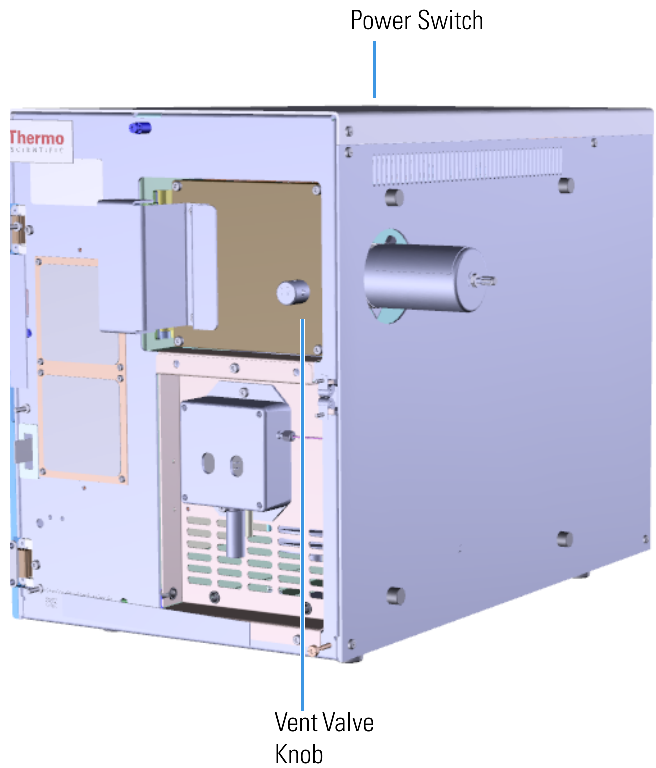
1. If you are using hydrogen, cool down the injector to prepare the GC for powering off. See the GC documentation for information. After the heated zones are cooled down, power-off the GC if you are using hydrogen.

WARNING BURN HAZARD: The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

WARNING - FIRE HAZARD: If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold. See the “Hydrogen Safety Precautions” on page xvii of the Preface for more information.

2. Shut down the TSQ Duo system using the software. See the *TSQ Duo User Guide* for more information.
3. Click the **Yes** button to continue the shutdown process. The heaters and the turbomolecular pump power off. Then the foreline pump powers off.
4. Reach around the left side of the instrument and push down on the power switch to power-off the instrument.
5. If you are using hydrogen, unscrew the hydrogen safety screw on the front door.

Figure 43. Powering Off the TSQ Duo System



6. Open the front door of the instrument.
7. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent.
8. Wait five minutes for the TSQ Duo instrument to vent.

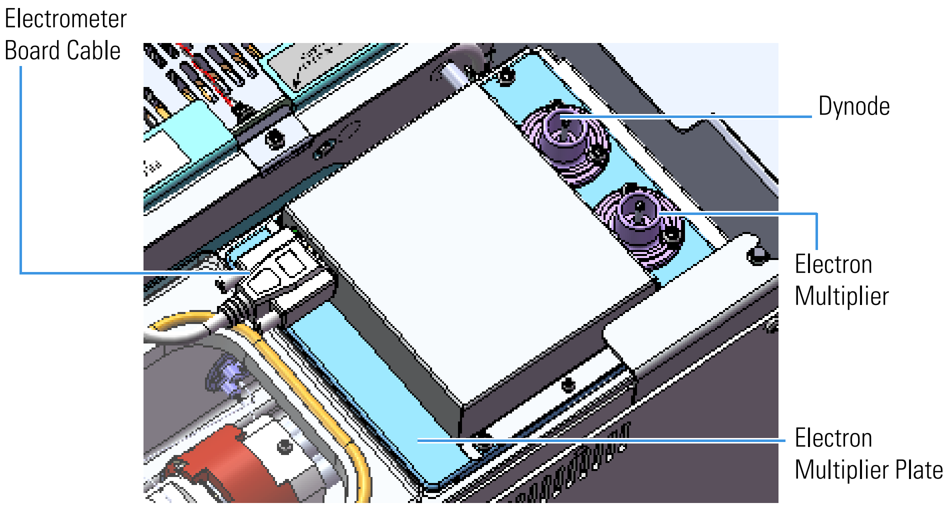
CAUTION - INSTRUMENT DAMAGE Do not proceed until the instrument is vented or pieces of the column or ferrule might blow into the instrument. To ensure that the instrument is vented, check how much the glass cover compresses the top cover o-ring in the manifold. Once the o-ring surface touching the glass is about 1 mm, it is safe to open the instrument and remove the column.

9. Open the front door of the GC and loosen the transfer line nut. Then pull the column back (into the oven) about 5 cm to ensure the column is no longer in the ion source.
10. Use a T20 Torxhead screwdriver to loosen the top cover panel.
11. If you are using hydrogen, remove the remaining hydrogen safety screws.

Note You might have to move the GC to access the right hydrogen safety screw.

12. Disconnect the electrometer board cable and large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

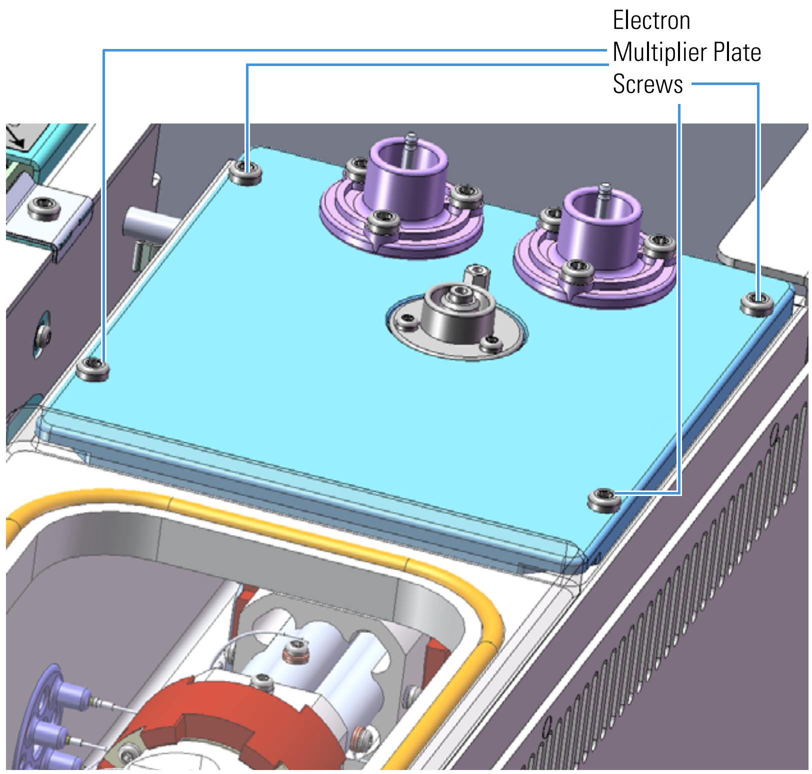
Figure 44. Disconnecting the Electron Multiplier Cables



13. Use a T20 Torxhead screwdriver to remove the four screws at each corner of the electron multiplier plate.

CAUTION - ELECTRICAL HAZARD Avoid dropping screws between chassis and side cover or board. If you drop a screw, find it before powering the instrument on again.

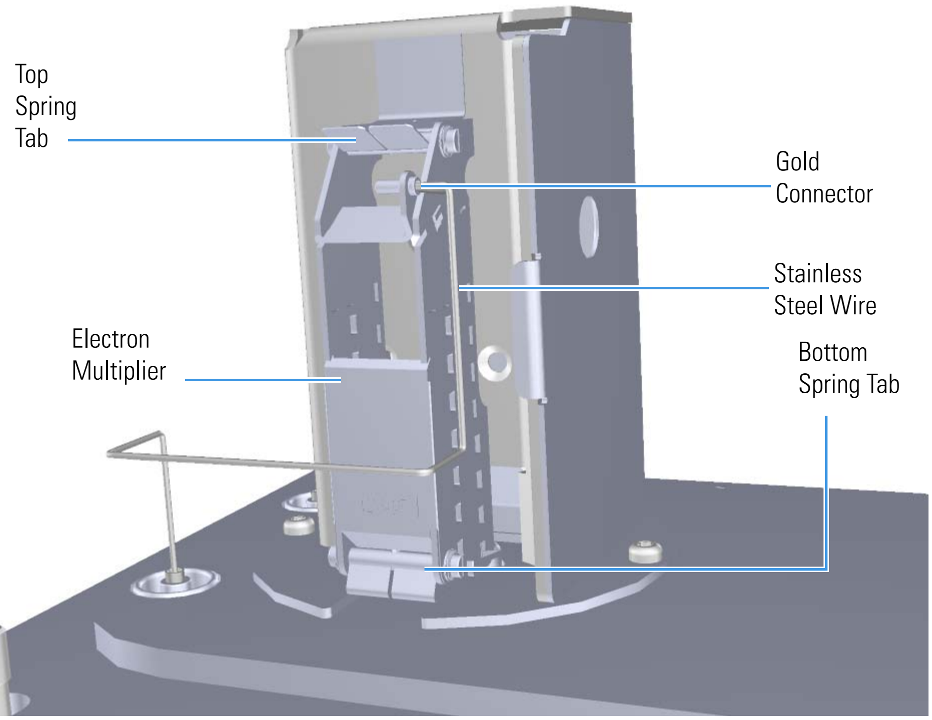
Figure 45. Disconnecting the Electron Multiplier Plate



14. Lift the electron multiplier plate out of the vacuum manifold.

15. Flip the electron multiplier and plate over so that the plate is resting on the work table.

Figure 46. Replacing the Electron Multiplier



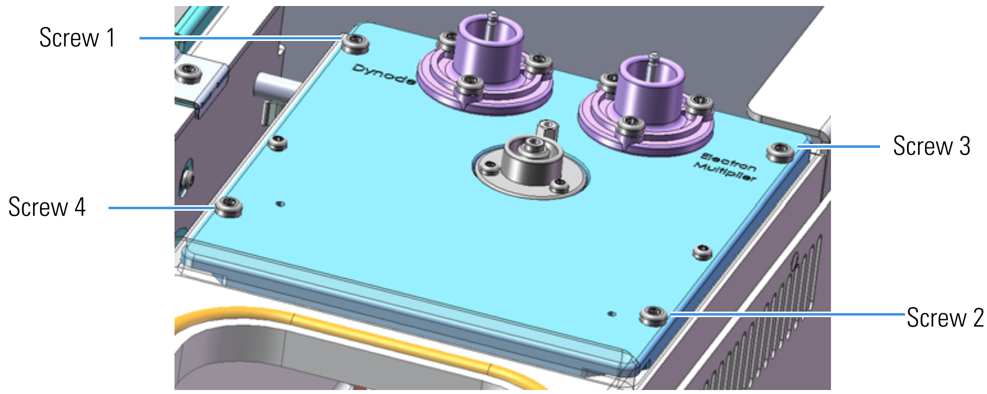
16. Remove the stainless steel wire that from the gold connector on the electron multiplier and move it out of the way.
17. Lift up on the spring tab at the top of the electron multiplier and remove the electron multiplier.
18. Insert the new electron multiplier through the bottom tab first and then slide it into the spring tab at the top until it clicks into place.

CAUTION INSTRUMENT DAMAGE: Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended when touching components inside the vacuum manifold. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information

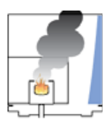
19. Make sure the electron multiplier fits snugly.
20. Reconnect the stainless steel wire to the gold connector.
21. Inspect the o-ring between the manifold and detector assembly for debris. If the o-ring is dirty, clean or replace it.
22. Flip the electron multiplier and plate over and insert them into the instrument.

23. Put the electron multiplier plate back into place and reattach the four screws. Tighten them in this order: screw 1, screw 2, screw 3, screw 4. See Figure 47 for clarification.

Figure 47. Reattaching the Electron Multiplier Plate

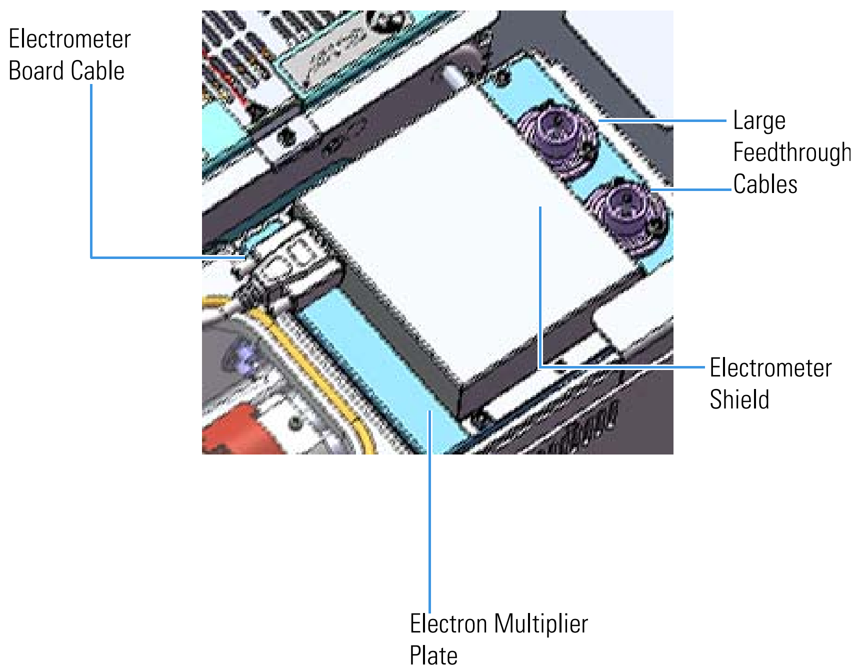


24. Reconnect the electrometer board cable and large feedthrough cables.



CAUTION INSTRUMENT DAMAGE: Do not mix up the cables or you will damage the power supply. Match the label on the cable to the label on the electron multiplier plate.

Figure 48. Reconnecting the Electron Multiplier Cables



25. Reattach the top cover panel and tighten the screw holding the top cover panel in place.

26. Close the front door of the instrument.
27. Twist the vent valve clockwise to close the valve. Be careful not to pinch the o-ring.
28. Reinsert the column to the proper length and tighten the transfer line nut. See “Replacing a Column” on page 13 for more information.
29. If you are using hydrogen, replace the front panel screw.
30. Replace the ion source cartridge. See “Reinserting the Ion Source Cartridge” on page 37 for more information.
31. Replace all hydrogen safety screws.
32. Power-on the TSQ Duo mass spectrometer.
33. If the GC is powered off, power it on and make sure vacuum compensation is on for the carrier gas flowing into the mass spectrometer.

WARNING FIRE HAZARD: If you are using hydrogen, do NOT reach over the top of the instrument to power it on. Instead, reach around the left side or go to the back of the instrument and flip up the power switch.

34. Open **TSQ Duo Auto Tune** on the TSQ Duo Dashboard.
35. Once vacuum has reached 100%, run any tune that sets the gain of the electron multiplier to 3 x 10^5.

Cleaning Durable Components

IMPORTANT If there is any doubt about a compatibility of decontamination of cleaning agents with parts of the equipment or material contained in it, the responsible party must contact Thermo Fisher Scientific product support personnel.

You can ONLY clean the following durable components inside the vacuum manifold:

- Repeller
- Ion volume
- Lens 1
- Lens 2
- Lens 3/RF lens
- Ion cartridge sleeve
- Heat shield for the source interface board
- Screws

Note You only need to clean the repeller, ion volume and all the lenses (except for the quad entrance lens) the most frequently. Cleaning the other components are not part of the expected maintenance.

To clean durable components of the TSQ Duo instrument, you will need the following cleaning supplies:

- Acetone, reagent grade (or other suitable polar solvent)
- Aluminum oxide abrasive powder, number 600
- Applicators, cotton-tipped
- Beaker
- Deionized water
- Detergent (Alconox, Micro, or equivalent)
- Dremel rotary tool or equivalent (recommended)
- Forceps
- Gas, clean and dry (Nitrogen, Helium or equivalent)
- Gloves, clean, lint- and powder-free, latex or nitrile
- Glycerol, reagent grade
- Toothbrush
- Cotton swab with wood handle
- Razor blade
- Ultrasonic cleaner


WARNING MATERIAL AND EYE HAZARD: Wear impermeable laboratory gloves and eye protection when cleaning components.

To clean the durable components:

1. Remove contaminants from all the components you are cleaning.

    a. Use a slurry of #600 aluminum oxide in glycerol on a cotton-tipped applicator to clean each component. Contamination can be indicated by a dark or discolored area, but it is often invisible. The heaviest contamination is usually found around the apertures, such as the electron entrance hole of the ion volume.

    > **Note** Clean only the metal pieces of the repeller, lens 1 and lens 3/RF lens with aluminum oxide.

    b. Clean each component thoroughly, even if no contamination is visible. To clean components faster, use a Dremel® tool and polishing swab at its lowest speed.

> **WARNING ELECTRICAL SHOCK HAZARD:** Exposing the Dremel tool to standing water may cause an electrical shock.

> **WARNING FIRE HAZARD:** Using the Dremel tool near flammable vapors may cause a fire.

    c. Clean the crevices of a component using a non-metal tool. It is very important to make sure you remove all of the debris or discoloration found in small edges of each component, in particular the ion volume. Otherwise, the debris or discoloration might affect the quality of your data.

    d. If you notice any scratches on the components, you may need to replace the component. Scratches can affect the performance of your instrument.

2. Rinse the components with clean tap water. Use a toothbrush under a stream of water to remove the aluminum oxide slurry. Do not let the slurry dry on the components because it is difficult to remove. If the components still look dirty, repeat step 1.

3. Sonicate the components in warm detergent.

    a. Use forceps to place the components in a beaker of warm detergent.

    b. Place the beaker and its contents in an ultrasonic bath for five minutes.

    c. Rinse the components with tap water to remove the detergent.

4. Sonicate the components in deionized water.

    a. Use forceps to place the components in a beaker of deionized water.

    b. Place the beaker and its contents in an ultrasonic bath for five minutes. If water is cloudy after sonicating, replace the water with fresh water, and put the beaker and contents in a ultrasonic bath again for five minutes. Repeat until the water is clear.

5. Use forceps to immediately transfer the components to a clean beaker of acetone.

6. Sonicate the components in acetone.

WARNING FIRE HAZARD: Acetone is flammable and volatile, so make sure the ultrasonic bath is properly ventilated to prevent the buildup of vapors.

   a. Place the beaker and its contents in an ultrasonic bath for one minute.
   b. Use forceps to transfer the components to a beaker of fresh acetone.
   c. Place the beaker and its contents in an ultrasonic bath for one minute.

7. Wearing gloves, blow clean, dry gas on the components to remove the acetone.

Note Acetone should not be allowed to dry on the part. It will leave a residue that may affect instrument performance.

Cleaning Delicate Components

IMPORTANT If there is any doubt about a compatibility of decontamination of cleaning agents with parts of the equipment or material contained in it, the responsible party must contact Thermo Fisher Scientific product support personnel

You can ONLY clean the following delicate components inside the vacuum manifold:
- Source-to-ion guide spacers
- Thumbscrew-repeller spacers
- Insulating spacers
- Lens heater block and grounding strap
- Repeller plate
- Lens plate and springs
- Repeller insulator
- Repeller nut
- Repeller spring
- Dynode, electron multiplier and anode feedthroughs (except the o-rings)
- 20-pin feedthrough (except the o-ring)
- 4-pin feedthrough (except the o-ring)
- Filament retaining spring
- Ion guide-quadrupole stabilizer
- Ion guide and quadrupole wires
- Quadrupole rod endcaps
- Tray alignment pins
- Vent valve knob (except o-ring)
- Source magnets
- Top (glass) manifold cover

Note Cleaning these components is not part of the expected maintenance.

To clean delicate components of the TSQ Duo instrument, you will need the following cleaning supplies:
- Applicators, cotton-tipped
- Deionized water
- Detergent (Alconox, Micro, or equivalent)
- Gas, clean and dry (Nitrogen, Helium or equivalent)
- Gloves, clean, lint- and powder-free, latex or nitrile
- Methanol, reagent grade (or other suitable polar solvent, such as Ethanol)

CAUTION INSTRUMENT DAMAGE: Do NOT use acetone to clean plastic components or it will damage them. Also, this procedure should not be used on any component outside the vacuum manifold.

1. Scrub all of the components with a warm detergent solution.

WARNING MATERIAL AND EYE HAZARD: Wear impermeable laboratory gloves and eye protection when cleaning components.

   a. Scrub the components with a toothbrush or clean applicator. Do not soak or sonicate the components in detergent.

   b. Using forceps, rinse the components thoroughly with tap water to remove the detergent.

2. Rinse the components in deionized water. Using forceps, dip the components in a beaker of deionized water. Change the water if it becomes cloudy. Do not soak or sonicate the components.

3. Rinse the components with methanol. Using forceps, dip the components in a beaker of methanol. Change the methanol if it becomes cloudy. Do not soak or sonicate the components.

4. While still wearing gloves, use clean, dry gas to blow the methanol off the components.

Cleaning the Filters

To clean the filters and fan filter on the TSQ Duo instrument:

Note If your filters wear out or get damaged, refer to the *TSQ Duo Spare Parts Guide* for information about ordering new ones.

1. Open the front door of the instrument.
2. If your instrument has an optional dust filter, use a T20 Torxhead screwdriver to remove the two M4 screws holding the dust filter frame to the front interior panel.
3. Use a T10 Torxhead screwdriver to remove the six M3 screws holding the EMI filter to the front interior panel.

Figure 49. Cleaning the Filters

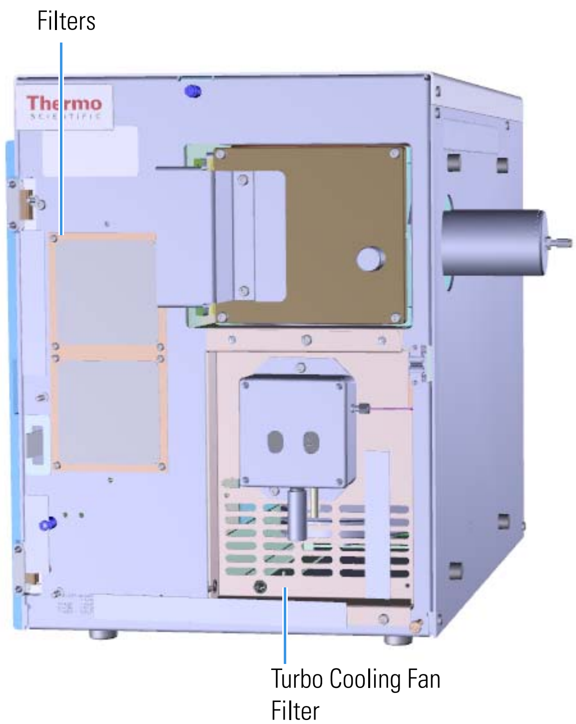
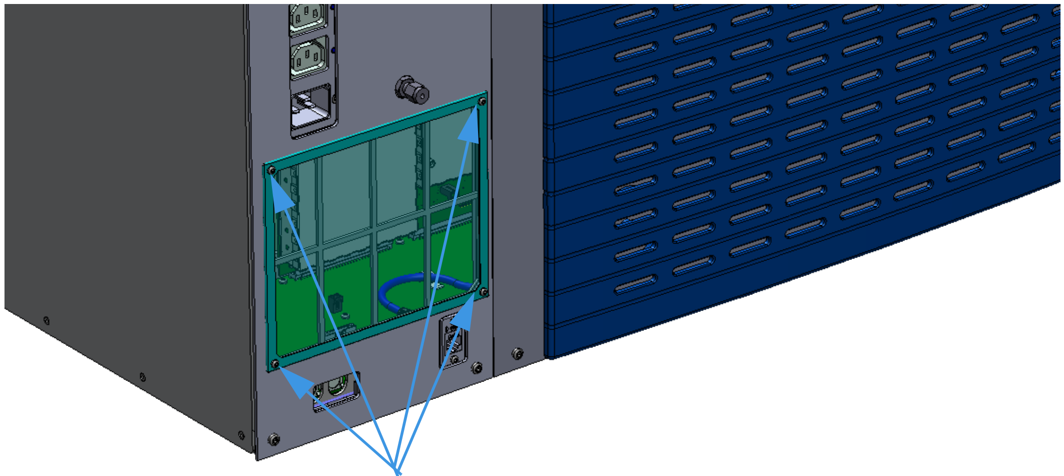


Figure 50. Removing the Left Rear Wire Mesh Filter



4. Use a T10 Torxhead screwdriver to remove the four M3 screws holding the left rear wire mesh filter to the left hand sub panel.
5. If you have an optional dust filter, use a T10 Torxhead screwdriver to remove the two M3 screws holding the filter to the interior front panel.
6. Remove the six screws holding the front wire mesh filter to the frame.
7. Remove the filters.
8. Remove the turbo cooling fan filter cover with a small flat-head screwdriver.
9. Remove the turbo cooling fan filter.
10. Wash the filters in soap and water.
11. Let the filters dry.
12. Reattach the filters.
13. Replace the turbo cooling fan filter cover.
14. Close the front door of the instrument.
15. If using hydrogen as a carrier gas, reattach the hydrogen safety screw.

2

Troubleshooting

In this section, we describe the symptom and remedy for each known issue with the TSQ Duo mass spectrometer. All of these issues are related to hardware, but your instrument or software will alert you to them. For issues that you discover while reviewing your data, see the *Troubleshooting* section of the *TSQ Duo User Guide.*

Contents

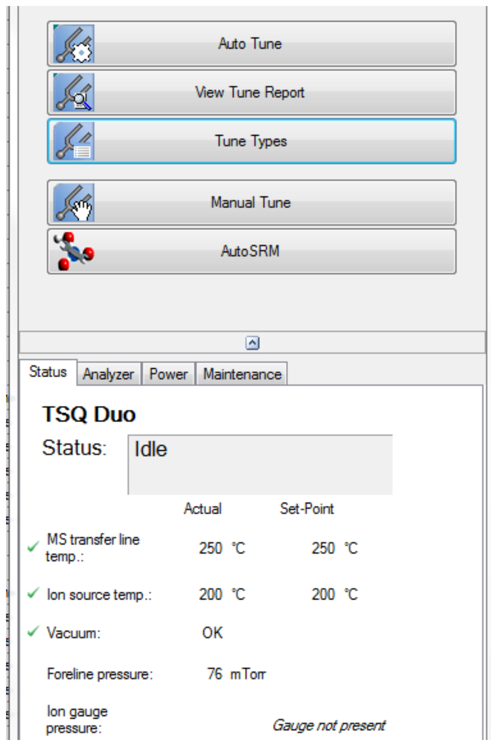
Using Diagnostics

If your TSQ Duo system is running poorly or suspiciously, you can run software diagnostics to detect the problem and find a solution. Diagnostics tests electronic circuits and reports whether the circuits pass or fail. However, problems in sensitivity due to misalignment, dirty components, or improper tuning are not detected by the software. Using the built-in Diagnostic Tune Type is recommended. If you need to create a special diagnostic tune type that removes some of the built in diagnostics, follow the procedure below.

Creating a New Diagnostic Tune File

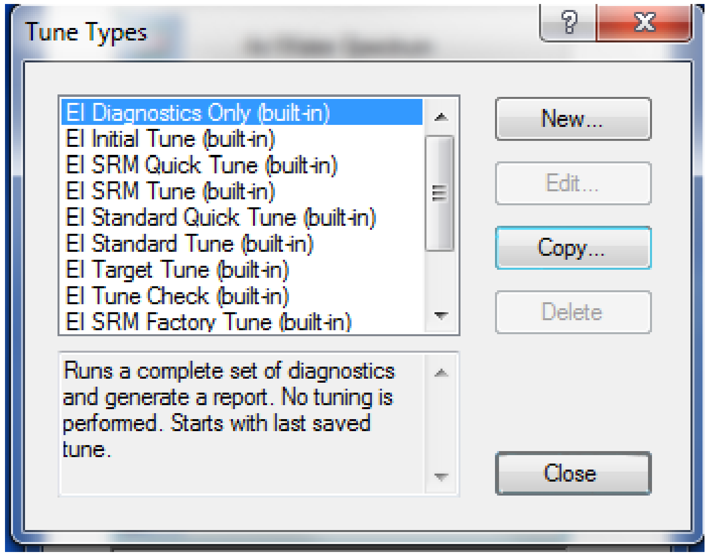
❖ To create a new diagnostic tune file

1. Click **Tune Types** on the TSQ Series Duo Dashboard.



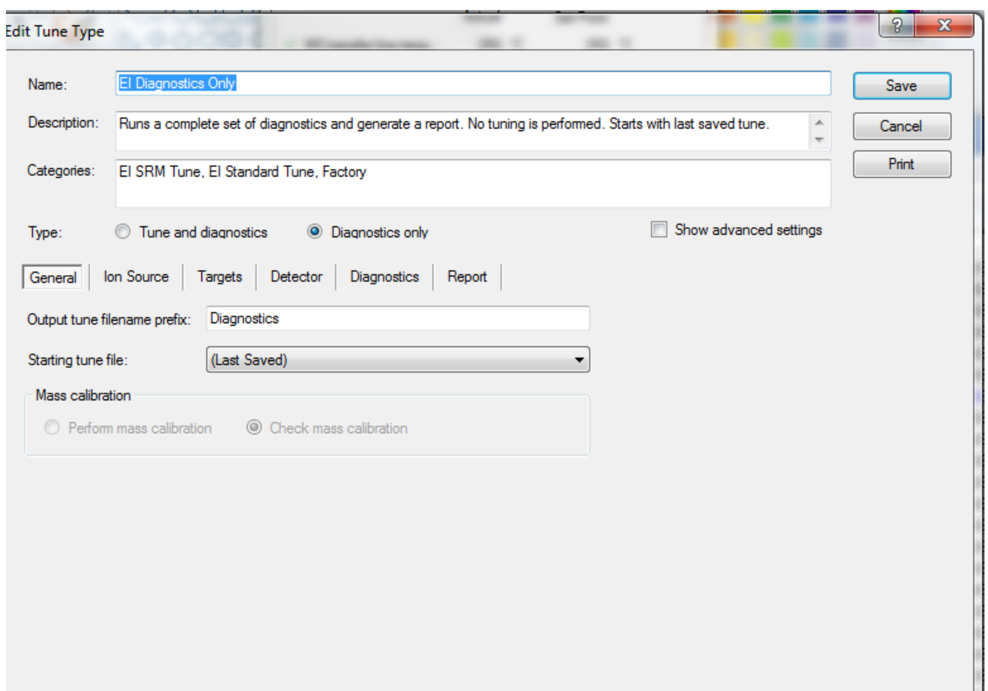
2. Select an existing tune type and click the **Copy** button.

Figure 51. Copying a Tune Type



3. Name your diagnostic tune type.

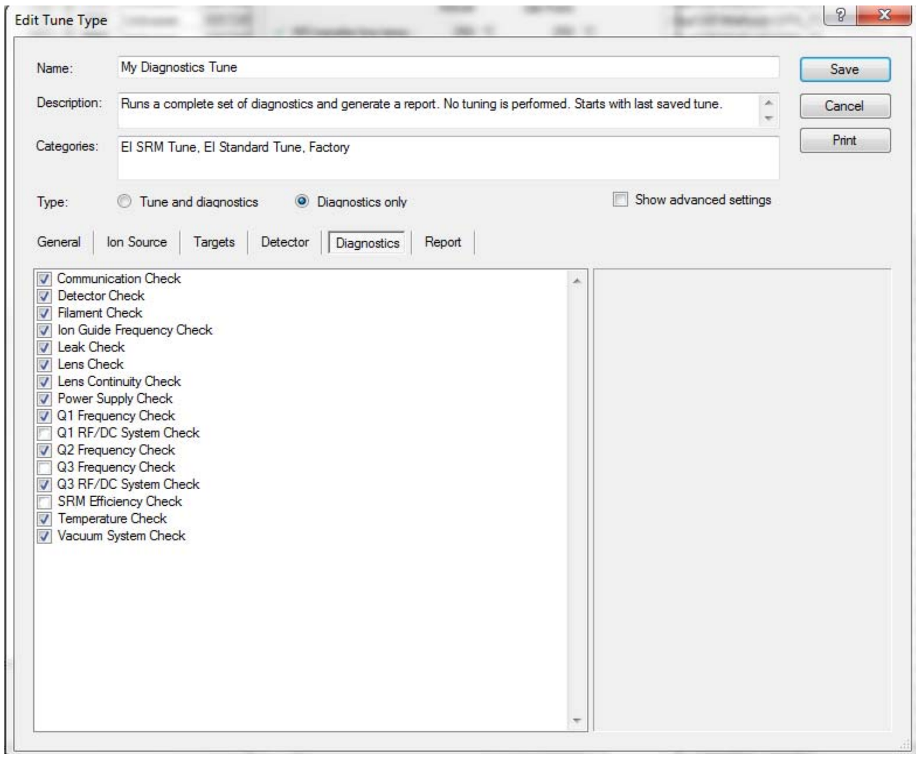
Figure 52. Naming Your Diagnostic Tune Type



4. Select the **Diagnostics Only** option in the Type field.

5. Click the **Diagnostics** tab and select the types of diagnostics you would like to perform on your instrument.

Figure 53. Selecting Types of Diagnostics



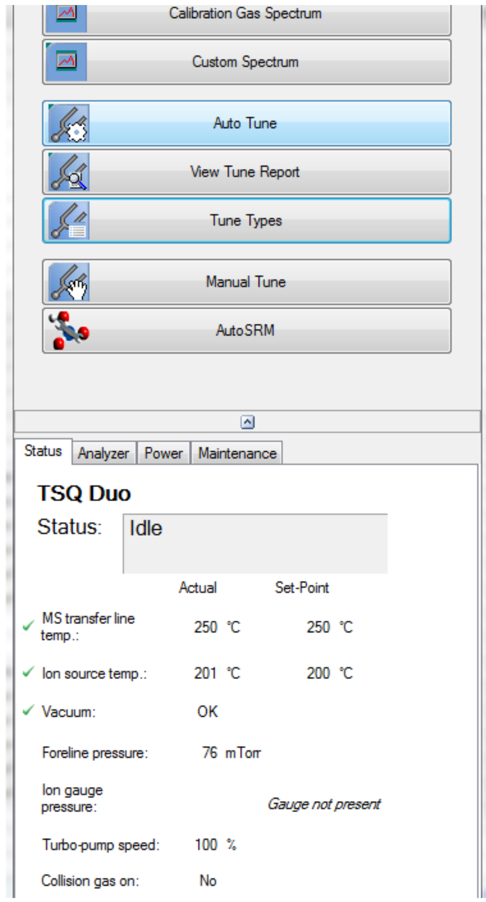
6. Click **Save**.

Running a Diagnostic Tune

To run a diagnostic tune:

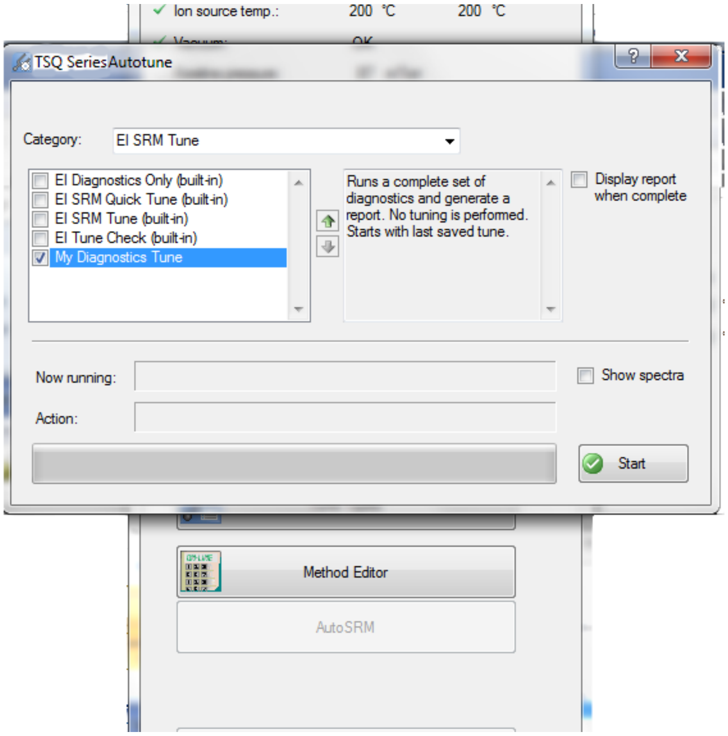
1. Click **Auto Tune** on the TSQ Series Duo Dashboard to run diagnostics.

Figure 54. Running an Automatic Tune

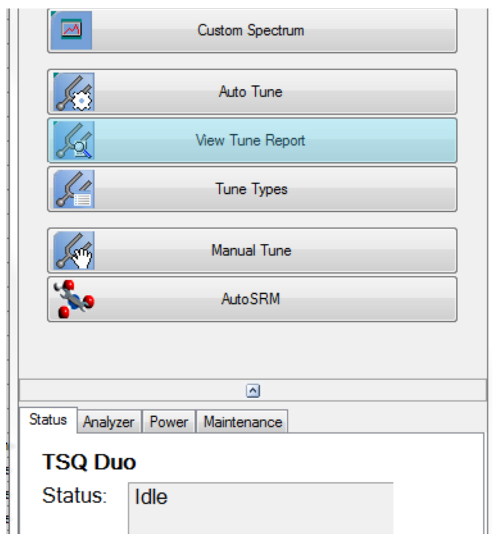


2. Select the diagnostics tune type you created and click **Start**.

Figure 55. Running Diagnostics



3. Click **View Tune Report** on the TSQ Duo Dashboard to view the diagnostic results.



4. Click the **Report Options** button in the upper right corner of the window.

5. Select **Diagnostics** in the Optional Reports area of the window.

Investigating Communication Issues

When you run Communications Check diagnostics on the TSQ Duo system, the Xcalibur of Chromeleon software verifies the instrument is communicating with the computer at the proper speed for fast scanning. Your instrument or software may indicate the following issues.

Note If the possible remedies do not correct the issue please contact Thermo Fisher Scientific technical support. See Contacting Us for contact information.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Software is not communicating with the TSQ Duo system.

Table 1. Possible Remedies for Software Communication Issues

If the TSQ Duo system and PC are not communicating, press the Reset button, which is found on the interior front panel inside the front door. You can also power-off the TSQ Duo system and power it back on again.
Make sure the Ethernet cable is properly connected to the TSQ Duo instrument.
Confirm the TCP/IP configuration on the computer matches the TSQ Duo system's.
Reboot the computer.

Cannot download methods to the TSQ Duo system.

Table 2. Possible Remedy for Inability to Download Methods

Verify that your instruments are properly configured in the *Instrument Configuration* utility.

GC does not start or is not ready.

Table 3. Possible Remedies if the GC will not Start

Open the *Instrument Configuration* utility and verify the GC methods and configuration.
Make sure the Remote Start cable is properly connected to the Generic/HS port on the GC and to the GC Start port on the TSQ Duo system.

Table 3. Possible Remedies if the GC will not Start

Make sure the Remote Start cable is properly connected to the Autosampler signals port on the GC and the GC port on the autosampler controller.
Confirm the GC handshaking parameter is set properly: Go to the Handshaking menu. On a TRACE 1300 GC: • Launch the Chromatography Data System. • In the relevant Configuration page, set the Inhibit Ready parameter. The default setting is *When High*. If your GC will still not become ready, try setting the parameter to <When Low> or <Do Not Inhibit>. On a TRACE 1310 GC touchscreen: • Select the Instrument Configuration icon to access the Configuration menu. • In the Configuration menu, select the Handshake icon to open the relevant submenu. • Set the Inhibit Ready parameter. The default setting is *When High*. If your GC will still not become ready, try setting the parameter to <When Low> or <Do Not Inhibit>. On a TRACE GC Ultra: • Press <CONFIG> to access the Configure menu options. • Press the down arrow key until *Handshaking* displays, then press <ENTER> to access the Config Handshaking menu options. • Press the down arrow key until *Inhibit ready in* displays, then press <ENTER> to access the Inhibit Ready menu options. • Set the Inhibit Ready parameter. The default setting is *When High*. If your GC will still not become ready, try setting the parameter to <When Low> or <Do Not Inhibit>. On a FOCUS GC, use the Keypad button in Xcalibur. • Press the Home button. • Scroll down to the <others> option and press <ENTER>. • Scroll down to <Configuration> and press <ENTER>.

Sample data are not acquired.

Table 4. Possible Remedies when Sample Data is not Acquired

Make sure the autosampler methods and configuration include starting up and injecting a sample. You should also make sure the sample has been injected.
Heated zone setpoint is not attained. See Investigating Temperature Issues for troubleshooting.
Verify that the TSQ Duo system's start mode is set properly.
Make sure the Remote Start cable is properly connected to the GC.
Make sure the End Run Time is set properly in the *TSQ Duo Instrument Setup* file.
Add more disk space to the computer by backing up and removing files.

GC is not communicating with the PC.

Table 5. Possible Remedies to Restore GC and PC Communication

Make sure the GC is powered on.
Open the *Instrument Configuration* utility and make sure the GC is properly configured.
Make sure the cable between the computer and the GC is properly connected.
Verify the TCP/IP port is properly configured on the computer.
Power-off the GC and power it back on again.

Autosampler is not communicating with the PC.

Table 6. Possible Remedies to Restore Autosampler and PC Communication

Make sure the autosampler is powered on.
Open the *Instrument Configuration* utility and make sure the autosampler is properly configured.
Make sure the cable between the PC and autosampler is properly connected.

Investigating Contamination Issues

Some chemical noise is common and difficult to eliminate completely.

Chemical noise is sometimes caused by:

- Septum bleed after a series of injections.
- Vial sample bleed, which occurs if more than one injection is made from a sample vial.
- Siloxane peaks that appear in the chromatogram at regular intervals from focusing at the head of the column or in the injector.

Other possible contamination sources include hydrocarbon contamination of the carrier gas, foreline pump, or cleaning solvents.

To minimize chemical noise, always wear clean, lint- and powder-free gloves when performing maintenance on components that go inside the vacuum chamber and always use clean carrier gas, filters, and liners.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Chemical noise is at *m/z* 429, 355, 281.

Table 7. Possible Remedies for Chemical Noise at *m/z* 429, 355, 281

Condition the column. It is best to condition the column outside of the TSQ Duo mass spectrometer so the contaminants can escape into the air instead of the instrument.
Make sure the column has not been damaged as a result of exposure to oxygen. Find the source of the oxygen in the carrier gas or air leak, and then recondition or replace the column.
Check the column and see if it has broken off in the ion volume. If necessary, remove the broken pieces.

Chemical noise is at *m/z* 207, 429, 355, 281.

Table 8. Possible Remedies for Chemical Noise at *m/z* 207, 429, 355, 281

If the baseline contains these masses, the septum is worn out or damaged and you should replace it. You should also check the injection port liner for pieces of septa and replace the liner if necessary.
If chromatographic peaks contain these masses, check the vial septa or use solvent to wash the vials.

Chemical noise is at *m/z* 149, 167, 279.

Table 9. Possible Remedies for Chemical Noise at *m/z* 149, 167, 279

If these masses are visible in your data, it is likely that phthalates have contaminated your system. Isolate the source of the phthalates, such as vial lids or plastic solvent containers, and either clean them or replace them.

Chemical noise is at *m/z* 43, 57, 71, 85, 99, etc.

Table 10. Possible Remedies for Chemical Noise at *m/z* 43, 57, 71, 85, 99, etc.

If these masses are visible in your data, it is likely that your carrier gas tubing is contaminated. Isolate the source of hydrocarbon contamination and remove it. Replace the carrier gas tubing or filters, if necessary.
Heat the ion source to at least 25 °C above your normal operating temperature and heat the transfer line to the maximum temperature allowed by your column. Hold this temperature for 4-6 hours, then cool the system back to your normal temperature. If necessary, repeat this process.

Spectra is showing solvent contamination.

Table 11. Possible Remedies for Solvent Contamination

You may have components that are contaminated by cleaning solvents. Remove any recently cleaned component, bake it in the GC oven, let them cool, and then blow them dry with a clean, oil-free gas stream.

Table 11. Possible Remedies for Solvent Contamination

You may have a leak that is allowing solvent vapors to get into the TSQ Duo instrument. Use a spray gas, such as Tetrafluoroethane, to check for leaks and then fix them. See Investigating Vacuum Issues for details.
Optimize the GC method to separate the solvent peak from the area of interest in the chromatogram. The following compounds may have been introduced during sample injection, a cleaning or autosampler rinsing solvent. The following commonly used solvents have ions at the listed *m/z*: • Acetone (*m/z* 43, 58, 59) • Hexane (*m/z* 41, 43, 56, 57, 58, 85, 86) • Methylene chloride (*m/z* 84/83) • Toluene (*m/z* 91, 92) • Trichloroethane (*m/z* 151, 153) • Xylene (*m/z* 105, 106)

Investigating Filament and Lens Control Issues

Filament Check diagnostics can test the filament and lenses of the TSQ Duo mass spectrometer. Handle the lenses with care. Damaged lenses may cause short circuits, which may damage the lens drivers.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Filament has burned out.

Table 12. Possible Remedies when Filament is Burned Out

Run a Filament Check diagnostic to narrow down the source of the problem. Then replace the filament, as described in Replacing a Dual Filament.
Make sure the filament wires are still connected to the source interface board. See Replacing a Dual Filament for details.
Make sure the lens driver board is connected to its bracket. See Lens Driver Board for details.

Filament does not last long.

Table 13. Possible Remedies to Prolong Filament Life

Run a Leak Check diagnostic to check the system for air leaks and then address them. Use the Tetrafluoethane gas to find the leak.
Reduce the emission current in the software.
Increase the time for your first scan until after the solvent peak has passed.

Diagnostics indicate there is a problem with lens voltages.

Table 14. Possible Remedies for Problems with Lens Voltages

Make sure the lens driver board is attached to the bracket. If the board isn't fully connected to the 20-pin feedthrough, you may get odd results. See Lens Driver Board for details.
Make sure the lenses are properly aligned in the ion cartridge sleeve.
Ensure that lens wires are not resting on metal surfaces.
Check the source interface board to make sure the filament wires are fully connected. See Source Interface Board and Heat Shield for details.

Investigating Temperature Issues

The ion source and transfer line are heated zones in the TSQ Duo instrument. The lens/source heater is controlled by the TSQ Duo mass spectrometer and the transfer line heater is controlled by the GC.

Often, a temperature issue is the result of downloading a method to the TSQ Duo system that has a different setpoint from the current setting, which causes a delay while the heated zone adjusts the temperature. Component failures are rare, but are usually caused by open circuits in the heater cartridges or damaged temperature sensors.

When you run Temperature Check diagnostics on the TSQ Duo system, the Xcalibur or Chromeleon software checks the temperature readbacks from the heaters and internal temperature devices. Your instrument or software may indicate the following types of issues.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Lens/source heater does not heat.

Table 15. Possible Remedies when Lens/source Heater does not Heat

Make sure the TSQ Duo system and computer are properly connected.
Check the vacuum status as the heaters will not turn on until vacuum status reads *OK*.
Run Power Supply Check diagnostics to make sure the +24 V supply is working. If necessary, replace the power supply. See Replacing the Power Supplies for details.
Check the resistance on the 20-pin feedthrough.
Remove the analyzer tray and measure the electrical resistance of the lens heater and the source heater. See Source Heater Block, Lens Heater Block, and Lens/Source Heater for details. The resistance should be approximately 24 ohms. You could also measure the resistance of the temperature sensors, which should be resistant at 50-300 ohms.

Lens/source heater overheats.

Table 16. Possible Remedies when Lens/source Heater Overheats

Make sure the wire insulation is not frayed, the wire is connected to the source interface board, and the wire is not in contact with any metal surface along its length.
Remove the analyzer tray and measure the electrical resistance of the lens heater and the source heater. The resistance should be approximately 24 ohms. You could also measure the resistance of the temperature sensors, which should be resistant at 50-300 ohms. Make sure the leads to the heaters and sensors are not electrically shorted to the tray.

Transfer line does not heat.

Table 17. Possible Remedies when Transfer Line does not Heat

Check the vacuum status.
Remove the right side panel and disconnect the 4-pin connector to the transfer line. Then make sure the resistance of the heater circuit is approximately 6 ohms and the resistance of the heater sensor is 50 to 300 ohms. If necessary, replace the transfer line.

Transfer line overheats.

Table 18. Possible Remedies when Transfer Line Overheats

Make sure the wire insulation is not frayed, the wire is connected to the source interface board, and the wire is not in contact with any metal surface along its length.
Remove the right side panel and disconnect the 4-pin connector to the transfer line. Then make sure the resistance of the heater circuit is approximately 6 ohms and the resistance of the heater sensor is 50 to 300 ohms. If necessary, replace the transfer line. See Source Heater Block, Lens Heater Block, and Lens/Source Heater for details. Make sure the leads to the heaters and sensors are not electrically shorted to the tray.

Investigating Vacuum Issues

When you run Vacuum System Check diagnostics on the TSQ Duo mass spectrometer, the Xcalibur or Chromeleon software checks the vacuum system. Vacuum issues may also be found when you run Leak Check diagnostics. Your instrument or software may indicate the following types of issues.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

An air leak is detected.

Table 19. Possible Remedies for Air Leak

Spray gas around the vacuum manifold and look for characteristic ions in full-scan EI mode. Correct any problems. Some of the most common ways to address leaks are: • Tighten the transfer line nut or union. • Tighten the vent valve knob. • Make sure there is clean helium flow from the GC. • Check the transfer line or inlet ferrules. Replace them if they are broken. See Transfer Line for details. • Clean dust or debris from the top cover O-ring. If you do not find a leak, turn on the TSQ Duo system in full-scan mode. Click **Custom Spectrum** on the TSQ Duo Dashboard. Set the Scan Type to Full Scan and Start/End mass to cover the characteristic ions for the compressed gas you are using. Most compressed gases have ions between m/z 35 and 100. While you are reviewing the ions, spray the gas around the components in the bulleted list above. When you see the characteristic ions in the real-time viewer, the component you just sprayed has a leak and needs to be addressed.

Foreline pump does not power on.

Table 20. Possible Remedies when Foreline Pump does not Power On

If the Vacuum light on the front of the instrument is flashing amber quickly, the system took too long to reach vacuum and shut off. You must restart the TSQ Duo system to enable the foreline pump to power-on.
Make sure the foreline pump switch is in the On position.
Make sure the cable from the foreline pump to the TSQ Duo instrument is properly attached to the SYSTEM MECH PUMP connector near the back of the instrument.
Configure the foreline pump for the proper line voltage.
Make sure the TSQ Duo instrument is properly connected to an electrical outlet and is powered on.

Foreline pump powers on, but the system does not pump down.

Table 21. Possible Remedies when Foreline Pump does Power-ons but System does not Pump Down

Tighten the vent valve knob.
Check the vacuum connection of the last component you performed maintenance on and make sure it is sealed properly.
Tighten the clamps and connectors on the foreline hose. Replace the foreline hose if it is damaged.
Check the level of the foreline pump oil and, if necessary, add more oil. See Adding Oil to the Foreline Pump for details.

Turbomolecular pump does not power on.

Table 22. Possible Remedy when Turbomolecular Pump does not Power On

Check the foreline pump and plumbing for leaks to ensure the fore pressure is low enough for use. You can check the foreline pressure readback on the dashboard to confirm the foreline pressure falls to less than 200 mTorr.

Turbomolecular pump shuts off while in use.

Table 23. Possible Remedies when Turbomolecular Pump Shuts Off While in Use

Run Leak Check diagnostics to look for leaks and address them. Excessive gas flow may cause the pump to overheat.
Ensure the temperature of the lab environment is 15-35 °C.

Investigating Power Supply Issues

When you run Power Supply Check diagnostics on the TSQ Duo mass spectrometer, the Xcalibur or Chromeleon software verifies that all power supply voltages are within the acceptable ranges. Your instrument or software may indicate the following types of issues.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

TSQ Duo system does not power on.

Table 24. Possible Remedies when TSQ Duo System does not Power On

Make sure the TSQ Duo instrument's power cable is properly connected to the instrument and electrical outlet.
Verify that the electrical outlet is functioning properly.
Replace the TSQ Duo instrument's power supply system. See Replacing the Power Supplies for details.

TSQ Duo system powers on temporarily and trips the circuit breaker.

Table 25. Possible Remedies when TSQ Duo System Powers On Temporarily and Trips the Circuit Breaker

Make sure the instrument's power cable is not damaged.
Check the foreline pump voltage setting and replace the pump, if necessary.
Replace the TSQ Duo instrument's power supply system. See Replacing the Power Supplies for details.

±RF DC supply is outside the acceptable range.

Table 26. Possible Remedy when the ±RF DC Supply is Outside the Acceptable Range

Make sure the Rod Driver board is properly connected and use Xcalibur Power Status to ensure the readback reports +48 V DC is present.

Investigating RF/DC Issues

When you run RF/DC System Check diagnostics on the TSQ Duo system, the Xcalibur or Chromeleon software checks the RF/DC system of the instrument. Your instrument or software may indicate the following types of issues.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

RF dip is incorrect.

Table 27. Possible Remedy if the RF Dip is Incorrect

Make sure the RF board is properly connected and use *Xcalibur* Power Status to ensure the readback reports +48 V DC is present. If +48 V DC is not present, contact Technical Support.

RF/DC System Check diagnostic fails.

Table 28. Possible Remedy if RF/DC System Check Diagnostic Fails

Use TSQ Duo Tune to tune the RF system. If the RF system will not tune, contact Technical Support.
Make sure the rod driver board is properly installed and undamaged. Replace it, if necessary. See Front and Rear RF Boards and Front and Rear Rod Driver Boards for details.

Investigating Sensitivity Issues

When you run Detector Check diagnostics on the TSQ Duo system, the Xcalibur software checks for noise on the electrometer, multiplier, dynode and RF board. Sensitivity issues are usually the result of an air leak, dirty components, or contamination. Sometimes sensitivity issues can be caused by simple to fix problems such as the carrier gas tank running out or a sample not being injected into the GC. Before troubleshooting for sensitivity issues, look for the simple problems. If the problem is more complex, then check for air leaks or dirty components. You can prevent these types of problems by properly cleaning and maintaining your GC/MS system. It is normal to see a decrease in sensitivity in the first few injections on a clean system.

Before troubleshooting for sensitivity issues, look for simple solutions, such as fixing a clogged autosampler syringe or raising the level of your sample. You can always prevent sensitivity issues from occurring by keeping your GC/MS system clean and free of contamination.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Poor sensitivity or sudden loss in sensitivity.

Table 29. Possible Remedies for Poor Sensitivity or Sudden Loss is Sensitivity

Tune the system.
Check the system for air leaks and address them.
Make sure the ion volume is properly positioned. See Reinserting the Ion Source Cartridge for details. If you recently performed maintenance on your ion source, remove the ion source, verify that it is assembled correctly, and reinsert it into the TSQ Duo.
Make sure the GC column does not extend into the ion source. Use the column measuring tool to ensure the column is the correct length.
Make sure the GC column did not break inside the ion source. If necessary, remove the pieces from the ion source.
Clean or replace the GC injection port liner to remove possible contamination, trim the injector end of the column, or replace the septum.
Make sure the source magnets are positioned so that their south poles are facing up. Reposition them, if necessary.
Clean the ion source and lenses. See Cleaning Durable Components for details.
Check the electron multiplier gain and make sure it is not too low. Retune the detector gain. Replace the electron multiplier, if necessary. See Replacing the Electron Multiplier for details.

Poor high mass response.

Table 30. Possible Remedies for Poor High Mass Response

Run a resolution tune to make sure the resolution is set correctly.
Clean the ion volume and lenses. See Cleaning Durable Components for details.
Reduce the ion source temperature to reduce the amount of thermal decomposition and fragmentation of your analyte.
Check the system for air leaks and address them. See Investigating Vacuum Issues for details.

Investigating Stability Issues

Stability issues occur when the instrument is not consistently precise and when accurate results are not reproducible. In addition, sample preparation, spiking errors, sample injection errors, and lack of routine maintenance on the instrument may cause false stability symptoms.

Before troubleshooting for stability issues, try simple solutions first, such as cleaning the ion volume and lenses or running a leak check diagnostic. Usually, a hardware fault that affects stability will show different symptoms than those attributed to stability.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Mass assignment is unstable.

Table 31. Possible Remedies for Unstable Mass Assignment

Wait at least 30 minutes after the system has reached vacuum before running a mass calibration. If the system was recently pumped down, the internal components may not be at temperature yet.
Wait at least four hours after the system reaches temperature before running a mass calibration. If you started with a cold system, it can it can take 30 minutes after the system has achieved vacuum for it to reach temperature.

Signal response is unstable or shows unexpected drop-out.

Table 32. Possible Remedies if Signal Response is Unstable or Shows Unexpected Drop-out

There is a problem with the filament or lens control. See Investigating Filament and Lens Control Issues for details.
Check the system for leaks and address them. See Investigating Vacuum Issues for details.
There is a contamination problem. See Investigating Contamination Issues for details.
There is a problem with the electrical connection to the ion source cartridge. This most often occurs when swapping the ion source cartridge, such as from EI to CI, or after cleaning the ion source cartridge. See Reinserting the Ion Source Cartridge for details.

Investigating Tuning Issues

In most cases, you will be alerted of a tuning issue when your automatic tune fails. In fact, your tune report may even indicate what is causing the issue.

WARNING - ELECTRICAL SHOCK HAZARD: When troubleshooting any issue that requires removing a cover on the TSQ Duo mass spectrometer, you should power-off and vent the instrument to avoid harming yourself.

Tune is interrupted.

Table 33. Possible Remedy if Tune is Interrupted

Make sure the computer is not set to go into Standby mode while you are acquiring data for your tune. Otherwise, it may interrupt your tune.

Cannot find calibration gas peaks.

Table 34. Possible Remedies if Calibration Gas Peaks cannot be Found

Run an initial tune.
Check the calibrant reservoir and add 50 µL (max) of FC 43, if necessary. See Maintaining the Calibration Gas Module for details.
Make sure the ion volume and lenses are properly installed and clean.
Make sure the stainless steel tubing inside the manifold is connected to the mixing chamber.

Cannot perform detector gain calibration.

Table 35. Possible Remedies if cannot Perform Detector Gain Calibration

Make sure you have an ion signal. The gain tune uses ions, so the system must have a signal to start.
Replace the electron multiplier if the voltage required to generate 3×10^5 gain on your electron multiplier is >2200 V. See Replacing Components of the Electron Multiplier for details.
Replace the electrometer board. See Electrometer Board and Shield for details.

Cannot calibrate resolution.

Table 36. Possible Remedies if Resolution cannot be Calibrated

Allow contaminants to pump away so they do not interfere with *m/z* 100 or *m/z* 502.
Run a full automatic tune if calibration gas ions (*m/z* 69, 131, 264) are present, but more than ±12.5% or ±20 u off (whichever is smaller).

Cannot perform mass calibration.

Table 37. Possible Remedies if Mass Calibrations is not Performed

Allow contaminants to pump away so they do not interfere with calibration gas ions.
Calibrate by running an automatic tune.

An air leak has been detected.

Table 38. Possible Remedy for Air Leaks

Check the system for air leaks and address them.

TSQ Duo Tune reports an error while saving a Tune file.

Table 39. Possible Remedy if Errors are Reported While Saving a Tune File

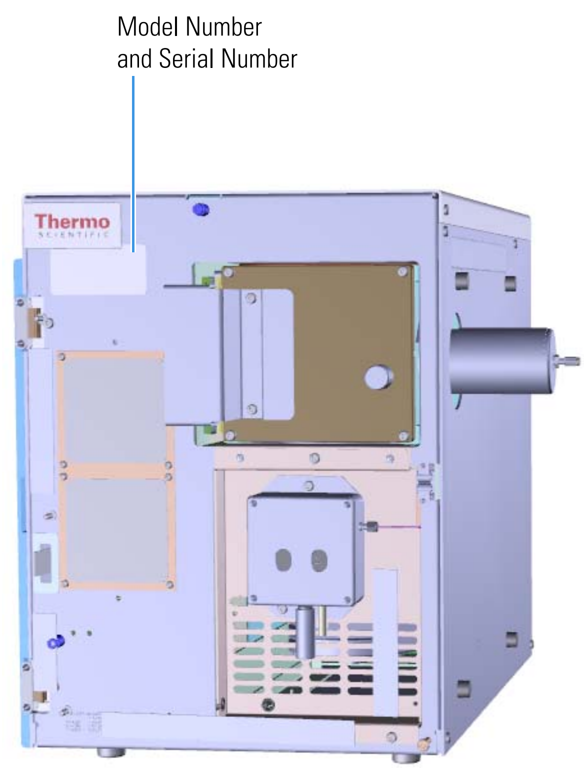
Check that there is sufficient space on the hard drive to save a new Tune file. If there is not enough space to save a new Tune file, copy old Tune files to another location and delete them from the hard drive.

Contacting Technical Support

If the information in this section does not help solve your problem, you can contact Technical Support. Be sure to reference the model number and serial number of your instrument when contacting them.

Every TSQ Duo system ships with a label inside the front door that lists the model number and serial number.

Figure 56. Identifying Your TSQ Duo Instrument



See “Contacting Us” on page xxv for information about contacting Thermo Fisher Scientific Technical Support personnel.

3

Advanced Troubleshooting

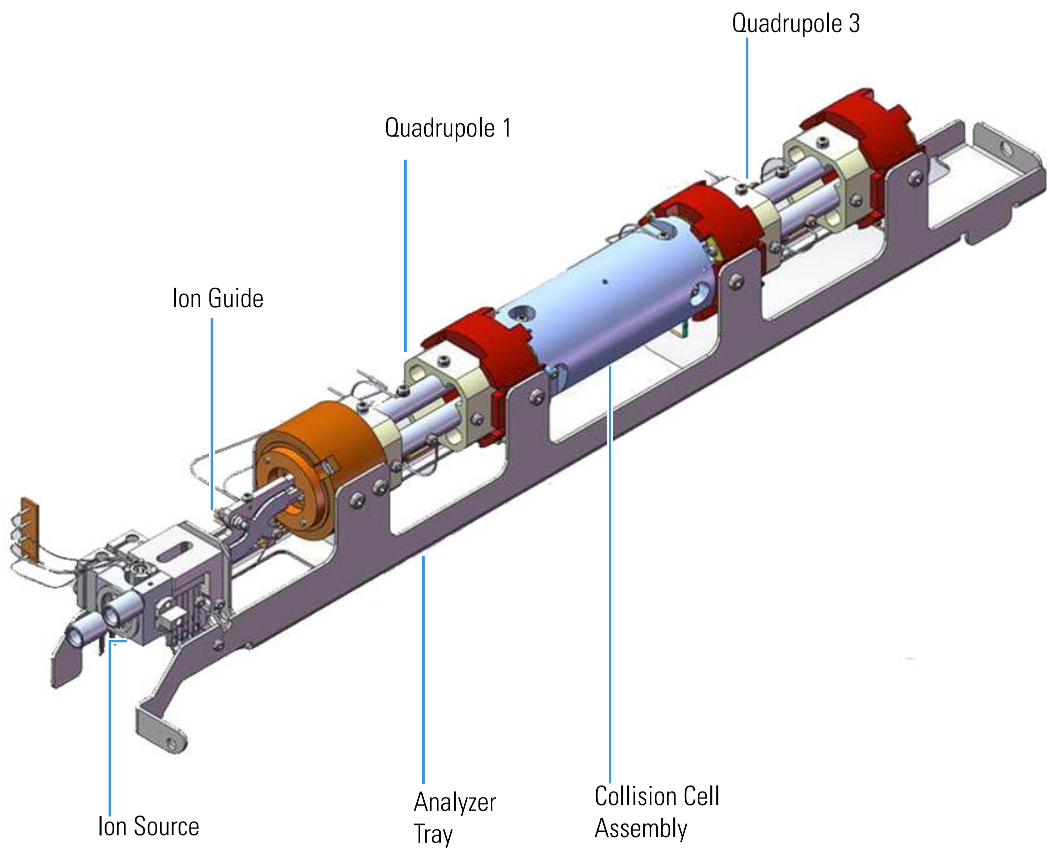
This chapter describes the TSQ Duo system's components that do not require routine maintenance, but troubleshooting may indicate they need to be replaced.

Contents

Replacing Components of the Analyzer

All of the components of the analyzer are on a removable tray. The main components are the ion source, ion guide, the Q1 quad assembly, the Q3 quad assembly, and the collision cell assembly.

Figure 57. Replaceable Components of the Analyzer Tray



Analyzer Tray

This section discusses how to remove and replace the analyzer tray. This part is unlikely to fail, but you must follow these steps any time you remove the analyzer tray from the TSQ Duo system to service or replace other components.

WARNING - INSTRUMENT DAMAGE Thermo Fisher Scientific strongly recommends that only trained Thermo Fisher Scientific Field Service Engineers remove the analyzer tray and service its components.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

Shutting Down the TSQ Duo System

❖ To shut down the TSQ Duo system

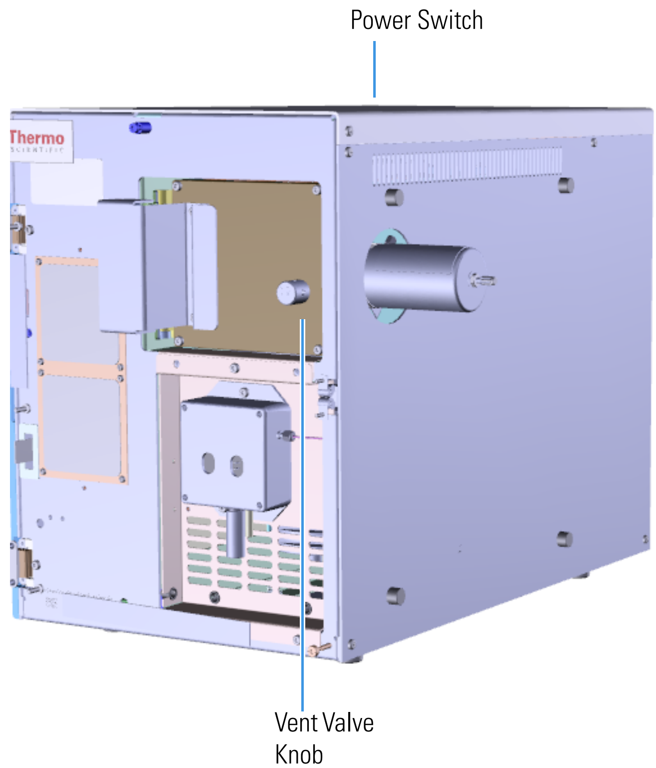
1. Remove the ion source cartridge according to "Ion Source Cartridge" on page 155.
2. Cool down the GC oven.
3. If you are using hydrogen, cool down the injector to prepare the GC for powering off. See the GC documentation for information. After the heated zones are cooled down, power-off the GC if you are using hydrogen.

WARNING BURN HAZARD: The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

WARNING - FIRE HAZARD: If you are using hydrogen as a carrier gas, you must cool down and shut off the GC to prevent the buildup of hydrogen in the vacuum manifold. See the "Hydrogen Safety Precautions" on page xvii of the Preface for more information.

4. Shut down the TSQ Duo system using the software. See the *TSQ Duo User Guide* for more information.
5. Click the **Yes** button to continue the shutdown process. The heaters and the turbomolecular pump power off. Then the foreline pump powers off.
6. Reach around the left side of the instrument and push down on the power switch to power-off the instrument.
7. If you are using hydrogen, unscrew the hydrogen safety screw on the front door.

Figure 58. Powering Off the TSQ Duo System



8. Open the front door of the instrument.
9. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent.
10. Wait five minutes for the TSQ Duo instrument to vent.

CAUTION - INSTRUMENT DAMAGE Do not proceed until the instrument is vented or pieces of the column or ferrule might blow into the instrument. To ensure that the instrument is vented, check how much the glass cover compresses the top cover o-ring in the manifold. Once the o-ring surface touching the glass is about 1 mm, it is safe to open the instrument and remove the column.

11. Open the front door of the GC and loosen the transfer line nut. Then pull the column back (into the oven) about 5 cm to ensure the column is no longer in the ion source.
12. Use a T20 Torxhead screwdriver to loosen the top cover panel.
13. If you are using hydrogen, remove the remaining hydrogen safety screws.

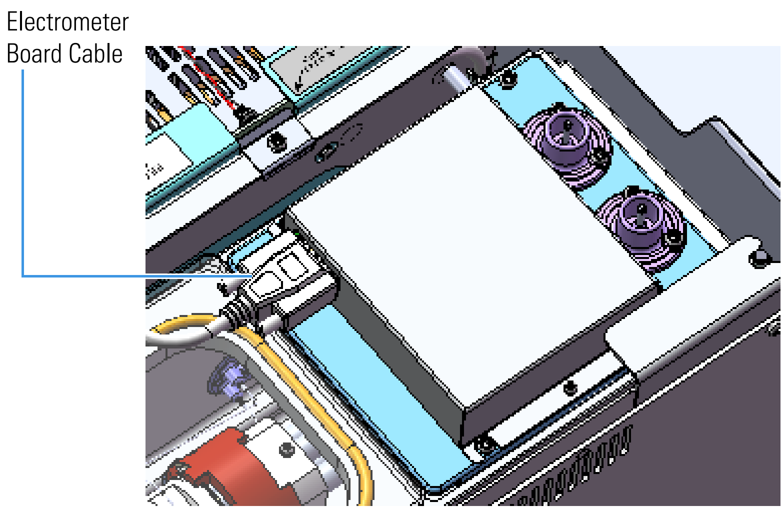
Note You might have to move the GC to access the right hydrogen safety screw.

Removing the Analyzer Tray from the TSQ Duo Instrument

❖ To remove the analyzer tray from the TSQ Duo instrument

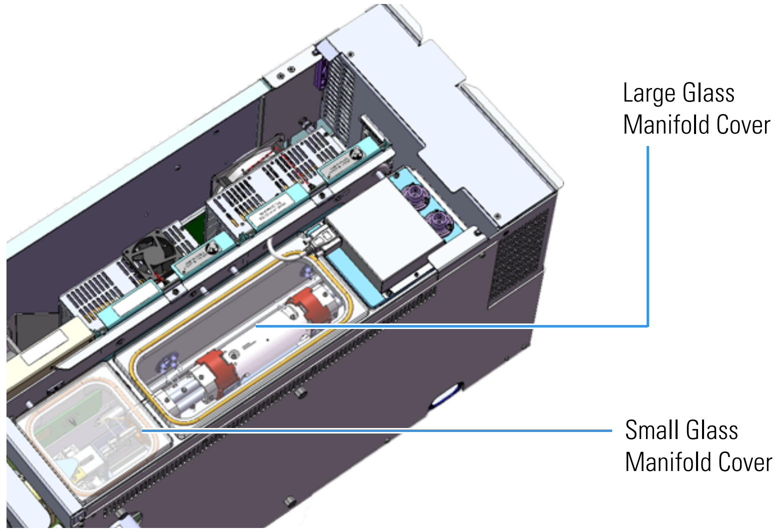
1. Slide the top cover panel toward the back of the instrument and lift it off.
2. Disconnect the electrometer board cable

   Figure 59. Disconnecting the Electrometer Board Cable

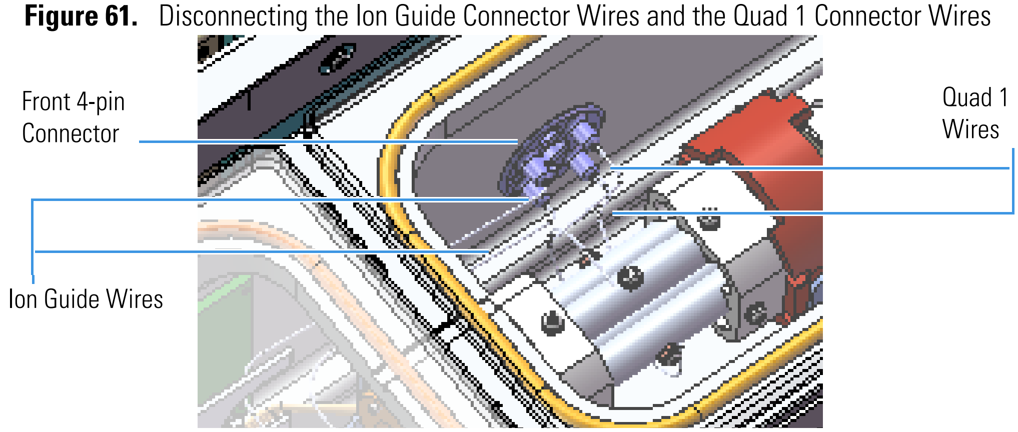
3. Remove the small and large glass manifold cover.
4. Set the glass covers on a surface where they will not be scratched or contaminated. Protect the glass and any other manifold components from dust accumulation. Wear cleanroom gloves when touching the glass. See the *TSQ Duo Spare Parts Guide* for information about ordering cleanroom gloves.

Figure 60. Removing the Small and Large Glass Manifold Covers



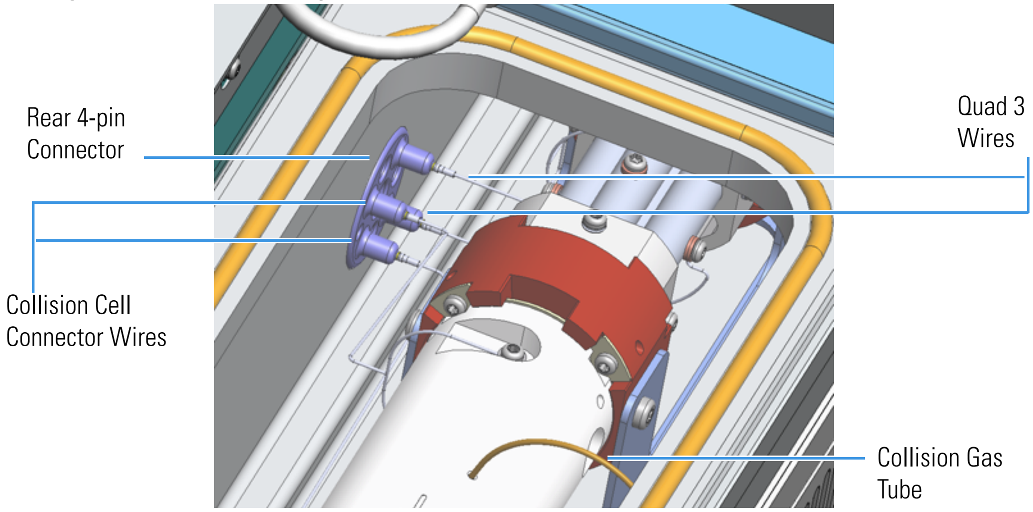
5. Disconnect the four wires that go to the ion guide and quadrupole 1. These wires are attached to the front 4-pin feedthrough in the vacuum manifold.

Figure 61. Disconnecting the Ion Guide Connector Wires and the Quad 1 Connector Wires



6. Disconnect the four wires that go to the collision cell and quadrupole 3. These wires are attached to the rear 4-pin feedthrough in the vacuum manifold.

Figure 62. Disconnecting the Quad 3 Connector Wires and the Collision Cell Connector Wires



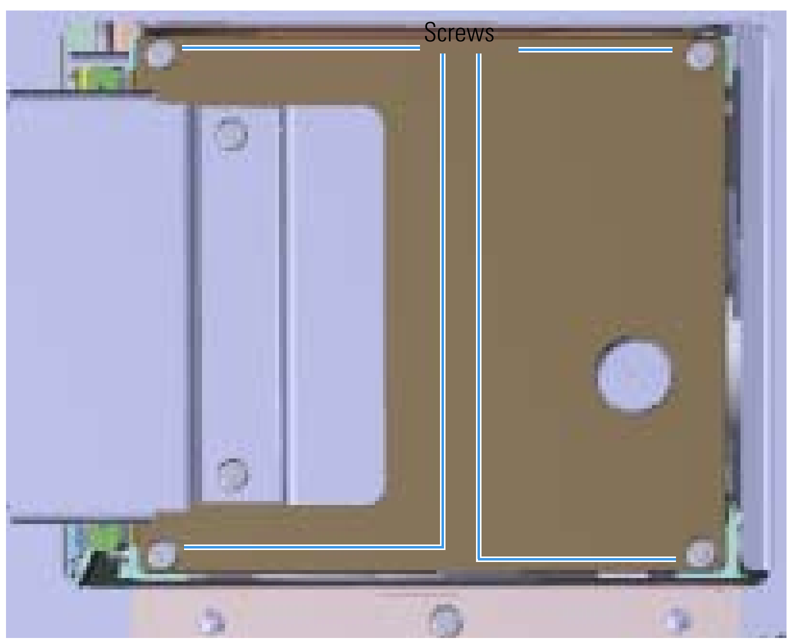
7. Remove the collision gas tube from the collision cell.

Note Pull straight back from the collision cell to prevent damage to the collision gas tube.

8. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

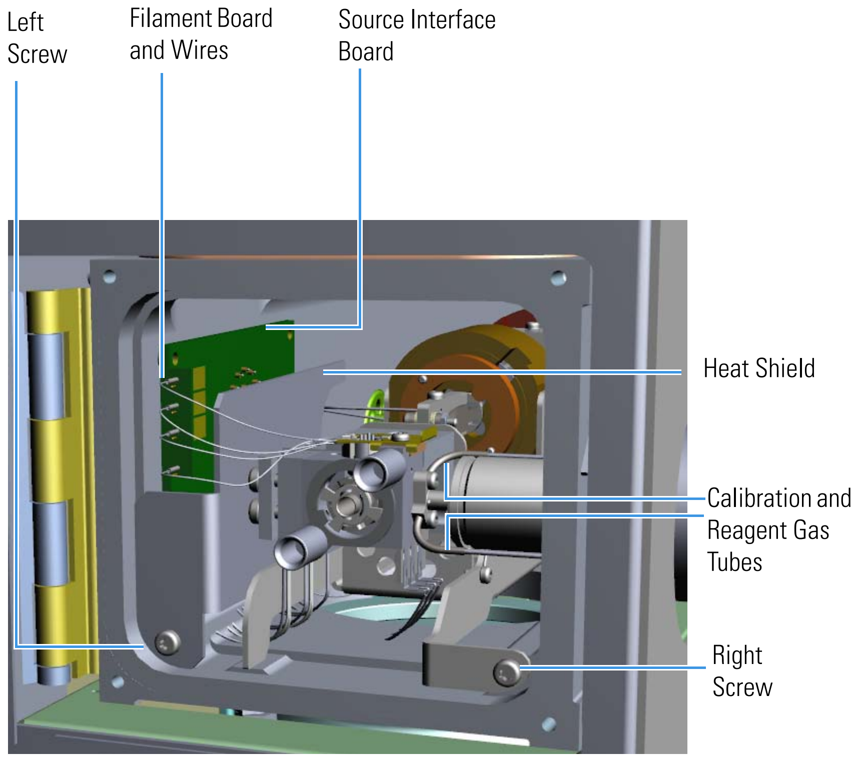
Note Remove the screws completely so that they do not scratch the manifold when you close the door.

Figure 63. Opening the Manifold Door



9. Open the manifold door and slide the filament board and wires off the pins on the source interface board

Figure 64. Disconnecting the Analyzer Tray from the Instrument



> **Note** Keep all manifold parts you remove covered on a clean work surface so they will not accumulate dust.

10. Disconnect the filament board and wires from the source interface board.

11. Remove the bottom left screw holding the metal heat shield to the manifold.

12. Remove the heat shield and wedge it between the source interface board and the wall of the manifold to disconnect the board from the 20-pin feedthrough.

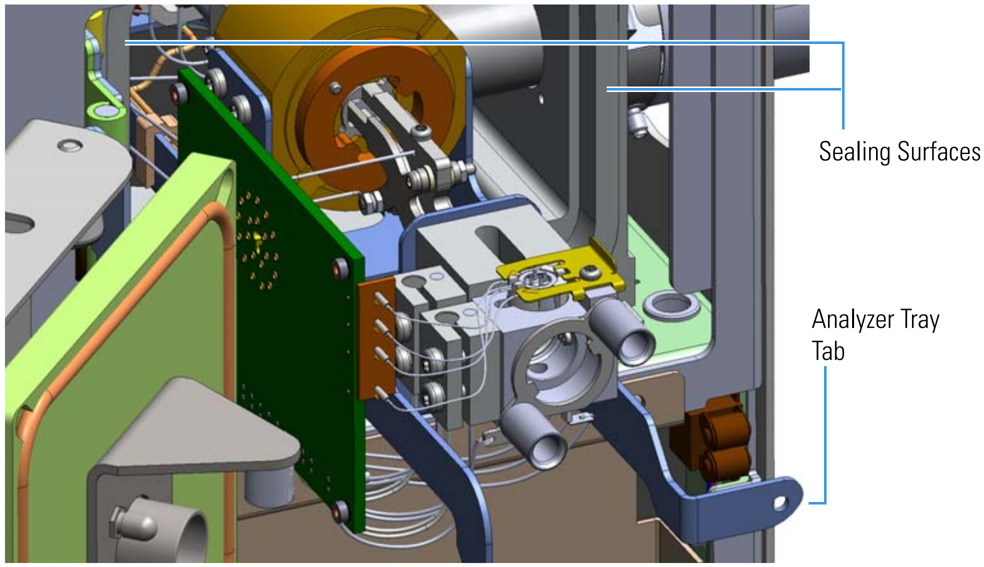
13. Remove the bottom right screw holding the tray to the manifold.

14. Detach the reagent gas and calibration gas tubes from the gas mixing chamber and remove from the manifold.

15. Move the large tab on the analyzer tray to the left, moving the ion source away from the transfer line, and then carefully pull the tray toward you through the manifold door.

> **CAUTION - INSTRUMENT DAMAGE** Do not scratch any of the sealing surfaces. Be especially careful when the source interface board reaches the o-ring surface.

Figure 65. Sliding the Analyzer Tray Out of the Instrument



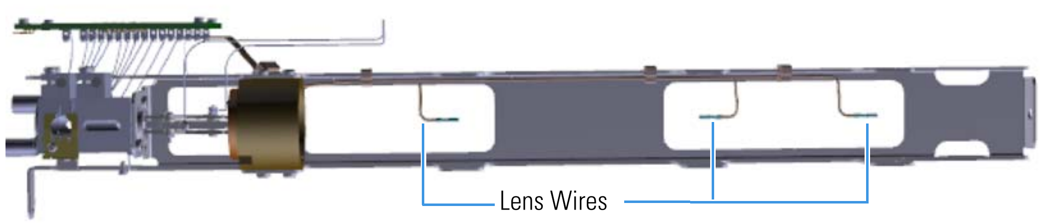
16. Set the tray on a clean work surface.

Removing the Analyzer Tray Components

❖ **To remove the analyzer tray components from the tray**

1. Turn the analyzer tray to access the bottom and disconnect the three lens wires attached to the lenses between the quadrupoles.

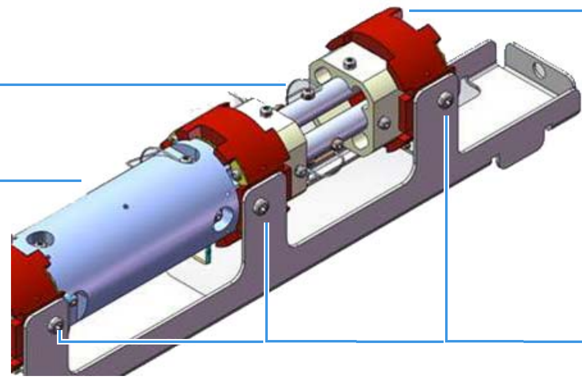
   Figure 66. Finding the Lens Wires between the Quadrupoles



CAUTION INSTRUMENT DAMAGE Quadrupole surface quality is critical for instrument performance. Take extreme care in handling the quadrupole components.

2. Remove the screws on the Q3 exit endcap holding it to the tray.
3. Remove the Q3 quad assembly and Q3 exit lens assembly from the tray.
4. Detach the Q3 exit lens assembly from the Q3 quad assembly.
5. Set the Q3 quad assembly and Q3 exit lens assembly on a clean work surface.

Figure 67. Removing the Q3 Quad Assembly from the Analyzer Tray



6. Remove the three screws holding the collision cell to the tray.
7. Remove the screw connecting the tray to the collision cell grounding wire. See Figure 68.
8. Remove the collision cell assembly and Q1 quad assembly from the analyzer tray.
9. Set the collision cell assembly on a clean work surface. Disconnect the Q1 entrance lens wire from the source interface board.

Figure 68. Removing the Collision Cell and Q1 Quad Assembly from the Analyzer Tray

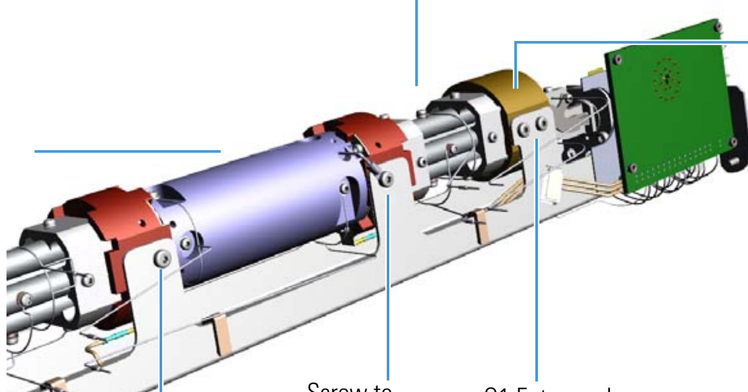
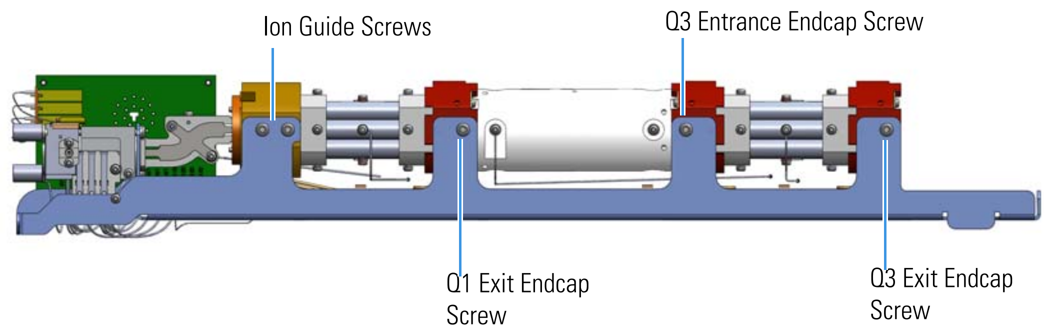


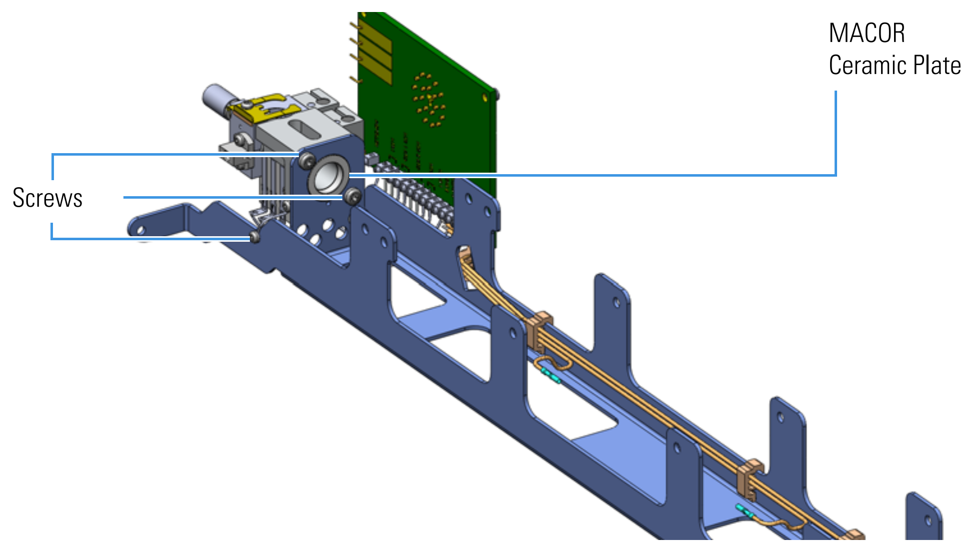
Figure 69. Removing the Analyzer Tray Screws



10. Remove the Q1 entrance lens wire from the source interface board.
11. Remove the ion guide assembly screws.
12. Remove the ion guide assembly.
13. Use a T10 Torxhead screwdriver to remove the lens heater block grounding strap from the analyzer tray.
14. Remove the Q1 exit, Q3 entrance, and Q1 exit lens wires from the analyzer tray. See Figure 66.
15. Use a T20 Torxhead screwdriver to remove the two screws attaching the source block to the analyzer tray.

IMPORTANT Be careful not to drop the MACOR ceramic plate. See Figure 70. It is fragile.

Figure 70. Removing the Ion Source from the Analyzer Tray



16. Remove the source block from the analyzer tray and set it aside.

17. Replace the analyzer tray with a new one if needed.

Reattaching the Analyzer Tray Components

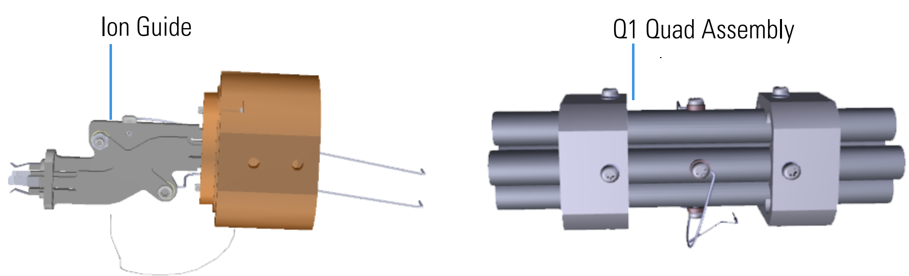
❖ To reattach the analyzer tray components to the tray

1. Reattach the source and lens heater block to the analyzer tray with the two screws.
2. Reattach the screw holding the lens heater block grounding strap to the analyzer tray.
3. Make sure the ion guide is aligned parallel to the flat on the endcap.
4. Tighten the T10 screws inside the endcap.

Note Make sure the Q1 entrance lens sits flush and centered in the Q1 entrance lens endcap.

5. Slide the ion guide and endcap back into the analyzer tray.

Figure 71. Rejoining the Ion Guide to the Quadrupole

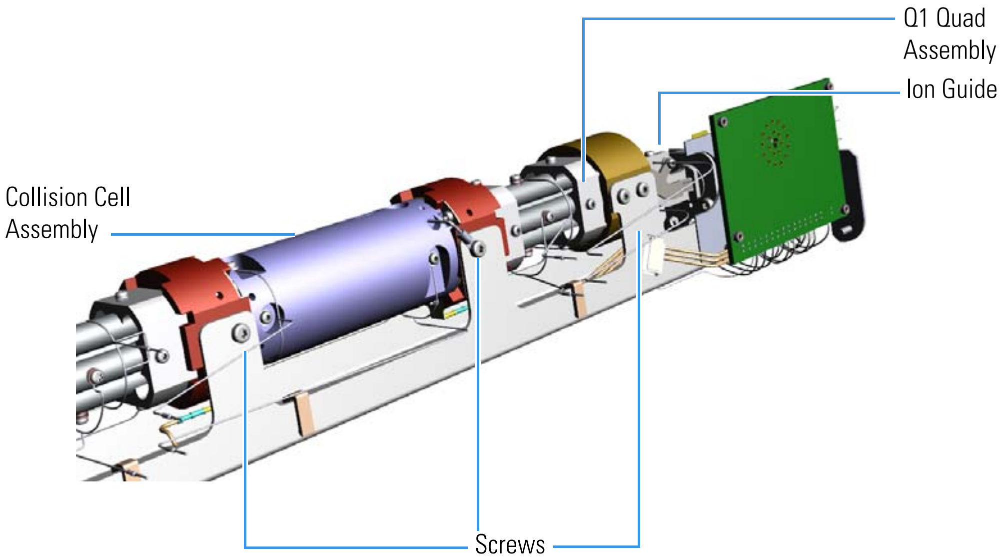


6. Reattach the four screws but do not tighten.
7. Position the Q1 entrance lens endcap as close to level as possible.
8. Insert the quad and ion guide into the Q1 entrance lens endcap.
9. Insert the Q1 quad assembly and the collision cell assembly onto the analyzer tray.
10. Tighten the scares on the entrance lens endcap

CAUTION - INSTRUMENT DAMAGE Do not overtighten the endcap screws. If torque exceeds 1.5 N•m, thread damage will occur.

IMPORTANT For optimal performance, the quadrupole ceramics must fit straight and securely in the endcap and be aligned so that the collision cell is level with the tray. Slightly tighten each screw several times going from one to another until all are securely tightened.

Figure 72. Reattaching Quadrupole 1, the Ion Guide, and the Collision Cell Assembly to the Analyzer Tray



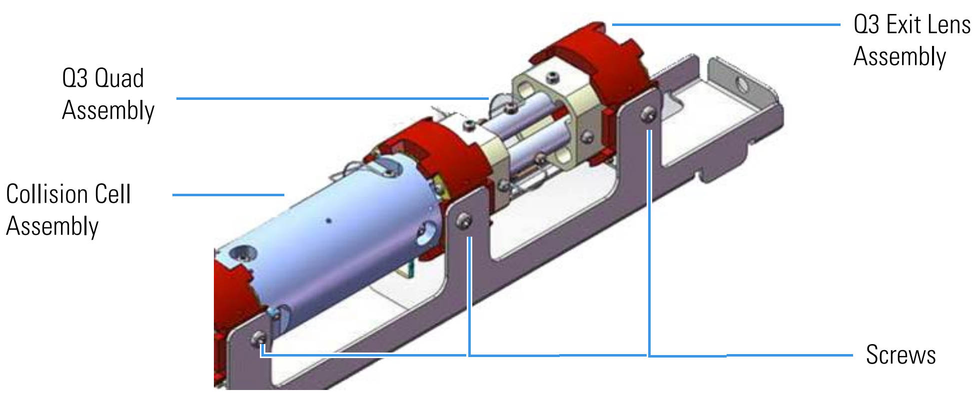
Tip You will get better signal if you gently push the quadrupole rod endcaps toward one another while tightening the screws.

11. Reattach the Q3 exit lens assembly and the Q3 quad assembly to the analyzer tray. Ensure that quadrupole 3 and the collision cell assembly are correctly positioned before tightening screws.

12. Reattach the two screws on each side of the quadrupole rod endcaps.

Tip The endcaps have cutouts that you should use to check to be sure the ceramics are aligned properly before attaching the two screws.

Figure 73. Replacing the Collision Cell and Quadrupole 3 in the Analyzer Tray



> **IMPORTANT** Be sure that the ceramics are aligned correctly before fastening the endcap to the analyzer tray.

13. Reconnect the three lens wires attached to the lenses between the quadrupoles.
14. Reconnect the Q1 entrance and Q1 exit lens assemblies.
15. Reconnect the Q1 entrance lens wire to the source interface board.

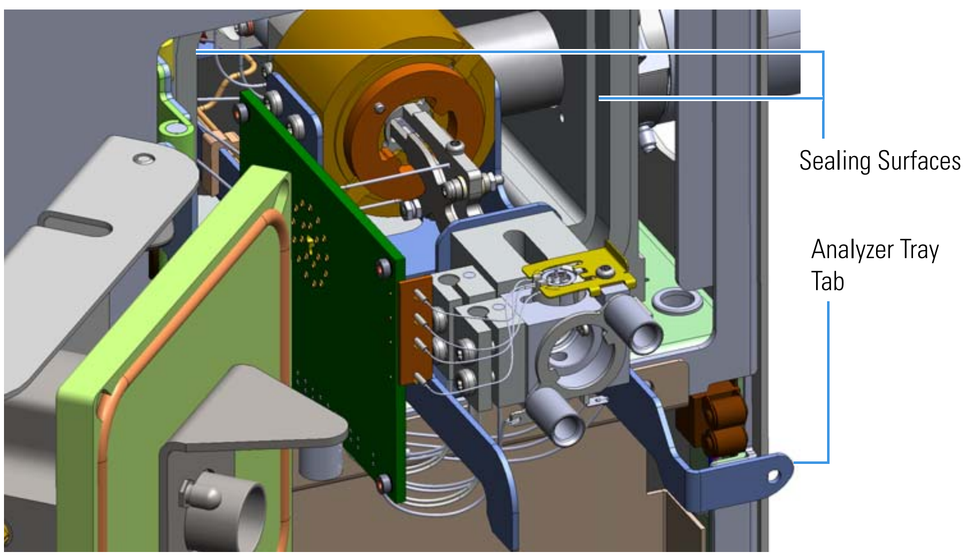
Replacing the Analyzer Tray in the TSQ Duo Instrument

❖ To replace the analyzer tray in the TSQ Duo instrument

1. Slide the analyzer tray back into the instrument.

> **Note** The analyzer tray will mount on one alignment pin in the back and the transfer line on the right. The mixing chamber will rest on the transfer line when installed.

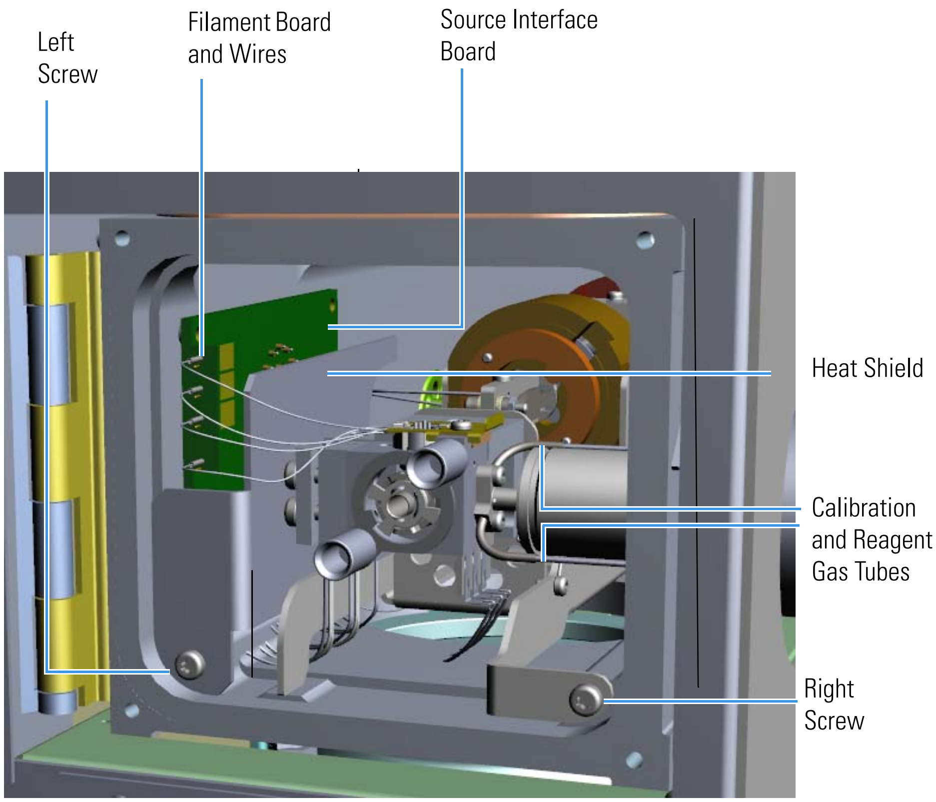
Figure 74. Sliding the Analyzer Tray Back into the Instrument



> **CAUTION INSTRUMENT DAMAGE** Do not scratch any of the sealing surfaces. Be especially careful when the source interface board reaches the o-ring surface.

2. Reattach the transfer line and both gas tubes to the gas mixing chamber.
3. Reattach the bottom right screw holding the tray to the manifold.

Figure 75. Reconnecting the Analyzer Tray to the Instrument



Note The dimensions of the transfer line and ion source allow a 0.5 mm gap between the mixing chamber and the transfer line. The mixing chamber does not need to bottom out on the transfer line.

4. Reattach the source interface board to the wall of the chassis.
5. Slide the heat shield back into its slot and reattach the bottom left screw. The heat shield should be flush with the manifold side wall.
6. Reattach the filament board and wires.
7. Check all wires to ensure that none contact any metal surface and that there is sufficient space left below the source block for the magnet yoke.

CAUTION Although the wires are insulated with glass braid, they may short through the insulation if they touch a metal surface.

8. Close the manifold door and reattach the four screws.
9. Reconnect the four wires that connect the rear 4-pin feedthrough to quadrupole 3 and the collision cell assembly. See Figure 62 on page 97.

10. Reconnect the four wires that connect the front 4-pin feedthrough to quadrupole 1 and the ion guide. See Figure 61 on page 96.
11. Reconnect the collision gas tube. See Figure 61 on page 96.
12. Put the glass manifold covers back into place. Be sure to blow off all dust from the covers and o-ring first.
13. Reconnect the electrometer board cable.
14. Reattach the top cover and tighten the top cover panel screw.

Restarting the System

❖ To restart your system

1. Close the front door of the instrument.
2. Twist the vent valve clockwise to close the valve. Be careful not to pinch the o-ring.
3. Reinsert the column to the proper length and tighten the transfer line nut. See "Replacing a Column" on page 13 for more information.
4. If you are using hydrogen, replace the front panel screw.
5. Replace the ion source cartridge. See "To reinsert the ion source cartridge" on page 164 for more information.
6. Replace all hydrogen safety screws if you are using hydrogen.
7. Power-on the TSQ Duo mass spectrometer.
8. If the GC is powered off, power it on and make sure vacuum compensation is on for the carrier gas flowing into the mass spectrometer.

WARNING FIRE HAZARD: If you are using hydrogen, do NOT reach over the top of the instrument to power it on. Instead, reach around the left side or go to the back of the instrument and flip up the power switch.

Ion Guide

❖ **To replace the ion guide:**

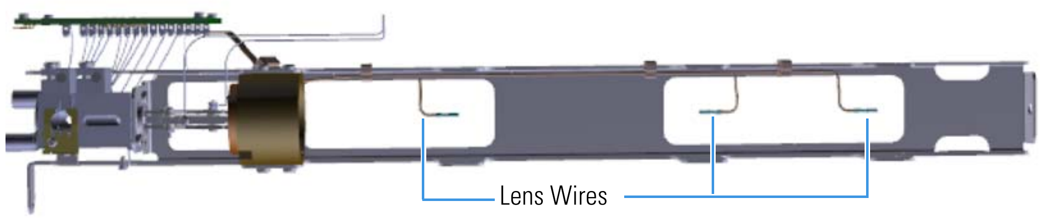
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.

3. Turn the analyzer tray to access the bottom and disconnect the three lens wires attached to the lenses between the quadrupoles.

   Figure 76. Finding the Lens Wires between the Quadrupoles



CAUTION INSTRUMENT DAMAGE Quadrupole surface quality is critical for instrument performance. Take extreme care in handling the quadrupole components.

4. Remove the screws holding the Q3 exit lens endcap to the tray.

5. Remove Q3 and the Q3 exit lens endcap.

6. Remove the screws holding the collision cell to the tray.

7. Remove the collision cell and Q1.

   Figure 77. Removing the Analyzer Tray Screws

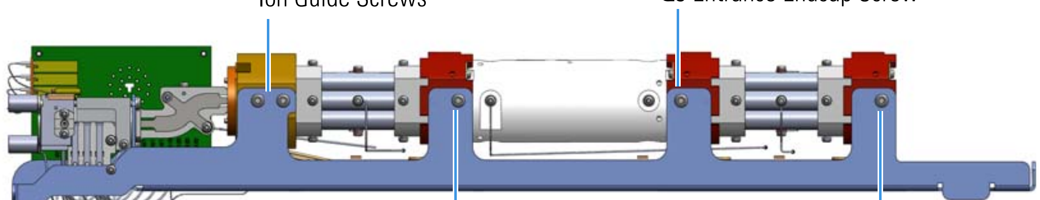
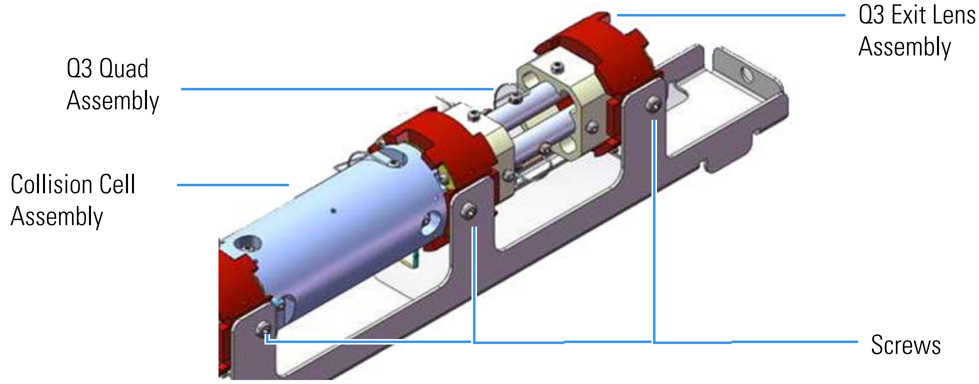


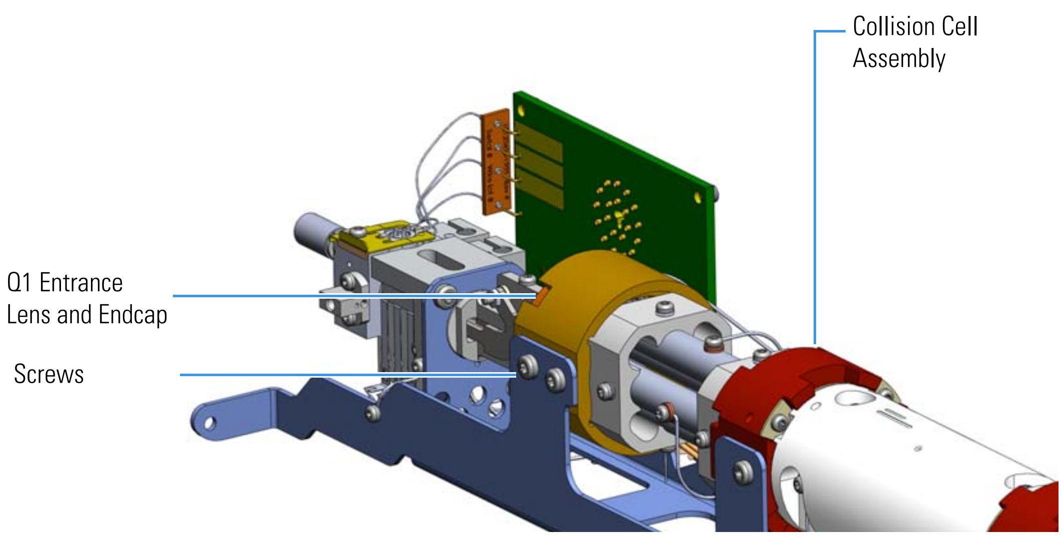
Figure 78. Removing the Collision Cell and Quadrupole 3 from the Analyzer Tray



8. Disconnect the Q1 entrance lens wire from the source interface board.

9. Remove the two screws on each side of the Q1 entrance endcap.

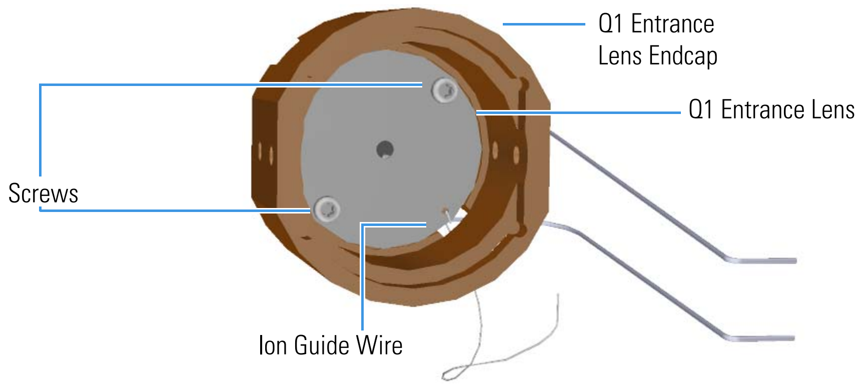
Figure 79. Removing Screws from the Quadrupole Rod Endcaps



10. Remove the Q1 entrance lens endcap and ion guide from the tray.

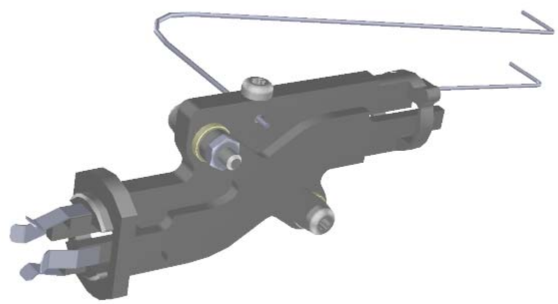
11. Look inside the endcap and use a T10 Torxhead screwdriver to remove the two screws holding the ion guide to the Q1 entrance lens endcap and Q1 entrance lens.

Figure 80. Finding the Quad Entrance Lens



12. Rotate the ion clamp until the ion guide can be separated from the endcap
13. Pull the ion guide clamp away from the ion guide.
14. Place the ion guide clamp over the new ion guide.

Figure 81. Replacing the Ion Guide

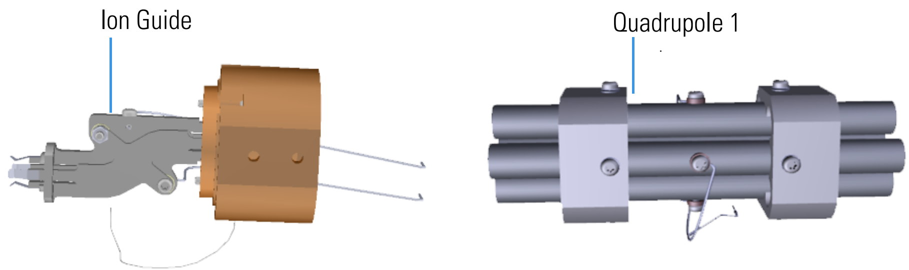


15. Insert the new ion guide into the Q1 entrance lens endcap.
16. Rotate the clamp until the ion guide is locked in place. Make sure the ion guide is aligned parallel to the flat on the endcap.
17. Tighten the two T10 screws inside the endcap.

Note Make sure the Q1 entrance lens sits flush and centered in the Q1 entrance lens endcap.

18. Slide the ion guide and endcap back into the analyzer tray.

Figure 82. Rejoining the Ion Guide to the Quadrupole

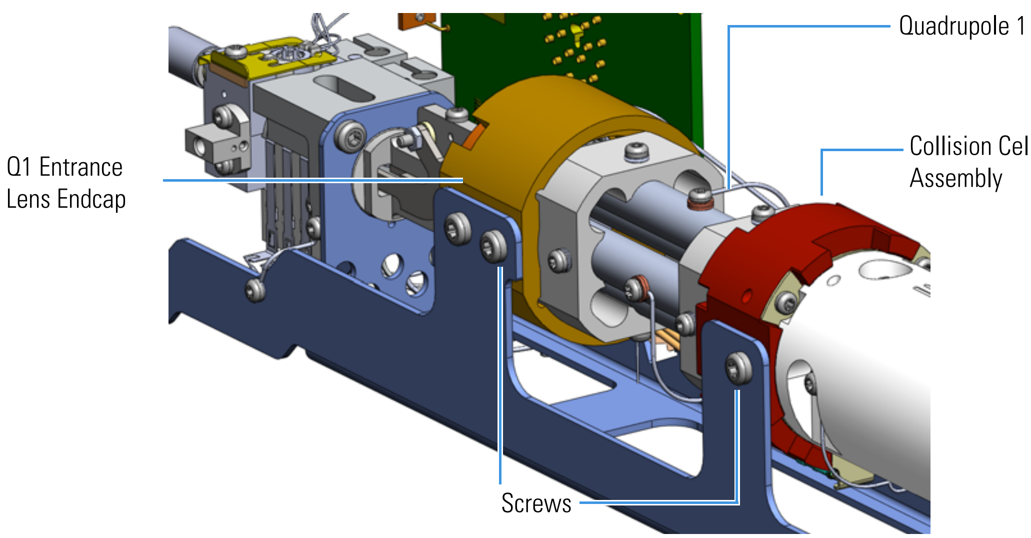


19. Reattach the four screws but do not tighten.
20. Insert Q1 and the collision cell assembly onto the analyzer tray.
21. Hold the collision cell and Q1 in the tray and make sure the quad and ion guide are correctly positioned before tightening the screws on the Q1 entrance lens endcap

CAUTION - INSTRUMENT DAMAGE Do not overtighten the endcap screws. If torque exceeds 1.5 N•m, thread damage will occur.

IMPORTANT For optimal performance, the quadrupole ceramics must fit straight and securely in the endcap and be aligned so that the collision cell is level with the tray. Slightly tighten each screw several times going from one to another until all are securely tightened.

Figure 83. Reattaching Quadrupole 1, the Ion Guide, and the Collision Cell Assembly to the Analyzer Tray,



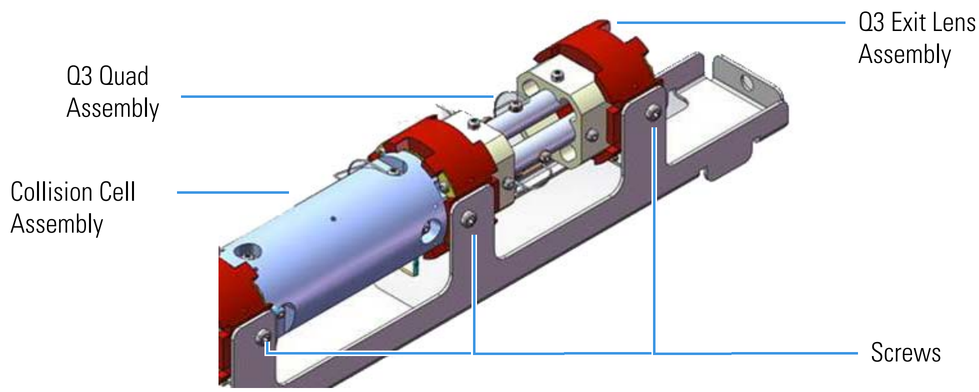
Tip You will get better signal if you gently push the quadrupole rod endcaps toward one another while tightening the screws.

22. Reattach the Q3 exit lens assembly and Q3 to the analyzer tray. Ensure that quadrupole 3 and the collision cell assembly are correctly positioned before tightening screws.

23. Reattach the two screws on each side of the quadrupole rod endcaps.

Tip The endcaps have cutouts that you should use to check to be sure the ceramics are aligned properly before attaching the two screws.

Figure 84. Replacing the Collision Cell and Quadrupole 3 in the Analyzer Tray



24. Reconnect the three lens wires attached to the lenses between the quadrupoles.

25. Reconnect the Q1 entrance lens wire to the source interface board.

26. Once the components are correctly attached to the analyzer tray, follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.

27. Restart your system by following the instructions in "Restarting the System" on page 106.

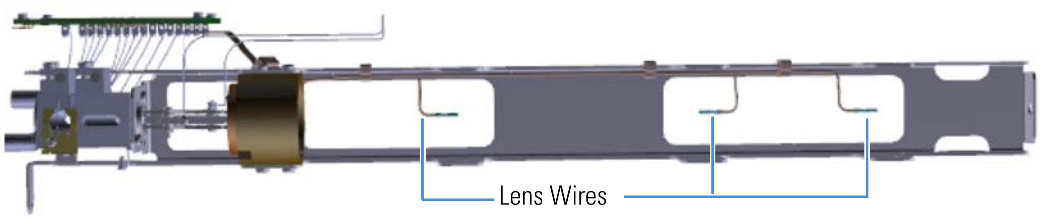
Q1 Entrance Lens and Q1 Entrance Lens Endcap

❖ To replace the Q1 entrance lens and Q1 entrance lens endcap

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Turn the analyzer tray to access the bottom and disconnect the three lens wires attached to the lenses between the quadrupoles.

Figure 85. Finding the Lens Wires between the Quadrupoles



CAUTION INSTRUMENT DAMAGE Quadrupole surface quality is critical for instrument performance. Take extreme care in handling the quadrupole components.

4. Remove the screws holding the Q3 exit lens endcap to the tray.
5. Remove Q3 and the Q3 exit lens endcap.
6. Remove the screws holding the collision cell to the tray.
7. Remove the collision cell and Q1.

Figure 86. Removing the Analyzer Tray Screws

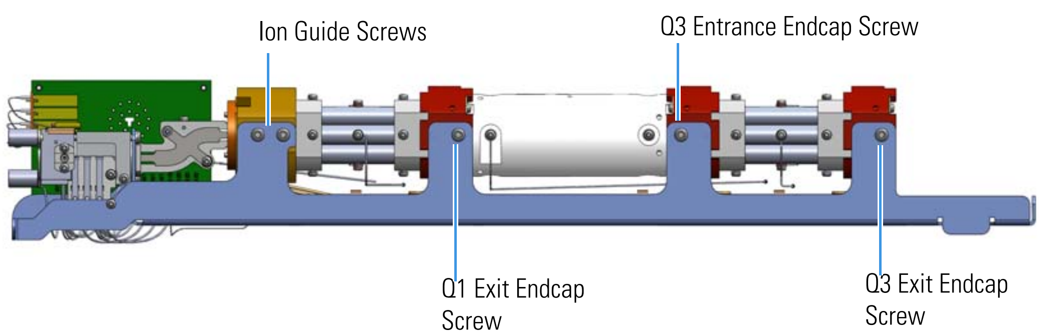
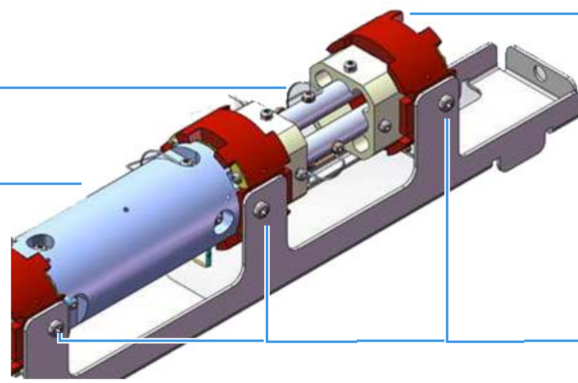
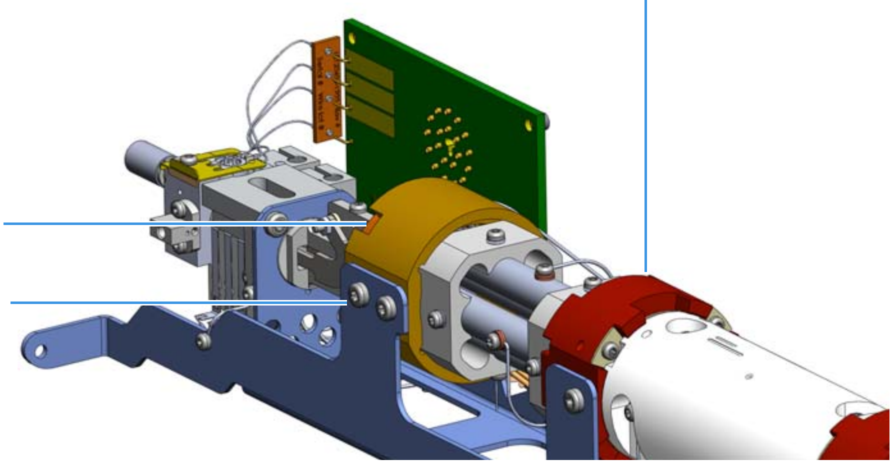


Figure 87. Removing the Collision Cell and Quadrupole 3 from the Analyzer Tray



8. Disconnect the Q1 entrance lens wire from the source interface board.
9. Remove the two screws on each side of the Q1 entrance endcap.

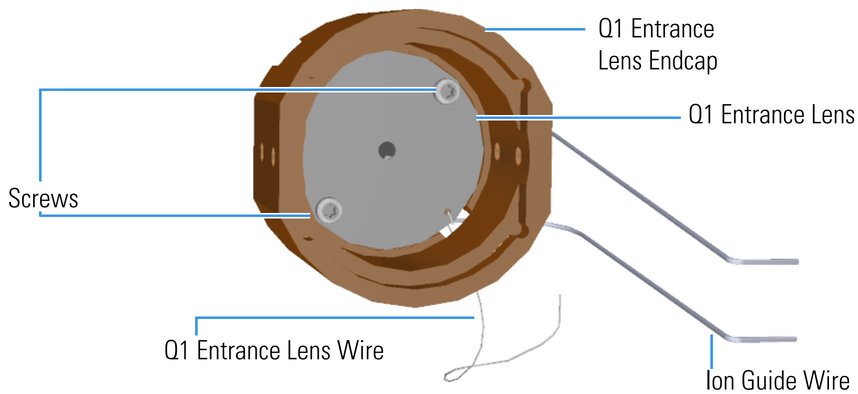
Figure 88. Removing Screws from the Quadrupole Rod Endcaps



10. Remove the Q1 entrance lens endcap and ion guide from the tray.

11. Look inside the endcap and use a T10 Torxhead screwdriver to remove the two screws holding the ion guide to the Q1 entrance lens endcap and Q1 entrance lens.

Figure 89. Replacing the Quad Entrance Lens



12. Remove and replace the Q1 entrance lens and ion guide into the new Q1 entrance lens endcap.

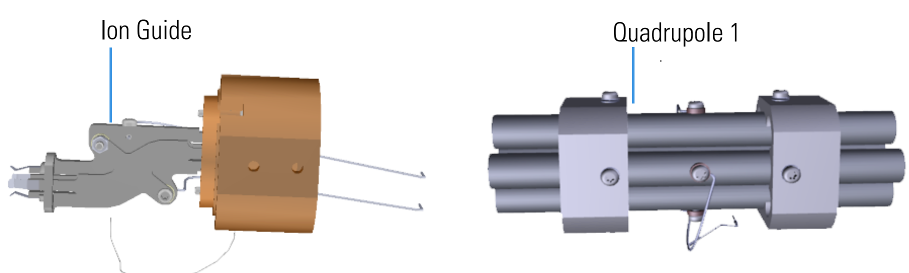
Note Make sure the Q1 entrance lens sits flush and centered in the Q1 entrance lens endcap.

13. Remove and replace the Q1 entrance lens and ion guide into the new Q1 entrance lens endcap.

Note Make sure the Q1 entrance lens sits flush and centered in the Q1 entrance lens endcap.

14. Slide the ion guide and endcap back into the analyzer tray.

Figure 90. Rejoining the Ion Guide to the Quadrupole



15. Reattach the four screws but do not tighten.

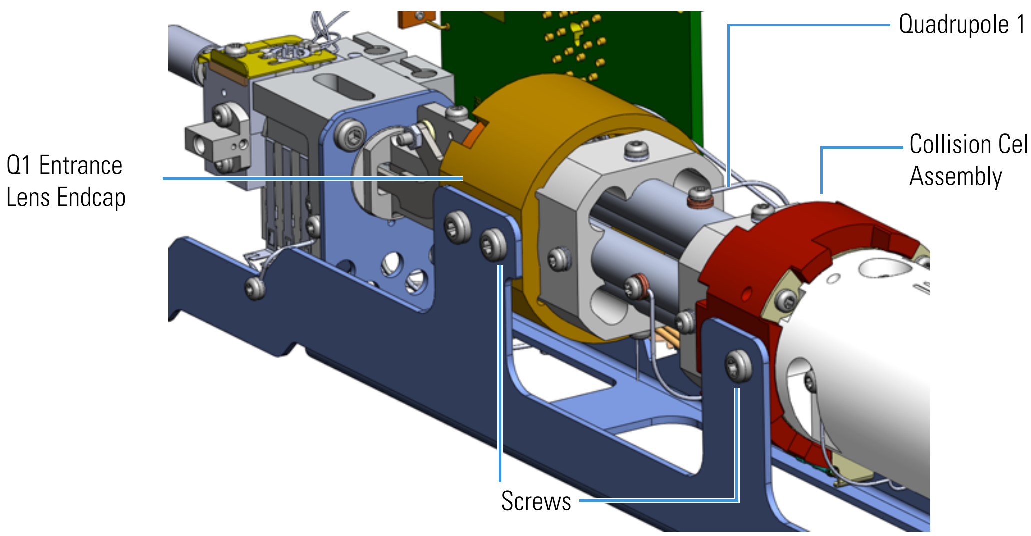
16. Insert Q1 and the collision cell assembly onto the analyzer tray.

17. Hold the collision cell and Q1 in the tray and make sure the quad and ion guide are correctly positioned before tightening the screws on the Q1 entrance lens endcap

CAUTION - INSTRUMENT DAMAGE Do not overtighten the endcap screws. If torque exceeds 1.5 N•m, thread damage will occur.

IMPORTANT For optimal performance, the quadrupole ceramics must fit straight and securely in the endcap and be aligned so that the collision cell is level with the tray. Slightly tighten each screw several times going from one to another until all are securely tightened.

Figure 91. Reattaching Quadrupole 1, the Ion Guide, and the Collision Cell Assembly to the Analyzer Tray



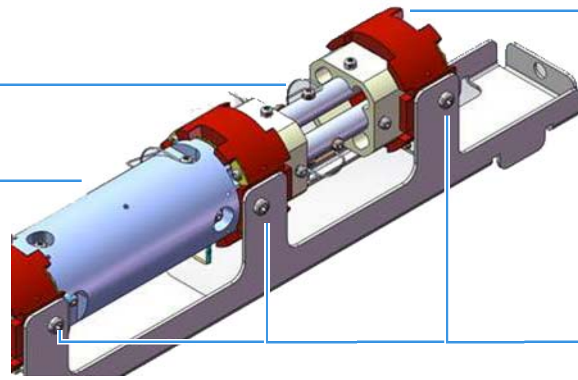
Tip You will get better signal if you gently push the quadrupole rod endcaps toward one another while tightening the screws.

18. Reattach the Q3 exit lens assembly and Q3 to the analyzer tray. Ensure that quadrupole 3 and the collision cell assembly are correctly positioned before tightening screws.

19. Reattach the two screws on each side of the quadrupole rod endcaps.

Tip The endcaps have cutouts that you should use to check to be sure the ceramics are aligned properly before attaching the two screws.

Figure 92. Replacing the Collision Cell and Quadrupole 3 in the Analyzer Tray



20. Reconnect the three lens wires attached to the lenses between the quadrupoles.

21. Reconnect the Q1 entrance lens wire to the source interface board.

22. Once the components are correctly attached to the analyzer tray, follow the instructions in “Replacing the Analyzer Tray in the TSQ Duo Instrument” on page 104 to replace the tray in the TSQ instrument.

23. Restart your system by following the instructions in “Restarting the System” on page 106.

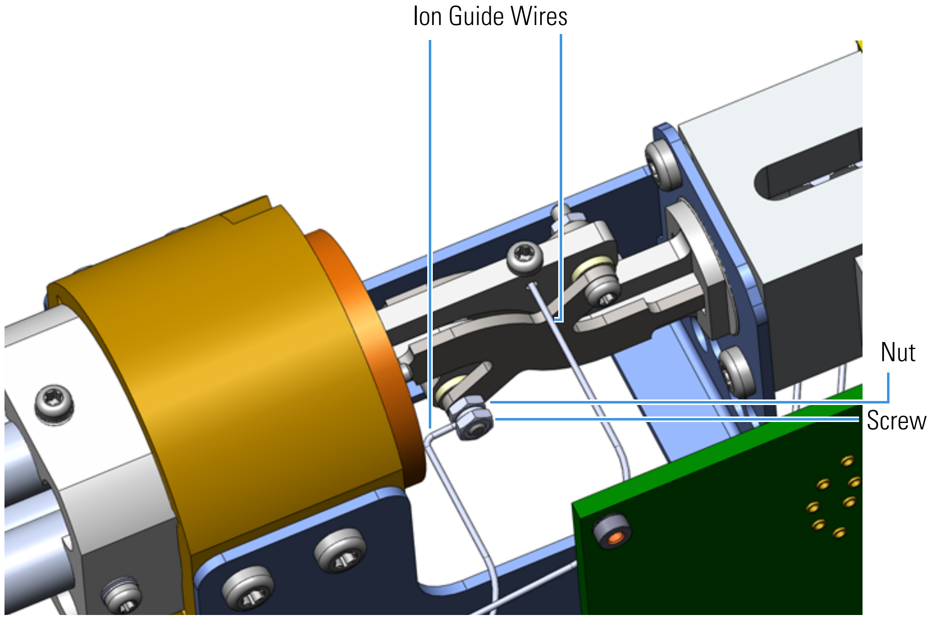
Ion Guide Wire Set

❖ To replace the ion guide wires

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Use a T10 Torxhead screwdriver to remove the screw connecting the ion guide wire to the top of the ion guide.

   Figure 93. Replacing the Ion Guide Wires



4. Use a wrench to remove the nut connecting the other ion guide wire to the side of the ion guide.
5. Attach new ion guide wires and reattach the nuts and screw.
6. Follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray into the instrument.
7. Restart your system by following the instructions in "Restarting the System" on page 106.

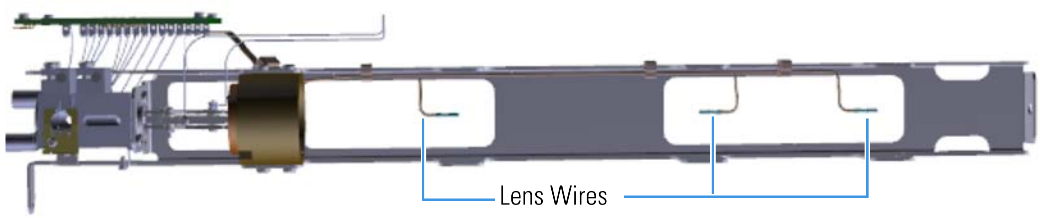
Q1 Quad, Q3 Quad, and Collision Cell Assemblies

❖ **To replace Q1 quad assembly, the Q3 quad assembly, or the collision cell assembly**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Turn the analyzer tray to access the bottom and disconnect the three lens wires attached to the lenses between the quadrupoles.

Figure 94. Finding the Lens Wires between the Quadrupoles



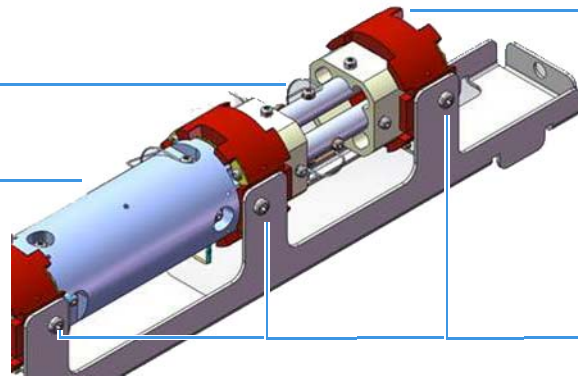
CAUTION INSTRUMENT DAMAGE Quadrupole surface quality is critical for instrument performance. Take extreme care in handling the quadrupole components.

4. Remove the screws on the Q3 exit endcap holding it to the tray.
5. Remove the Q3 quad assembly and Q3 exit lens assembly from the tray.
6. If needed, replace Q3.

Note If you only need to replace quadrupole 3, you may skip to step 14.

7. Remove the four screws that hold the collision cell assembly to the analyzer tray.
8. Remove the collision cell assembly and the Q1 quad assembly and the tray.

Figure 95. Removing the Collision Cell and Quadrupole 3 from the Analyzer Tray

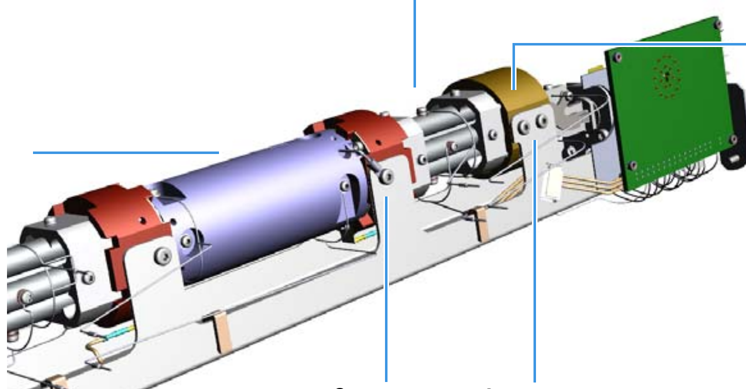


9. Replace the collision cell assembly if needed.

IMPORTANT It is critical that you use the correct collision cell, with the TSQ Duo MS. If you install a new collision cell in a TSQ 8000 (classic) instrument, you must update the lens driver board. See the *TSQ Duo Spare Parts Guide* for more information.

Note If you do not need to replace quadrupole 1, go to step 14.

Figure 96. Removing Screws from the Quadrupole Rod Endcaps



10. Slide the Q1 quad assembly away from the Q1 entrance lens and endcap.

11. Replace Q1 if necessary.

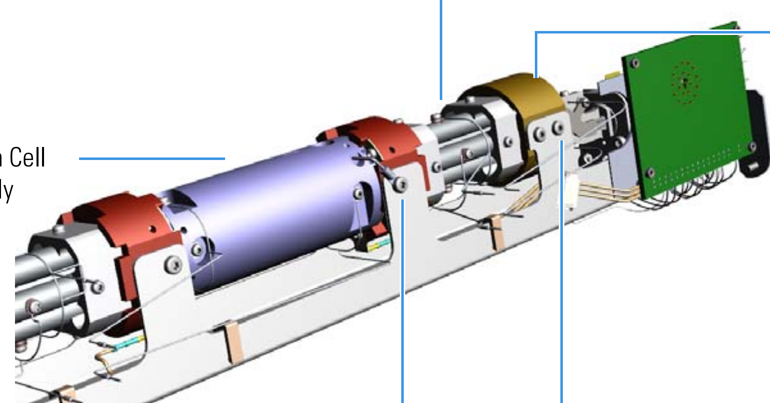
12. Slide Q1 back into the Q1 entrance lens endcap.

13. Slide the collision cell assembly onto the analyzer tray. Hold the collision cell and Q1 in the tray and make sure Q1 and the collision cell are correctly positioned before tightening the screws on the Q1 exit endcap

CAUTION - INSTRUMENT DAMAGE Do not overtighten the endcap screws. If torque exceeds 1.5 N•m, thread damage will occur.

IMPORTANT For optimal performance, the quadrupole must fit straight and securely in the endcap and be aligned so that the collision cell is level with the tray. Slightly tighten each screw several times going from one to another until all are securely tightened.

Figure 97. Reattaching Quadrupole 1 and the Collision Cell Assembly to the Analyzer Tray



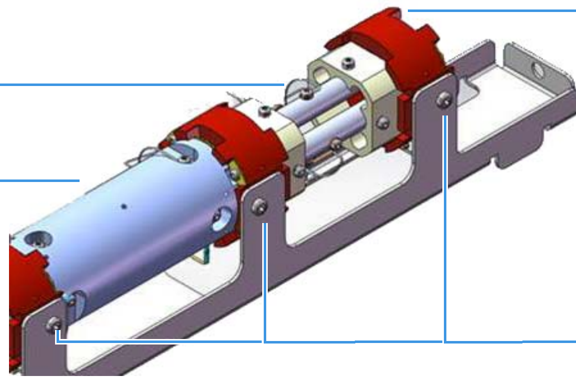
Tip You will get better signal if you gently push the quadrupole rod endcaps toward one another while tightening the screws.

14. Reattach the Q3 exit lens assembly and the Q3 quad assembly to the analyzer tray. Ensure that quadrupole 3 and the collision cell assembly are correctly positioned before tightening screws.

15. Reattach the two screws on each side of the quadrupole rod endcaps.

Tip Look through the endcaps to be sure the quadrupole ceramics are aligned properly.

Figure 98. Replacing the Collision Cell and Quadrupole 3 in the Analyzer Tray



16. Replace the analyzer tray into the instrument by following the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104.
17. Restart your system by following the instructions in "Restarting the System" on page 106.

Quad 1 and Quad 3 Wire Sets

❖ **To replace the quad 1 or quad 3 wire sets**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in “Removing the Analyzer Tray from the TSQ Duo Instrument” on page 95.
3. For both quad assemblies, use a T10 Torxhead screwdriver to remove the four screws around the rods. These screws hold the wires in place. If the screws won’t come off the rods, you must replace the whole quad assembly.
4. Use on the screws provided. These screws are made from a special material designed not fuse with the quadrupole rods.

Figure 99. Replacing the Q1 Quad Assembly Wires

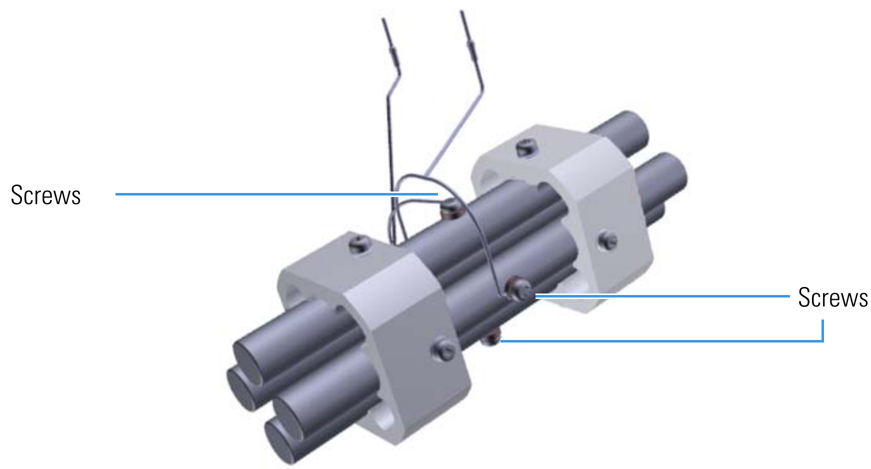
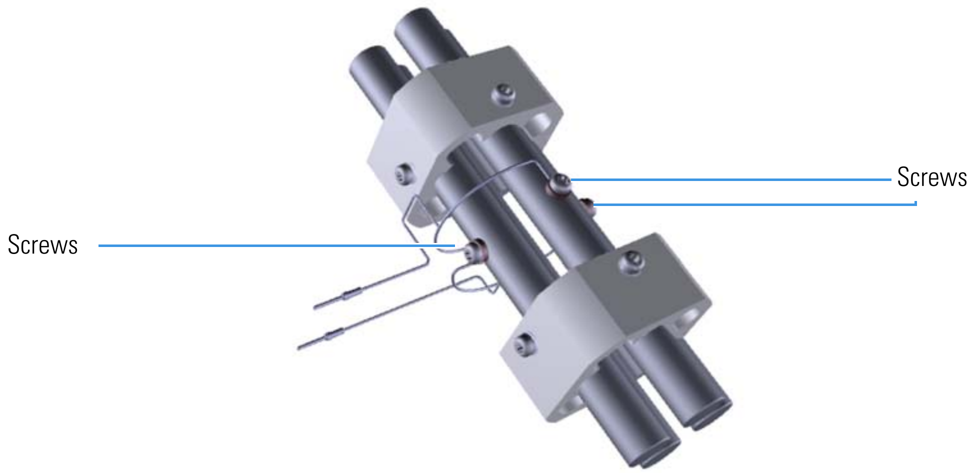
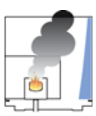


Figure 100. Replacing the Q3 Quad Assembly Wires

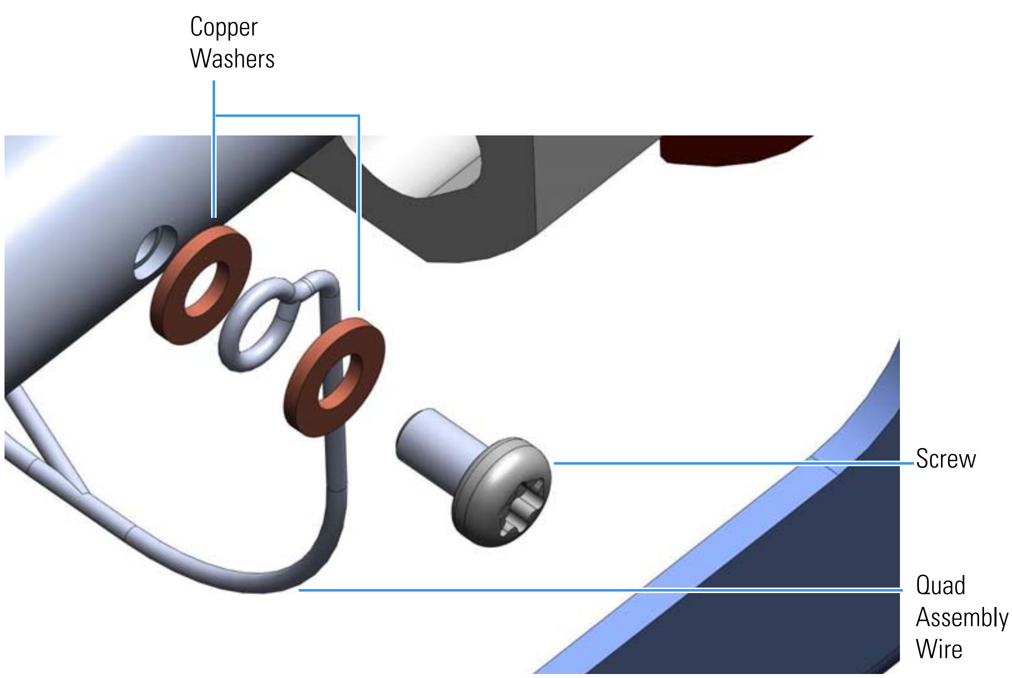


5. Attach new wires to each side of the rods. Ensure that the copper washers are on either side of the wires.



CAUTION - INSTRUMENT DAMAGE Be careful when removing and inserting the screws on the metal quadrupole rod endcaps. The screws are susceptible to falling between the rods.

Figure 101. Attaching the Screws and Washers Correctly



6. Replace the analyzer tray into the instrument by following the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104.

7. Restart your system by following the instructions in "Restarting the System" on page 106.

Q3 Exit Lens Assembly

❖ **To replace the Q3 exit lens assembly**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

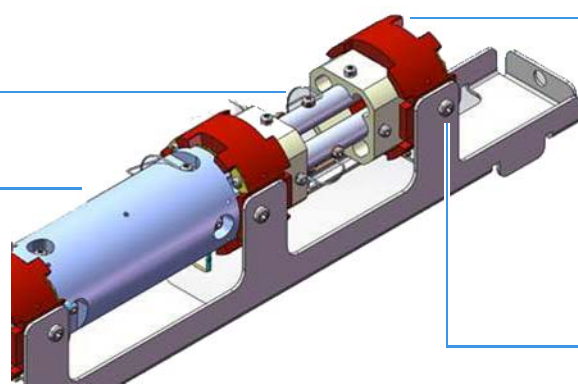
1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93.

2. Remove the analyzer tray from the instrument by following the instructions in “Removing the Analyzer Tray from the TSQ Duo Instrument” on page 95.

3. Turn the tray to access the bottom and remove the wire to the Q3 exit lens.

4. Remove the two screws on each side of the Q3 exit lens assembly and slide it off the back of the tray while holding the Q3 quad assembly in place.

Figure 102. Removing the Q3 Exit Lens Assembly from the Analyzer Tray



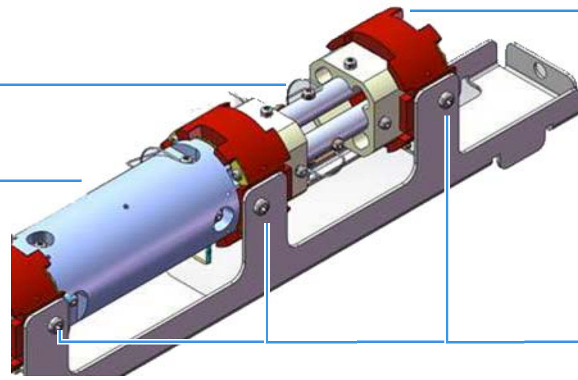
5. Attach a new Q3 exit lens assembly and reattach the two screws.

Tip You will get better signal if you gently push the Q3 exit lens assembly forward while tightening the screws.

6. Reattach the two screws on each side of the quadrupole rod endcaps.

Tip Look through the endcaps to be sure the screws are aligned properly.

Figure 103. Replacing the Collision Cell and Quadrupole 3 in the Analyzer Tray



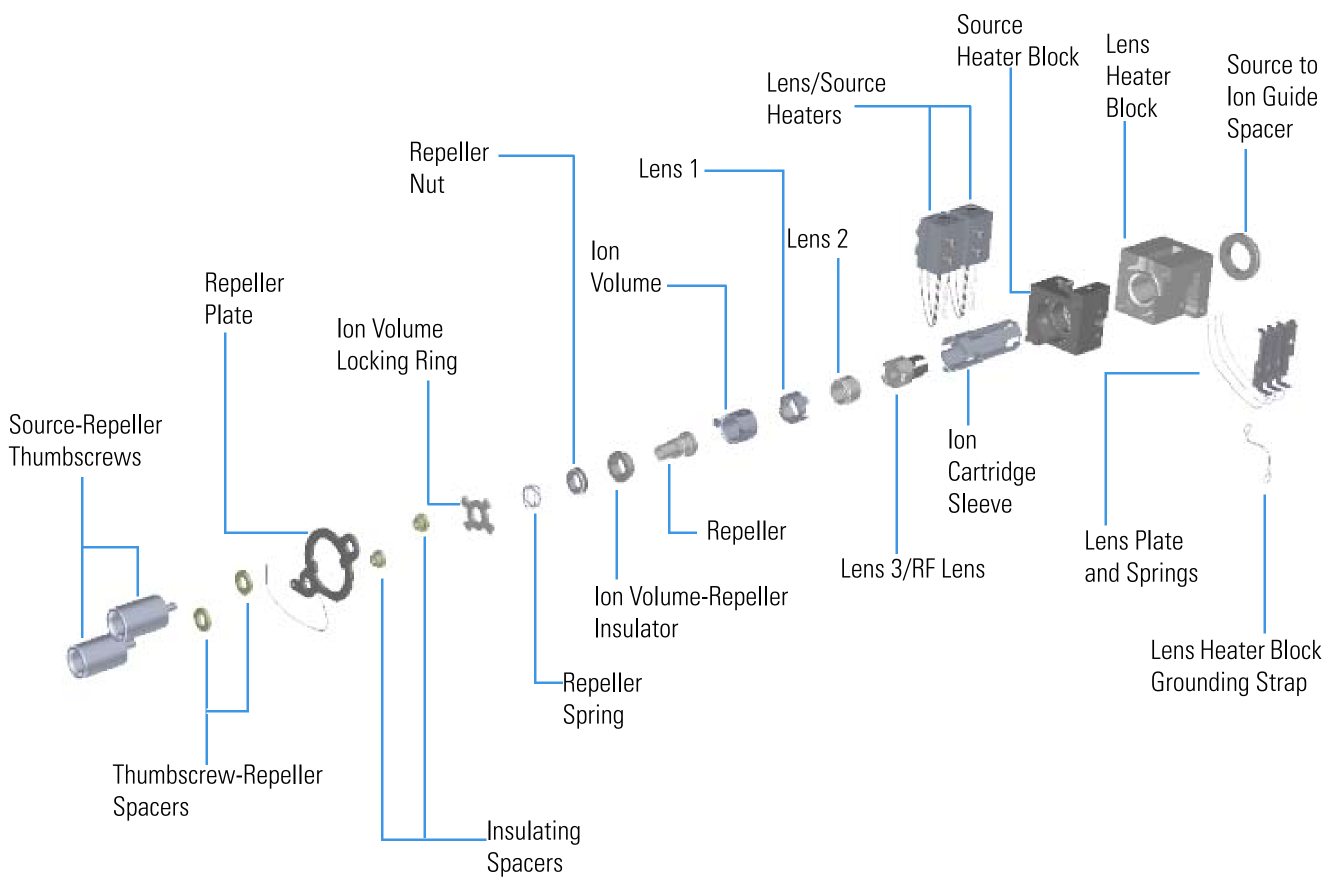
7. Reattach the wire to the Q3 exit lens.
8. Replace the analyzer tray into the instrument by following the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104.
9. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing Components of the Ion Source

If the components of your ion source get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it. If you just need to clean the ion source cartridge, see Removing the Ion Source Cartridge for Cleaning.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

Figure 104. Replaceable Components of the Ion Source



NOTE: You can also replace the entire ion source cartridge, which consists of the locking ring, spring, nut, repeller, lenses, and sleeve. See Ion Source Cartridge for details.

Source Heater Block, Lens Heater Block, and Lens/Source Heater

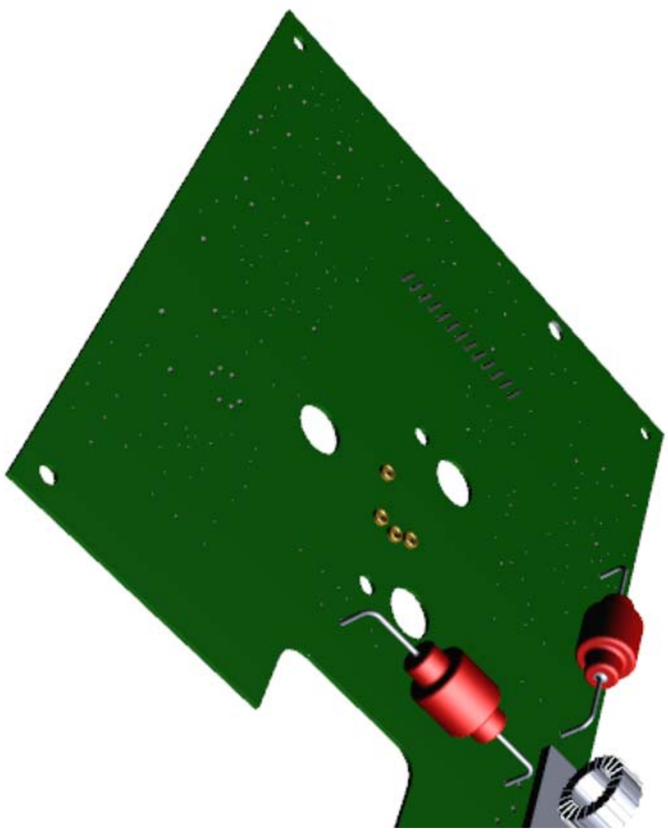
❖ To replace the source heater block, lens heater block, or lens/source heater

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

WARNING - INSTRUMENT DAMAGE Thermo Fisher Scientific strongly recommends that only trained Thermo Fisher Scientific Field Service Engineers remove and service these components.

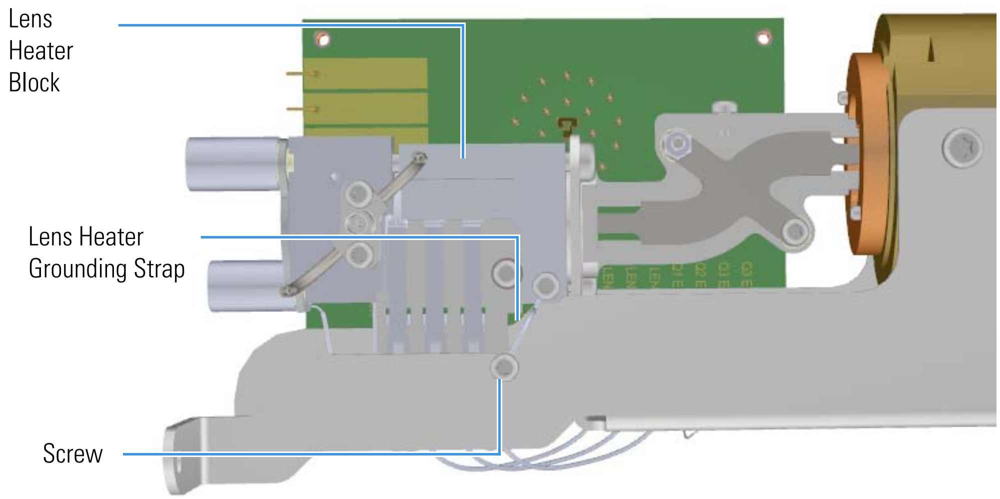
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Disconnect the Q1 entrance lens, Q2 entrance lens, Q3 entrance lens, and Q3 exit lens wires from the source interface board using a flat-tipped screwdriver.

Figure 105. Locating Wires on the Source Interface Board



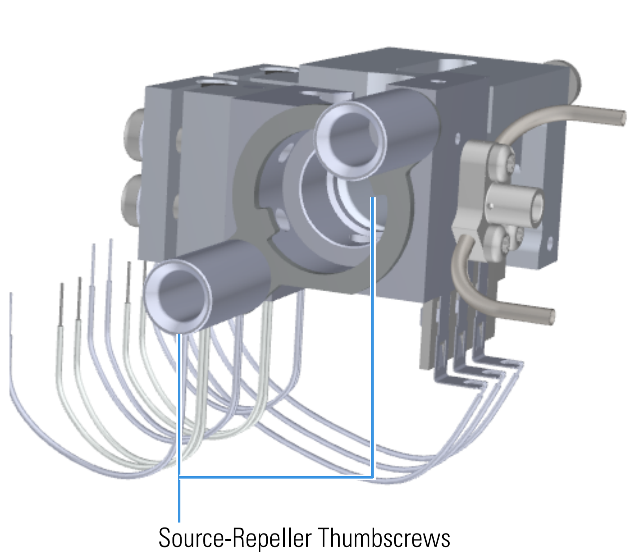
4. Use a T10 Torxhead screwdriver to disconnect the lens heater block grounding strap from the lens heater block, but leave it attached to the tray.

Figure 106. Disconnecting the Lens Heater Block Grounding Strap



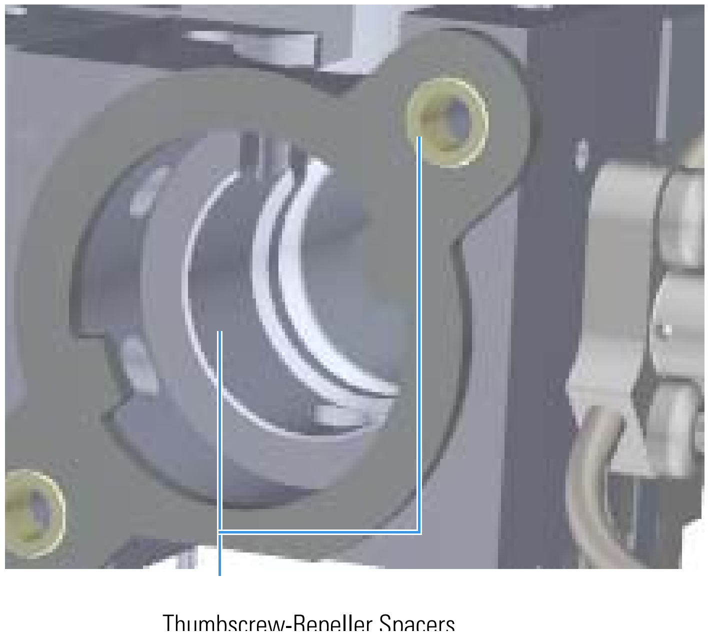
5. Using a T10 Torxhead remove the screw holding the filament clip in place.
6. Remove both pieces of the filament clip.
7. Lift the filament out of the block.
8. Using a T10 Torxhead to remove the two screws on the mixing chamber and pull the chamber off.
9. Twist and remove the two source-repeller thumbscrews.

Figure 107. Removing the Source-Repeller Thumbscrews



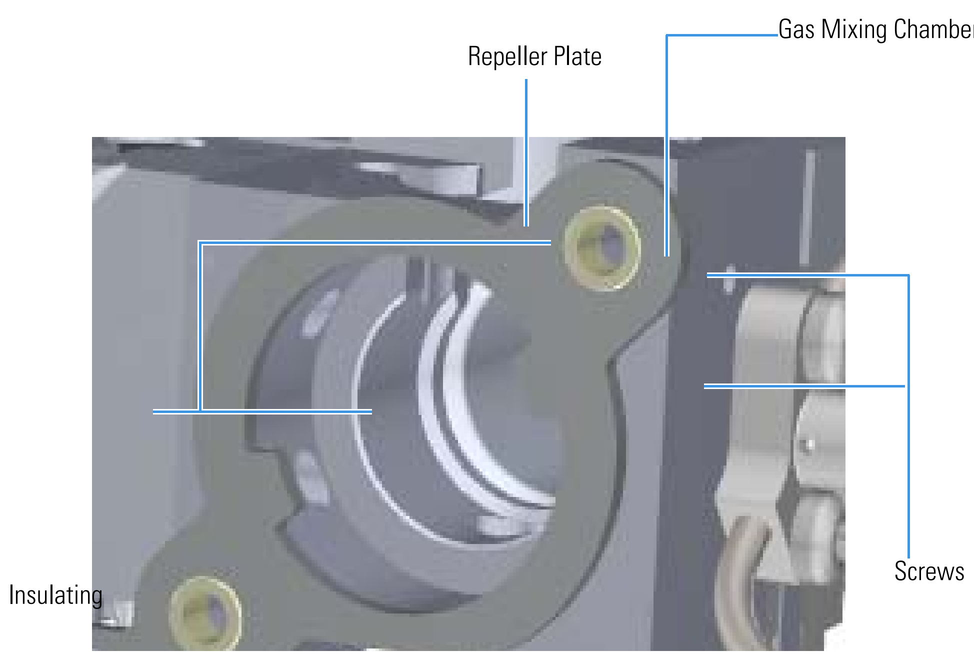
10. Remove the thumbscrew-repeller spacers and set them aside.

Figure 108. Removing the Thumbscrew-Repeller Spacers



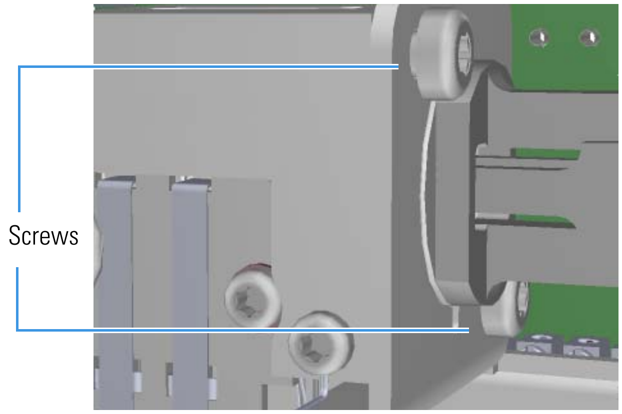
11. Pull away the repeller plate and remove the insulating spacers.

Figure 109. Removing the Repeller Plate and Insulating Spacers



12. Use a T20 Torxhead screwdriver to remove the two screws on the back of the source heater block.

Figure 110. Disconnecting the Ion Source to the Analyzer Tray

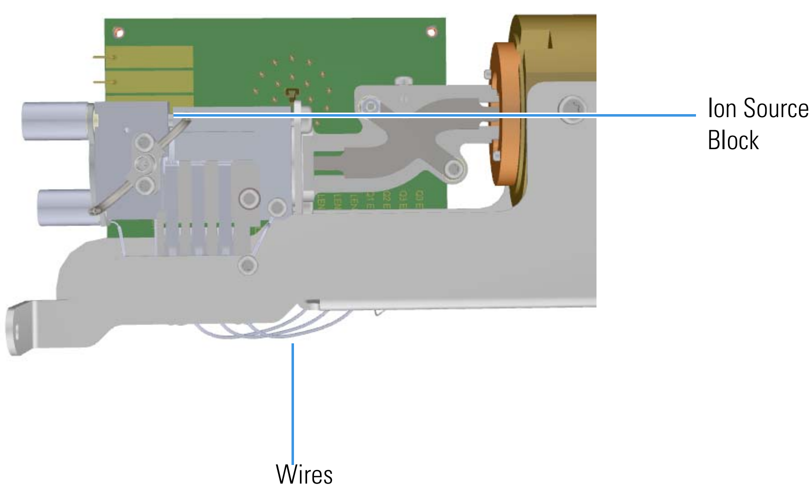


Note Some of the pieces may become slack as you loosen the screws. Do not let them fall.

13. Slide the source interface board and the source block out from under the tray without damaging or disconnecting the wires.

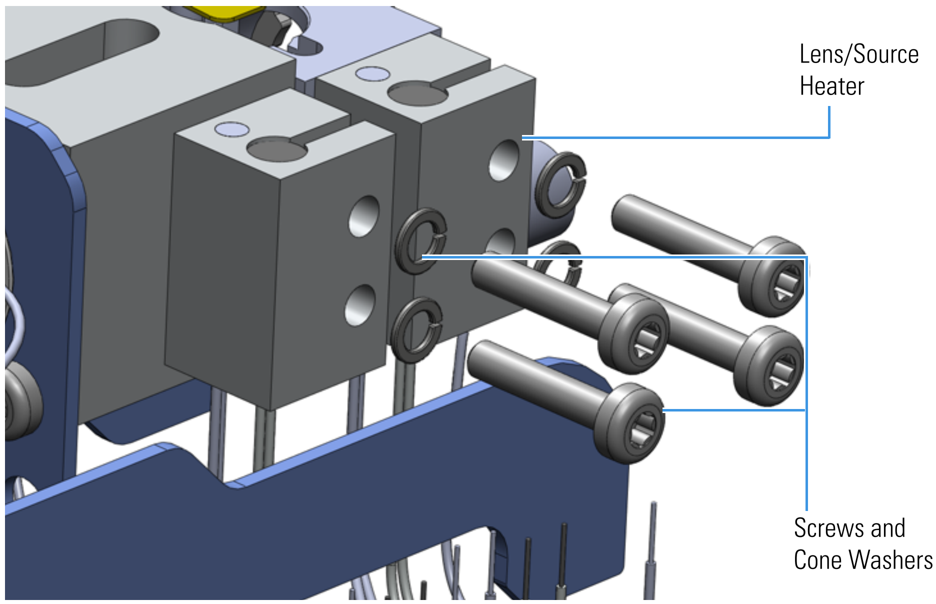
CAUTION - INSTRUMENT DAMAGE The lens/source heater may be fused to the source block and difficult to remove. To avoid damage, separate the block from the tray before removing the lens/source heater.

Figure 111. Removing the Ion Source from the Analyzer Tray



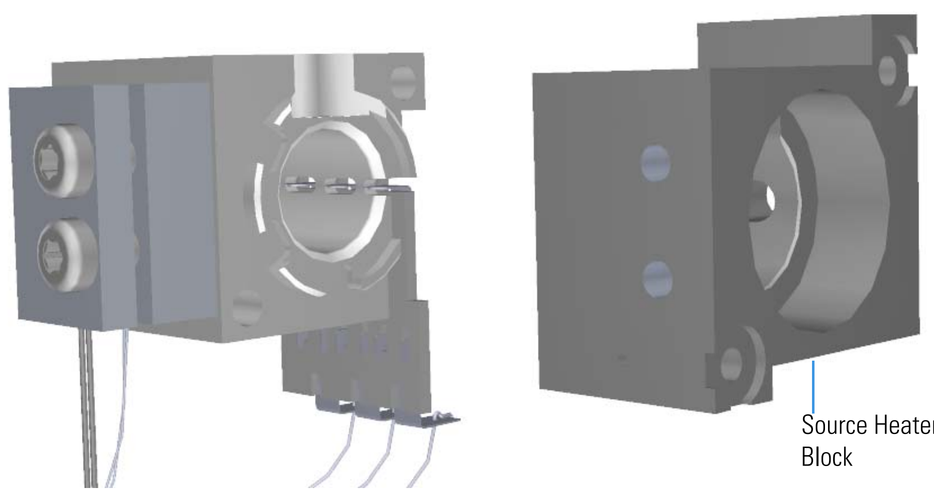
14. Use a T20 Torxhead screwdriver to remove the two screws connecting the lens/source heater to the source heater block. Replace the lens/source heater if necessary.

Figure 112. Disconnecting the Lens/Source Heater



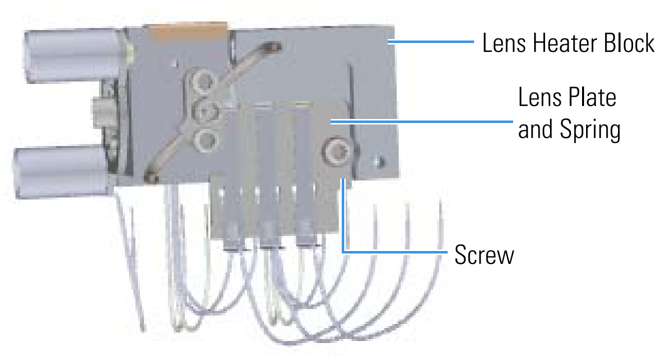
15. Remove and replace the source heater block if necessary.

Figure 113. Replacing the Source Heater Block



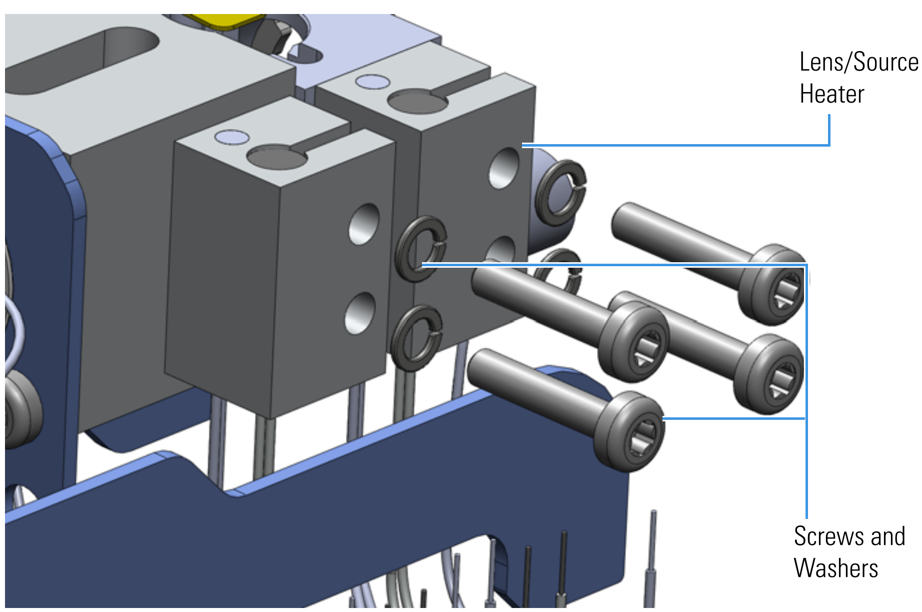
16. If you need to replace the lens heater block, remove the screw holding the lens plate and springs to the lens heater block.

Figure 114. Replacing the Lens Heater Block



17. Remove and replace the lens heater block.
18. Attach the lens plate and springs to the lens heater block.
19. Attach the source heater block.
20. Reattach the lens/source heater to the new source heater block and set them next to the rest of the ion source.

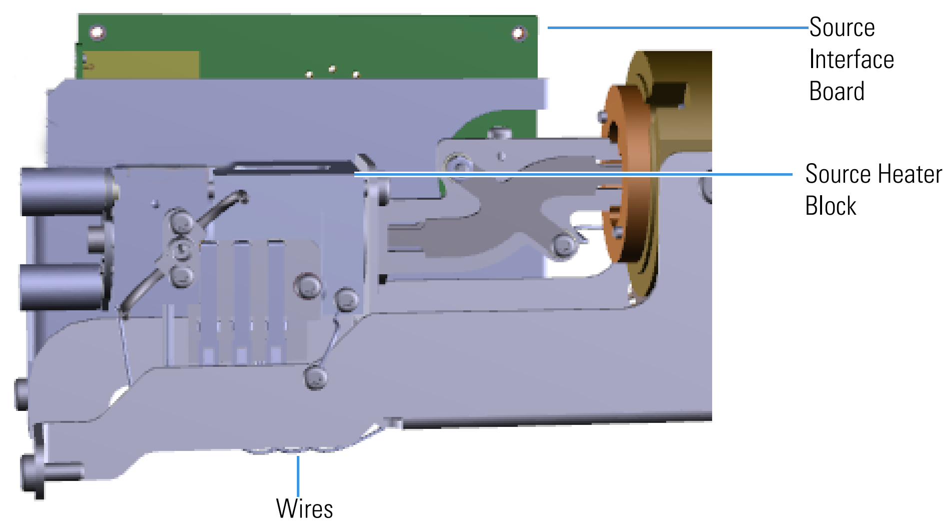
Figure 115. Reattaching the Lens/Source Heater



IMPORTANT When assembling the source and optics block, take extra care to ensure the blocks are centered properly and that the ion source cartridge provided with the instrument can easily slide in and out of the assembly.

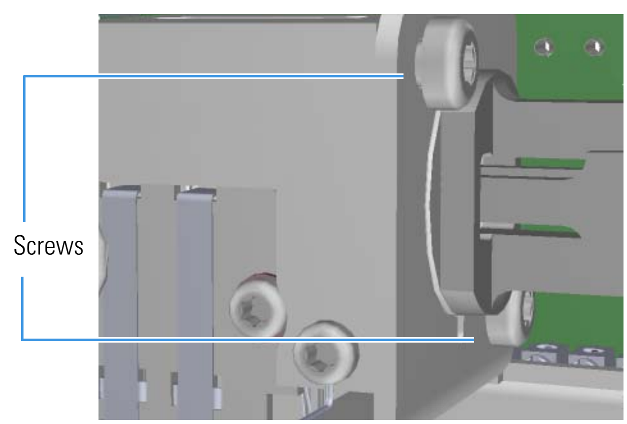
21. Slide the source interface board and source block onto the tray without damaging or disconnecting the wires.

Figure 116. Sliding the Source Block onto the Analyzer Tray



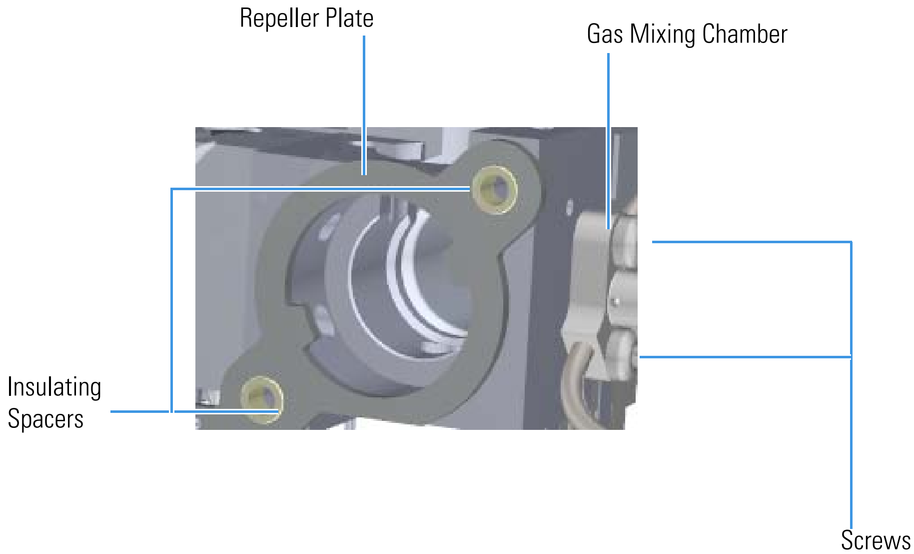
22. Reattach the two screws to the back of the ion source.

Figure 117. Reconnecting the Source Block to the Analyzer Tray



23. Reattach the gas mixing chamber to the ion source block.

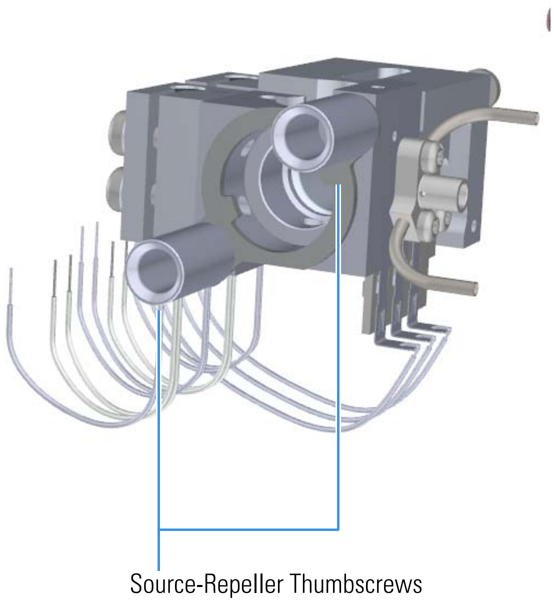
Figure 118. Reattaching the Gas Mixing Chamber



24. Reattach the repeller plate and insulating spacers.
25. Insert the thumbscrew-repeller spacers into a groove in the thumbscrew.

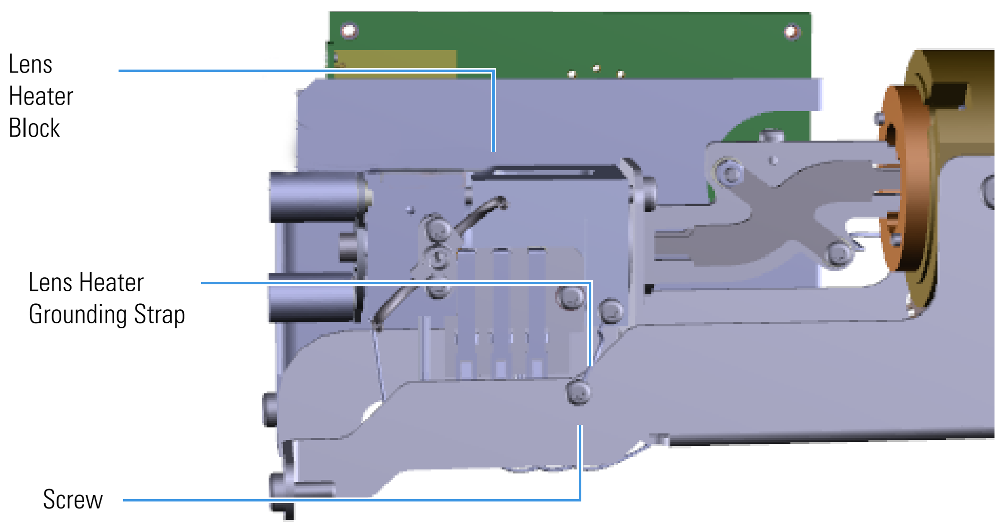
26. Attach the source-repeller thumbscrews to the endcaps and twist them back on. When you are tightening the thumbscrews, make sure the spacers stay in the groove or you could crush them.

Figure 119. Reattaching the Source-Repeller Thumbscrews



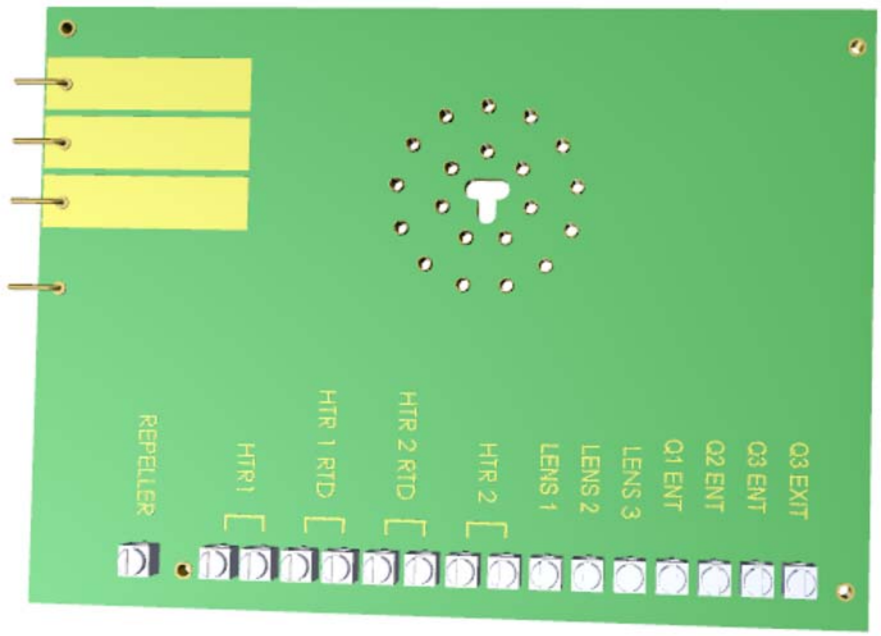
27. Reconnect the lens heater block grounding strap to the lens heater block

Figure 120. Reconnecting the Lens Heater Block Grounding Strap



28. Reconnect the Q1 entrance lens, Q2 entrance lens, and Q3 exit lens wires to the source interface board using a flat-tipped screwdriver.

Figure 121. Locating Wires on the Source Interface Board



29. Replace the analyzer tray into the instrument by following the instructions in “Replacing the Analyzer Tray in the TSQ Duo Instrument” on page 104.

30. Restart your system by following the instructions in “Restarting the System” on page 106.

Source-Repeller Thumbscrews

❖ **To replace the source-repeller thumbscrews:**

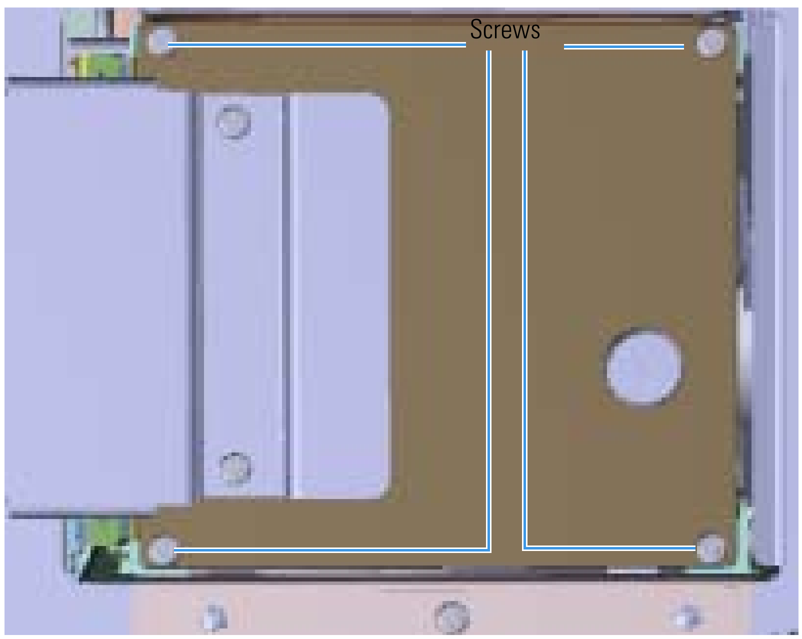
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93.
2. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

3. Open the manifold door.

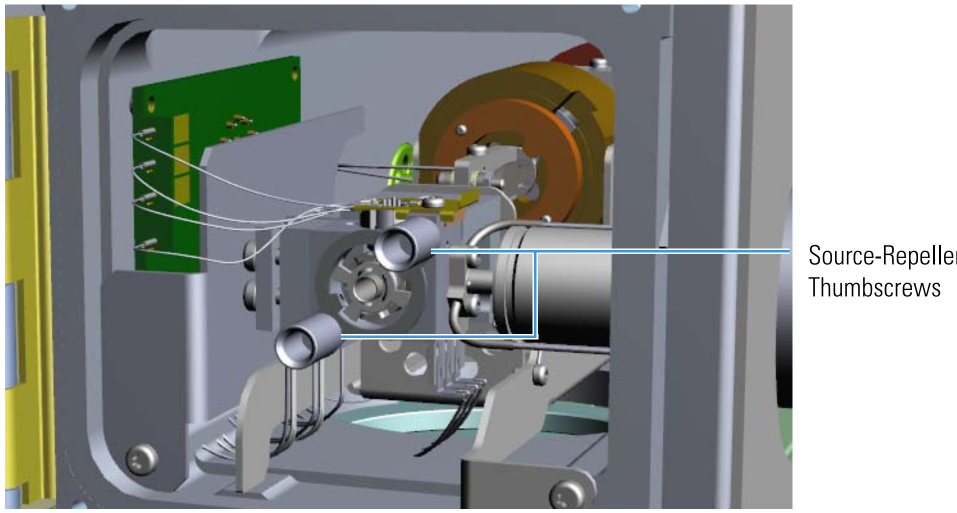
Figure 122. Opening the Manifold Door



4. Twist off each source-repeller thumbscrew one at a time to prevent the repeller plate from falling out.

5. Extract the thumbscrew-repeller spacers and transfer to new thumbscrews.

Figure 123. Replacing the Source-Repeller Thumbscrews



6. Attach new source-repeller thumbscrews to the ion source.
7. Reattach the manifold door and the four screws.
8. Restart your system by following the instructions in "Restarting the System" on page 106.

Thumbscrew-Repeller Spacers

❖ To replace the thumbscrew-repeller spacers

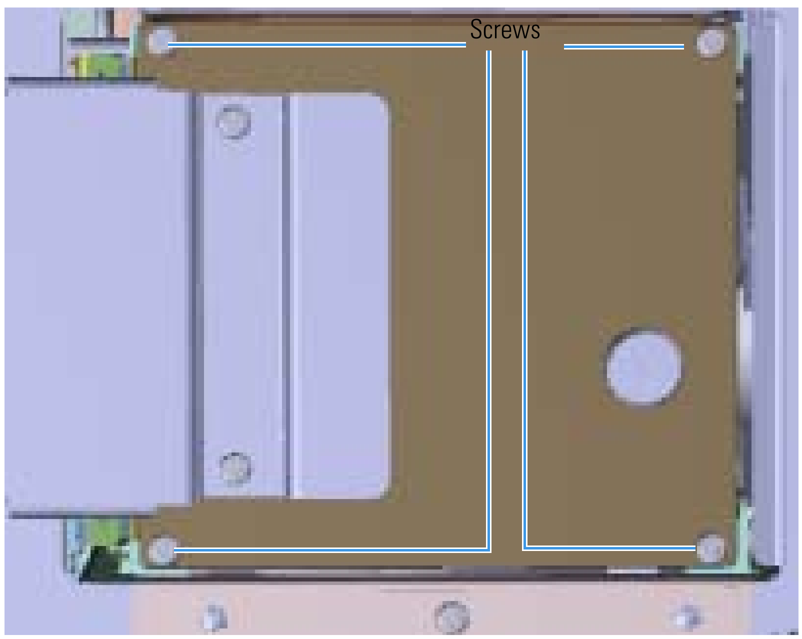
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

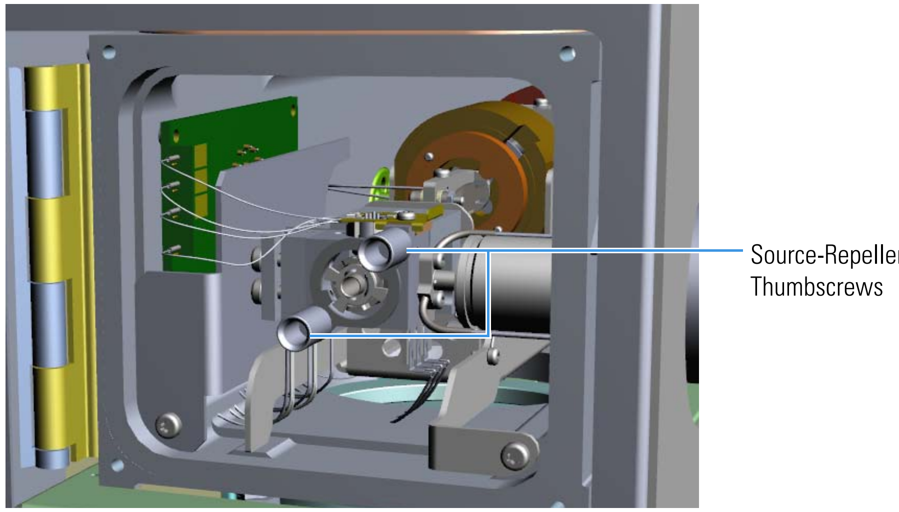
3. Open the manifold door.

Figure 124. Opening the Manifold Door



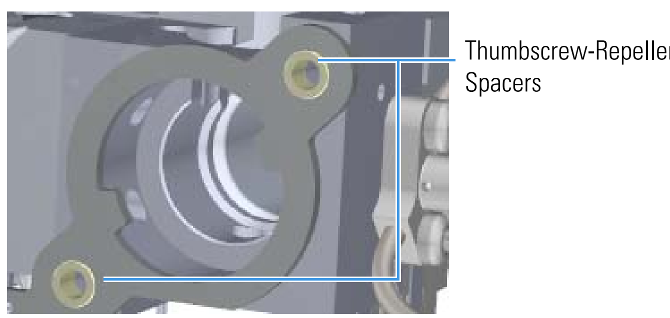
4. Twist off each source-repeller thumbscrew one at a time to prevent the repeller plate from falling out.

Figure 125. Replacing the Source-Repeller Thumbscrews



5. Remove the thumbscrew-repeller spacers from the thumbscrews and replace them.

Figure 126. Replacing the Thumbscrew-Repeller Spacers



Note When reattaching the spacers, make sure they fit into the grooves on the thumbscrews. Also, do not over-tighten the thumbscrews or it may crack the spacers.

6. Reattach the source-repeller thumbscrews to the spacers.

7. Reattach the manifold door and the four screws.

8. Restart your system by following the instructions in "Restarting the System" on page 106.

Insulating Spacers

❖ **To replace the insulating spacers**

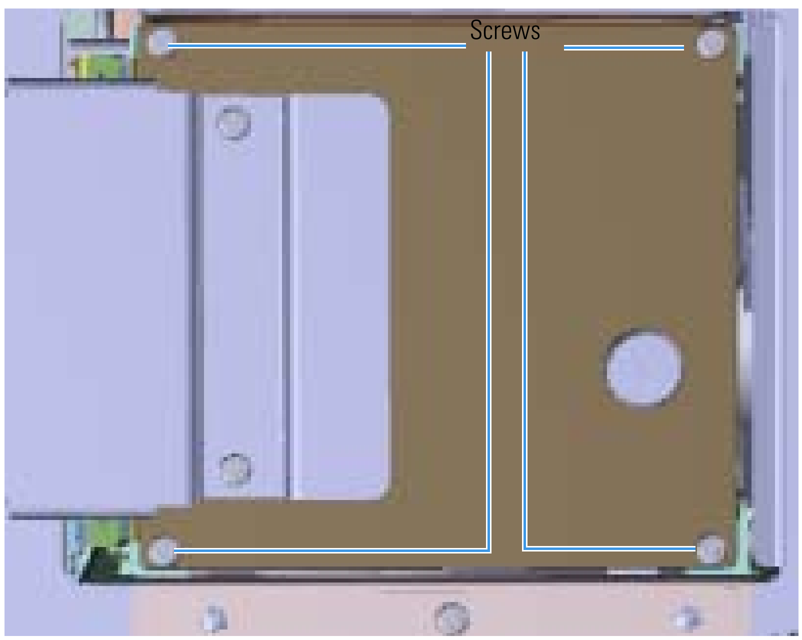
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

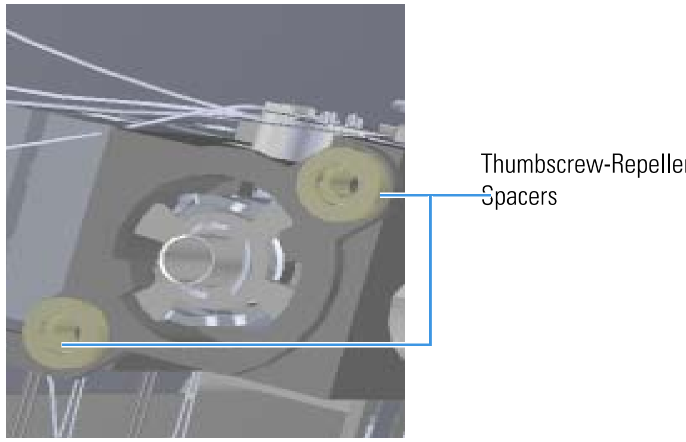
4. Open the manifold door.

Figure 127. Opening the Manifold Door



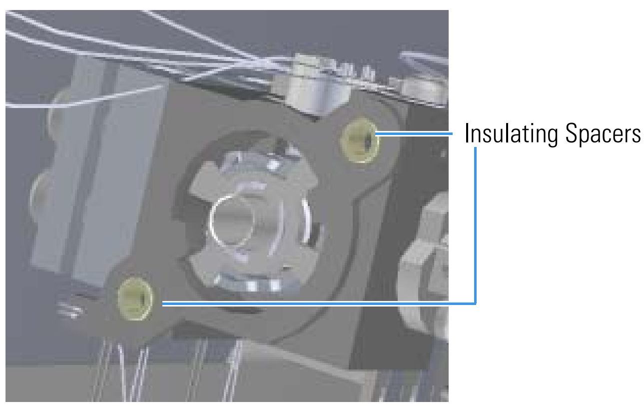
5. Remove the thumbscrew-repeller spacers from the thumbscrews.

Figure 128. Replacing the Thumbscrew-Repeller Spacers



6. Move the locking ring out of the way.
7. Remove and replace the insulating spacers.

Figure 129. Replacing the Insulating Spacers



8. Move the locking ring back into place.
9. Reattach the thumbscrew-repeller spacers.

Note When reattaching the spacers, make sure they fit into the grooves on the thumbscrews. Also, do not over-tighten the thumbscrews or it may crack the spacers.

10. Reattach the source-repeller thumbscrews to the spacers.
11. Reattach the manifold door and the four screws.
12. Reattach the top cover and tighten the top cover panel screw.
13. Restart your system by following the instructions in “Restarting the System” on page 106.

Repeller Plate

❖ **To replace the repeller plate:**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

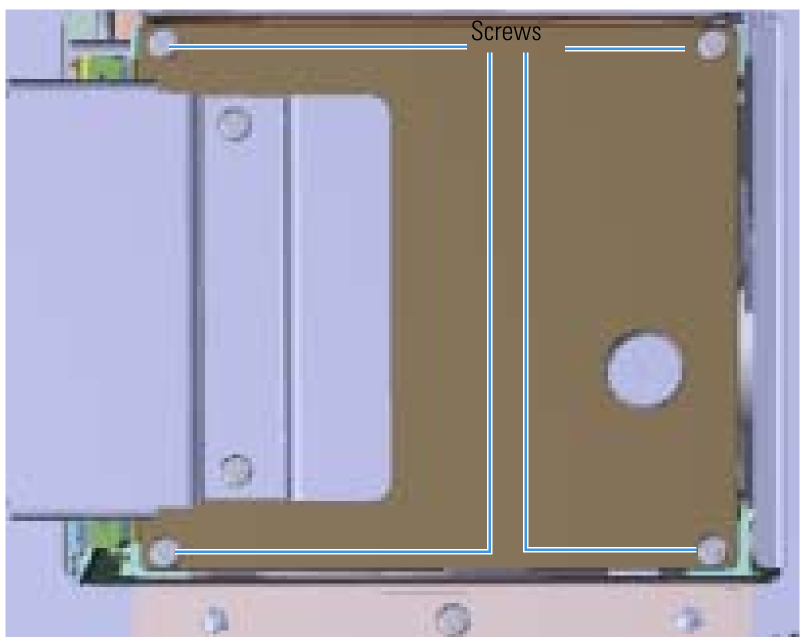
2. Slide the top cover panel toward the back of the instrument and lift it off.

3. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

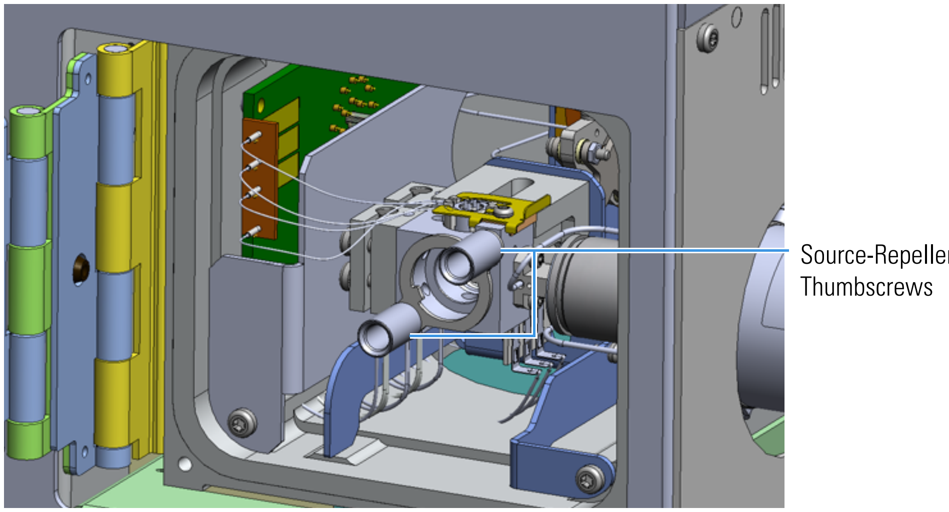
4. Open the manifold door.

Figure 130. Opening the Manifold Door



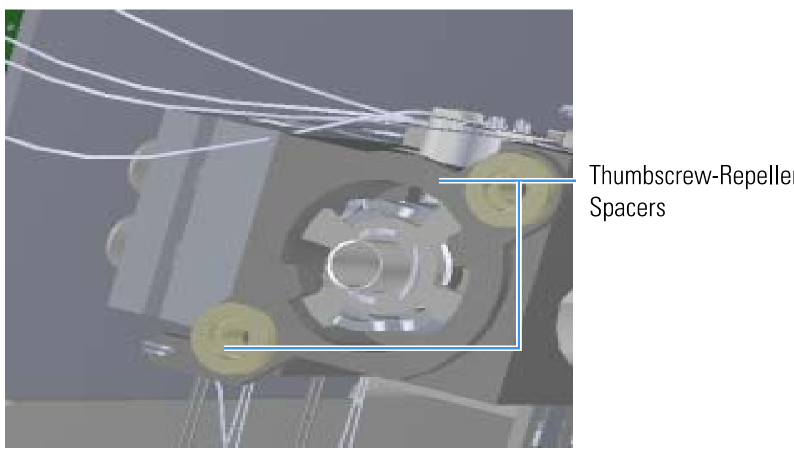
5. Twist off each source-repeller thumbscrew.

Figure 131. Removing the Source-Repeller Thumbscrews



6. Remove the thumbscrew-repeller spacers from the thumbscrews.

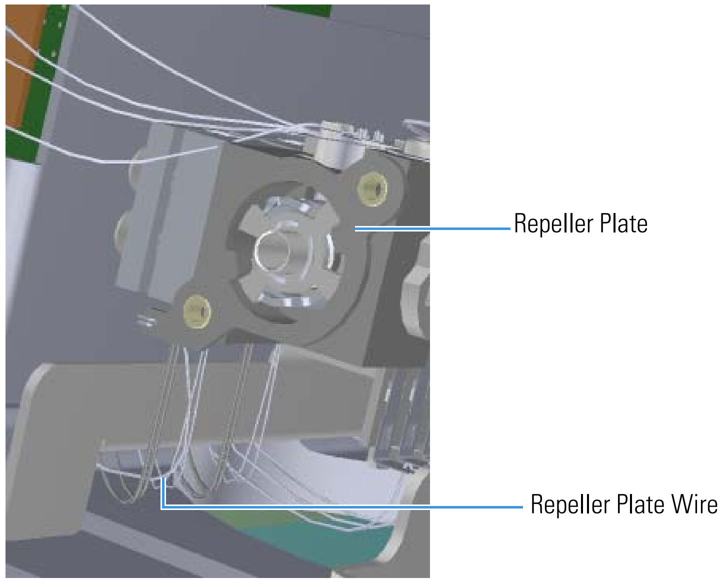
Figure 132. Removing the Thumbscrew-Repeller Spacers



7. Move the locking ring out of the way.

8. Remove repeller plate

Figure 133. Removing the Repeller Plate



9. Disconnect the repeller plate wire from the source interface board.
10. Connect the new repeller plate wire to the source interface board. Do not trap any insulation in the source interface board connector.
11. Attach the new repeller plate.
12. Reattach the insulating spacers.
13. Reattach the source-repeller thumbscrews.
14. Reattach the manifold door and the four screws.
15. Reattach the top cover and tighten the screw.
16. Restart your system by following the instructions in “Restarting the System” on page 106.

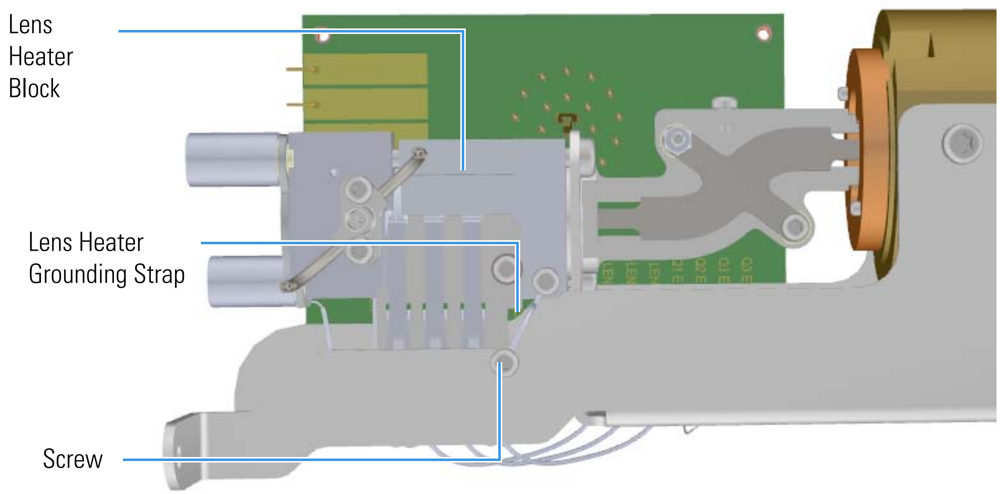
Lens Heater Block Grounding Strap

❖ **To replace the lens heater block grounding strap:**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Use a T10 Torxhead screwdriver to disconnect the lens heater block grounding strap from the lens heater block.

   Figure 134. Disconnecting the Lens Heater Block Grounding Strap



4. Attach a new lens heater block grounding strap and reattach the screws.
5. Once the components are correctly reattached, follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.
6. Restart your system by following the instructions in "Restarting the System" on page 106.

Lens Plate and Springs

❖ To replace the lens plate and springs

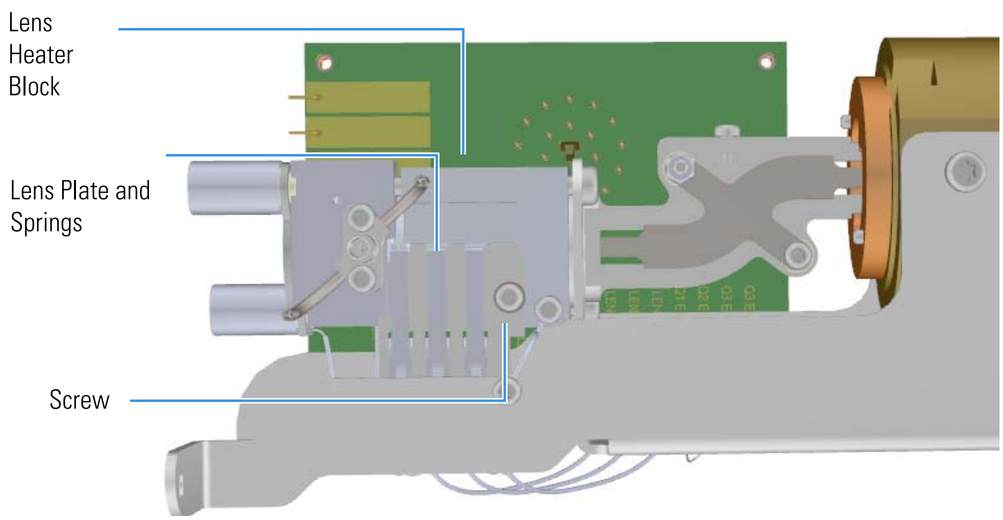
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.

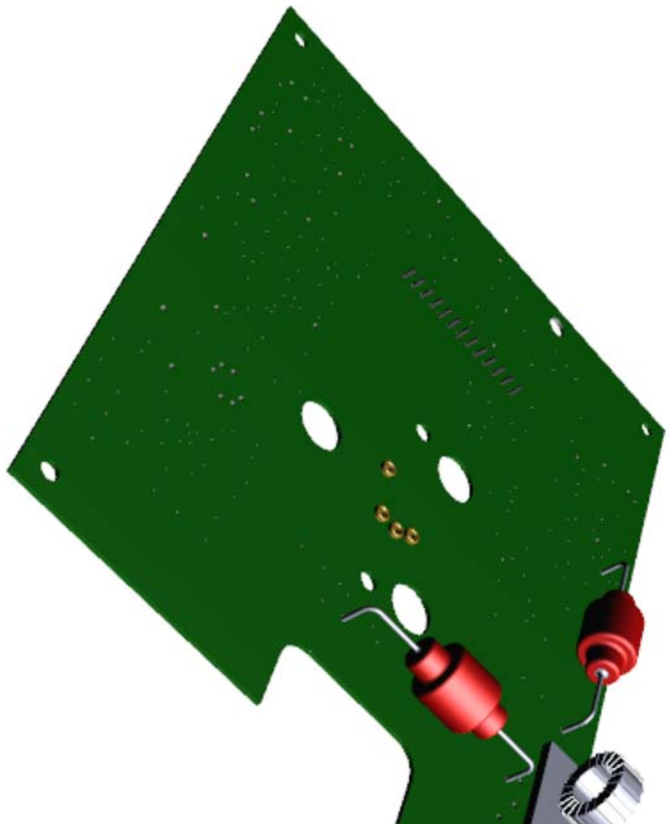
3. Use a T10 Torxhead screwdriver to disconnect the lens plate and springs from the lens heater block.

   Figure 135. Disconnecting the Lens Heater Block Grounding Strap



4. Disconnect the lens 1, lens 2, and lens 3 wires from the source interface board using a flat-tipped screwdriver.

Figure 136. Locating Wires on the Source Interface Board



5. Attach a new lens plate and springs to the lens heater block and reattach the screws.
6. Reattach the lens 1, lens 2, and lens 3 wires from the source interface board using a flat-tipped screwdriver.
7. Once the components are correctly reattached, follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.
8. Restart your system by following the instructions in "Restarting the System" on page 106.

Source to Ion Guide Spacer

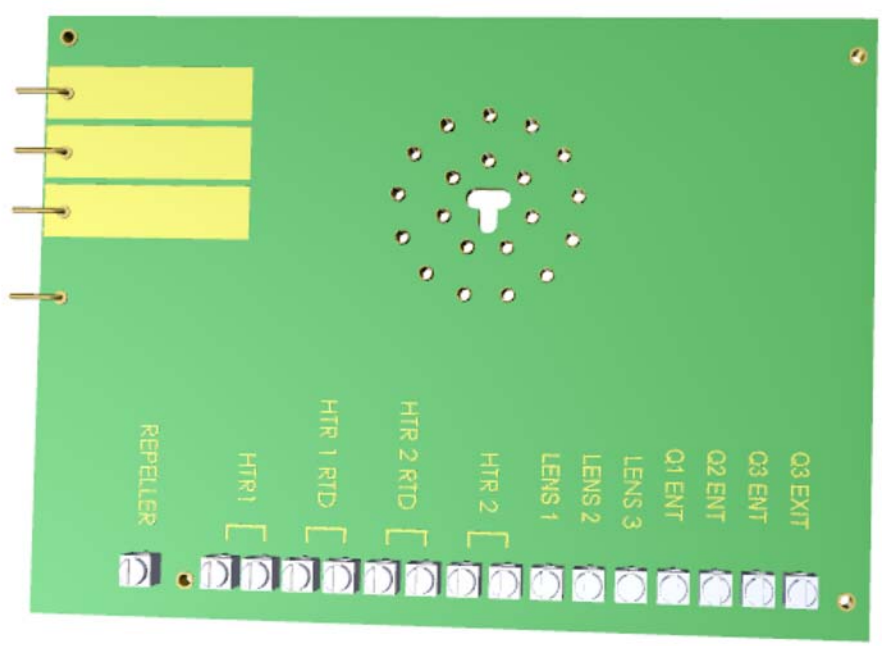
To replace the source to ion guide spacer:

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

WARNING - INSTRUMENT DAMAGE Thermo Fisher Scientific strongly recommends that only trained Thermo Fisher Scientific Field Service Engineers remove and service this component.

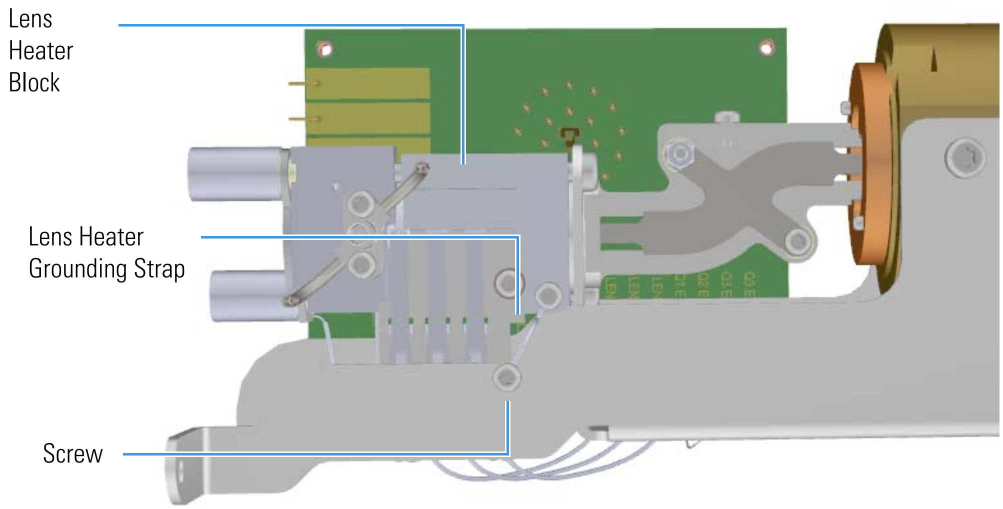
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.
3. Disconnect the Q1 entrance lens, Q1 exit lens, Q3 entrance lens, and Q3 exit lens from the source interface board using a flat-tipped screwdriver.

Figure 137. Locating Wires on the Source Interface Board



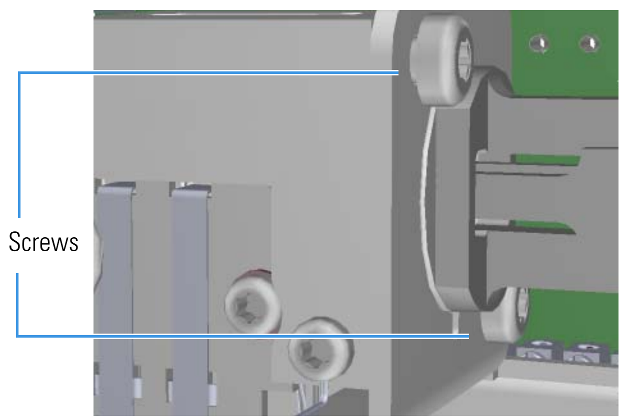
4. Use a T10 Torxhead screwdriver to disconnect the lens heater block grounding strap from the lens heater block, but leave it attached to the tray.

Figure 138. Disconnecting the Lens Heater Block Grounding Strap



5. Use a T20 Torxhead screwdriver to remove the two screws on the back of source block.

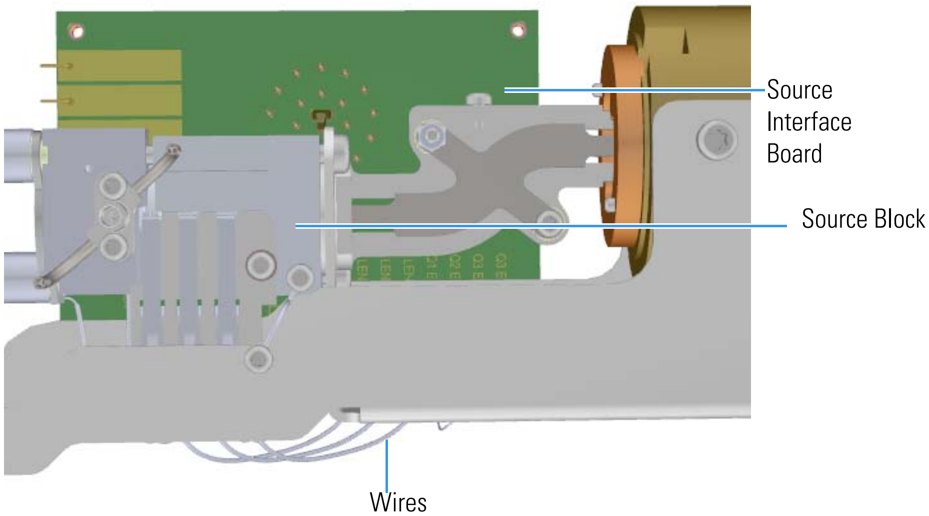
Figure 139. Disconnecting the Source Block to the Analyzer Tray



Note Some of the pieces may detach as you loosen the screws. Do not let them fall.

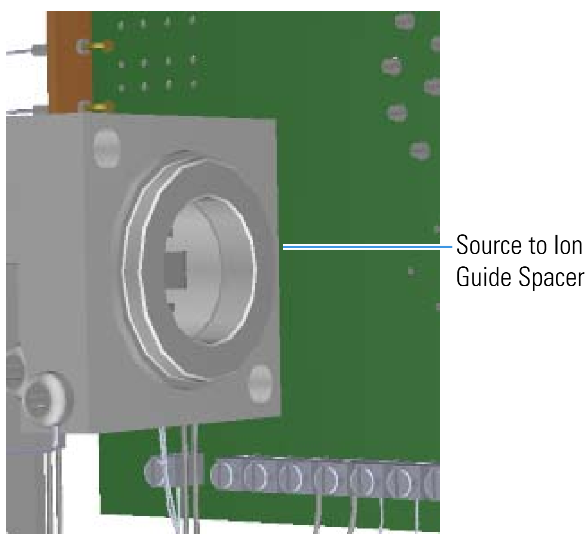
6. Slide the source interface board and the source block out from under the tray without damaging or disconnecting the wires.

Figure 140. Removing the Ion Source from the Analyzer Tray



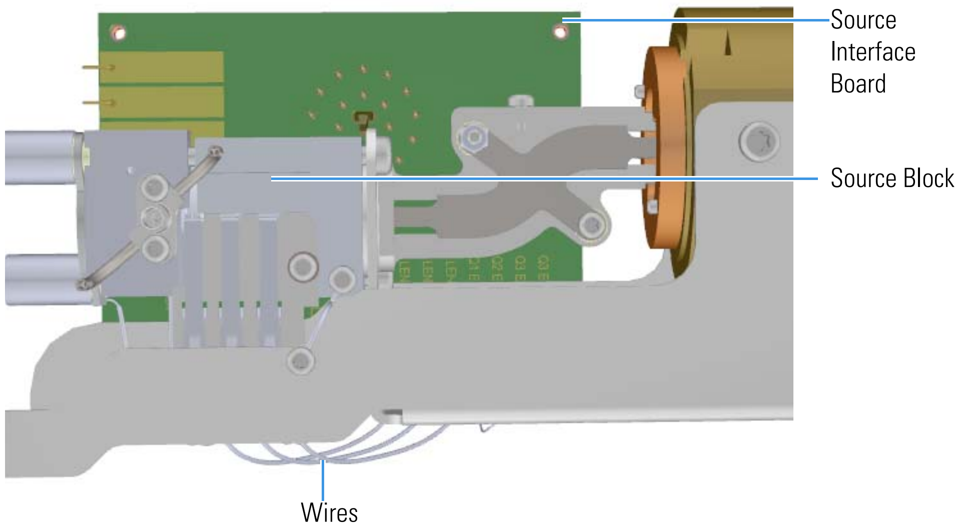
7. Remove and replace the source to ion guide spacer.

Figure 141. Replacing the Source to Ion Guide Spacer



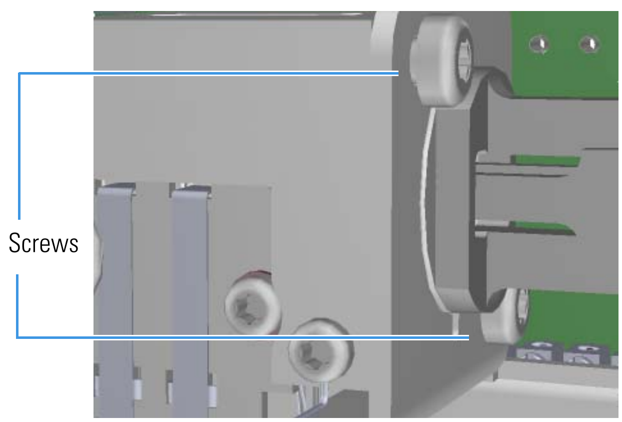
8. Slide the source interface board and source block onto the tray without damaging or disconnecting the wires.

Figure 142. Sliding the Ion Source Block onto the Analyzer Tray



9. Reattach the two screws to the back of the source block.

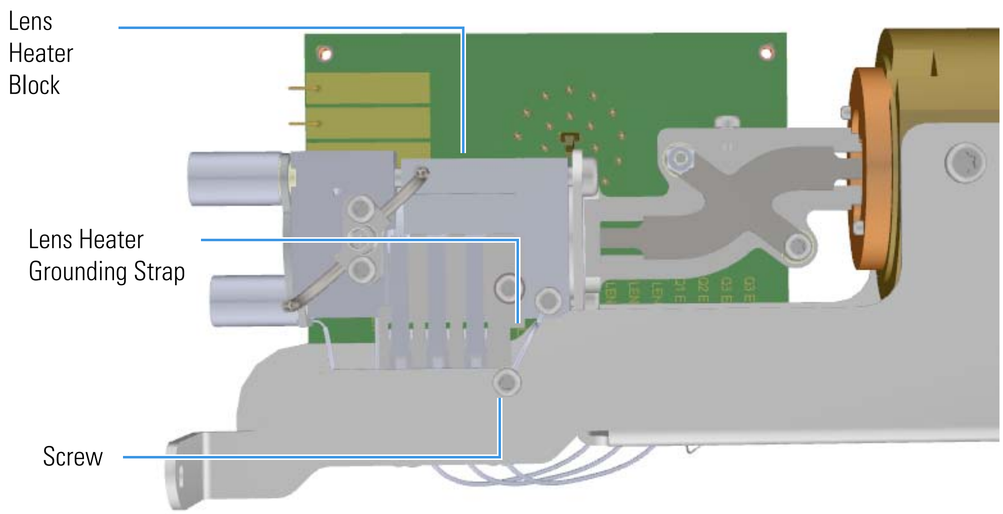
Figure 143. Reconnecting the Ion Source to the Analyzer Tray



IMPORTANT When assembling the source and optics block, take extra care to ensure the blocks are centered properly and that the ion source cartridge provided with the instrument can easily slide in and out of the assembly.

10. Reconnect the lens heater block grounding strap to the lens heater block

Figure 144. Reconnecting the Lens Heater Block Grounding Strap



11. Reconnect the Q1 entrance lens, Q1 exit lens, Q3 entrance lens, and Q3 exit lens to the source interface board using a flat-tipped screwdriver.

12. Once the components are correctly reattached, follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.

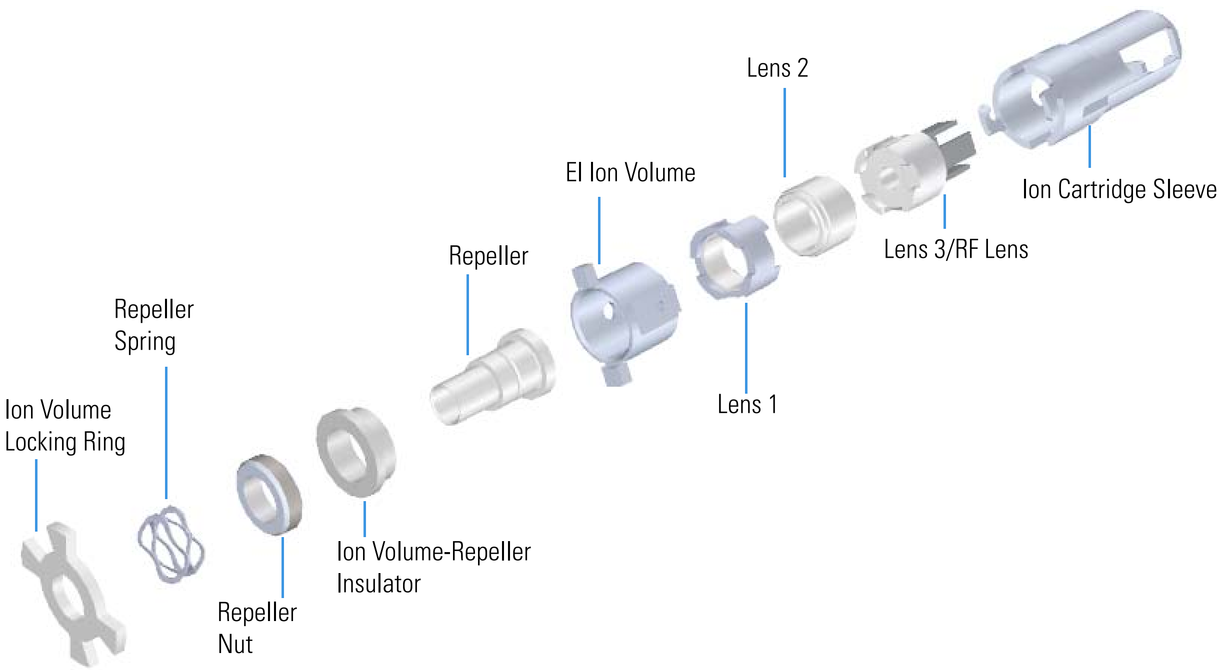
13. Restart your system by following the instructions in "Restarting the System" on page 106.

Ion Source Cartridge

If the components of your ion source cartridge get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

Figure 145. Replaceable Components of the Ion Source Cartridge



❖ To remove the ion source cartridge

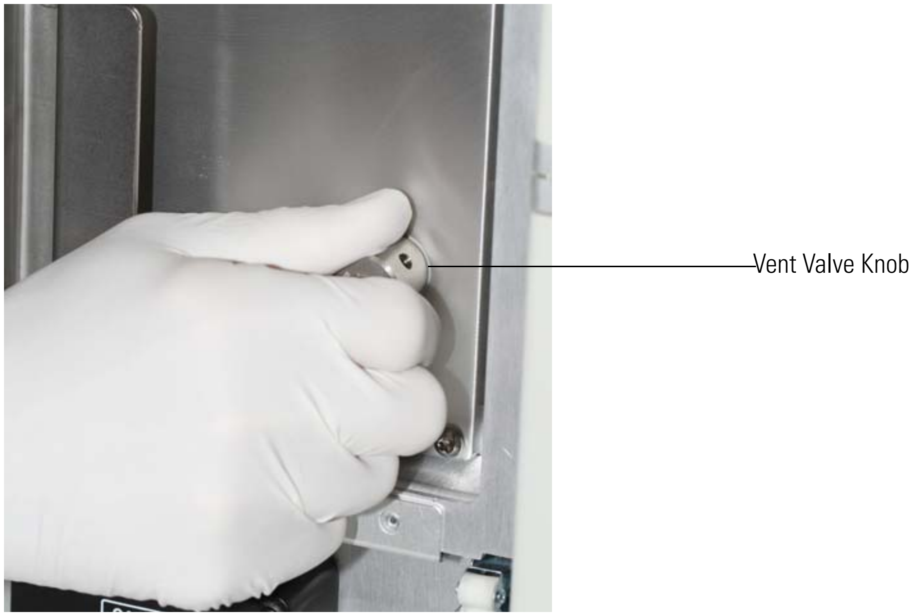
1. Click **Shut Down** on the TSQ Series Duo Dashboard.
2. Click **Yes** to continue the shutdown process. The high voltages, heaters, and turbomolecular pump power off. Once the turbomolecular pump reaches 50% speed, or five minutes elapses, the foreline pump powers off and you may vent the system.

Note The amber vacuum light on the front of the instrument starts blinking rapidly, indicating the mechanical pump has powered off after a five minute period with the turbomolecular pump off (such as when the instrument is shut down), or due to a sustained vacuum fault lasting five minutes. When the turbomolecular pump spins down below 50% speed due to the shut down process, the vacuum light turns off.

3. Reach around the left side to the back of the instrument and push down on the power switch to power-off the instrument.
4. Open the front door of the TSQ Duo mass spectrometer.
5. Open the front door of the instrument.

6. Twist the vent valve knob one and a half times in a counter-clockwise direction to open the vent.

Figure 146. Venting the TSQ Duo Mass Spectrometer



7. Wait five minutes for venting to complete.

CAUTION - INSTRUMENT DAMAGE Do not proceed until the instrument is vented, or pieces of the column or ferrule might blow into the instrument. To ensure that the instrument is vented, check how much the glass cover compresses the top cover o-ring in the manifold. Once the o-ring surface touching the glass is about 1 mm, it is safe to open the instrument and remove the column.

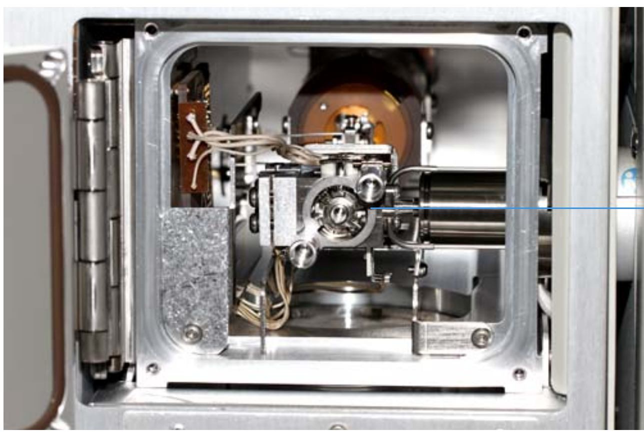
8. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door. See Figure 147.

Note Remove the screws completely so that they do not scratch the manifold when you close the door.

Figure 147. Removing the Manifold Door Screws

9. Open the manifold door. You can now see the ion source block.

Figure 148. Locating the Ion Source Block

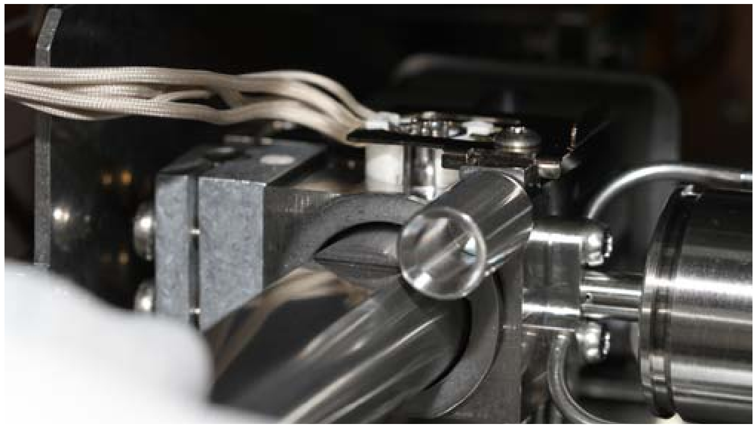


10. With the flat side of the small source removal tool twisted slightly to the right, insert the tool into the ion source block as shown in Figure 149.

Figure 149. Inserting the Small Source Removal Tool

11. Twist the tool to the left so that the flat side faces up. The ion source cartridge should now be connected to the small source removal tool. See Figure 150.

Figure 150. Twisting the Small Source Removal Tool



12. Slowly remove the ion source cartridge from the instrument.

Figure 151. Removing the Ion Source Cartridge

CAUTION - BURN HAZARD The ion source cartridge may be hot.

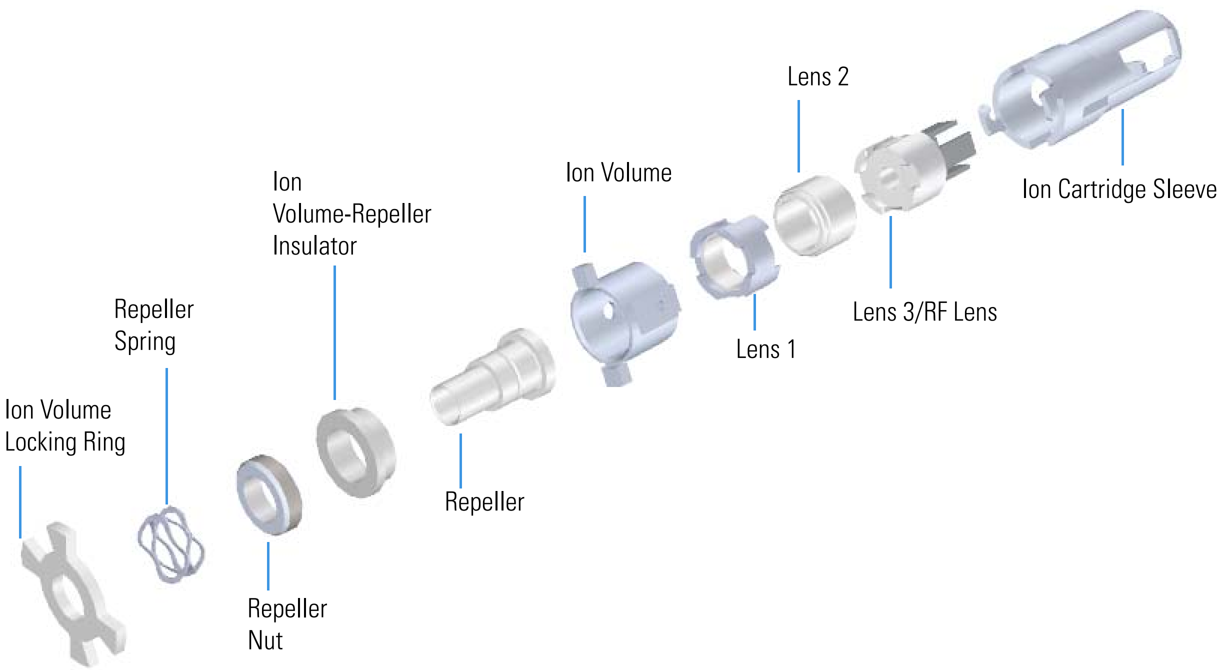
13. Let the ion source cartridge cool down before removing the components from the source tool.

14. Set the ion source cartridge and holder on a clean surface

15. Disassemble the ion source cartridge by removing the locking ring first, then the repeller spring, then the nut, insulator, and repeller (which comes out in one piece), ion volume, lens 1, lens 2, and lens 3/RF lens.

IMPORTANT Many nitrile and latex gloves not certified for clean room use contain silicone mold releasing agents that will contaminate the instrument. For this reason, clean room gloves are strongly recommended when handling the ion source cartridge. We recommend Cardinal Health CP100 Nitrile Cleanroom Gloves. See the *TSQ Duo Spare Parts Guide* for ordering information.

Figure 152. Ion Source Cartridge Components



16. Set the components on a clean work surface.

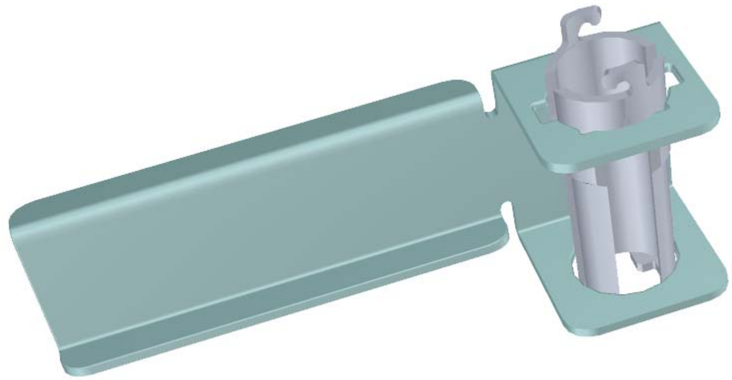
17. Replace the ion source cartridge or any individual component.

❖ To reassemble the ion source cartridge

1. Place the ion volume-repeller insulator on the repeller and hold it in place with the repeller nut. Set it aside for now.

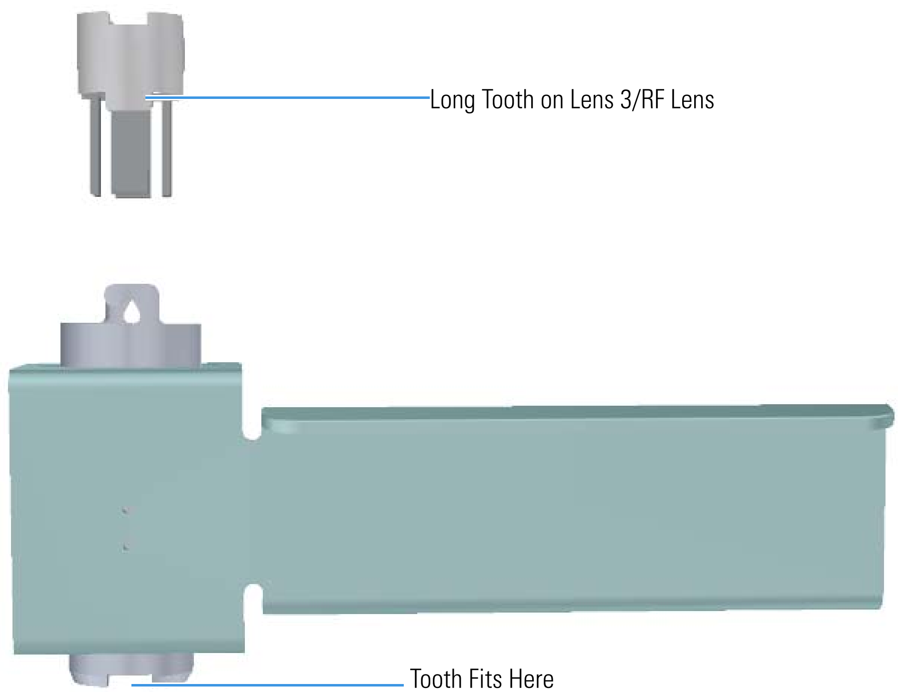
2. Insert the ion cartridge sleeve into the source holder.

Figure 153. Inserting the Sleeve into the Source Holder



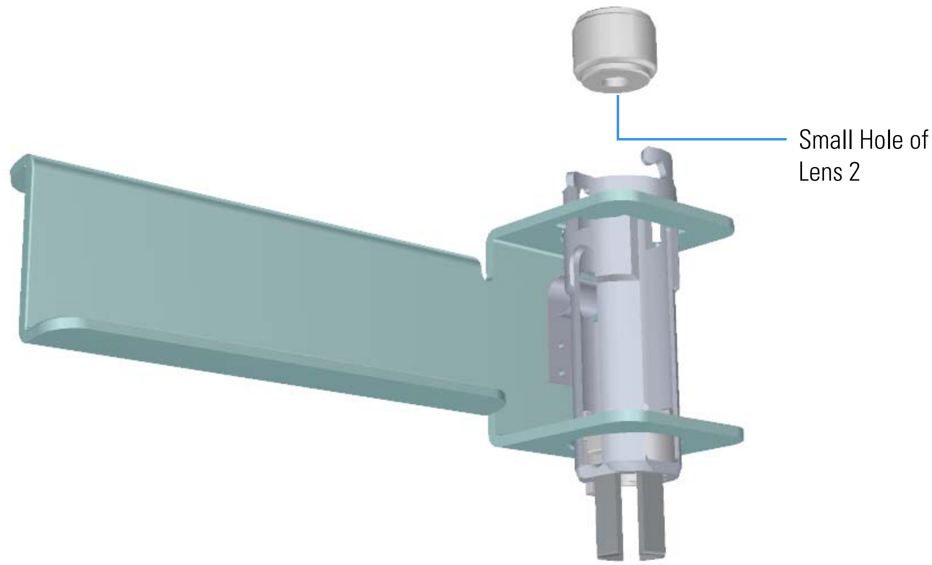
3. Align the long tooth of lens 3/RF lens with the notch on the bottom of the sleeve and drop the lens into the sleeve.

Figure 154. Inserting Lens 3/RF Lens into the Source Sleeve



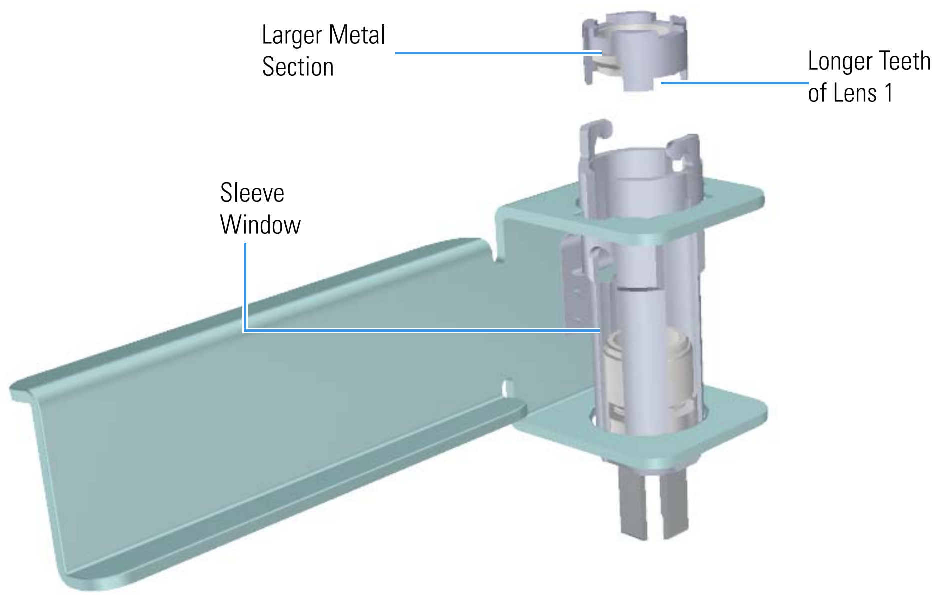
4. Place lens 2 on top of lens 3/RF lens with the small hole facing down. It should fit snugly and sit evenly on top of lens 3/RF lens.

Figure 155. Inserting Lens 2 into the Source Sleeve



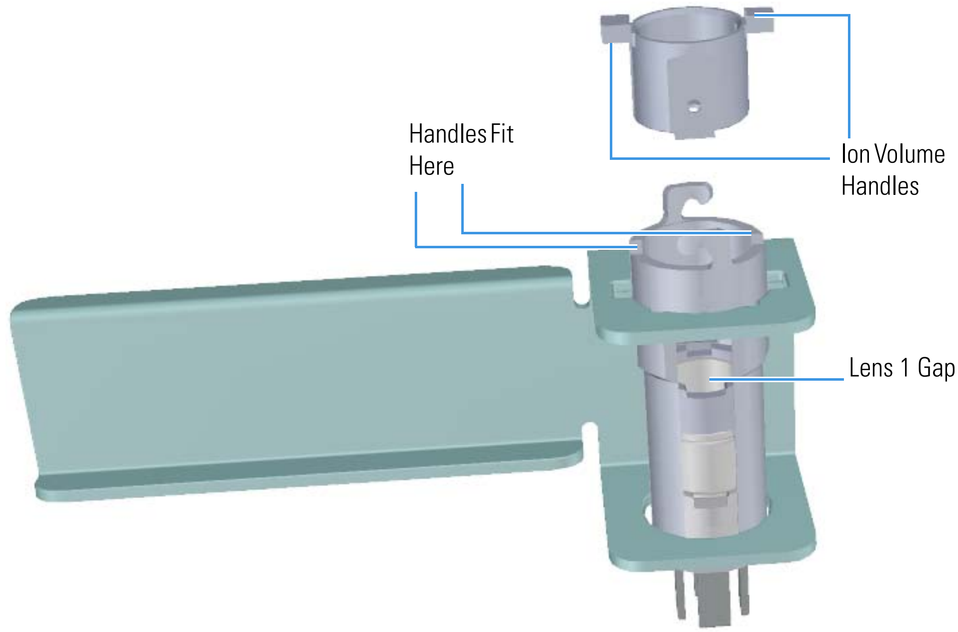
5. With the longer teeth of lens 1 facing down toward lens 2, align the larger metal section of lens 1 with the sleeve window and let it fall into place.

Figure 156. Inserting Lens 1 into the Source Sleeve



6. Insert the ion volume with the handles fitting into the notches of the sleeve. Make sure the ion volume is firmly seated into the gap on lens 1. You may need to rotate lens 1 slightly to make the ion volume fit correctly.

Figure 157. Inserting the Ion Volume into the Source Sleeve



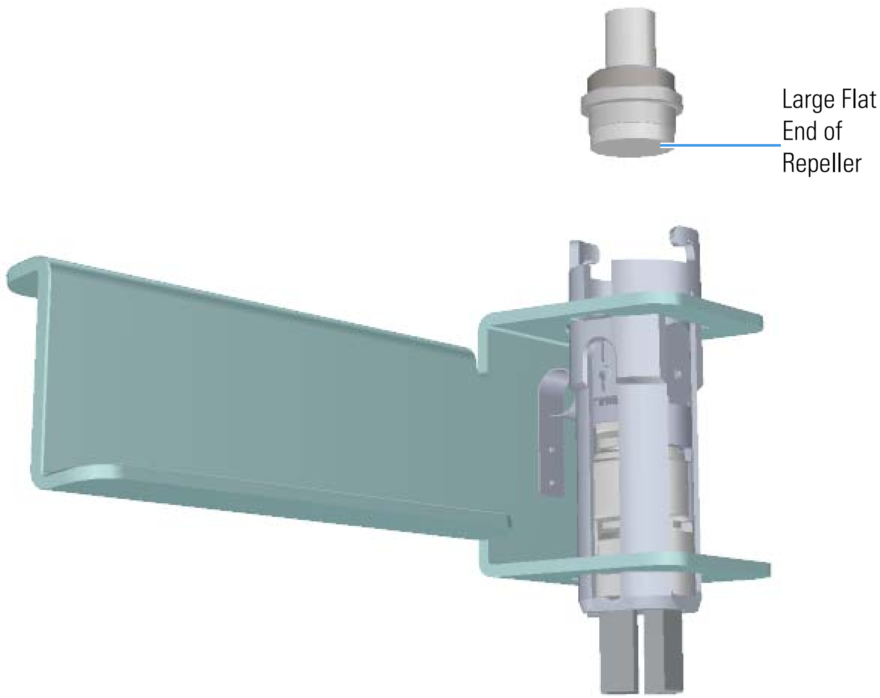
Note The ion volume handles are different sizes and will only fit into the sleeve one way.

7. Insert the ion volume repeller insulator onto the repeller.

8. Tighten the repeller nut.

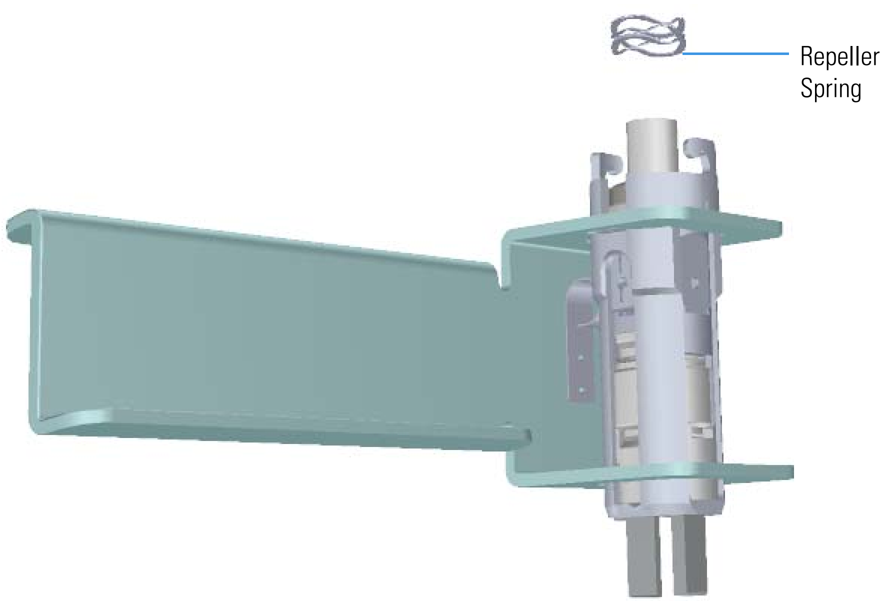
9. Insert the large flat end of the repeller so that it rests on top of the ion volume.

Figure 158. Inserting the Repeller into the Source Sleeve



10. Slide the repeller spring onto the repeller.

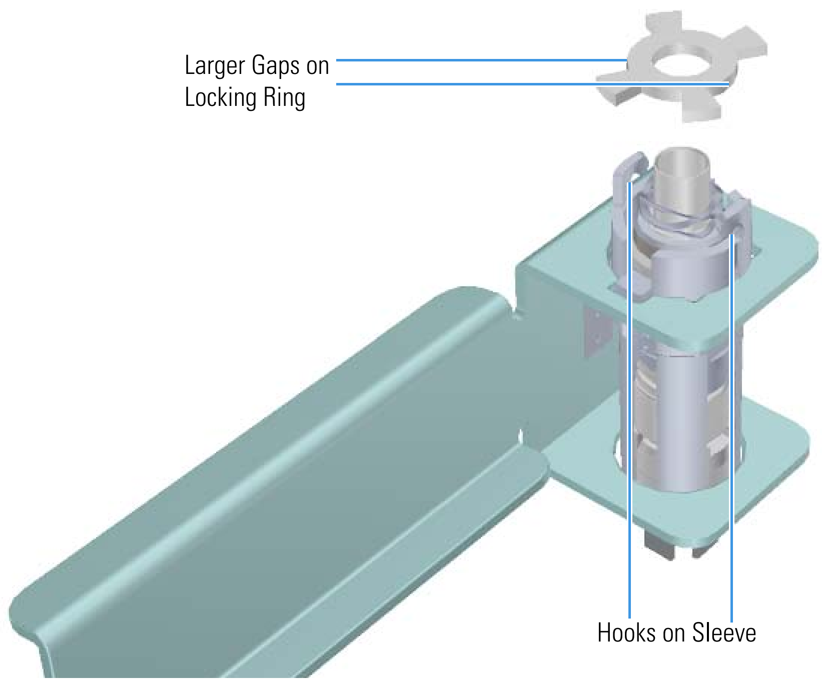
Figure 159. Inserting the Repeller Spring into the Sleeve



11. Place the locking ring on top of the repeller spring so that the repeller protrudes through the center hole on the locking ring. The hooks on the sleeve fit between the larger gaps on the locking ring.

Note Do not twist and lock the locking ring on the sleeve at this time.

Figure 160. Inserting the Locking Ring into the Sleeve



❖ To reinsert the ion source cartridge

IMPORTANT When inserting a cold ion source cartridge such as after cleaning, the ion source and lens stack will expand as the source cartridge heats, often pushing the ion volume and lenses away from the rear of the instrument where they are firmly held by the RF Lens spring contacts. To avoid intermittent electrical contacts to the lenses, you should insert the ion source cartridge, wait 30 minutes for it to get to temperature, then remove and reinsert it.

1. Attach the ion source cartridge to the end of the small source removal tool as shown in Figure 161.

Figure 161. Attaching the Ion Source Cartridge to the Small Source Removal Tool

2. With the source and the flat side of the tool facing straight up, insert the ion source cartridge into the instrument. See Figure 162.

Figure 162. Inserting the Ion Source Cartridge into the Instrument

3. Once the ion source cartridge is inserted into the ion source block, turn the small source tool to the right until you feel the ion source cartridge engage.

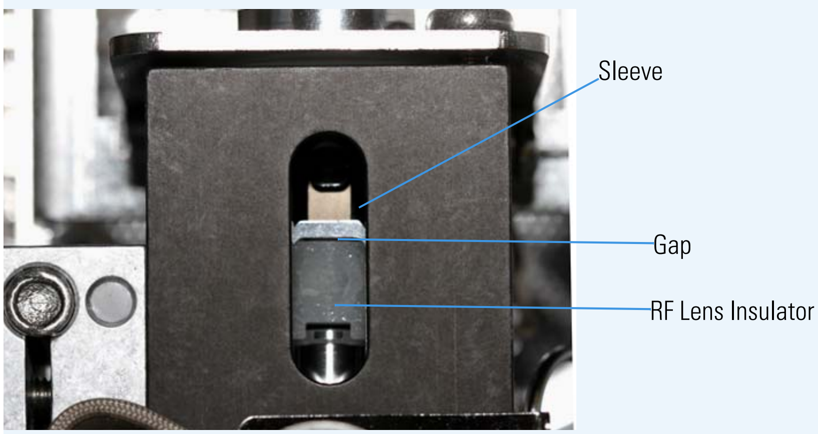
4. Remove the small source tool from the instrument.

Figure 163. Removing the Small Source Tool from the Instrument

5. Be sure that the source interface board wires do not touch anything metal in the manifold before closing the door.

Figure 164. Securing the Source Interface Board Wires

Tip At this point, you may want to remove the top cover and look at the position of the ion source cartridge through the manifold cover. There should be a small gap between the RF Lens insulator and the inside end of the sleeve. This helps to prevent thermal expansion of the sleeve from moving the optics.



6. Close the manifold door and slightly tighten the vent valve knob by turning it one half turn clockwise.

7. Flip the power switch on the back of the TSQ Duo instrument upwards to power on the instrument. This will help you achieve good vacuum.

8. Center the manifold door so that the screw holes are aligned with the manifold. And insert the four manifold screws, tightening each finger-tight such that the o-ring is engaged on every surface.

9. Tighten the four manifold screws using a T20 Torxhead screwdriver.

10. Tighten the vent valve knob completely by turning it approximately one turn clockwise.

11. Close the front door of the instrument.

12. For optimal performance, wait at least fifteen minutes for the ion source to heat up to the same temperature as the inside of the instrument. Otherwise, the masses or intensities may be different

IMPORTANT When inserting a cold ion source cartridge such as after cleaning, the ion source and lens stack will expand as the source cartridge heats, often pushing the ion volume and lenses away from the rear of the instrument where they are firmly held by the RF Lens spring contacts. Inserting the source with the gap shown in the tip above can help prevent contact issues.

Replacing Components of the Manifold

If the components of your manifold get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

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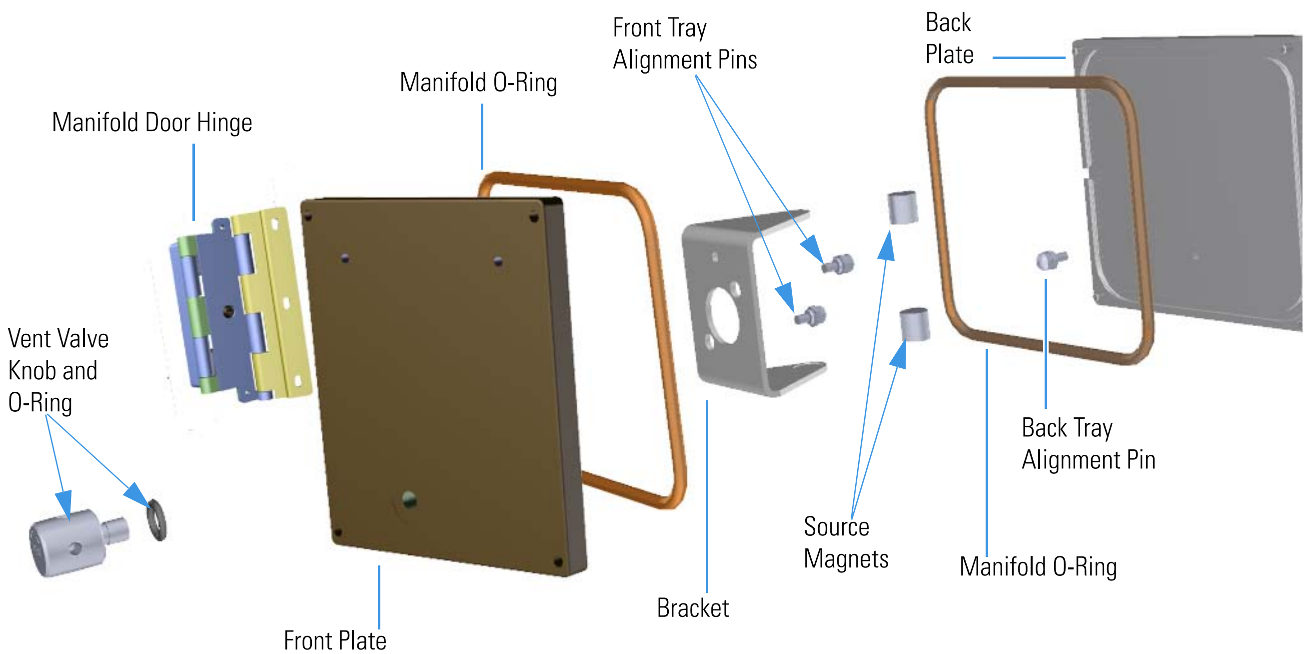
Figure 165. Replaceable Components of the Manifold



Manifold Door Hinge

❖ **To replace the manifold door hinge:**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

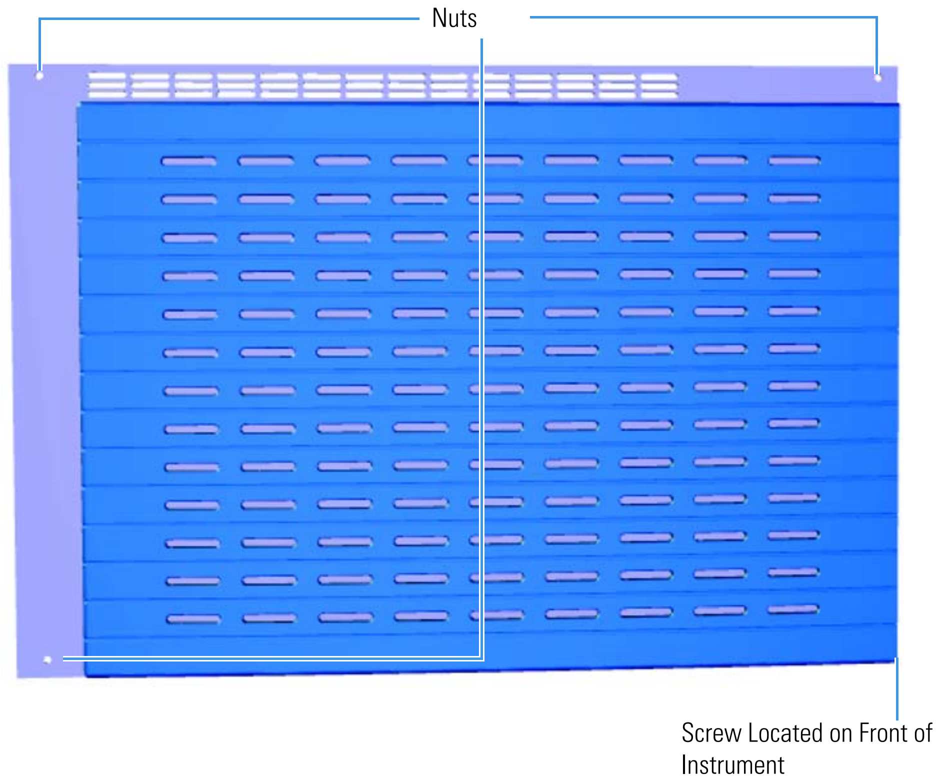
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column.

2. Slide the top cover panel toward the back of the instrument and lift it off.

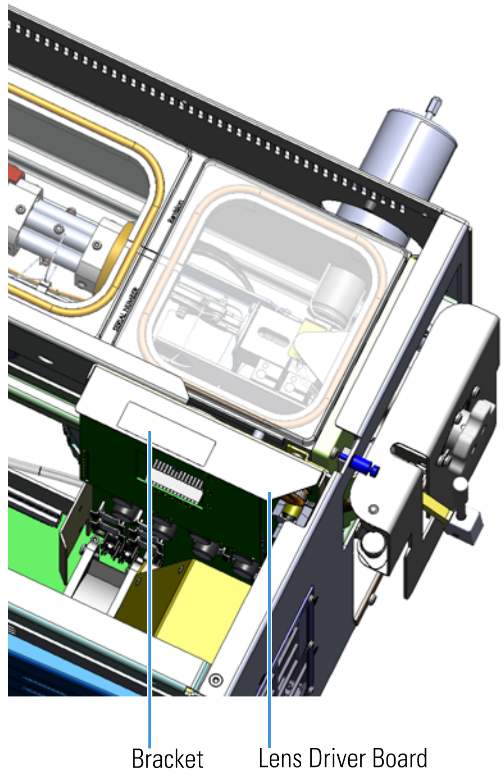
3. Remove the four screws on the left hand front panel and remove the panel. One is located at the bottom left side of the front of the instrument.

Figure 166. Locating the Left Hand Front Panel Screws



4. The lens driver board is the first board standing on end in the center of the instrument.

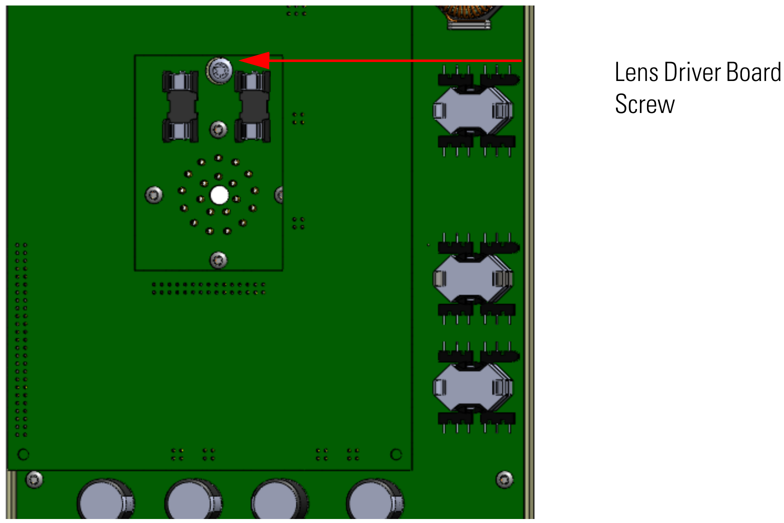
Figure 167. Locating the Lens Driver Board



5. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

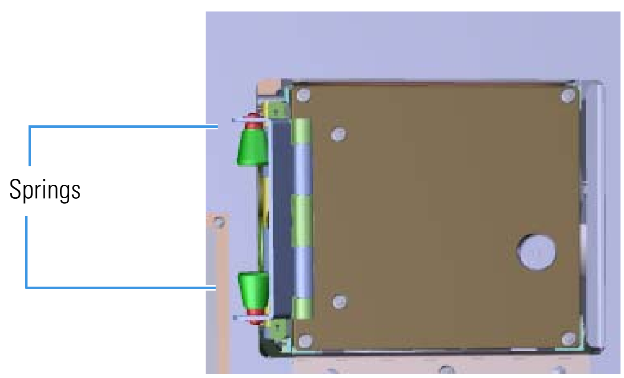
Figure 168. Removing the Lens Driver Board



6. Use your fingers to carefully pull the bracket of the board away from the chassis and toward the left side of the instrument, until the 20 pin connector clears the feedthrough.

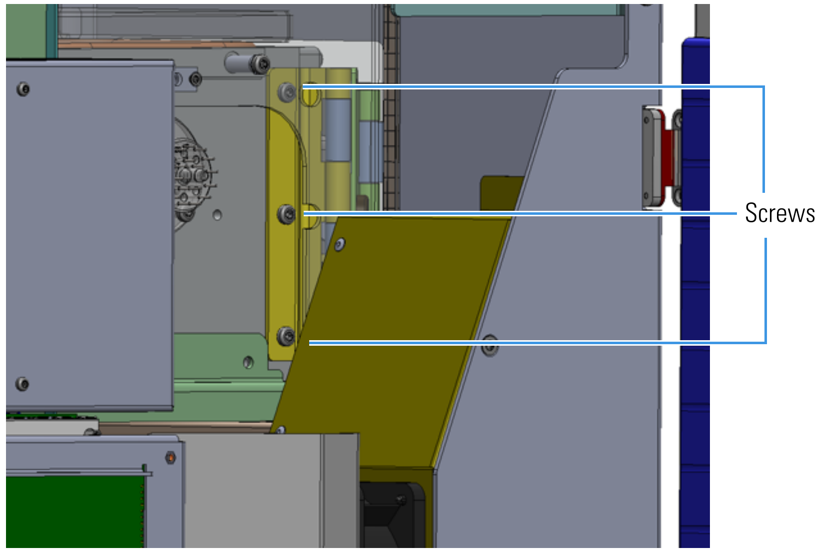
7. Pinch together the two springs on the left side of the manifold door to free the hinge.

Figure 169. Freeing the Hinge



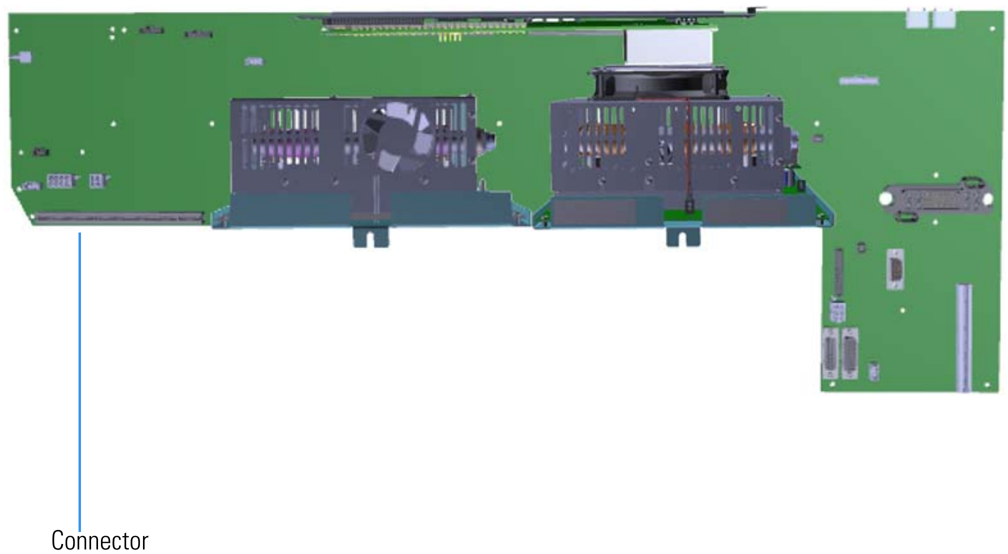
8. Look through the left side of the instrument and use a T20 Torxhead screwdriver to remove the three screws connecting the hinge to the chassis.

Figure 170. Replacing the Manifold Door Hinge



9. Replace the manifold door hinge and reattach the screws.
10. From the front of the instrument, reattach the hinge spring to the manifold front plate.
11. Align the connector on the bottom of the lens driver board with the connectors on the distribution board beneath it. It will click into place when its in the right position.

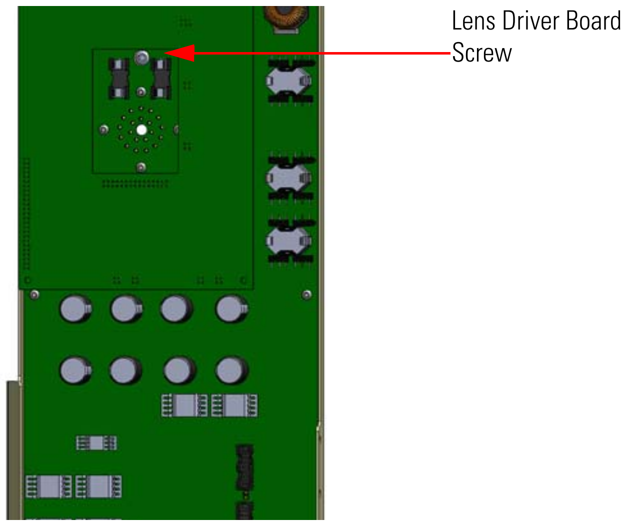
Figure 171. Reinstalling the Lens Driver Board



12. Look through the left side of the instrument and use a T20 Torxhead screwdriver to tighten the screw holding the lens driver board in place on the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 172. Replacing the Lens Driver Board



13. Replace the left hand front panel and tighten the two screws.

14. Restart your system by following the instructions in "Restarting the System" on page 106.

Front Manifold Plate

❖ **To replace the front manifold plate:**

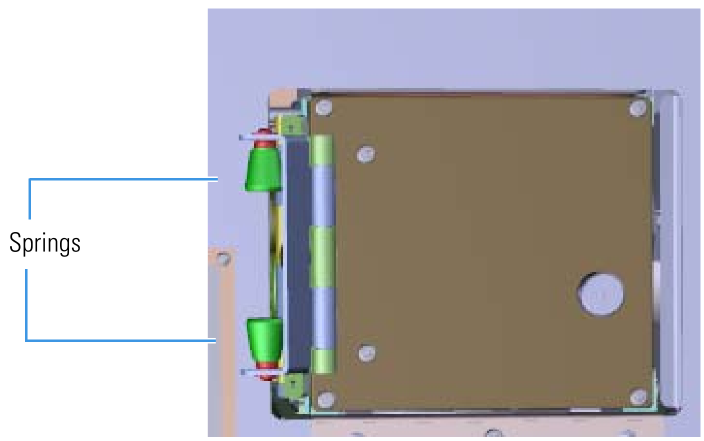
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column.

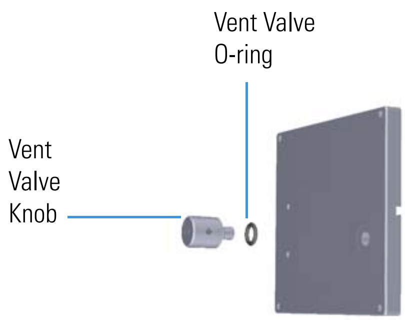
2. Pinch together the two springs on the left side of the manifold and remove the hinge.

Figure 173. Removing the Hinge



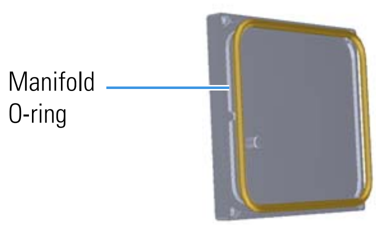
3. Use a T20 Torxhead screwdriver to remove the four screws found in the four corners of the manifold door.
4. Set the manifold door right side up on a clean work surface
5. Twist the vent valve knob to remove it and the vent valve o-ring.

Figure 174. Removing the Vent Valve Knob and O-Ring



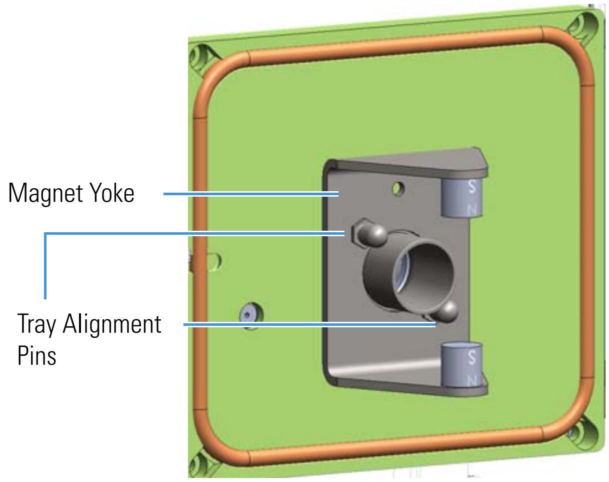
6. Flip the manifold door over and remove the manifold o-ring.

Figure 175. Removing the Manifold O-Ring



7. Twist and remove the tray alignment pins that hold the magnet yoke to the back of the manifold door. The magnet yoke will pull free of the door, releasing the alignment collar.

Figure 176. Removing the Tray Alignment Pins and Bracket



8. Replace the front manifold plate.
9. Reattach the front plate o-ring.
10. Reattach the magnet yoke, alignment collar, and tray alignment pins.
11. Flip the door over and insert and tighten the vent valve knob and o-ring into the front manifold plate.
12. Pinch the springs together and reattach the hinge.
13. Restart your system by following the instructions in “Restarting the System” on page 106.

Back Manifold Plate

❖ **To replace the back manifold plate:**

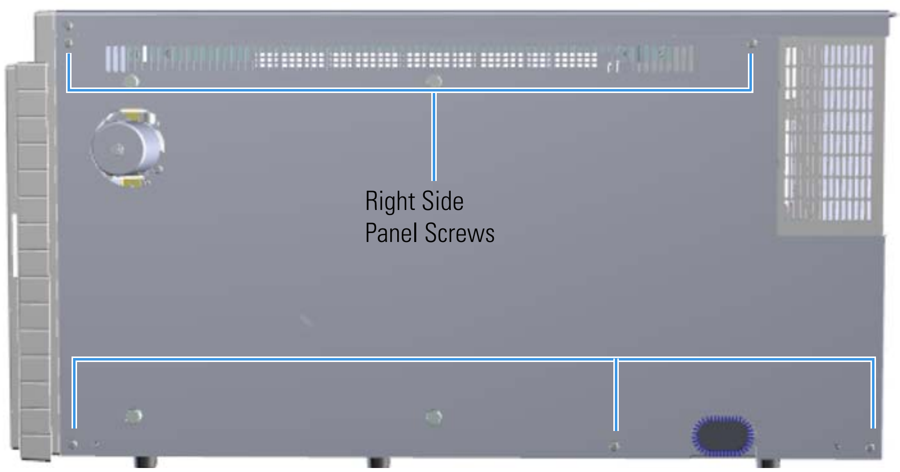
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge.

2. Pull the column fully out of the transfer line and move the instrument away from the GC.
3. Slide the top cover panel toward the back of the instrument and lift it off.
4. Use a T20 Torxhead screwdriver to remove the screw at each corner of the right side panel.

Figure 177. Removing the Right Side Panel Screws

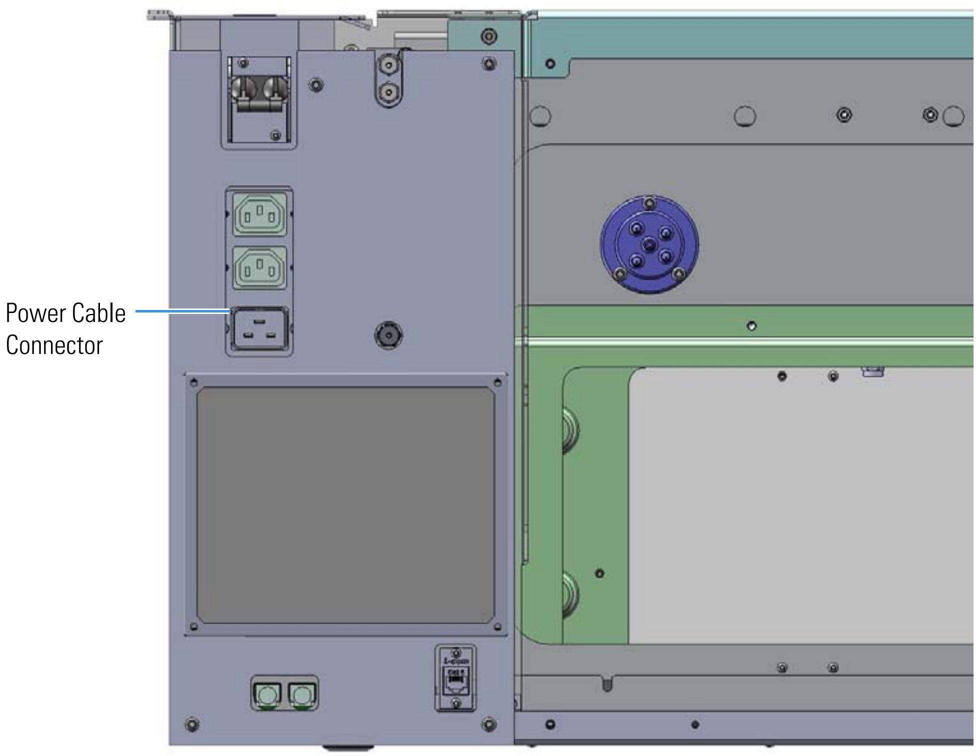


5. Pull the right side panel away from the chassis.

6. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.

7. Disconnect the power cable from the left side of the TSQ Duo instrument.

Figure 178. Disconnecting the Power Cables



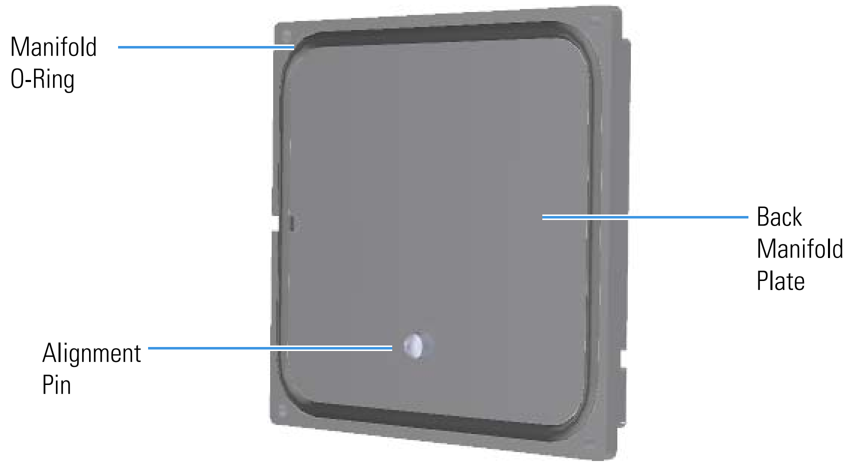
8. Use a T20 Torxhead screwdriver to remove the two screws holding the power supply system to the top of the back panel.

9. Grasp the power supply system and lift it out of the instrument. It fits snug, so you may have to shake it as you lift it out.

10. Use a T20 Torxhead screwdriver to remove the four screws holding the back manifold plate onto the instrument.

11. Remove the tray alignment pin and manifold o-ring and put them on the new back manifold plate. Replace the pin and o-ring, if necessary.

Figure 179. Replacing the Back Manifold Plate



12. Reattach the back manifold plate to the instrument. The back manifold plate must be reinstalled with the pin at the bottom.

13. Slide the power supply back into the instrument.

> **Note** Make sure the electrometer board cable is not in the way when you reinstall the power supply.

14. Reattach the two screws holding the power supply to the instrument.

15. Reconnect the power cables on the left hand sub panel of the TSQ Duo instrument.

16. Replace the analyzer tray into the instrument by following the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104.

17. Reattach the right side panel and top cover panel and tighten the screws.

18. Reattach the GC oven and transfer line.

19. Restart your system by following the instructions in "Restarting the System" on page 106.

Tray Alignment Pins, Magnet Yoke, Manifold O-Ring, and Source Magnets

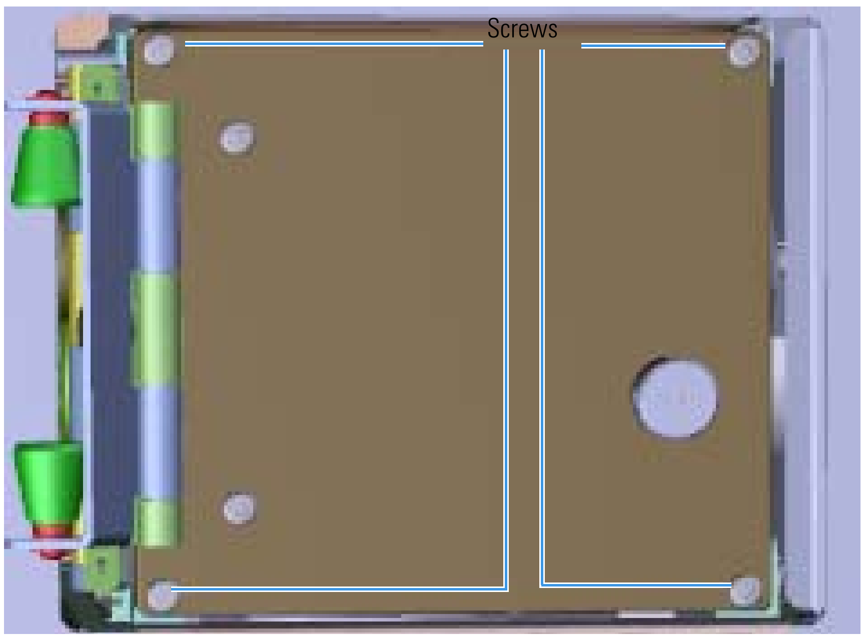
❖ **To replace the tray alignment pins, magnet yoke, manifold o-ring, or source magnets on the manifold door**

Note For information about replacing the tray alignment pin on the back manifold plate, see Back Manifold Plate.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or the column. If you are using hydrogen as a carrier gas, power off the GC.

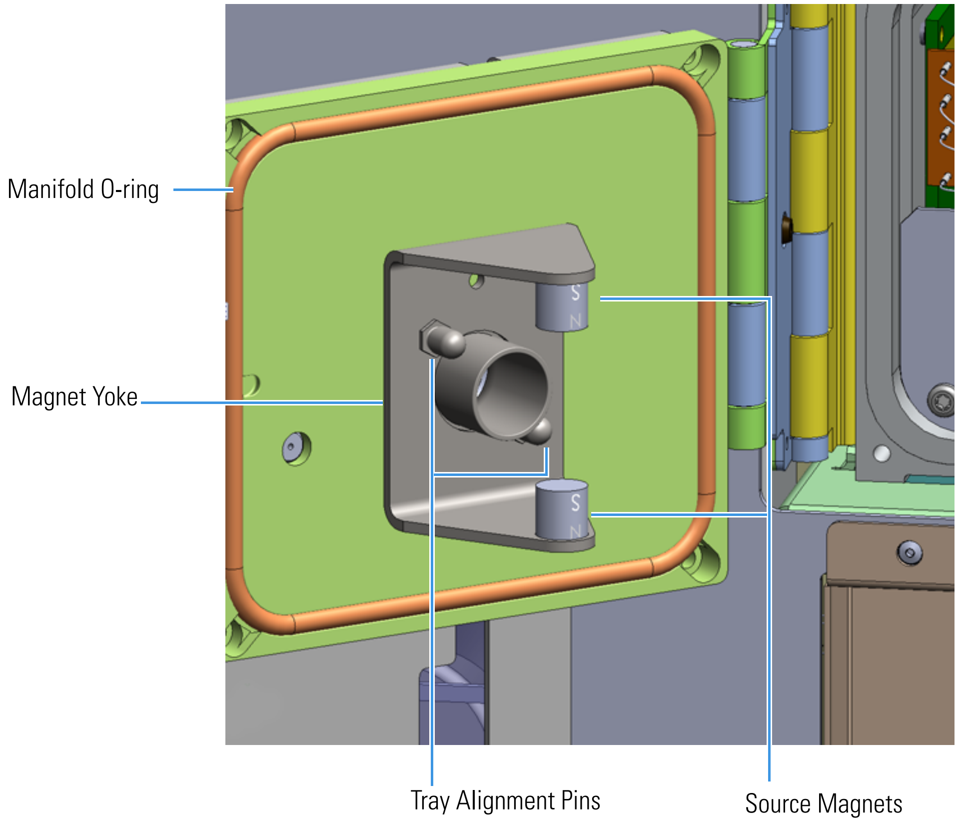
2. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Figure 180. Opening the Manifold Door



3. Open the manifold door and replace the tray alignment pins, magnet yoke, source magnets, or manifold o-ring as needed on the back of the door,

Figure 181. Replacing the Tray Alignment Pins, Bracket, Manifold O-ring, and Source Magnets



4. Close the manifold door and reattach the four screws.

5. Restart your system by following the instructions in "Restarting the System" on page 106.

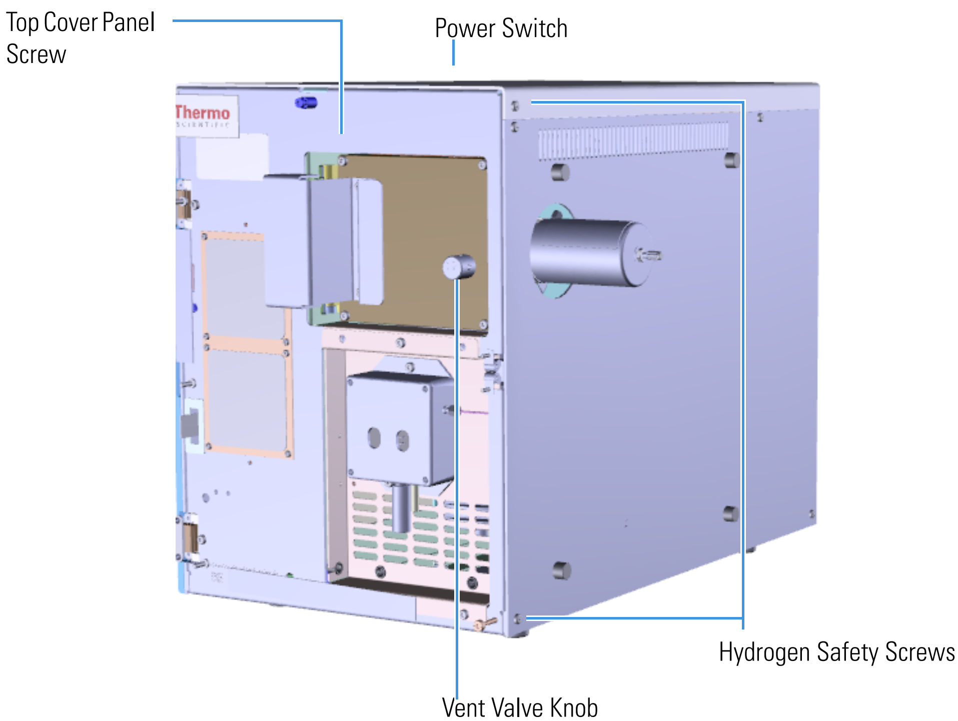
Vent Valve Knob and O-Ring

❖ To replace the vent valve knob and o-ring

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or column. If you are using hydrogen as a carrier gas, power off the GC.

   Figure 182. Powering Off the TSQ Duo Instrument



2. Remove and replace the vent valve knob and o-ring. Be careful not to pinch the o-ring during installation.

3. Restart your system by following the instructions in "Restarting the System" on page 106.

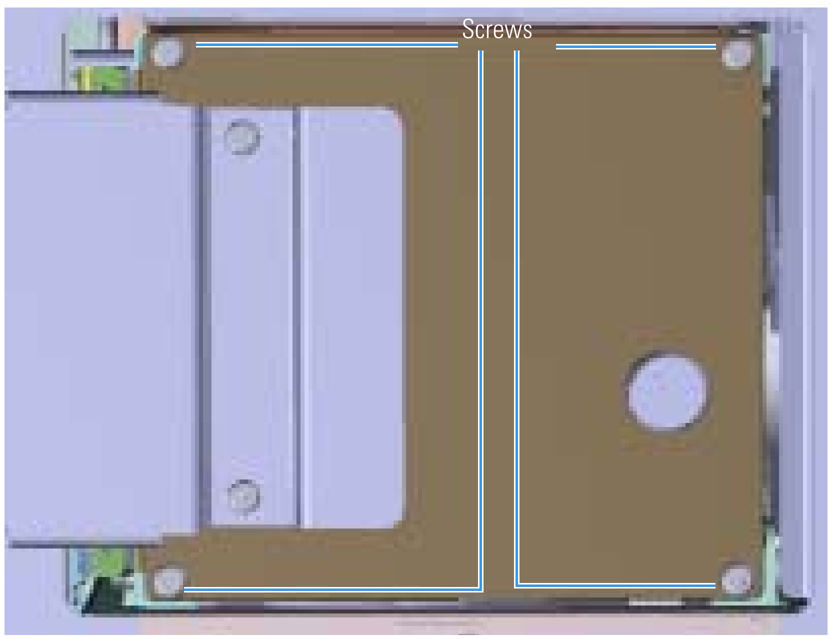
Delivery Tubes

❖ **To replace the delivery tubes**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

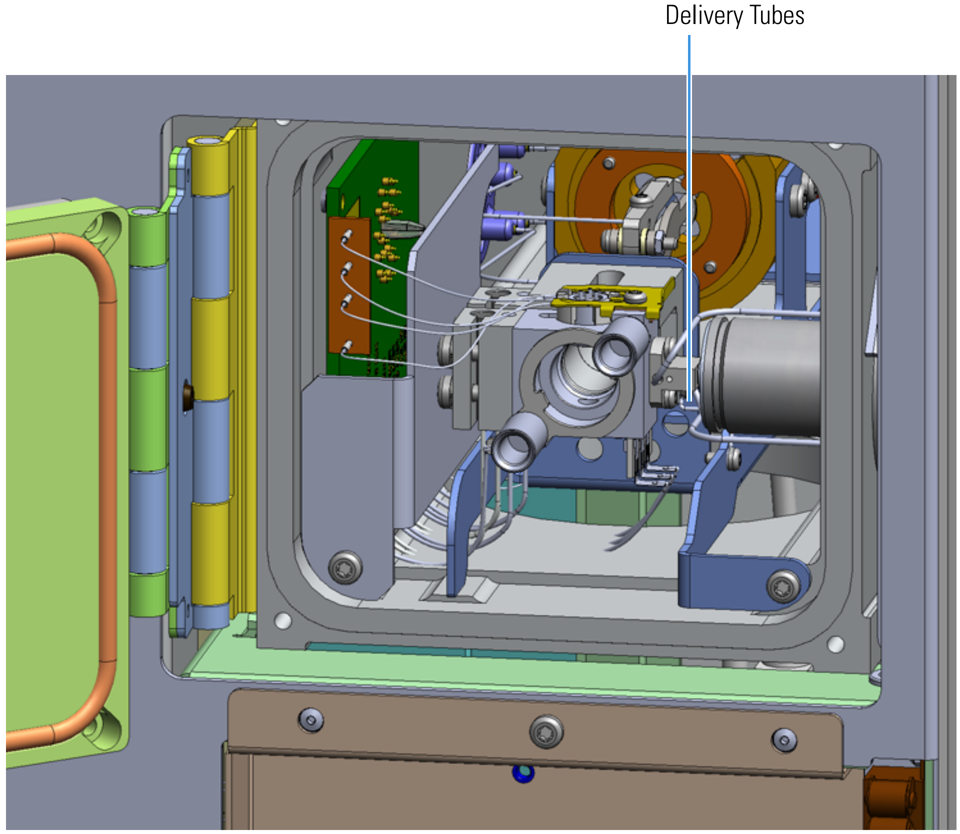
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or the column. If you are using hydrogen as carrier gas, power off the GC.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

Figure 183. Opening the Manifold Door



4. Open the manifold door and replace the delivery tubes.

Figure 184. Replacing the Delivery Tube



5. Close the manifold door and reattach the four screws.

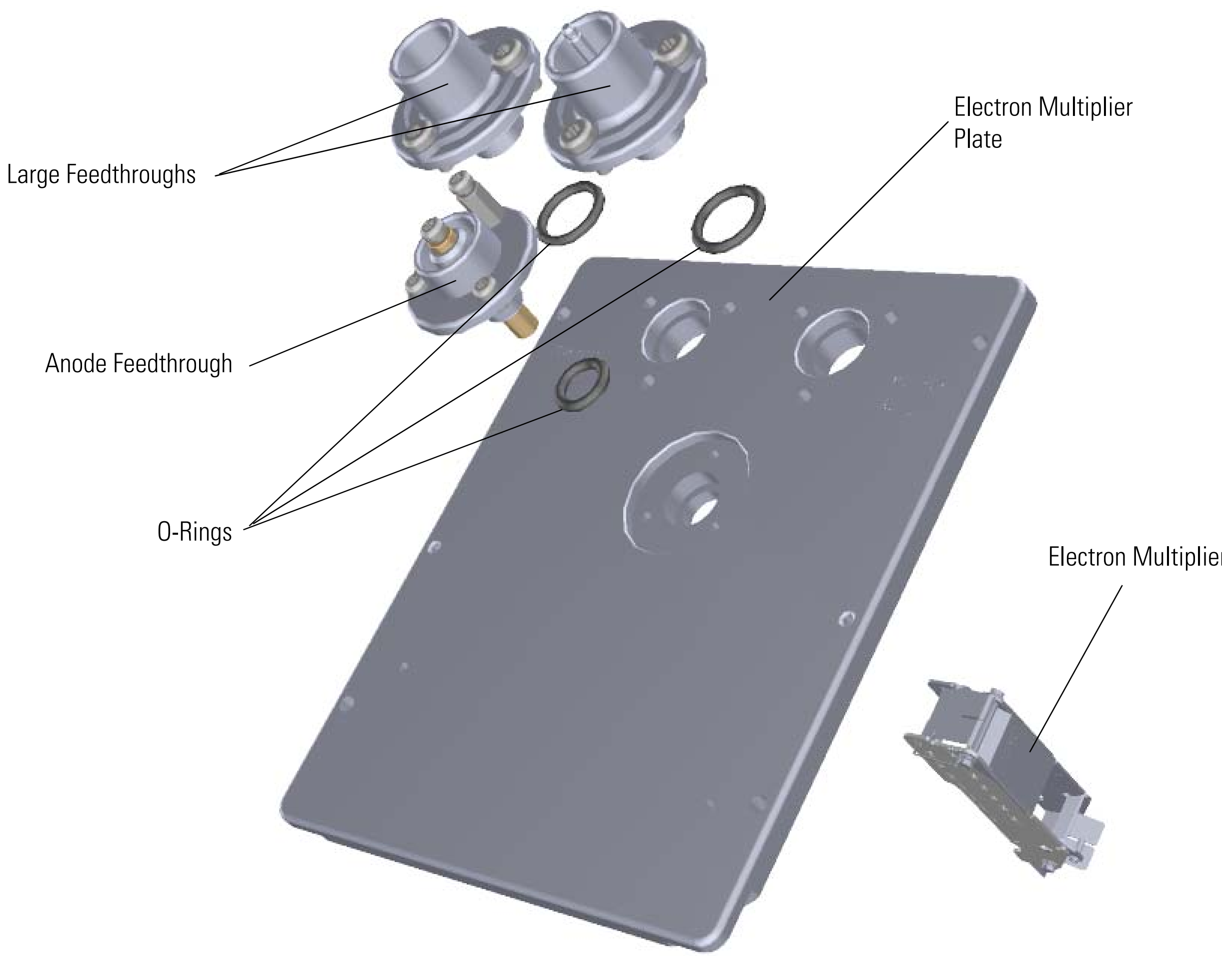
6. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing Components of the Electron Multiplier

If the components of your electron multiplier get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

Figure 185. Replaceable Components of the Electron Multiplier



For information about replacing the electron multiplier, see Replacing the Electron Multiplier. The electron multiplier is replaced more frequently than the other components, so it is described in Chapter 2: Performing Routine Maintenance.

Electron Multiplier Plate

❖ To replace the electron multiplier plate:

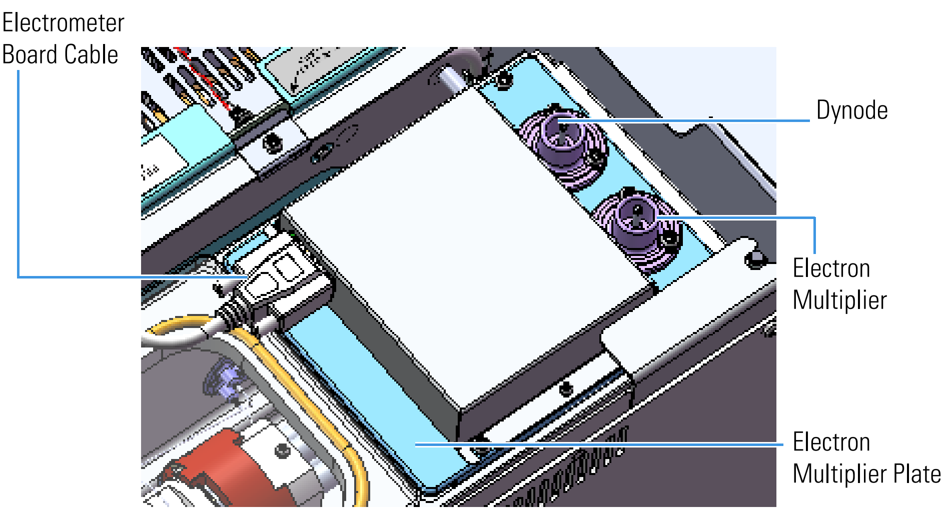
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. However, you must vent the instrument.

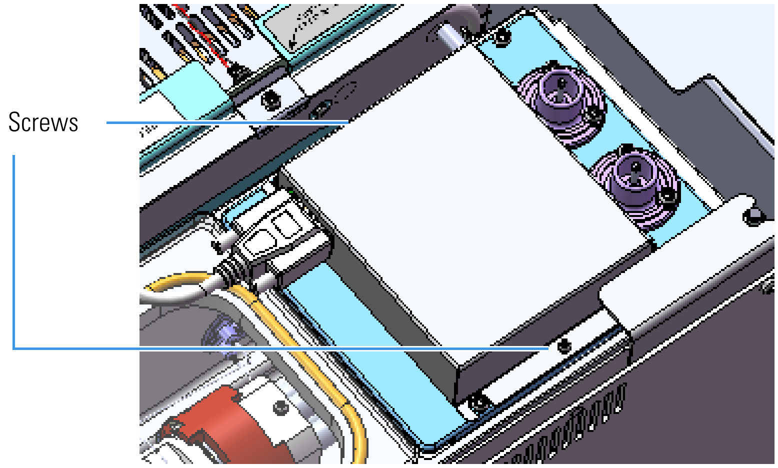
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Disconnect the electrometer board cable and large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

Figure 186. Disconnecting the Electron Multiplier Cables



4. Remove the two screws holding the electrometer shield to the electron multiplier plate.

Figure 187. Removing the Electrometer Shield



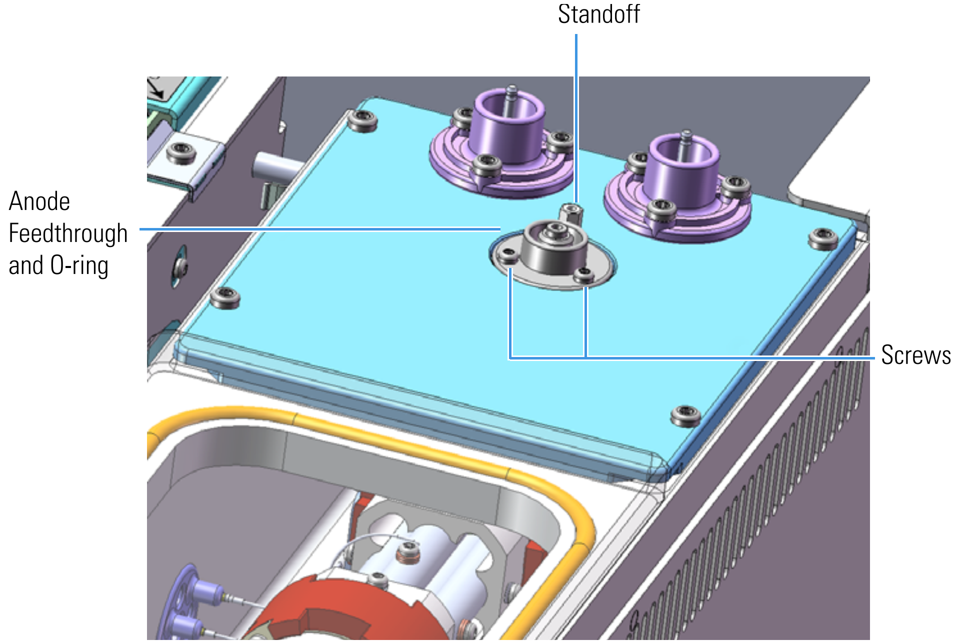
5. Remove the four screws holding the electrometer board to the electron multiplier plate.

CAUTION - ELECTRICAL HAZARD Avoid dropping screws between chassis and side cover or board. If you drop a screw, find it before powering the instrument on again.

Figure 188. Removing the Electrometer Board

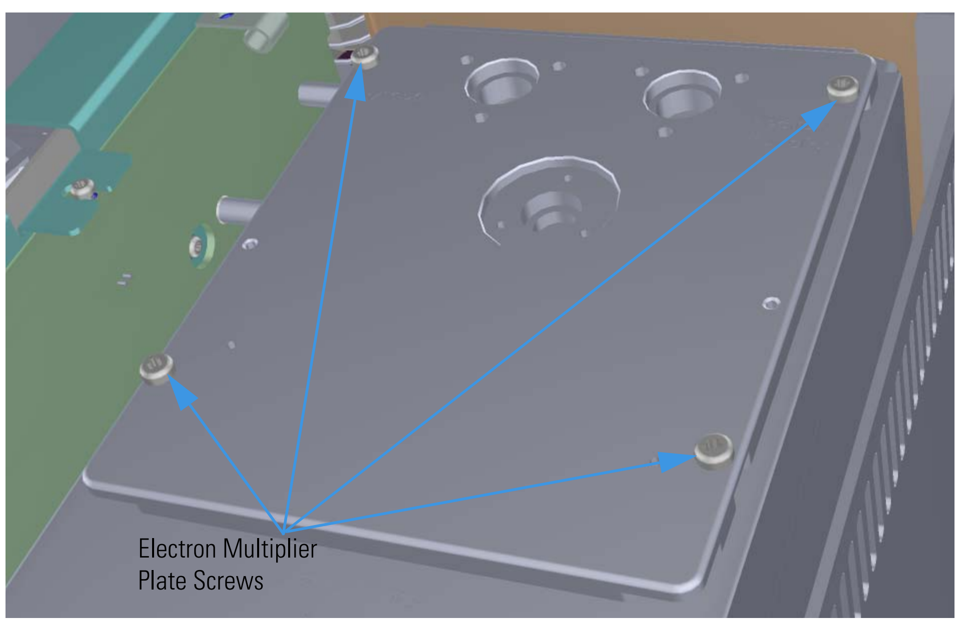
6. Use a T10 Torxhead screwdriver to remove the anode feedthrough, two screws, standoff. and o-ring. Set them aside on a clean work surface.

Figure 189. Removing the Anode Feedthrough



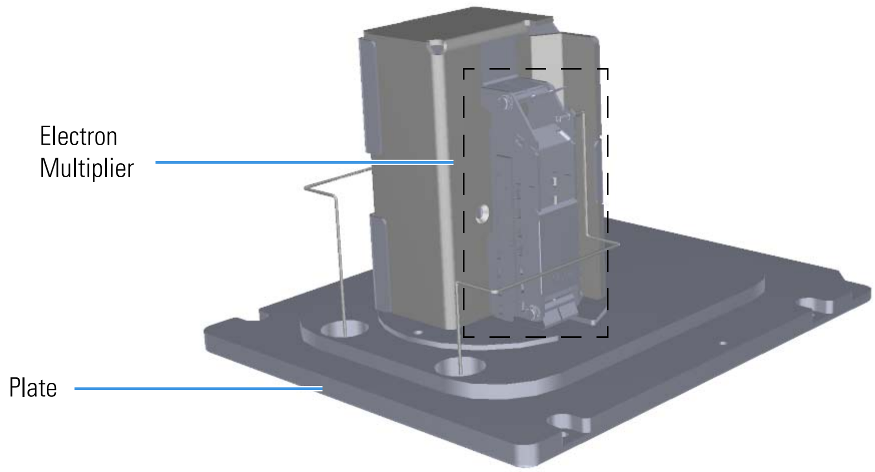
7. Use a T20 Torxhead screwdriver to remove the four screws at each corner of the electron multiplier plate.

Figure 190. Disconnecting the Electron Multiplier Plate



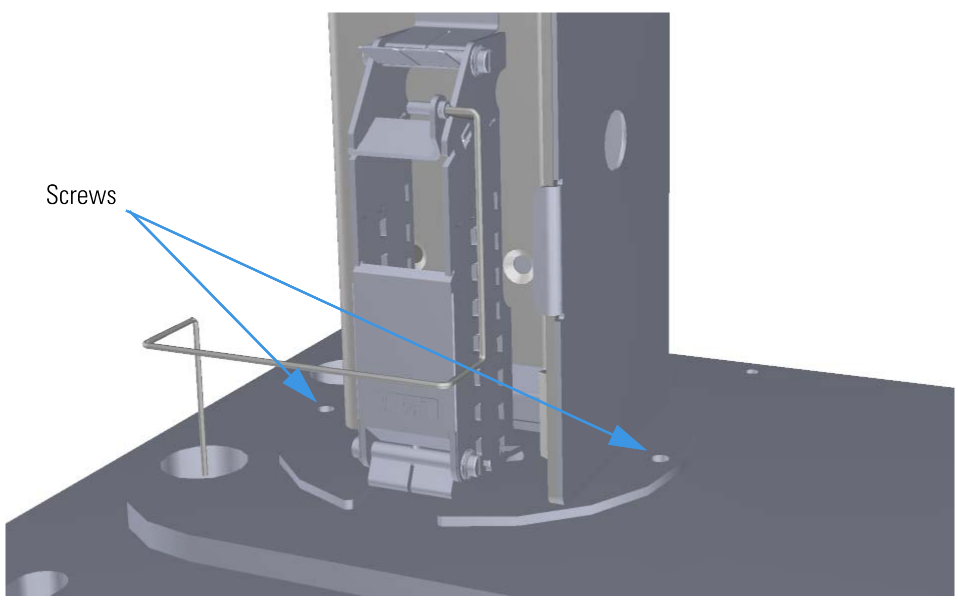
8. Flip the electron multiplier and plate over so that the plate is resting on the worktable.

Figure 191. Resting the Electron Multiplier Plate on the Worktable



9. Remove the two screws connecting the electron multiplier to the plate and attach the electron multiplier to a new plate.

Figure 192. Replacing the Electron Multiplier Plate



10. Reattach the large feedthroughs, screws, and o-rings
11. Reattach the anode feedthrough, two screws, standoff. and o-ring
12. Move the wires into the large feedthroughs.
13. Put the electron multiplier plate back into place on the manifold and reattach the four screws. Reattach the electrometer board and the four screws.
14. Reattach the electrometer shield and the two screws

15. Reconnect the electrometer board cable and large feedthrough cables.

CAUTION INSTRUMENT DAMAGE: Do not mix up the cables or you will damage the power supply.

16. Reattach the top cover panel and tighten the screw.

17. Restart your system by following the instructions in "Restarting the System" on page 106.

Large Feedthroughs

❖ To replace the large feedthroughs, o-rings, and screws

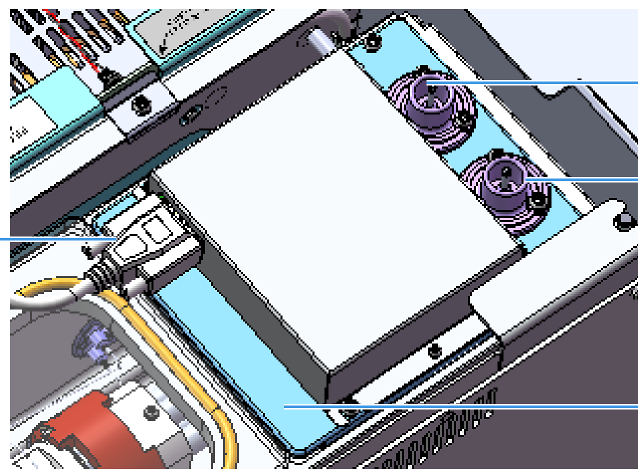
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. However, you must vent the instrument.

2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Disconnect the electrometer board cable and large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

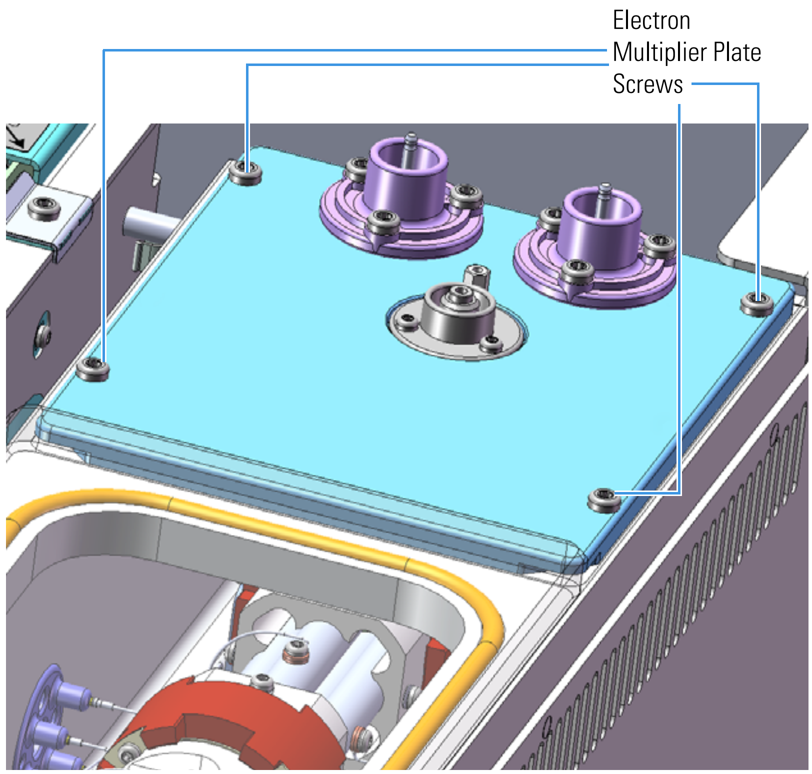
Figure 193. Disconnecting the Electron Multiplier Cables



4. Use a T20 Torxhead screwdriver to remove the screws around the large feedthroughs.
5. Replace the large feedthroughs, o-rings and screws.
6. Use a T20 Torxhead screwdriver to remove the four screws at each corner of the electron multiplier plate.

CAUTION - ELECTRICAL HAZARD Avoid dropping screws between chassis and side cover or board. If you drop a screw, find it before powering the instrument on again.

Figure 194. Disconnecting the Electron Multiplier Plate



7. Flip the plate over and attach the wire to the large feedthrough.
8. Use a T20 Torxhead screwdriver to reattach the four screws at each corner of the electron multiplier plate
9. Reconnect the large feedthrough cables.
10. Reattach the top cover panel and tighten the screw.
11. Restart your system by following the instructions in "Restarting the System" on page 106.

Anode Feedthrough

❖ **To replace the anode feedthrough, o-ring, four screws, and a standoff:**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

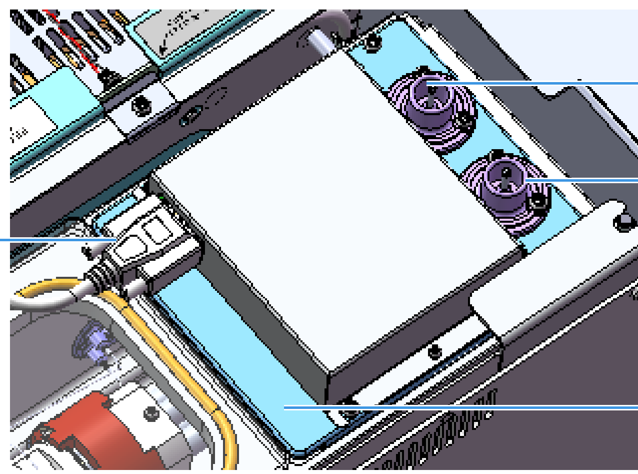
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. However, you must vent the instrument.

2. Slide the top cover panel toward the back of the instrument and lift it off.

3. Disconnect the electrometer board cable and large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

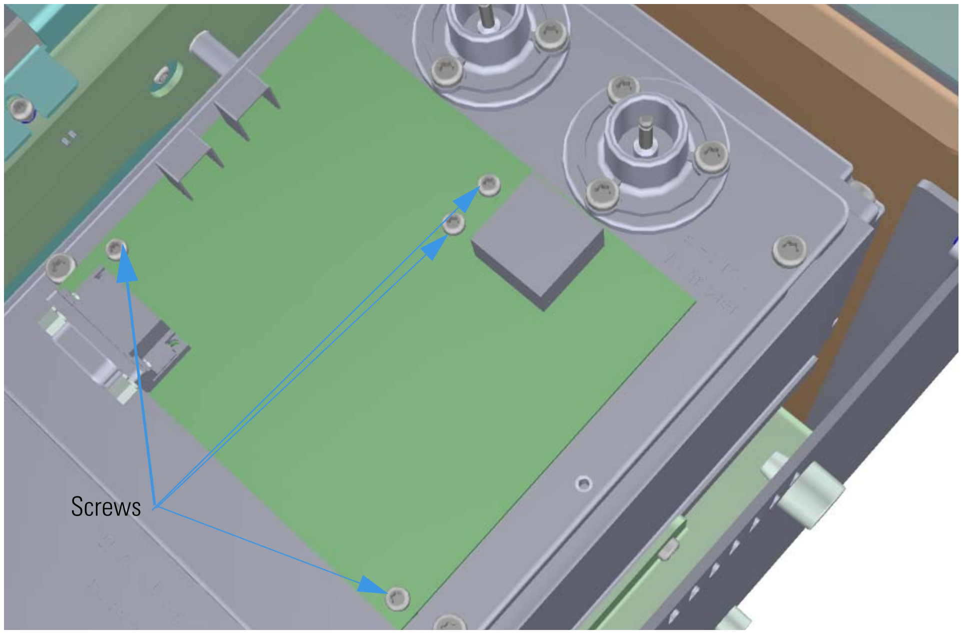
Figure 195. Disconnecting the Electron Multiplier Cables



4. Lift the electrometer shield off the instrument and set it aside.

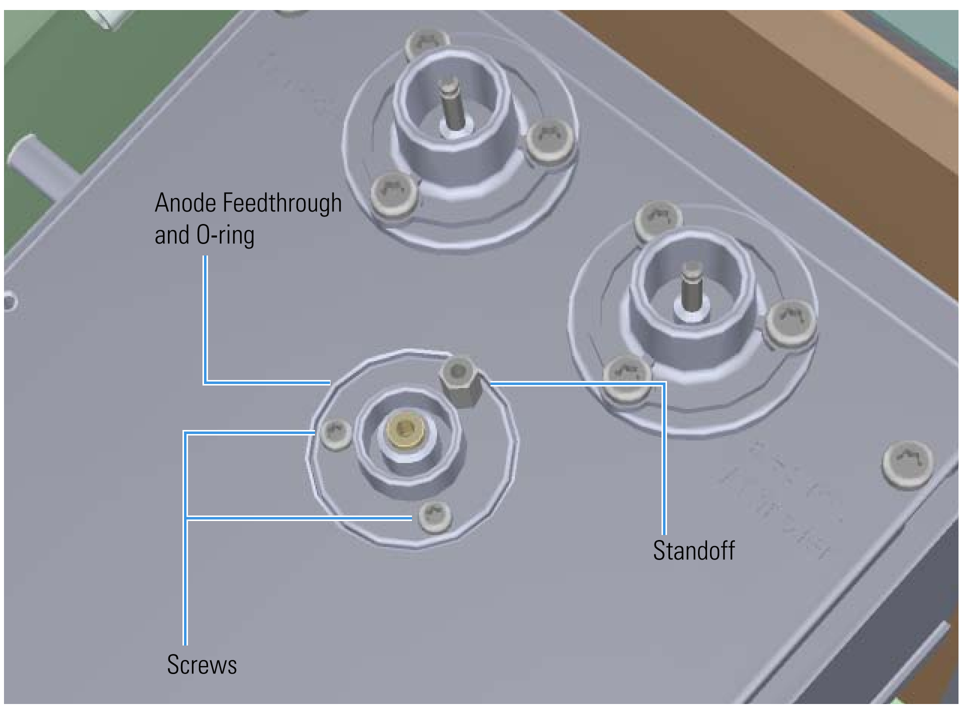
5. Use a T10 Torxhead screwdriver to remove the four screws holding the electrometer board in place.

Figure 196. Removing the Electrometer Board



6. Remove the electrometer board to reveal the anode feedthrough.

Figure 197. Removing the Anode Feedthrough, O-ring, Standoff and Screws



7. Use a T10 Torxhead screwdriver to remove the two screws and 5.5 mm nut driver to remove the standoff located on the outer rim of the anode feedthrough, but leave the center pin of the standoff intact. The standoff serves as the ground for the electrometer board. The center pin is the signal path for the electrons generated in the electron multiplier going into the electrometer.
8. Remove and replace the anode feedthrough, o-ring, standoff and screws.
9. Insert one screw and tighten it until it is snug. Then insert and tighten the other screw. Once both screws fit snugly, re-tighten them.

Note Be sure to attach the standoff at the location shown in Figure 63.

10. Reattach the electrometer board and the four screws that hold it in place.
11. Reattach the electrometer shield and the four screws.
12. Reconnect the electrometer board cable and large feedthrough cables.
13. Restart your system by following the instructions in “Restarting the System” on page 106.

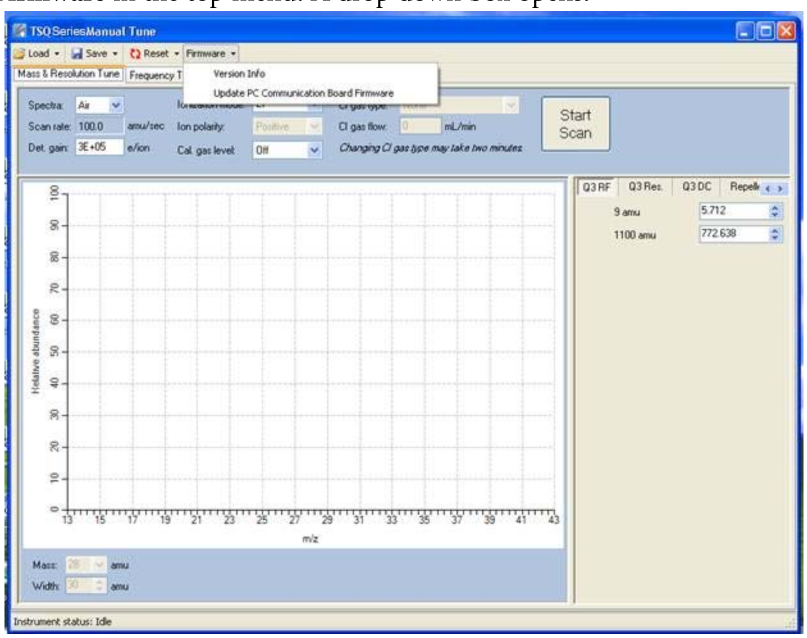
Reinstalling the TSQ Duo System Software

Your TSQ Duo system has software on the instrument, as well as on the computer that was shipped with it. This section describes how to upgrade both of them.

Updating the Firmware on the Instrument

❖ To update the firmware on the TSQ Duo system

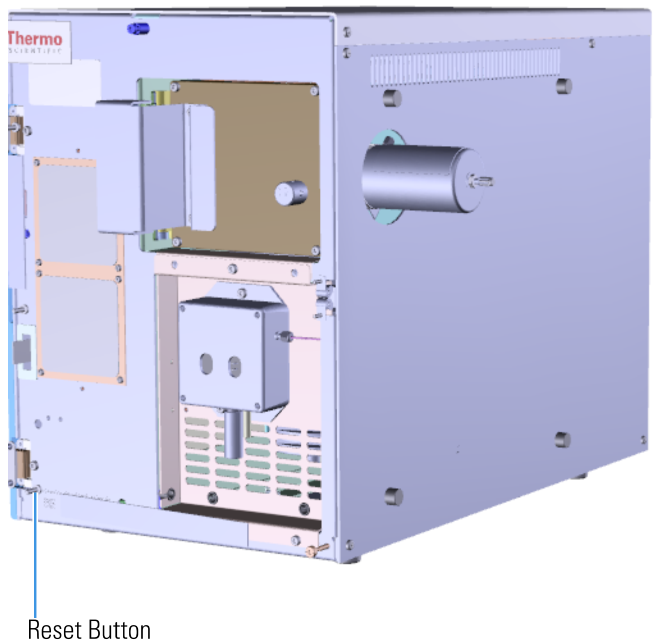
1. Open the *TSQ Series Manual Tune* utility. Open the TSQ Series Duo Dashboard and select **Manual Tune** to open the manual tune utility.
2. Click **Firmware** in the top menu. A drop down box opens.



3. Select **Update PC Communication Board Firmware**.
4. Browse to the updated firmware file. Once the firmware is selected, a dialog box will indicate that the firmware is being updated.
5. Once the firmware is updated, open the front door of the instrument and use a small screwdriver to press the Reset button on the interior front panel. This button allows the TSQ Duo instrument to start using the new firmware and reestablish communication with the computer.

Note Pushing the button for more than five seconds causes the system to load the default firmware. You do not want to do this unless the updated version of the firmware fails.

Figure 198. Resetting the System



Upgrading Software on the Computer

> **IMPORTANT** These instructions refer to Thermo Chromeleon 7.2. Check the latest Thermo Scientific software CD for the latest versions of Thermo Chromeleon. If the CD contains later versions, follow the steps in the installation help document on the CD to update your software.

This section describes how to reinstall the Chromeleon 7.2 software on the TSQ Duo system.

System Requirements

Your TSQ Duo data system must meet these minimum requirements.

System	Requirements
Hardware	• 2.4 GHz processor with 8 GB RAM • DVD/CD-ROM drive • Resolution display 1280 × 1024 (XGA) • 500 GB hard drive • NTFS format
Software	• Microsoft™ Windows™ 7 SP1 Operating System (64-bit) • Thermo Foundation 3.0 SP2 (Thermo Scientific software) • Thermo Scientific™ Dionex™ Chromeleon™ 7 (release 7.2 SR1 MUa or later).

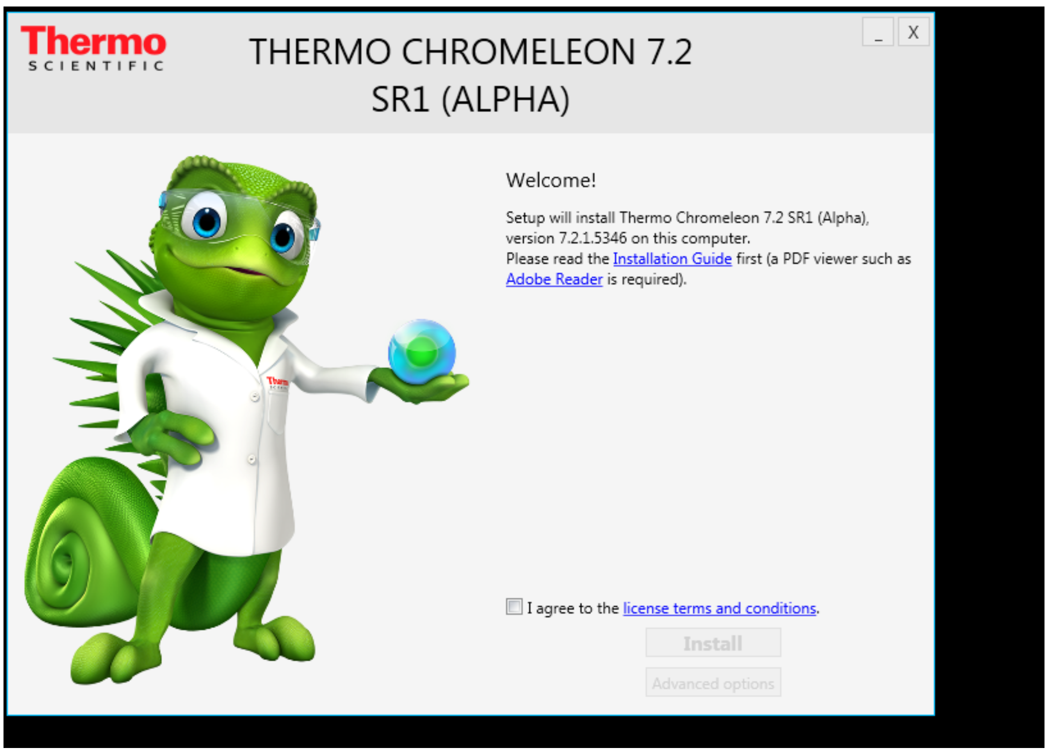
Installing the Software Set

To install the system software set:

Note Check the contents of the Chromeleon software DVD for the most recent version of these installation instructions.

1. Insert the Chromeleon 7.2 DVD into the CD/DVD-ROM drive of your computer. The installer launches automatically after the DVD is inserted. When the installation screen appears (see Figure 199), check the **I Agree to the License Terms and Conditions** box.

Figure 199. Thermo Chromeleon 7.2 SR1 Installation Page



2. Click **Advanced Options**, and select TSQ Duo from the list of Mass Spectrometry Drivers. Click **Install**.

3. Adobe Reader, Microsoft SQL Server, the .NET Framework, and the Chromeleon software are installed automatically. Installation may take up to 30 minutes.

4. Once the software is installed, an Installation Qualification Report is generated. View this report as needed.

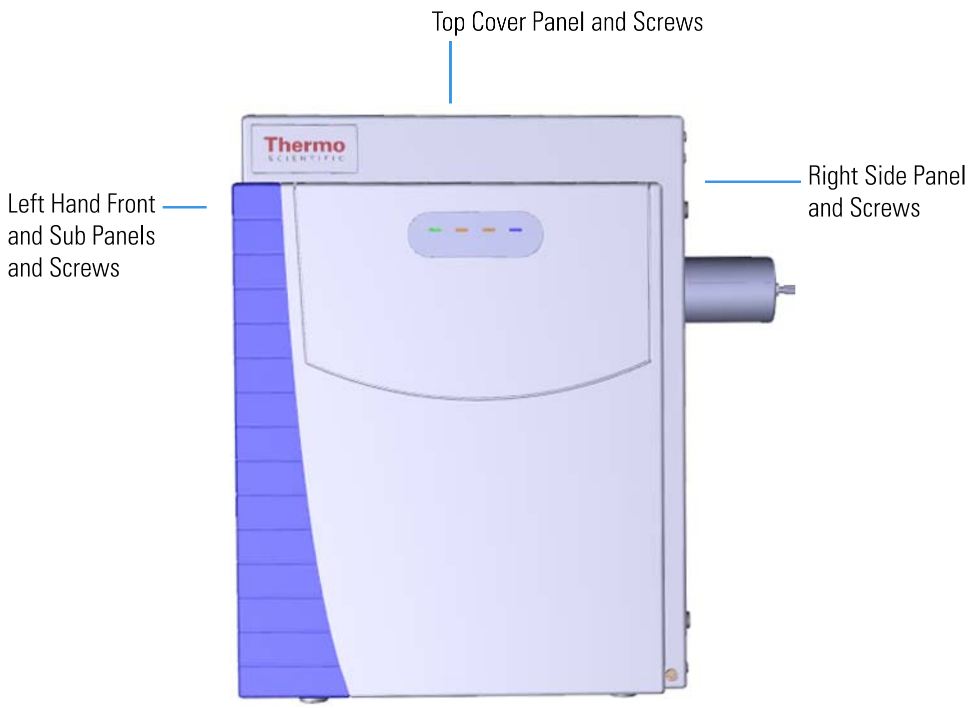
5. The installation of Xcalibur 3.0 will complete with the automatic generation of an IQ/OQ report. You will not need to restart the PC after the Xcalibur 3.0 installation.

6. After installation, a Chromeleon 7 icon appears on the desktop. You may also start Chromeleon by going to **Start > Thermo Chromeleon 7 > Chromeleon 7**.

Replacing the Covers of the TSQ Duo Instrument

If the covers of your instrument get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it.

Figure 200. Replaceable Covers of the TSQ Duo Instrument



Top Cover Panel

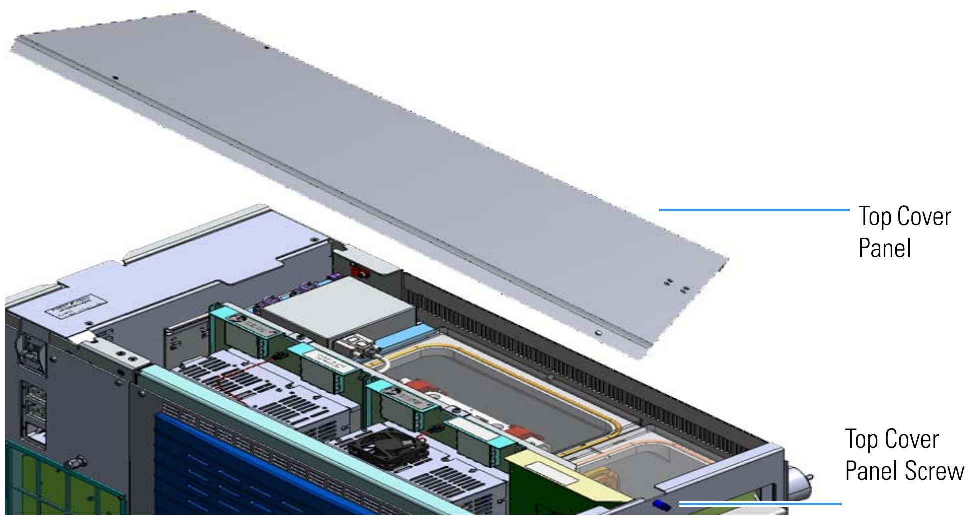
❖ **To replace the top cover panel of the TSQ Duo instrument**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or column or vent the system. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.

Figure 201. Replacing the Top Cover Panel



3. Replace the top cover panel and tighten the screw holding it in place.

4. Restart your system by following the instructions in "Restarting the System" on page 106.

Left Hand Front Panel and Left Hand Sub Panel

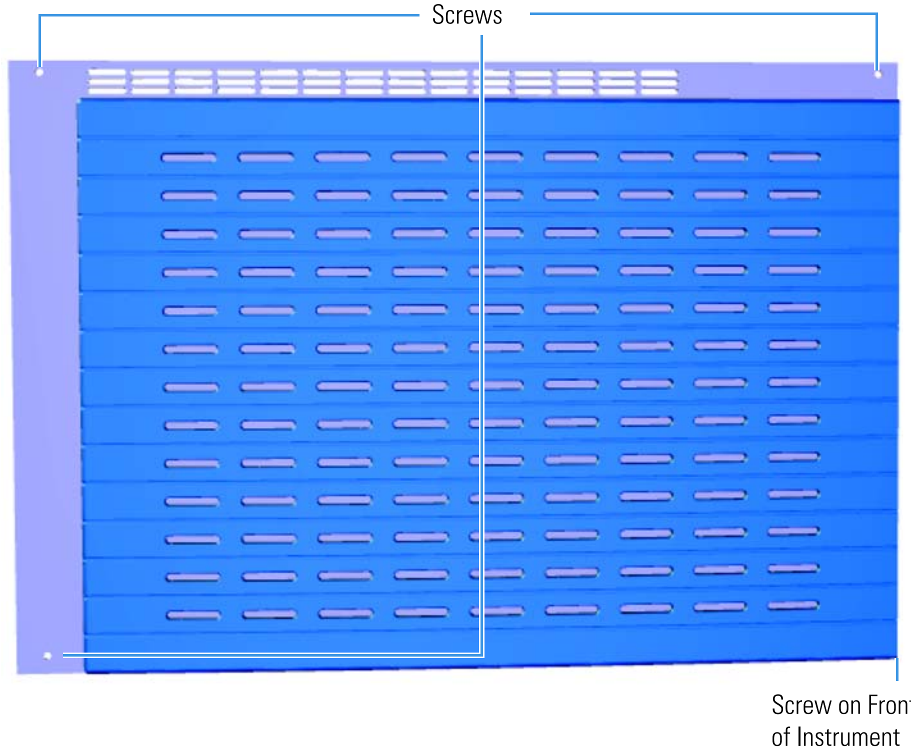
❖ **To replace the left hand front panel and the left hand sub panel of the TSQ Duo instrument**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or column or vent the system. If you are using hydrogen as a carrier gas, power off the GC.

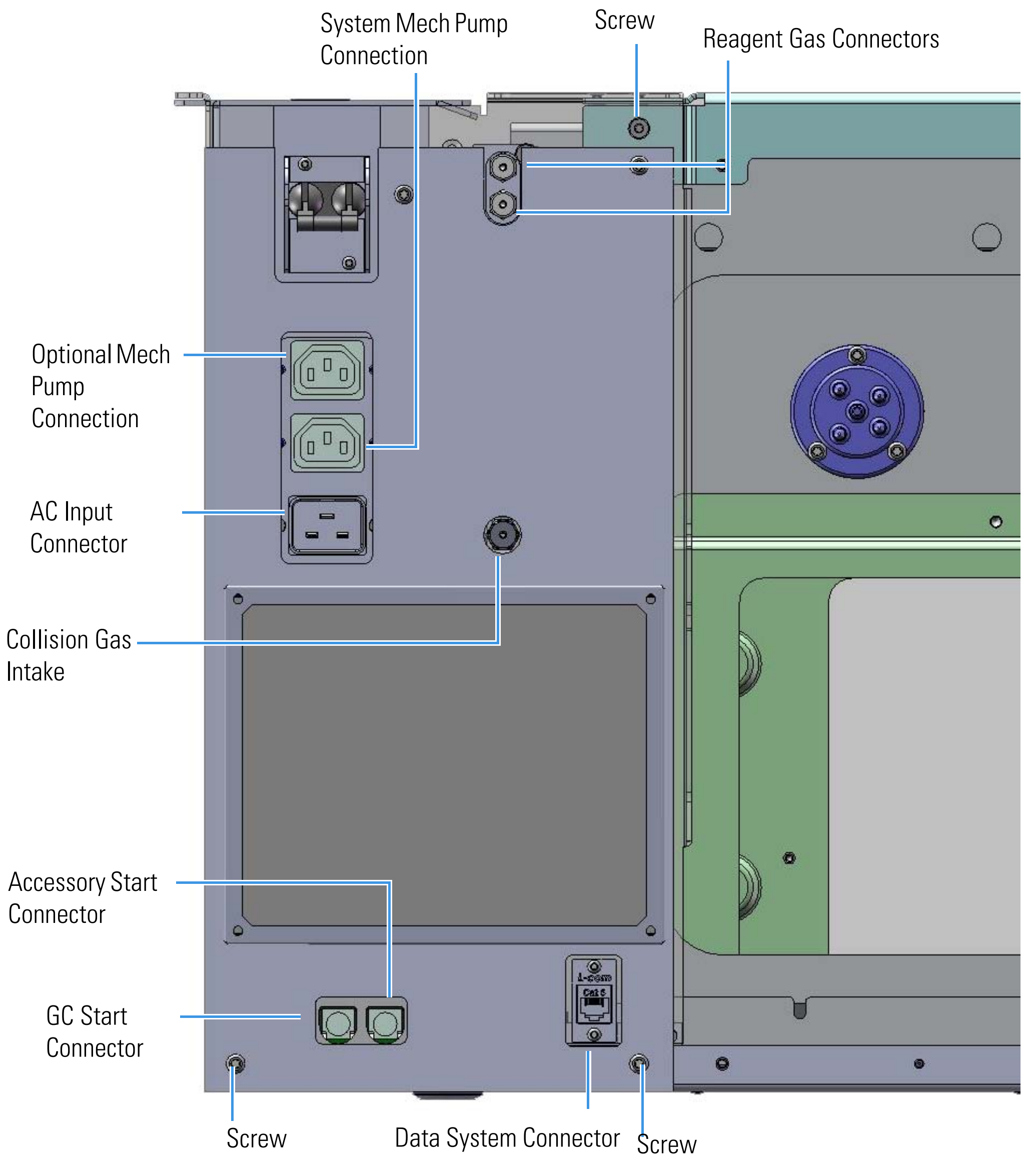
2. Remove the four screws on the left hand front panel. One is located on the bottom left of the interior front panel of the instrument.

   Figure 202. Locating the Left Hand Front Panel Screws



3. To replace the left hand sub panel, disconnect the inputs as shown in Figure 203.

Figure 203. Finding the Inputs and Screws on the Left Hand Sub Panel



4. Remove the three screws on the left hand sub panel.
5. Replace the left hand sub panel and tighten the three screws holding it in place.
6. Replace the inputs.
7. Replace the left hand front panel and tighten the four screws holding it in place.
8. Restart your system by following the instructions in "Restarting the System" on page 106.

Right Side Panel

❖ To replace the right side panel of the TSQ Duo instrument

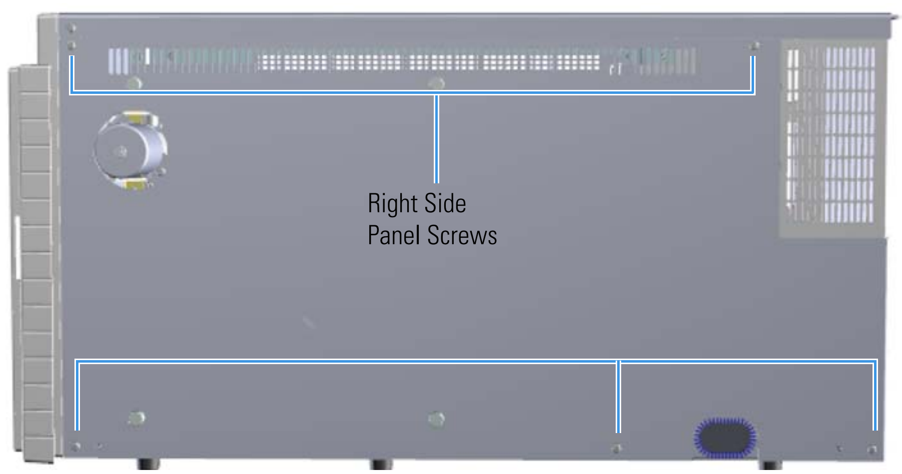
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge. However, you must vent the instrument and remove the column.

2. Remove the column from the transfer line completely.
3. Slide the top cover panel toward the back of the instrument and lift it off.
4. Use a T20 Torxhead screwdriver to remove the screw at each corner of the right side panel.

Figure 204. Removing the Right Side Panel Screws



5. Replace the right side panel and tighten the screws.
6. Replace the top cover panel and tighten the screw holding it in place.
7. Reinsert the column to the proper length and tighten the transfer line nut. See "Replacing a Column" on page 13 for more information.
8. Restart your system by following the instructions in "Restarting the System" on page 106.

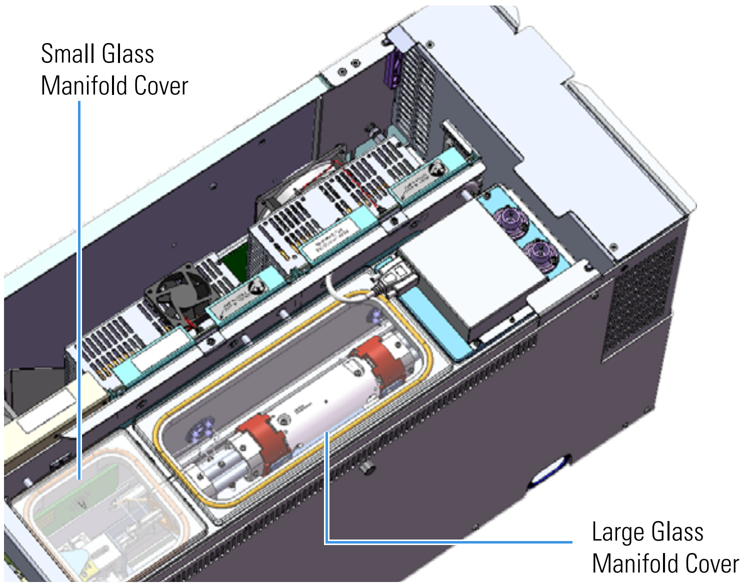
Top Manifold Cover

❖ To replace the top manifold cover

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or column. However, you must vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Remove and replace the large or small glass manifold covers as needed on the top of the instrument.

Figure 205. Replacing the Small and Large Glass Manifold Covers



4. Replace the top cover panel and tighten the screw holding it in place.
5. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing the Chassis Feet

❖ To replace the chassis feet on the bottom of the TSQ Duo instrument

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93.
2. Remove the analyzer tray from the instrument by following the instructions in “Removing the Analyzer Tray from the TSQ Duo Instrument” on page 95.
3. Follow the instructions in the section, “Distribution Board” on page 247 to remove the components required to safely replace the chassis feet.
4. Remove the small and large glass covers in the manifold.
5. Carefully tip the TSQ Duo instrument and rest it on its left side.
6. Use a T20 Torxhead screwdriver to remove the screws holding any damaged feet to the bottom of the instrument.

   Figure 206. Removing the Feet on the Bottom of the TSQ Duo Instrument

7. Attach the new chassis feet.
8. Set the instrument upright.
9. Replace the large and small glass manifold covers.
10. Follow the instructions in the section, “Distribution Board” on page 247 to replace the components you removed.

11. Replace the analyzer tray into the instrument by following the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104.

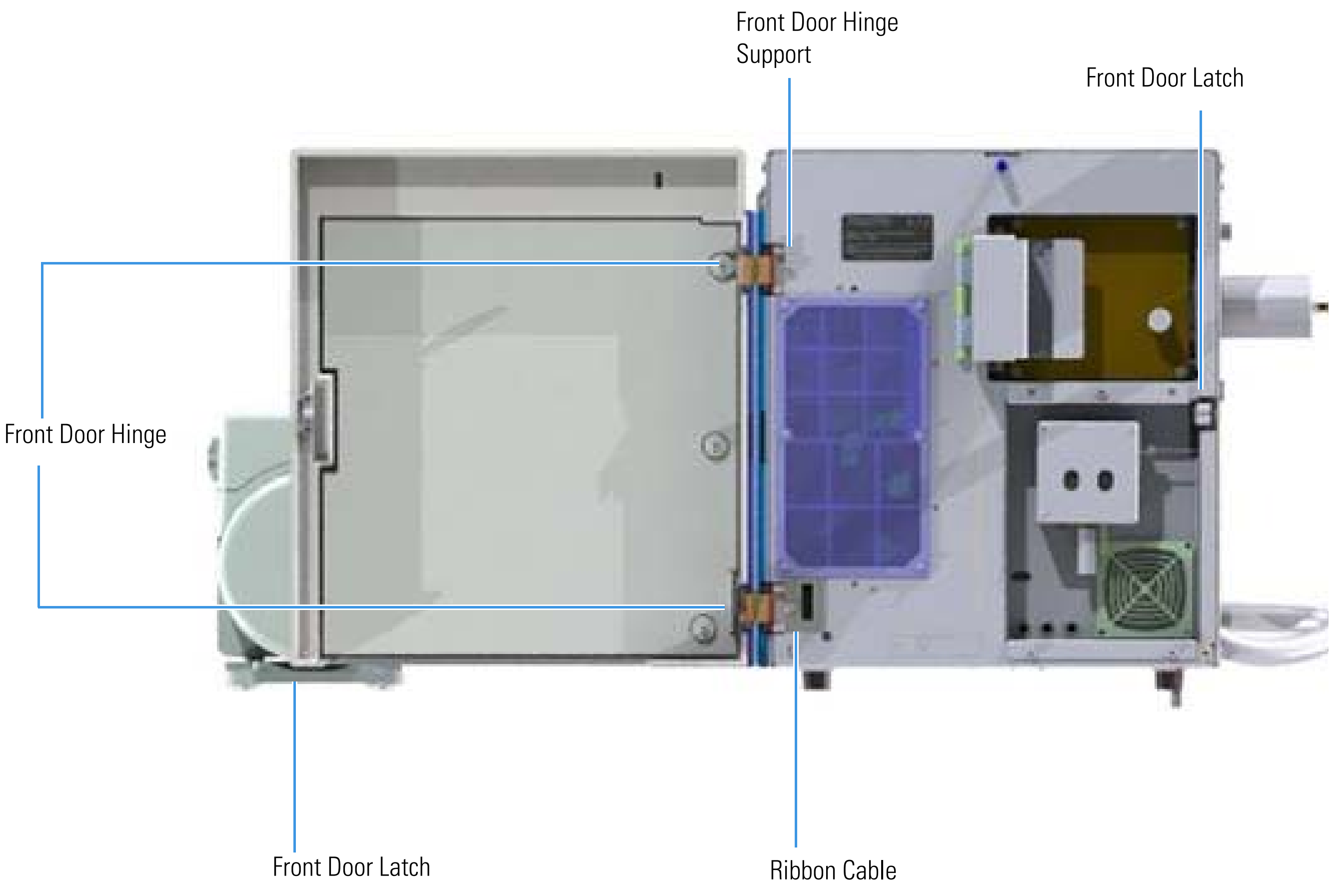
12. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing Components of the Front Door

If the front door of your TSQ Duo instrument gets damaged, you can use the illustration below to visually locate a replaceable component and then follow the process to replace it.

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

Figure 207. Replaceable Components of the Front Door



Front Door Hinges and Supports

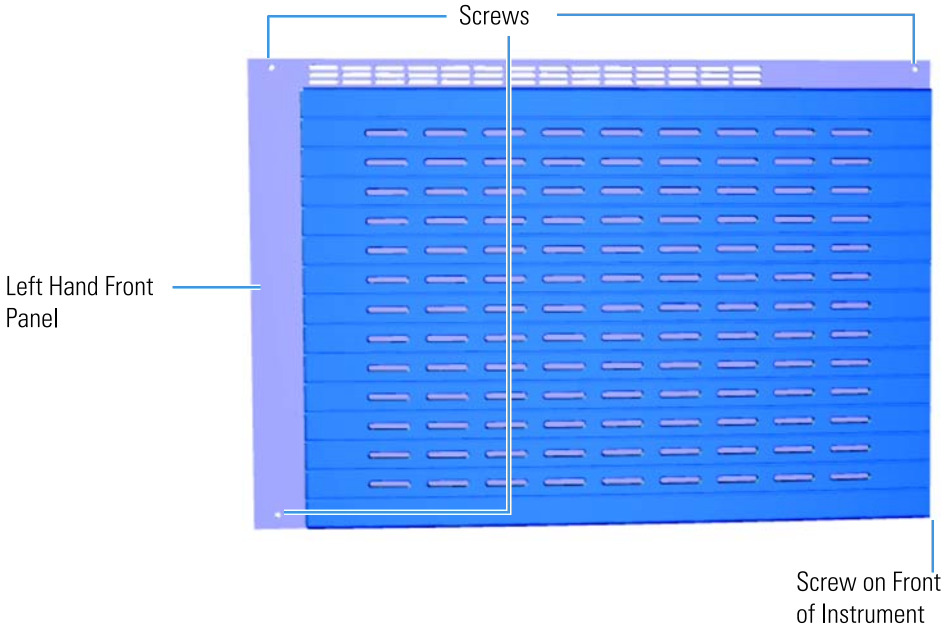
❖ **To replace the hinges and supports that connect the front door to the chassis**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

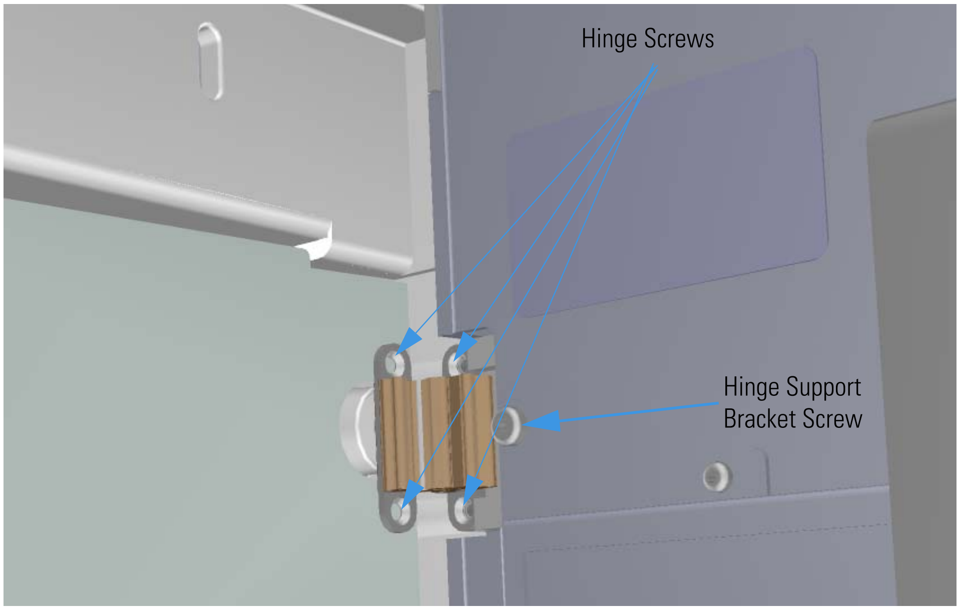
Figure 208. Locating the Left Hand Front Panel Screws



3. Lift the left hand front panel off the instrument.

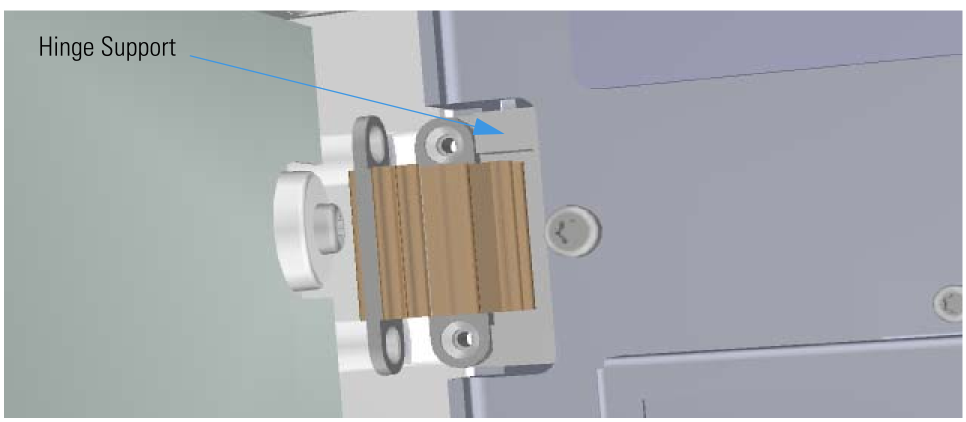
4. On the front interior panel, use a T20 Torxhead screwdriver to remove the hinge support bracket screw.

Figure 209. Replacing the Hinges on the Front Door



5. Use a T10 Torxhead screwdriver to remove the all four screws connecting each hinge to the front door and interior front panel.
6. Attach new hinges and supports, as well as the hinge support bracket screw.

Figure 210. Replacing the Hinge Supports



Note Replace one hinge at a time to prevent the door from falling.

7. Reattach the left hand front and top cover panels and tighten the screws.
8. Restart your system by following the instructions in "Restarting the System" on page 106.

Front Door Latch

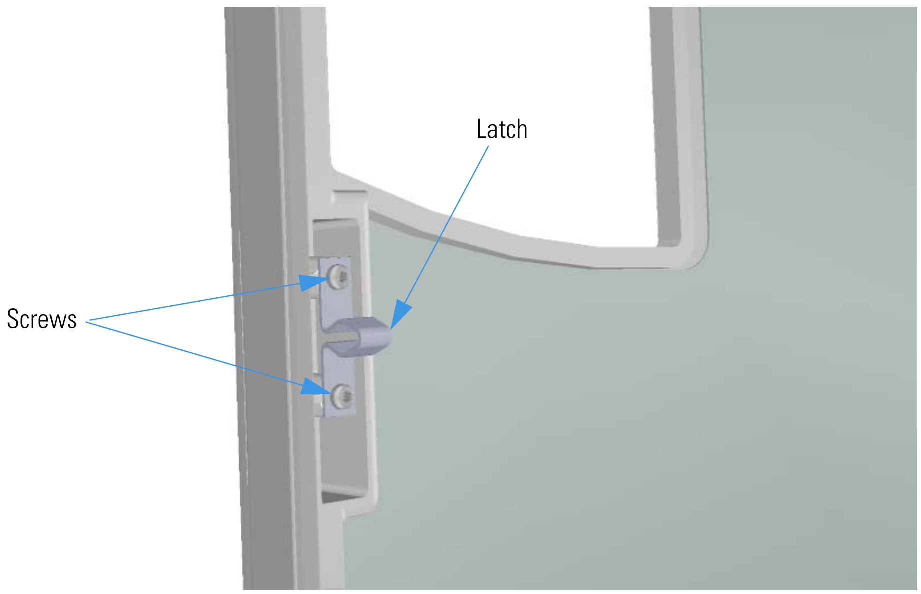
❖ To replace the latch on the front door

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

There are two major parts to front door latch. One is located on the front door, and one is on the chassis. If you only need to replace the part on the front door, simply open the door and follow the instructions below.

1. Use a T10 Torxhead screwdriver to remove the two screws holding the latch onto the front door.

   Figure 211. Removing the Latch from the Front Door

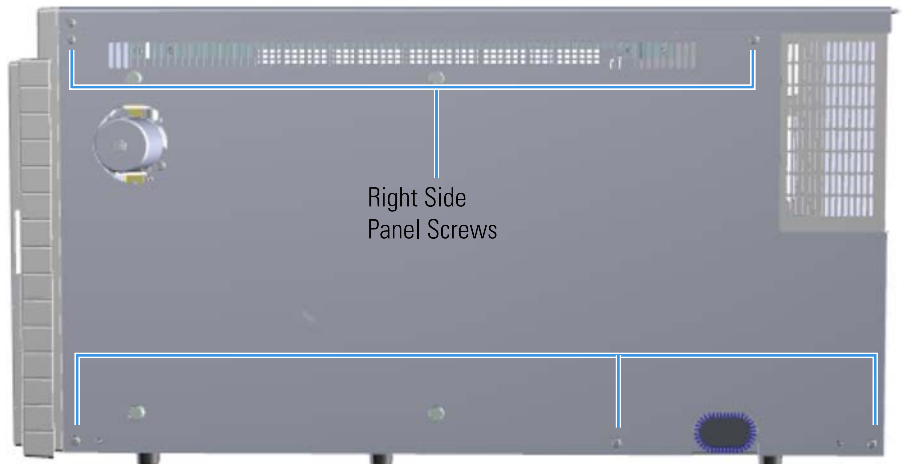
   

2. Replace the latch and close the front door of the instrument.
3. To replace the latch on the chassis, shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
4. Slide the top cover panel off the instrument.
5. Open the front door of the GC and disconnect the column and transfer line nut.
6. Move the TSQ Duo instrument away from the GC so you can access the transfer line on the right side.

WARNING BURN HAZARD: The transfer line may be hot, so be careful.

7. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

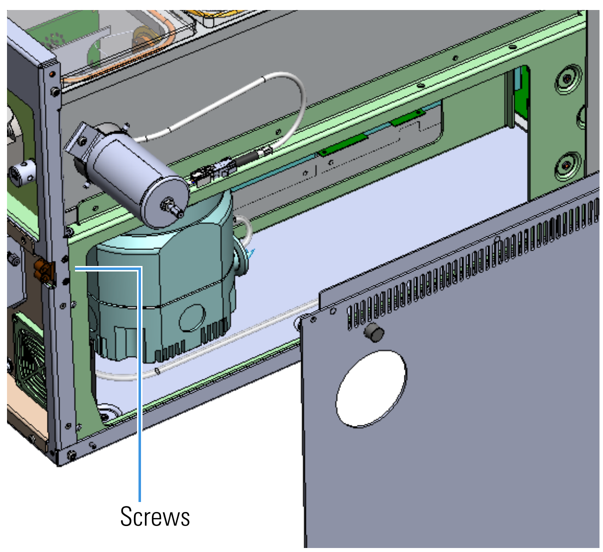
Figure 212. Removing the Right Side Panel Screws



8. Slide the right side panel to the right of the instrument and lift it off.

9. Use a 5.5 mm open head wrench to hold the M-3 lock washers and remove the two M3 flathead screws suing a T10 Torxhead screwdriver.

Figure 213. Removing the Latch from the Chassis



10. Attach a new latch to the chassis.

11. Reattach the right side and top cover panels and tighten the screws.

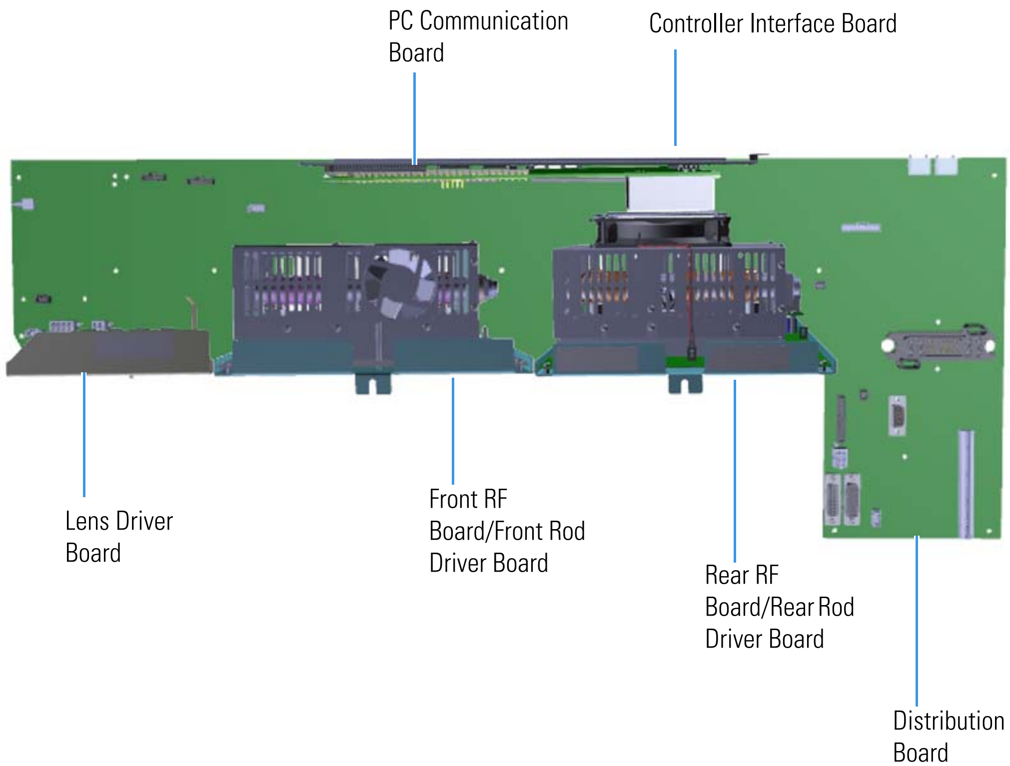
12. Reattach the GC to the transfer line.

13. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing the Boards in the TSQ Duo Instrument

If the boards in your TSQ Duo instrument get damaged, you can use the illustration below to visually locate a board and then follow the process to replace it.

Figure 214. Replaceable Board Components of the TSQ Duo System



WARNING ELECTRICAL SHOCK HAZARD: For safety reasons, the fuses on the lens driver board can only be replaced by Field Service Engineers.

Front and Rear RF Boards and Front and Rear Rod Driver Boards

❖ **To replace the front and rear radio frequency (RF) boards and front and rear rod drive boards.**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering an RF board. This board must be replaced by a Field Service Engineer, so when you place an order for a new board, schedule the Field Service Engineer as well.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the system. If you are using hydrogen as a carrier gas, power off the GC.

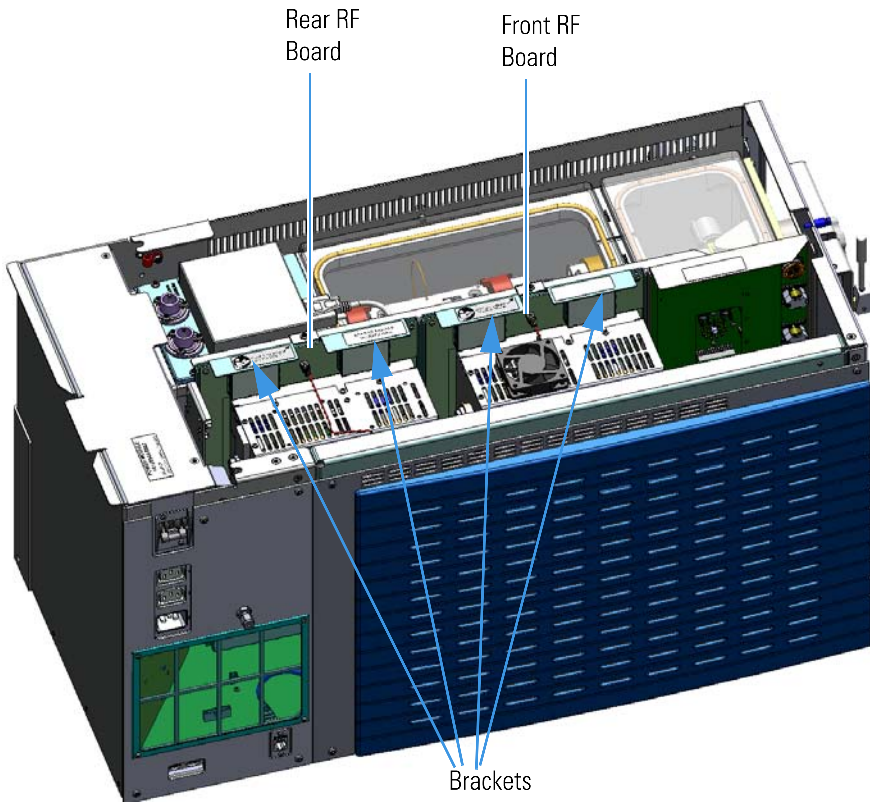
2. Slide the top cover panel toward the back of the instrument and lift it off.

Note The steps to remove and replace the front and rear RF boards are the same. Refer to the images for the proper location of each board.

3. The front RF board is the second board standing on end toward the center of the instrument. The rear RF board is the third board standing on end toward the center of the TSQ Duo instrument. Use a T20 Torxhead screwdriver to remove the screw holding the board and bracket to the chassis.

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

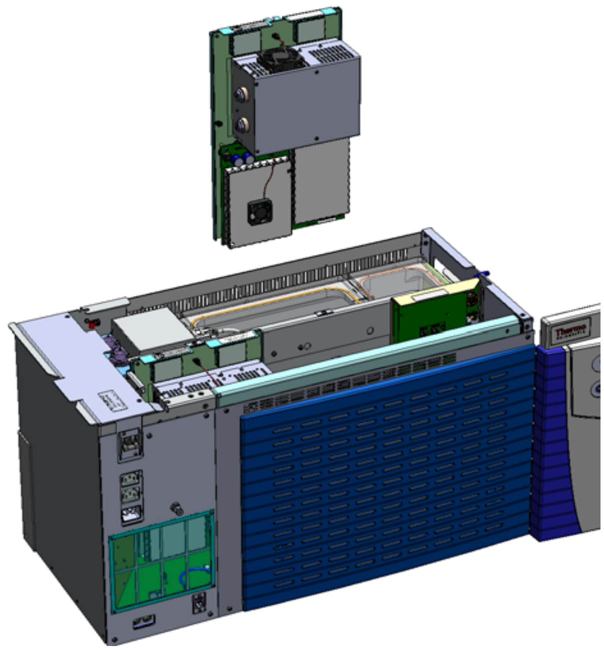
Figure 215. Locating the RF Boards and Brackets



4. To remove the front RF board, use your fingers to pry the brackets of the board away from the chassis and toward the left side of the instrument.

5. Lift the board out of the instrument.

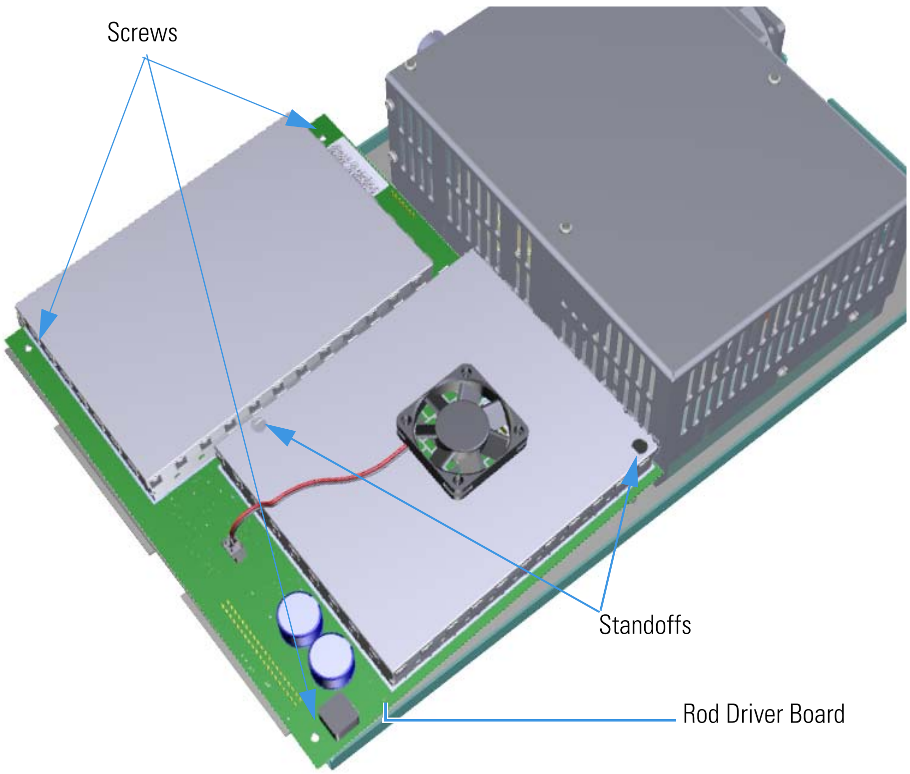
Figure 216. Removing the RF Board from the Instrument



6. Use a T10 Torxhead screwdriver to remove the three screws at each corner of the rod driver board. Be careful not to drop the parts under the metal cover.

7. Use a 2.5 mm nut driver to remove the standoffs on the rod driver board.

Figure 217. Disconnecting the Rod Driver Board from the RF Board



8. Incrementally, remove the 40-pin connector on the rod driver board from the front RF board. and the 7-pin connector on the rod driver board away from the front RF board.

Figure 218. Disconnecting the Rod Driver Board 40-Pin Connector

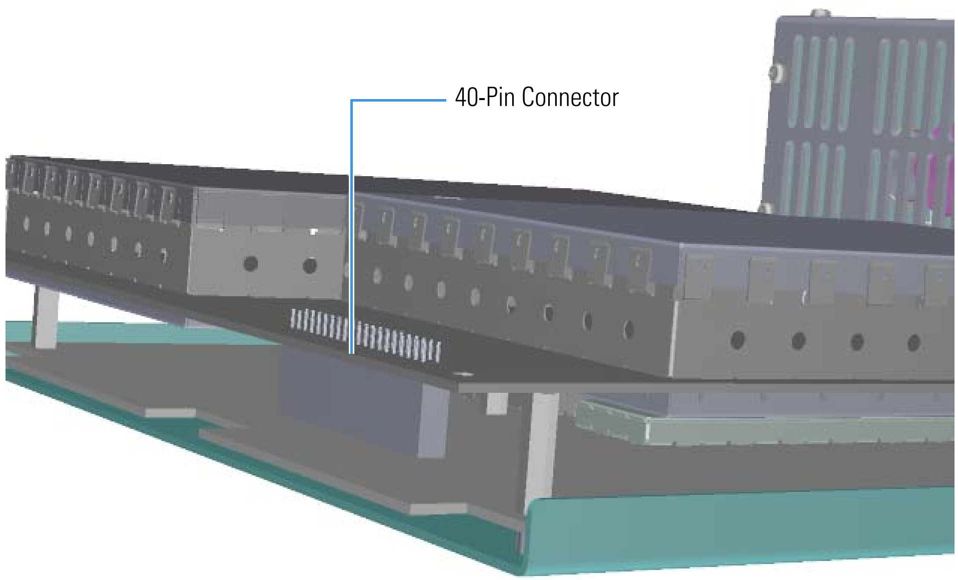
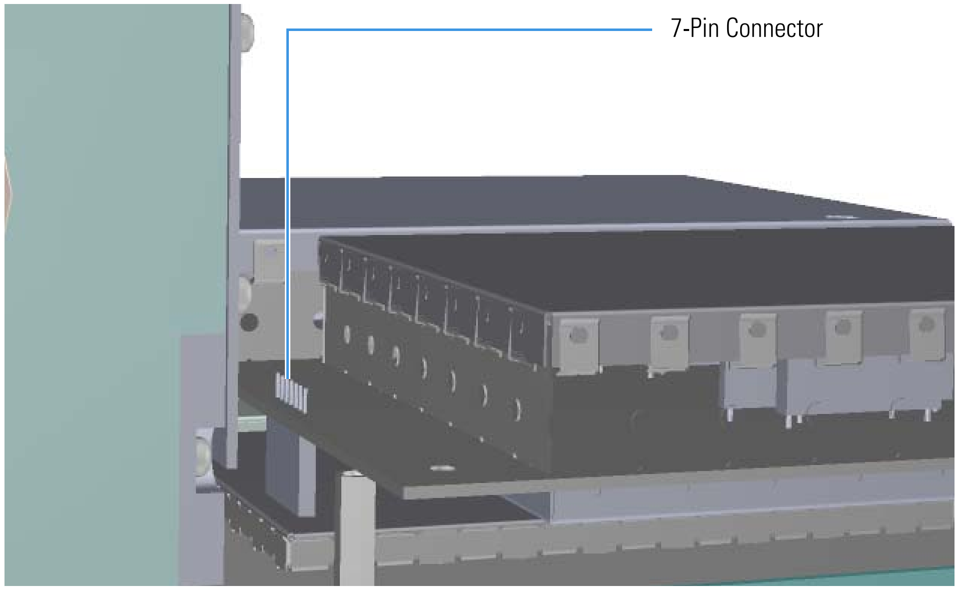


Figure 219. Disconnecting the Rod Driver Board 7-Pin Connector



Note Be careful not to bend the connector on the rod driver board on the pins on the RF board.

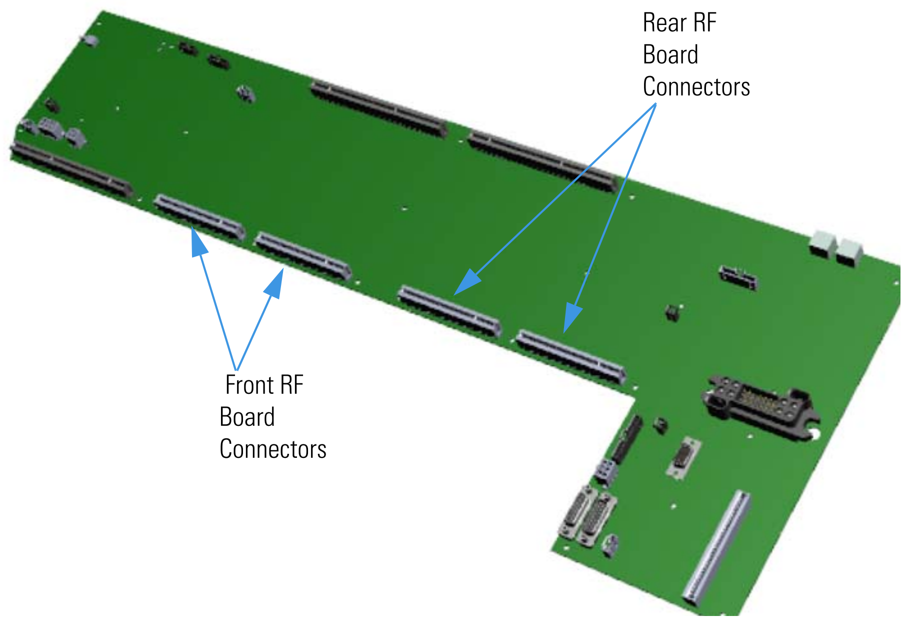
9. Replace the rod driver board if necessary. Check the pin connections for accuracy when you connect the board.

Figure 220. Replacing the Rod Driver Board

10. Attach the rod driver board to the new RF board.
11. Reattach the rod driver board's 40-pin and 7-pin connectors to the RF board.
12. Reattach the three screws and two standoffs.

13. Insert a new RF board by aligning the connectors on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 221. Reinstalling the RF Boards



14. Push the board down into the connectors.

15. Gently push the RF board toward the instrument, carefully aligning the board over the feedthrough pins, until it stops.

16. Reattach the screw holding the RF board to the bracket.

> **Note** This screw is required for good ground contact.

17. Reattach the top cover panel and tighten the screw holding it in place.

18. Restart your system by following the instructions in "Restarting the System" on page 106.

> **Note** The new RF board will have a slightly different performance than your current board. It will need to be adjusted by a Field Service Engineer because the adjustments must be made while the system is running.

RF Board/Rod Driver Board Kits

❖ **To replace the RF board/rod driver board kit**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering an RF board/rod driver board kit. This kit must be replaced by a Field Service Engineer, so when you place an order for the kit, schedule the Field Service Engineer as well.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the system. If you are using hydrogen as a carrier gas, power off the GC.

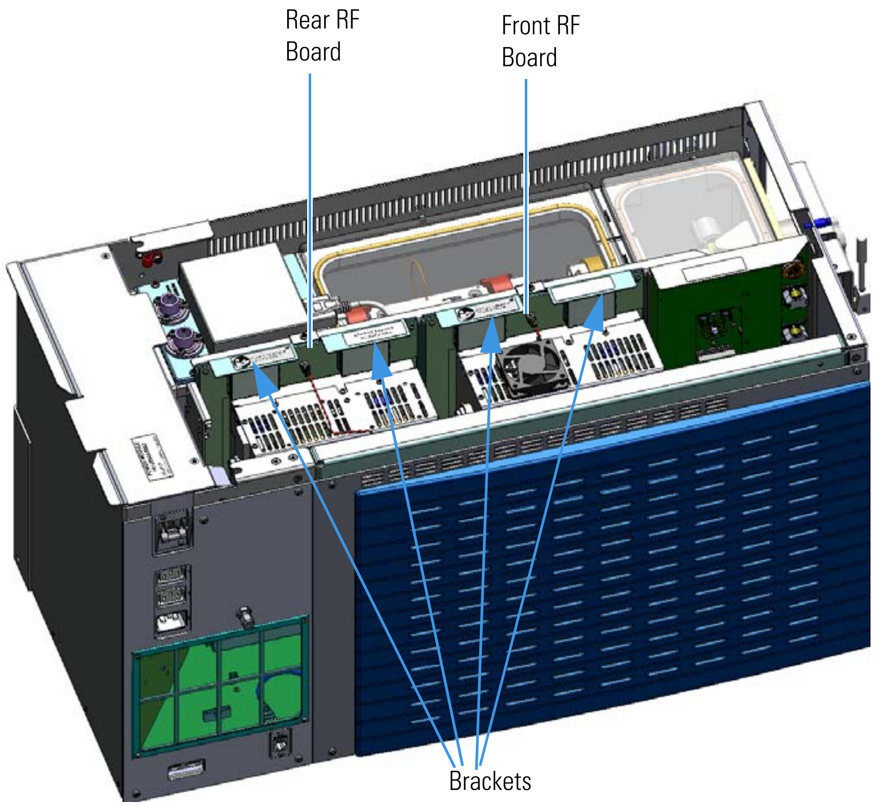
2. Slide the top cover panel toward the back of the instrument and lift it off.

Note The TSQ Duo system contains a front and a rear RF board/rod driver kit. The steps are the same to replace each kit, except for the location.

3. The front RF board is the second board standing on end toward the center of the instrument. The rear RF board is the second board standing on end toward the center of the TSQ Duo instrument. Use a T20 Torxhead screwdriver to remove the screw holding the board and bracket to the chassis.

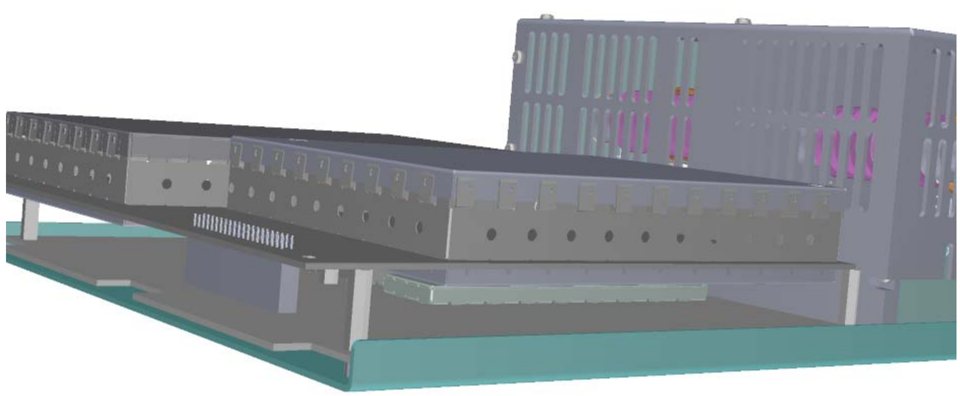
CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

Figure 222. Locating the RF Boards and Brackets



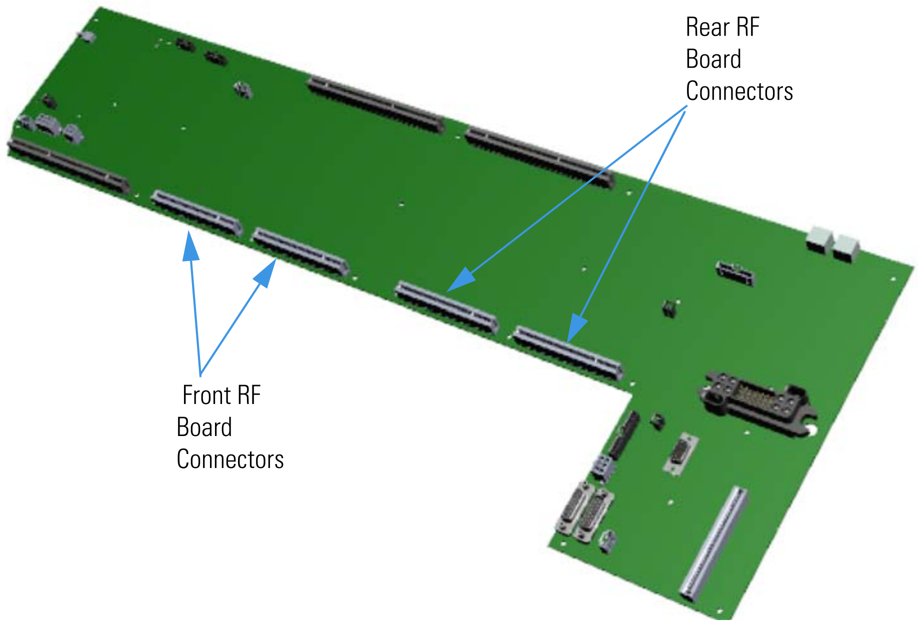
4. Use your fingers to pry the bracket of the board away from the chassis and toward the left side of the instrument.
5. Lift the RF board out of the instrument. The rod driver board is attached to it.

Figure 223. Replacing the RF Board/Rod Driver Board Kits



6. Insert a new RF board/rod driver board kit by aligning the connectors on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 224. Reinstalling the RF Board/Rod Driver Board Kits



7. Push the board down into the connectors.

8. Gently push the board toward the instrument, carefully aligning the board over the feedthrough pins, until it stops.

9. Reattach the screw holding the RF board to the bracket.

Note This screws is required for good ground contact.

10. Reattach the top cover panel and tighten the screw holding it in place.

11. Restart your system by following the instructions in "Restarting the System" on page 106.

Note The new RF board/rod driver board kit will have a slightly different performance than your current board. It will need to be adjusted by a Field Service Engineer because the adjustments must be made while the system is running.

4- Pin Feedthrough

❖ **To replace the 4-pin feedthrough:**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

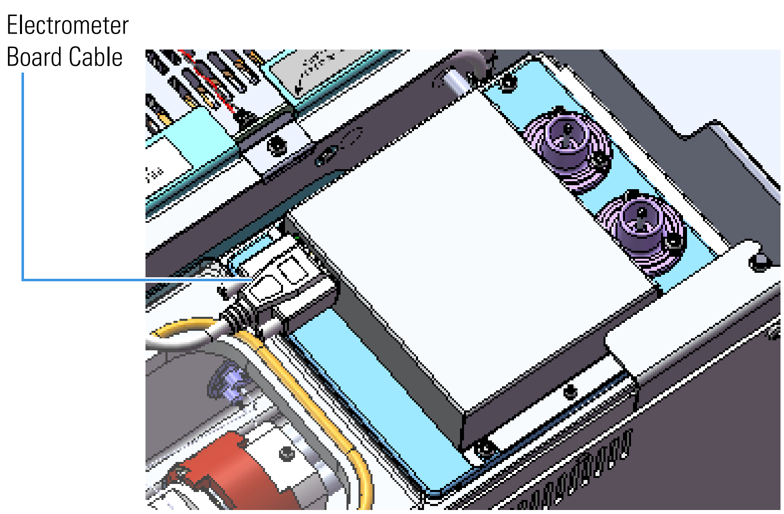
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. However, you must vent the instrument.

2. Slide the left hand front and top cover panels toward the back of the instrument and lift them off.

3. Disconnect the electrometer board cable

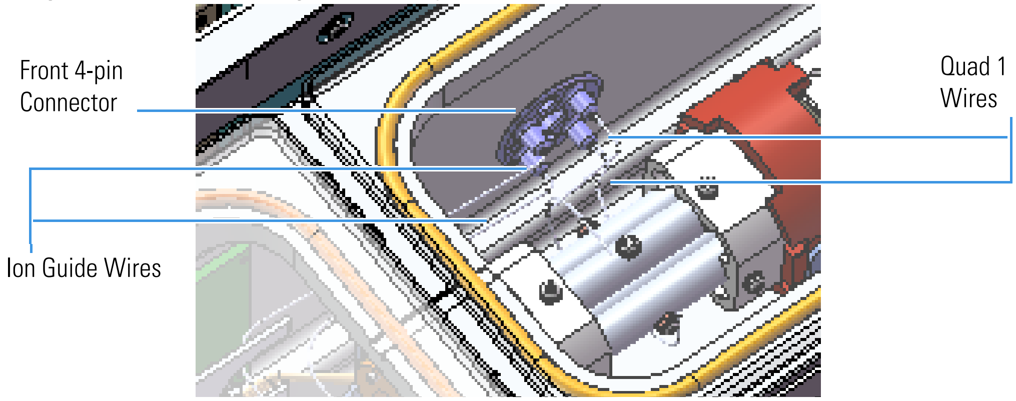
Figure 225. Disconnecting the Electrometer Board Cable



4. Disconnect the four wires from the front 4-pin feedthrough if you need to change it.

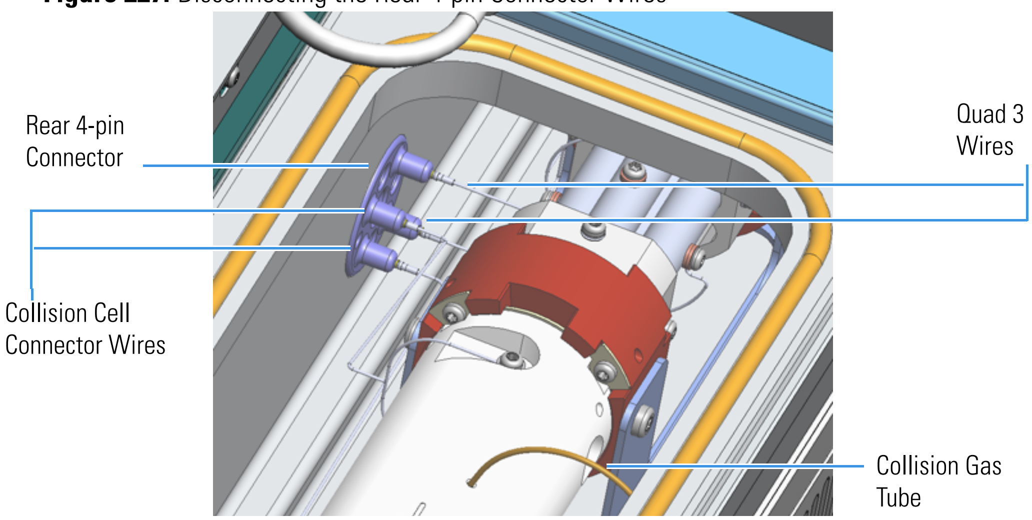
Note Each wire must be reattached to the same connector later in this process, so make a note of their placement.

Figure 226. Disconnecting the Front 4-pin Connector Wires



5. Disconnect the four wires that go to the rear 4-pin feedthrough if you need to change it.

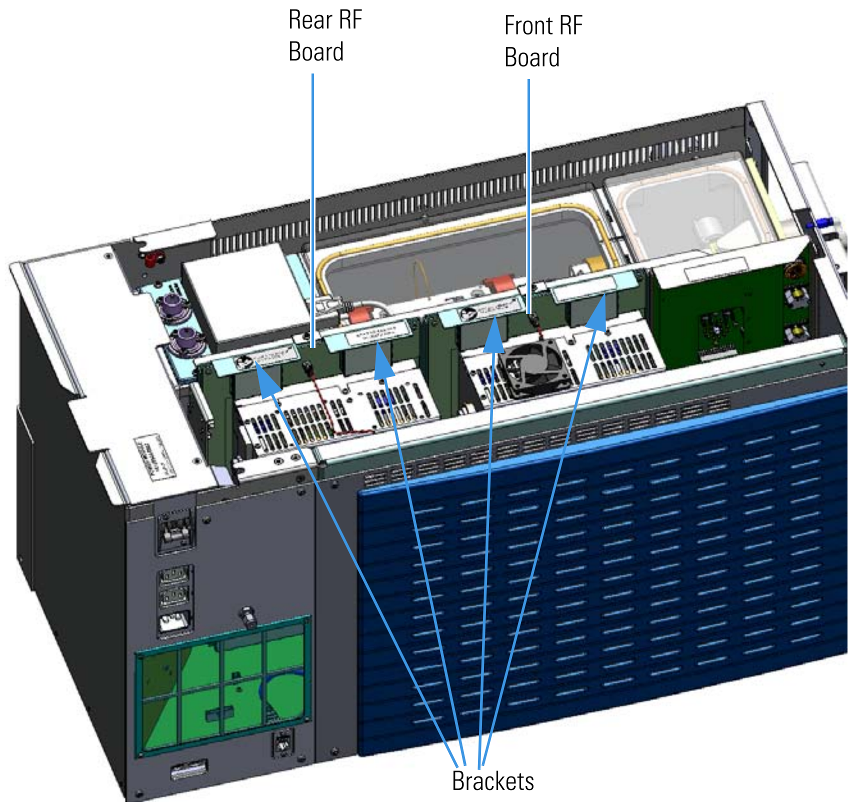
Figure 227. Disconnecting the Rear 4-pin Connector Wires



6. Remove the RF board attached to the feedthrough you wish to change. The front RF board is the second board standing on end toward the center of the TSQ Duo instrument. The rear RF board is the second board standing on end toward the center of the instrument. Use a T20 Torxhead screwdriver to remove the screw holding the board to the top of the chassis.

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

Figure 228. Locating the RF Boards and Brackets



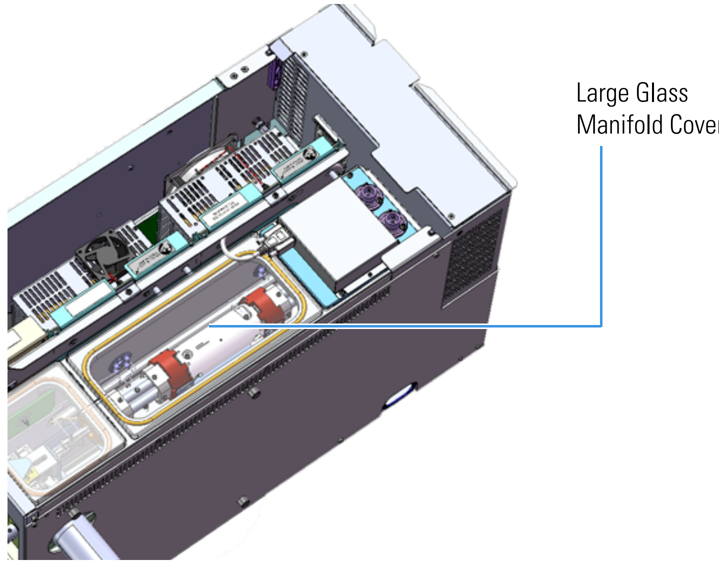
7. Use your fingers to pry the bracket of the board away from the chassis and toward the left side of the instrument.

8. Lift the board out of the instrument.

9. Remove the large glass manifold cover.

10. Set the glass cover on a surface where it will not be scratched or contaminated. Protect the glass and any other manifold components from dust accumulation. Wear cleanroom gloves when touching the glass. See the *TSQ Duo Spare Parts Guide* for information about ordering cleanroom gloves.

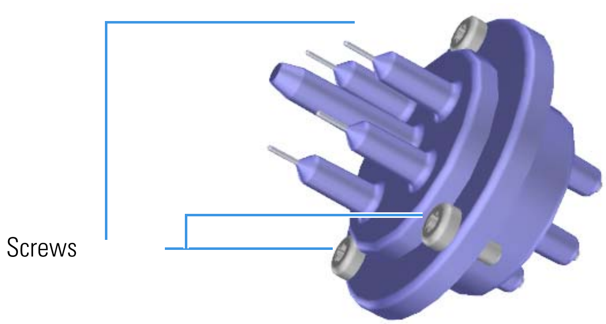
Figure 229. Removing the Large Glass Manifold Covers



CAUTION - ELECTRICAL HAZARD Avoid dropping screws between chassis and side cover or board. If you drop a screw, find it before powering the instrument on again.

11. Look into the instrument from the left side and use a T20 Torxhead screwdriver to remove the three screws around the 4-pin feedthrough.

Figure 230. Removing the 4-pin Feedthroughs



12. Remove and replace the 4-pin feedthrough. You can also remove and replace the o-ring, if necessary.
13. Reattach the 4-pin feedthrough to the chassis.
14. Replace the large glass manifold cover.
15. Reinsert the RF board by aligning the connectors on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.
16. Push the board down into the connectors.
17. Gently push the board toward the instrument, carefully aligning the board over the feedthrough pins, until it stops.
18. Reattach the screw holding the RF board to the bracket.

> **Note** This screw is required for good ground contact.

19. Reconnect the wires to the 4-pin connector.

> **CAUTION INSTRUMENT DAMAGE:** Make sure you reattach these wires to the same connectors they were attached to before.

20. Reconnect the electrometer board cables.
21. Reattach the top cover and left hand front panels and tighten the screws.
22. Restart your system by following the instructions in “Restarting the System” on page 106.

> **Tip** Once your system is under vacuum and stable, check your RF tune. The new feedthrough may have slightly different RF characteristics that may shift the RF that is best for your system.

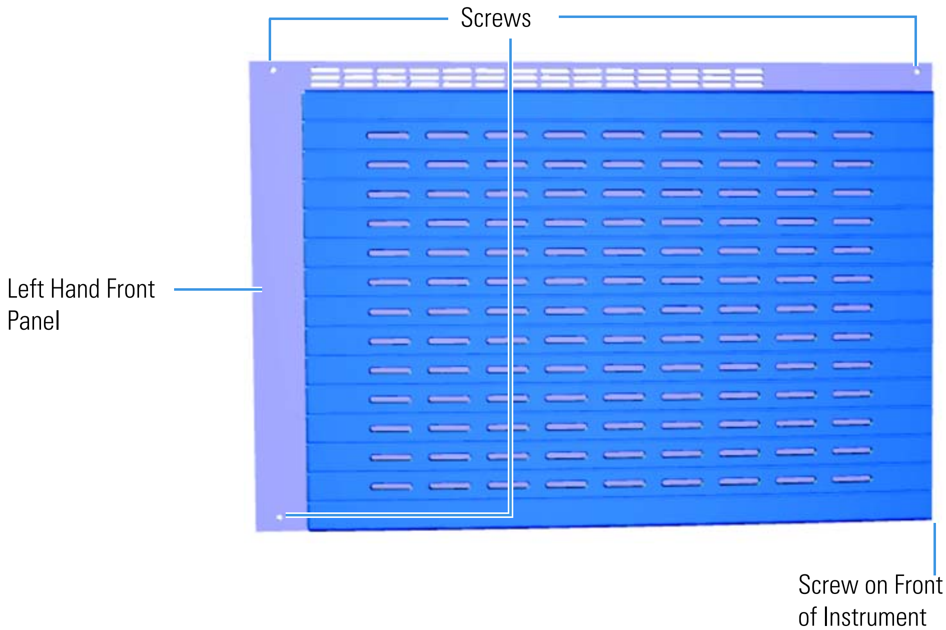
Lens Driver Board

❖ To replace the lens driver board

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or the column.
2. Slide the top cover panel toward the back of the instrument and it them off.
3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

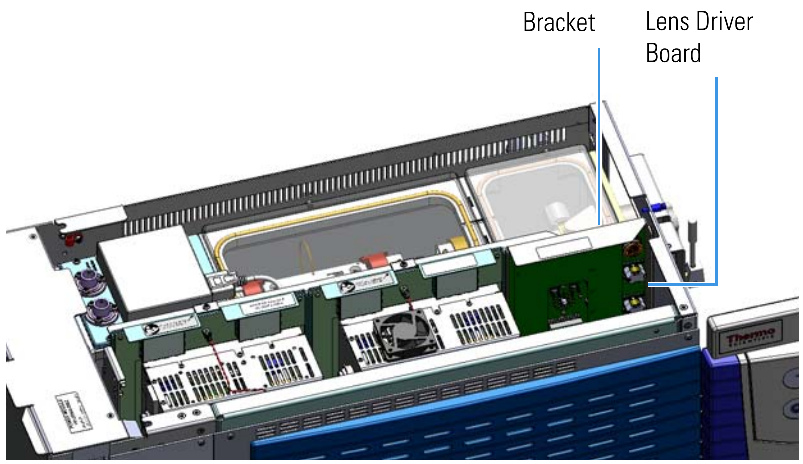
   Figure 231. Locating the Left Hand Front Panel Screws

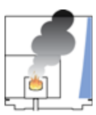


4. Lift the left hand front panel off the instrument.

5. The lens driver board is the first board standing on end in the center of the instrument.

Figure 232. Locating the Lens Driver Board



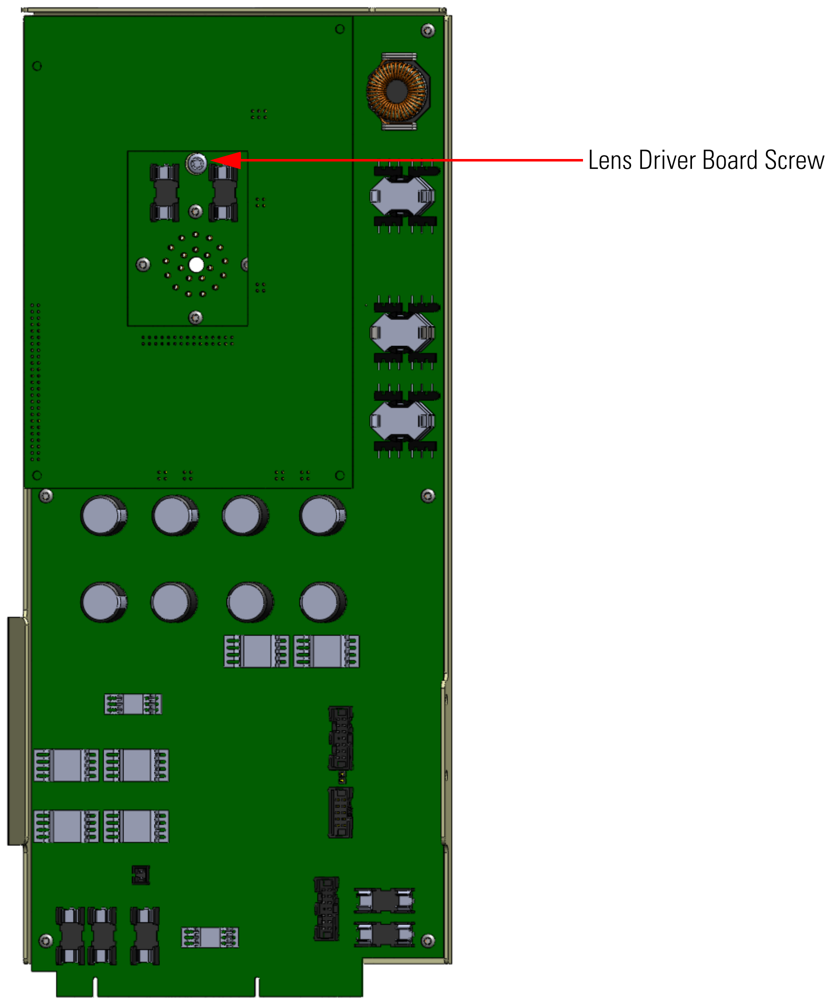


CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

6. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 233. Removing the Lens Driver Board

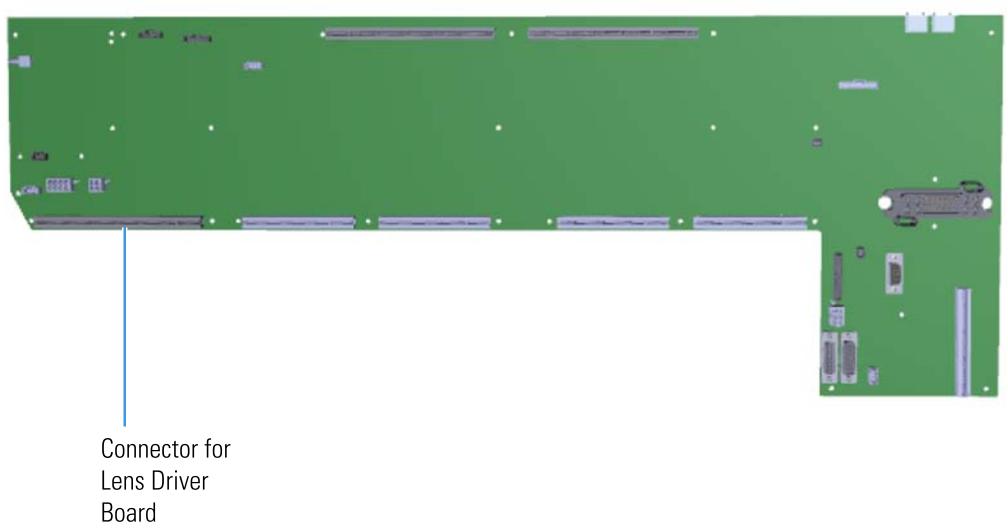


7. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove the screw from the board and bracket.

8. Lift the lens driver board out of the instrument. Be careful as space is limited.

9. Insert a new lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 234. Reinstalling the Lens Driver Board



10. Push the board down into the connector.
11. Look through the left side of the instrument and use a T20 Torxhead screwdriver to tighten the screw holding the lens driver board in place on the chassis.
12. Reattach the top cover and left side panels and tighten the screws.
13. Restart your system by following the instructions in “Restarting the System” on page 106.

20-Pin Feedthrough

To replace the 20-pin feedthrough:

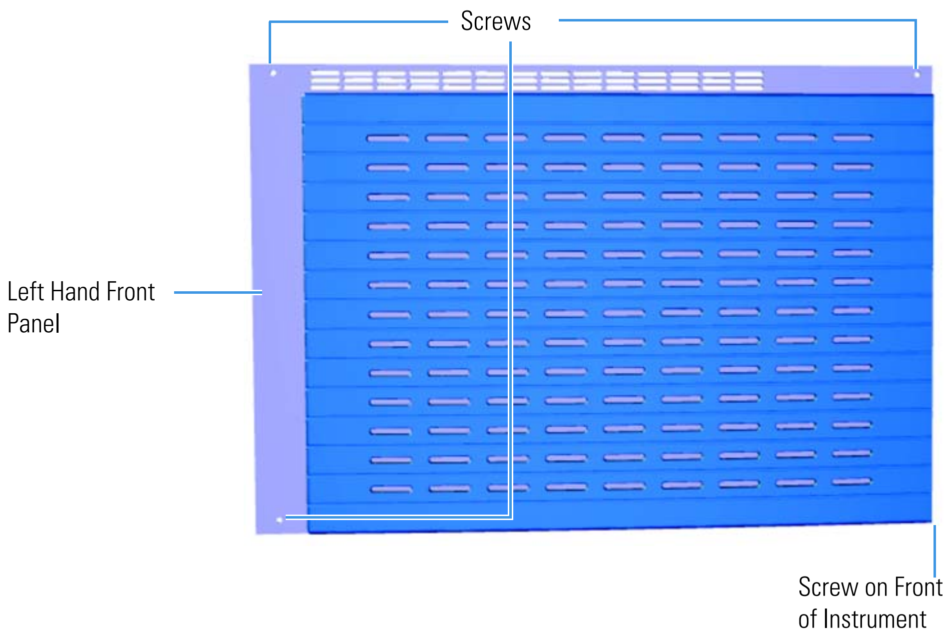
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. However, you must vent the instrument.

2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

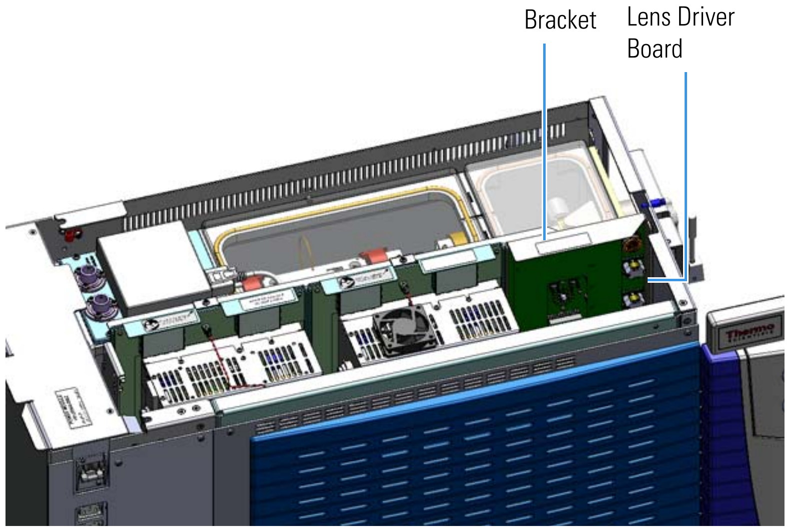
Figure 235. Locating the Left Hand Front Panel Screws



4. Lift the left hand front panel off the instrument.
5. The lens driver board is the first board standing on end in the center of the instrument

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

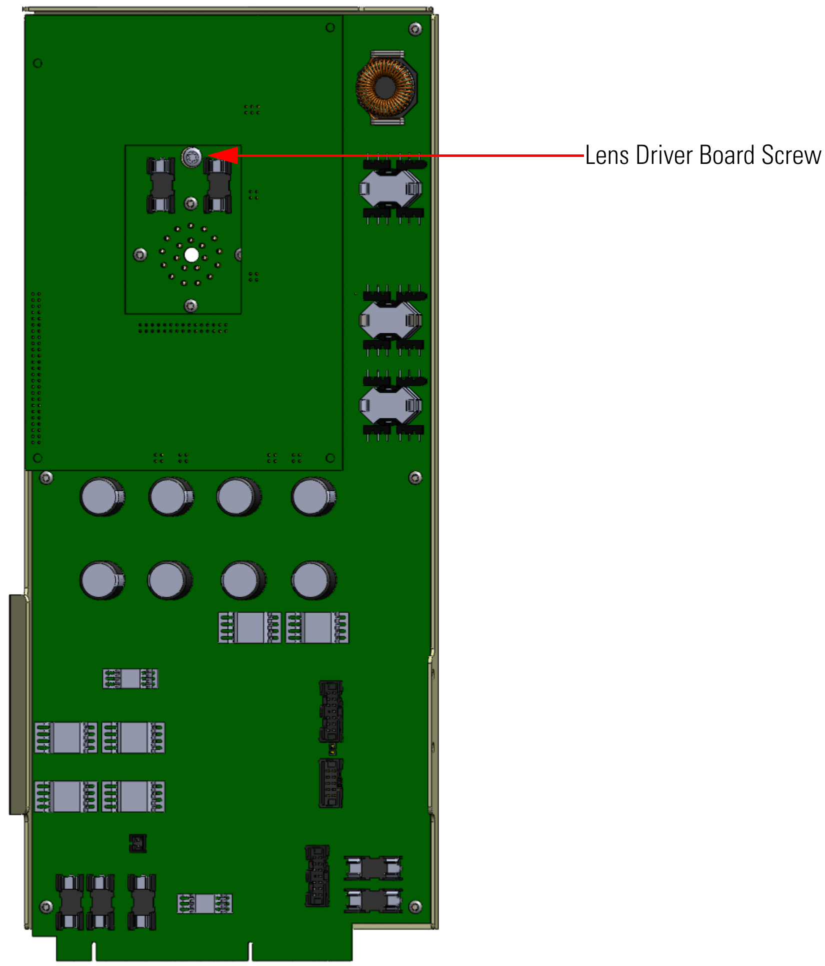
Figure 236. Locating the Lens Driver Board



6. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove the screw from the board and bracket.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 237. Removing the Lens Driver Board



7. Use your fingers to pry the bracket of the board away from the chassis and toward the left side of the instrument.

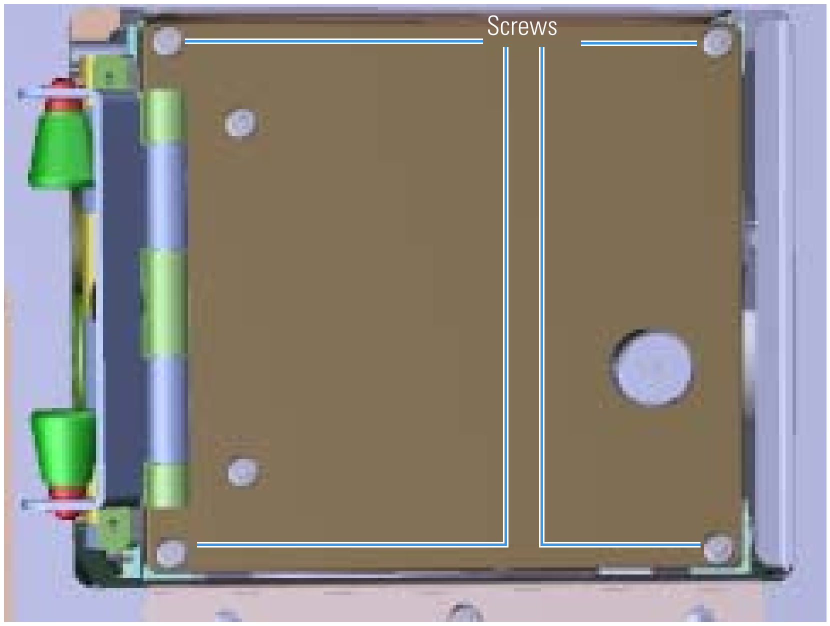
8. Remove the top manifold cover (glass) out of the top of the instrument and set it aside.

9. Open the front door of the TSQ Duo instrument.

10. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

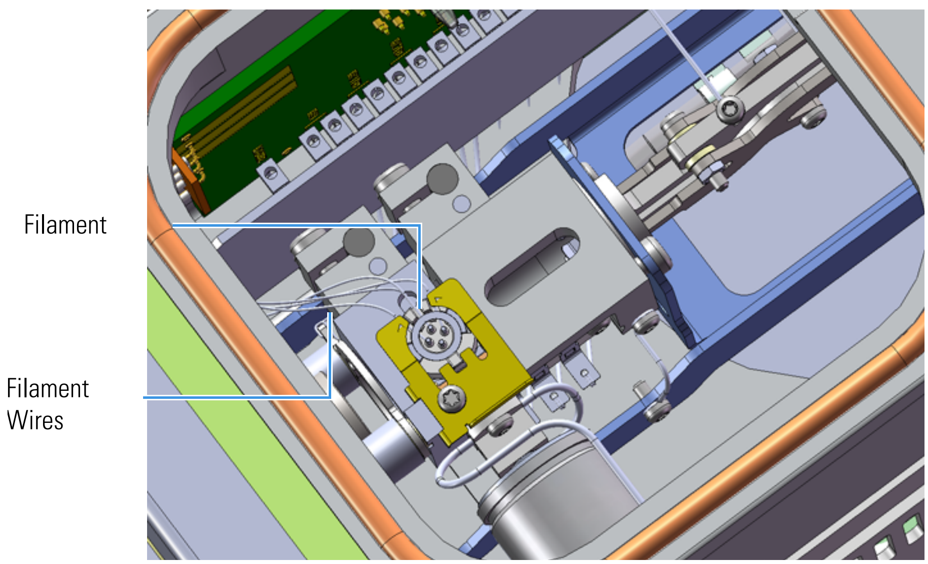
Note Remove the screws completely so that they do not scratch the manifold when you close the door.

Figure 238. Opening the Manifold Door



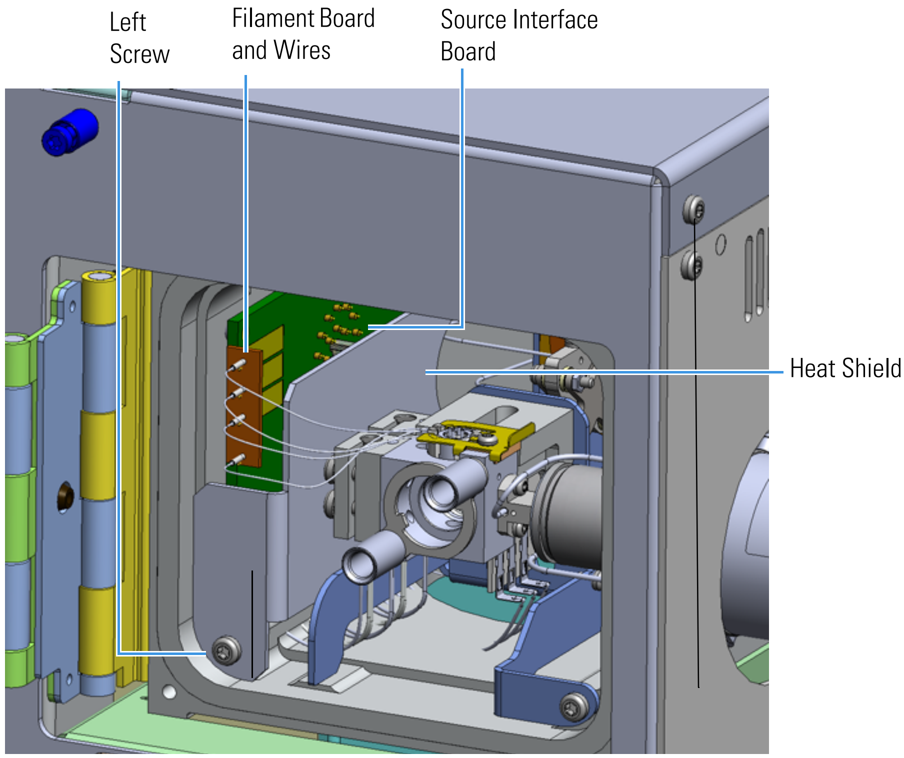
11. Open the manifold door and slide the filament board and wires off the pins on the source interface board.

Figure 239. Disconnecting the Filament Wires



12. Remove the bottom left screw holding the metal heat shield to the manifold.

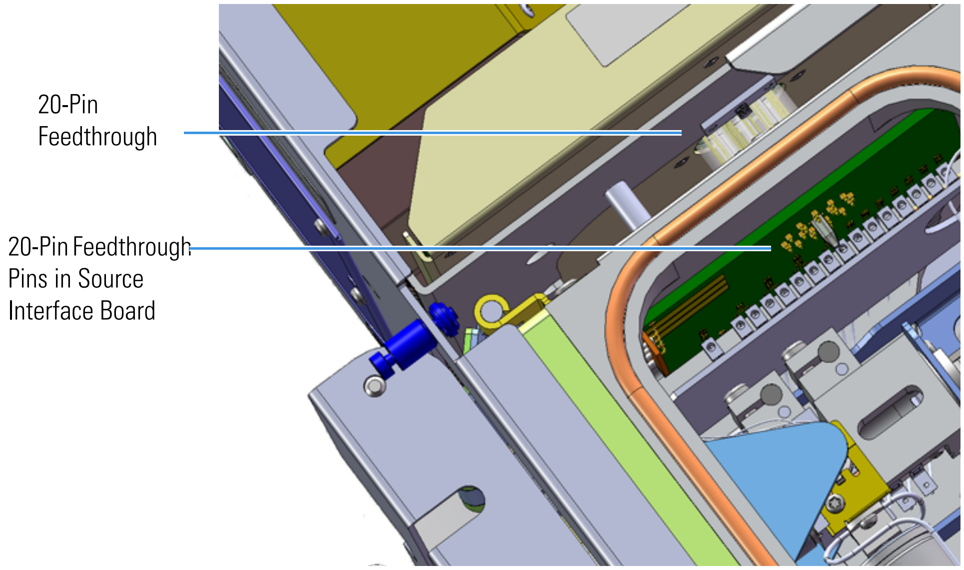
Figure 240. Removing the Heat Shield



Note Keep all manifold parts you remove covered on a clean work surface so they will not accumulate dust.

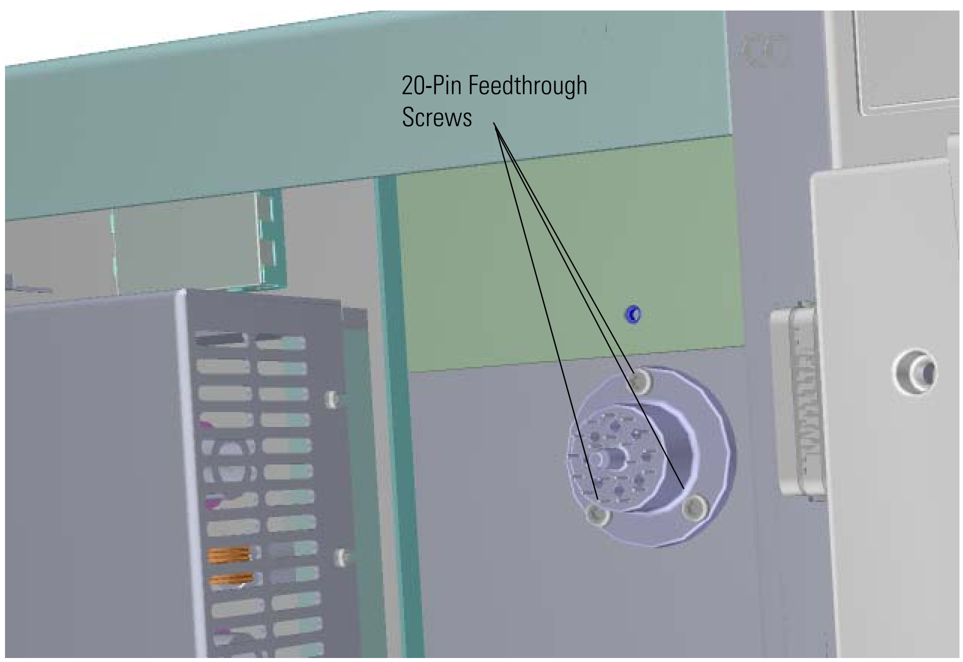
13. Look through the top of the instrument and use the heat shield to pry the source interface board off of the 20-pin feedthrough.

Figure 241. Detaching the Source Interface Board From the 20-Pin Feedthrough



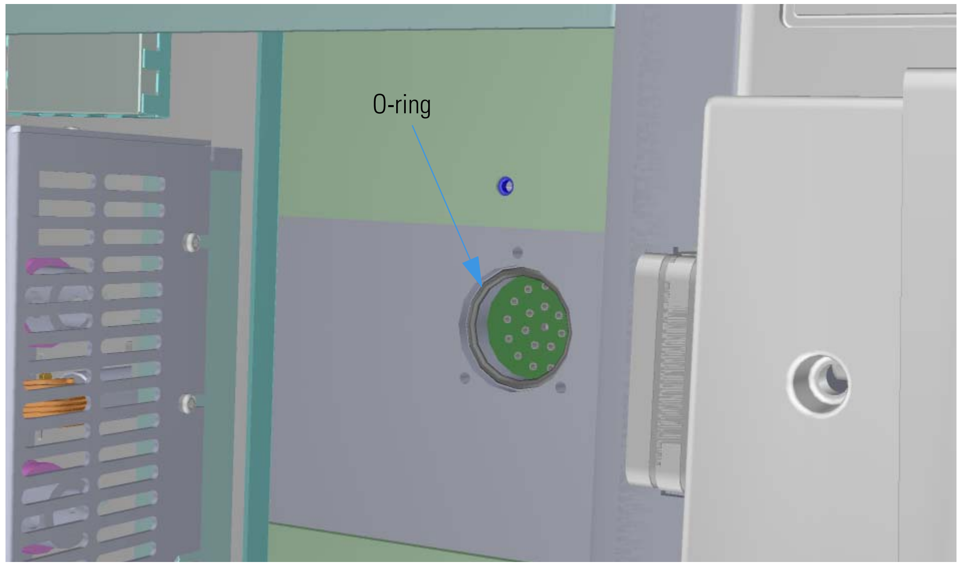
14. From the left side of the instrument, use a T20 Torxhead screwdriver to remove the three screws around the 20-pin feedthrough.

Figure 242. Removing the 20-Pin Feedthrough



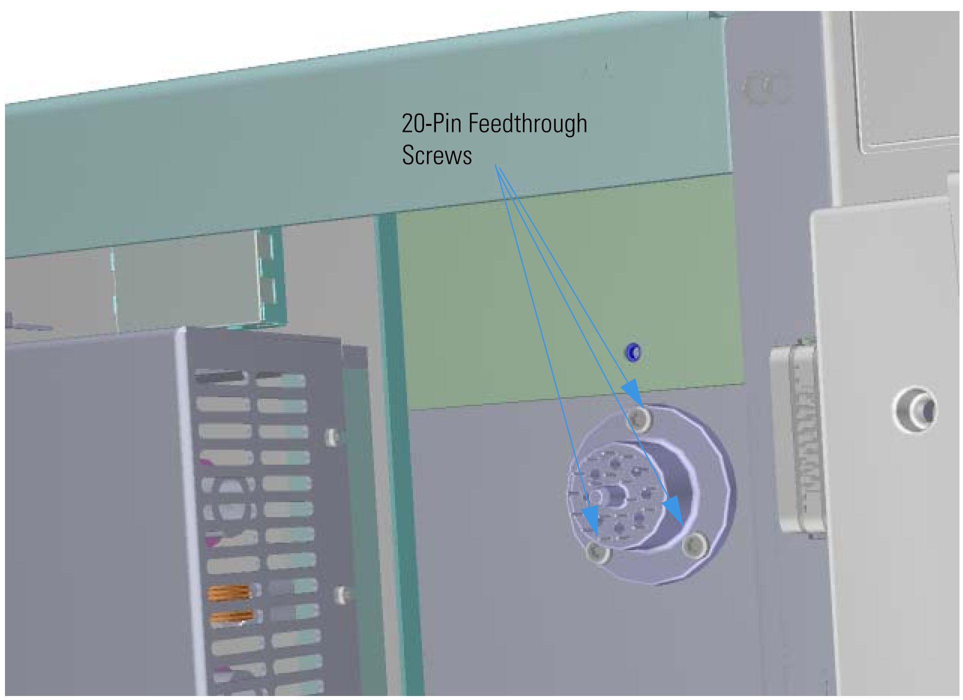
15. Remove and replace the 20-pin feedthrough. If necessary, replace the o-ring and make sure it is properly aligned and free of dust.

Figure 243. Replacing the 20-Pin Feedthrough



16. From the left side of the instrument, reattach the three screws around the 20-pin feedthrough. Tighten the screws uniformly.

Figure 244. Reattaching the 20-Pin Feedthrough



17. Look through the top of the instrument and align the pins on the 20-pin feedthrough with the holes in the source interface board to connect them together.

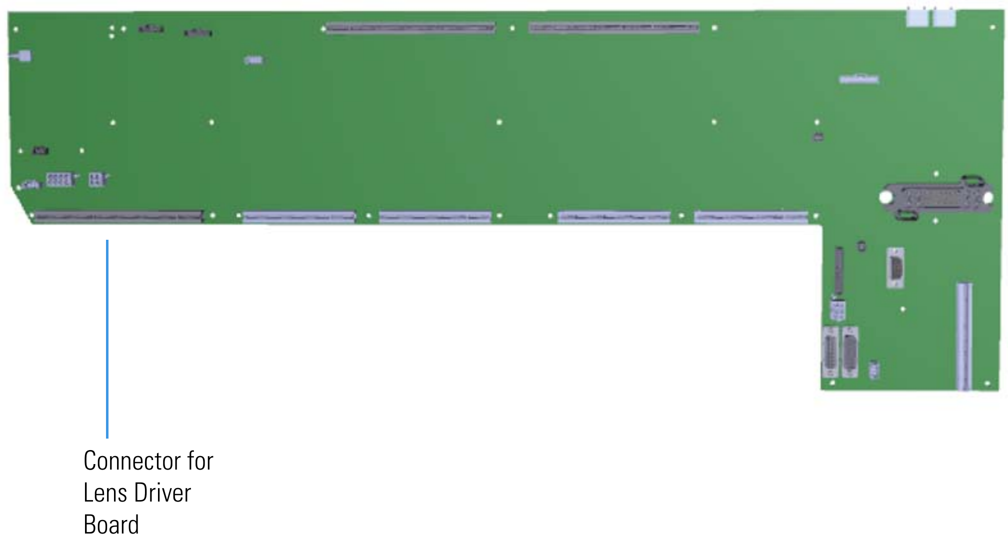
18. Slide the heat shield into its slot and reattach the screw holding it in place.

19. Reattach the filament board to the source interface board.

20. Close the manifold door and reattach the four screws.

21. Reinsert the lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 245. Reinstalling the Lens Driver Board



22. Push the board down into the connector.

23. Look through the left side of the instrument and tighten the screw that holds the lens driver board in place on the chassis.

24. Reattach the top cover panel and tighten the screw.

25. Restart your system by following the instructions in "Restarting the System" on page 106.

PC Communication Board, Controller Interface Board, and Support Bracket

❖ **To replace the PC communication board, controller interface board, or support bracket**

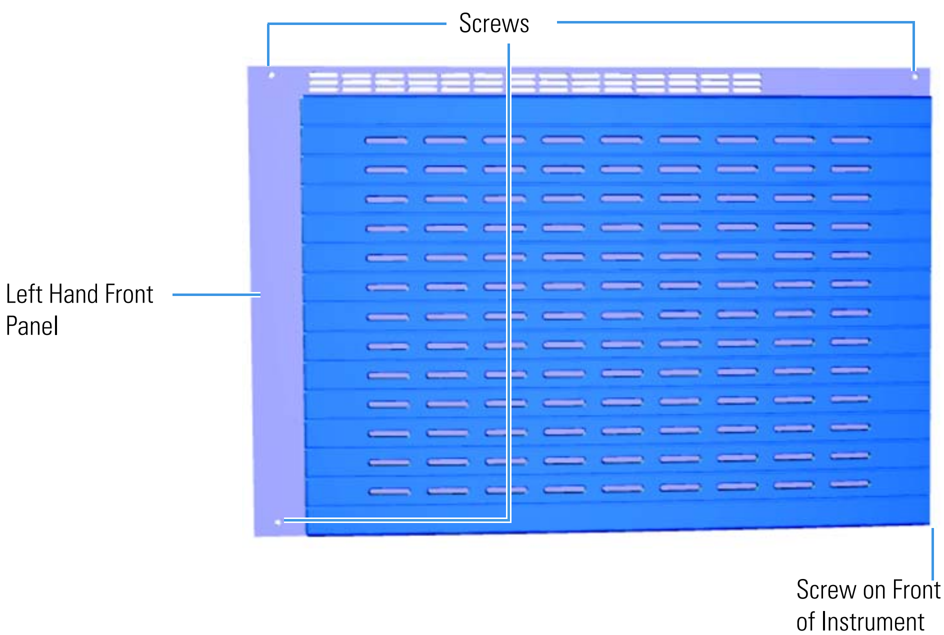
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column or vent the instrument.

2. Slide the top cover panel off the instrument.
3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

Figure 246. Locating the Left Hand Front Panel Screws



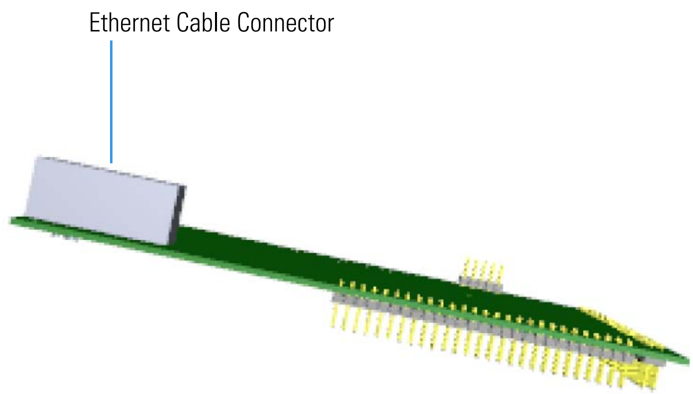
4. Lift the left hand front panel off the instrument.

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

5. Locate the PC communication board, which is attached to the controller interface board.

Note Although the PC communication board is attached to the controller interface board, they are sold separately. See the *TSQ Duo Spare Parts Guide* for ordering information.

Figure 247. Locating the Ethernet Cable Connector on the PC Communication Board

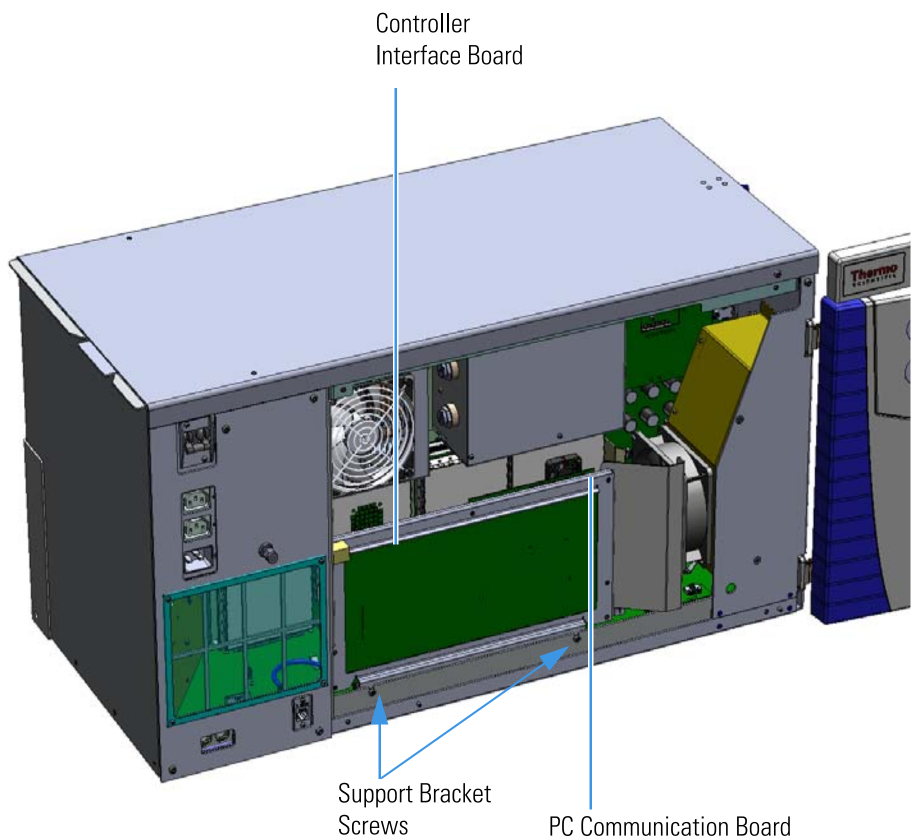


6. Disconnect the Ethernet cable from the PC communication board.

7. Use a T20 Torxhead screwdriver to loosen the two M4 screws holding the controller interface board support bracket to the bottom of the instrument.

8. Remove the controller interface board and PC communication board from the instrument.

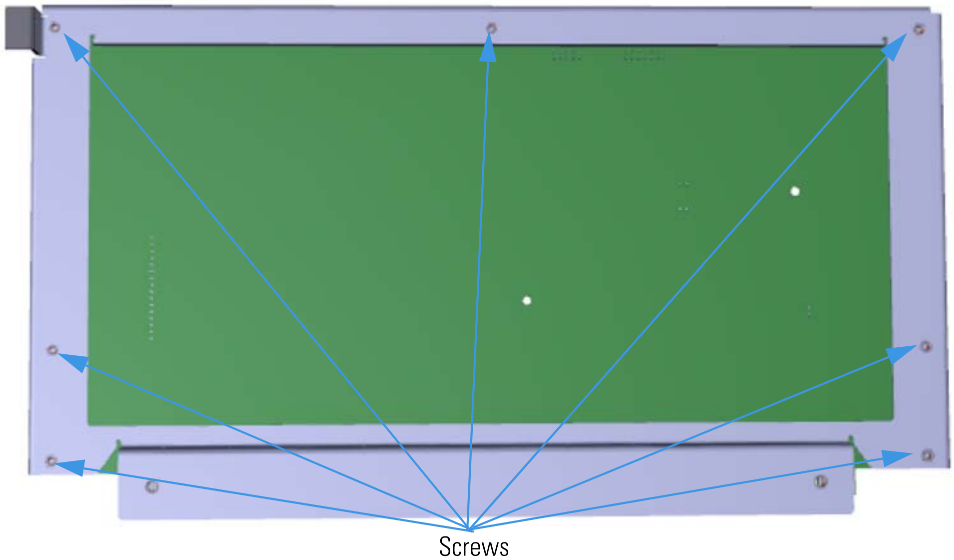
Figure 248. Removing the Controller Interface Board Support Bracket



9. If you need to replace the support bracket, use a T10 Torxhead screwdriver to remove the seven M3 screws securing the controller interface board to the support bracket.

10. Replace the bracket and reattach it to the controller interface board.

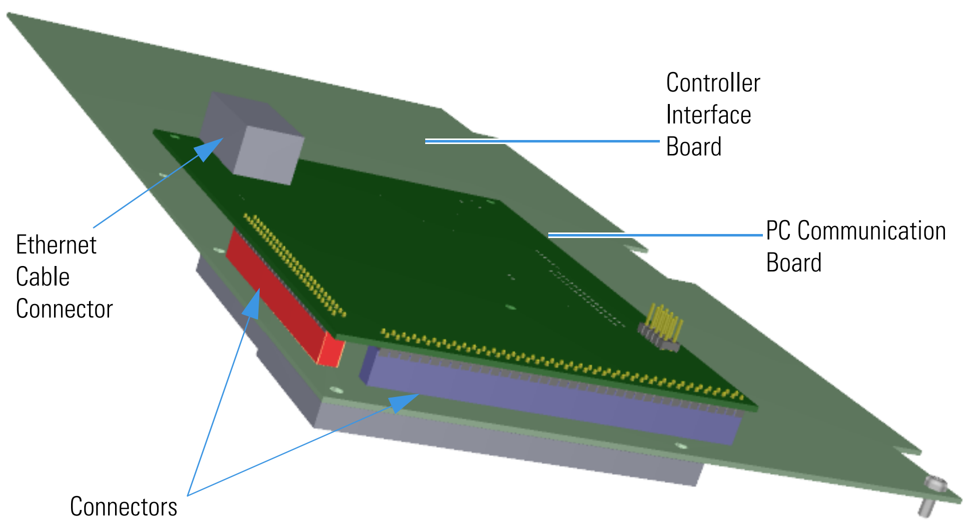
Figure 249. Removing the Support Bracket Screws



11. Incrementally, and very carefully, disconnect the PC communication board from the controller interface board by separating the two connectors. Inspect the pins to be certain they are not bent.

CAUTION INSTRUMENT DAMAGE: Be careful not to exert too much pressure when separating these boards. Flexing the boards will cause damage.

Figure 250. Replacing the PC Communication Board and Controller Interface Board



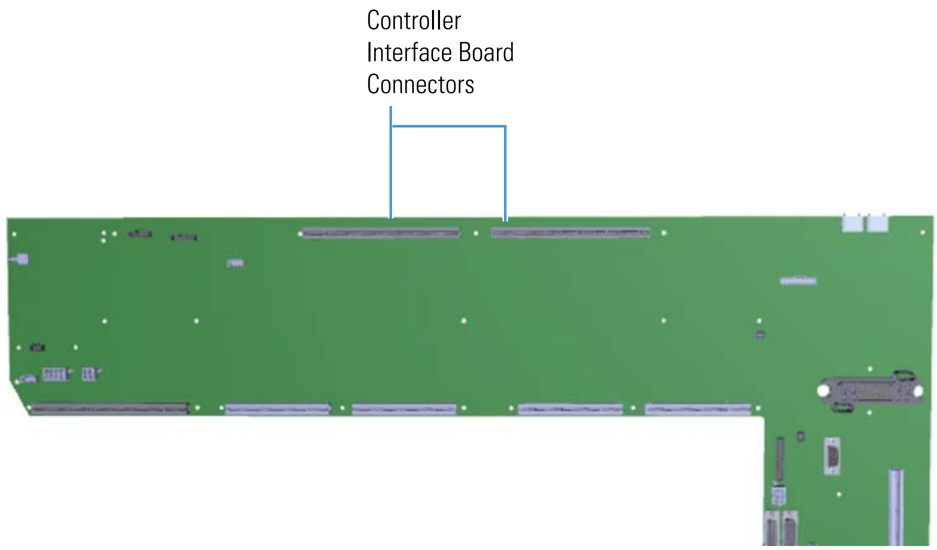
12. Reattach the existing or new PC communication board to the existing or new controller interface board. Be careful not to bend the pins.

13. Inspect the boards from multiple angles to ensure all pins are inserted into the connectors. It is possible to shift the board and miss a row of pins when you plug the boards together.

14. Reconnect the Ethernet cable to the controller interface board.

15. Insert the new controller interface board by aligning the two connectors on the bottom of the board to the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 251. Reinstalling the Controller Interface Board



16. Push the board down into the connectors.

17. Use a T20 Torxhead screwdriver to secure the two M4 screws on the controller interface board support bracket to the chassis.

18. Reattach the top cover and left hand front panels and tighten the screws.

19. Restart your system by following the instructions in "Restarting the System" on page 106.

Distribution Board

The distribution board lies on the bottom of the TSQ Duo instrument chassis.

❖ **To replace the distribution board**

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

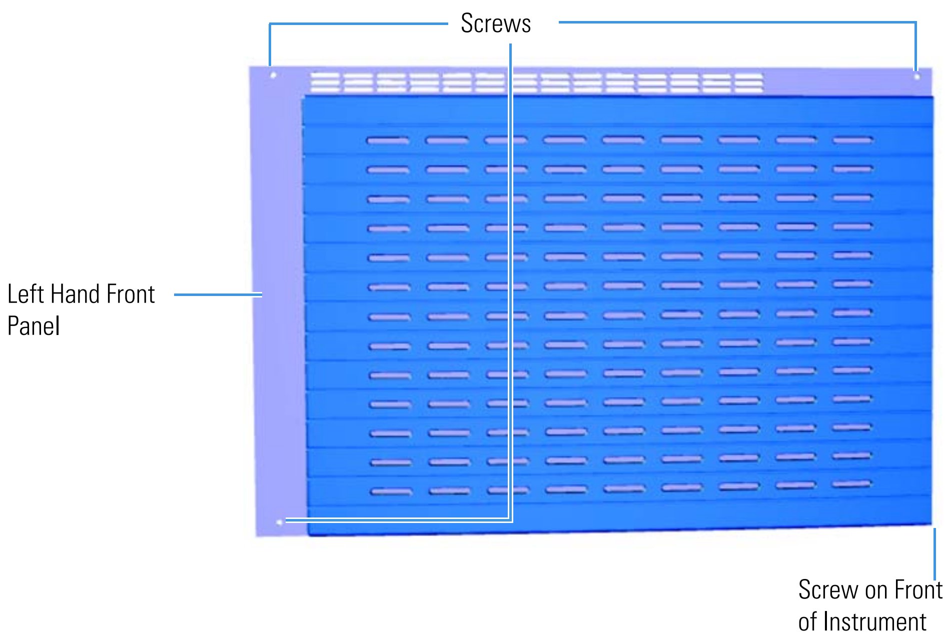
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.

3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

Figure 252. Locating the Left Hand Front Panel Screws



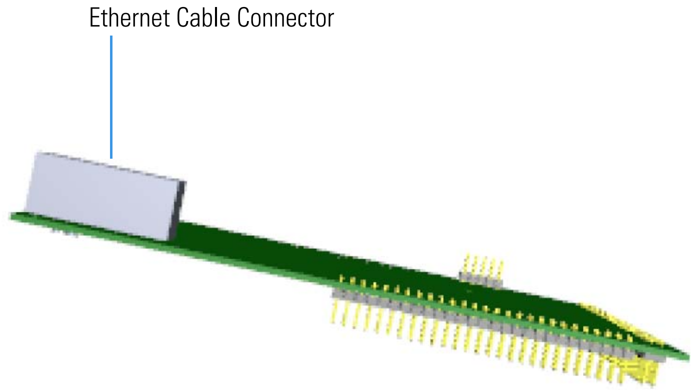
4. Lift the left hand front panel off the instrument.

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

5. Locate the PC communication board, which is attached to the controller interface board.

Note Although the PC communication board is attached to the controller interface board, they are sold separately. See the *TSQ Duo Spare Parts Guide* for ordering information.

Figure 253. Locating the Ethernet Cable Connector on the PC Communication Board

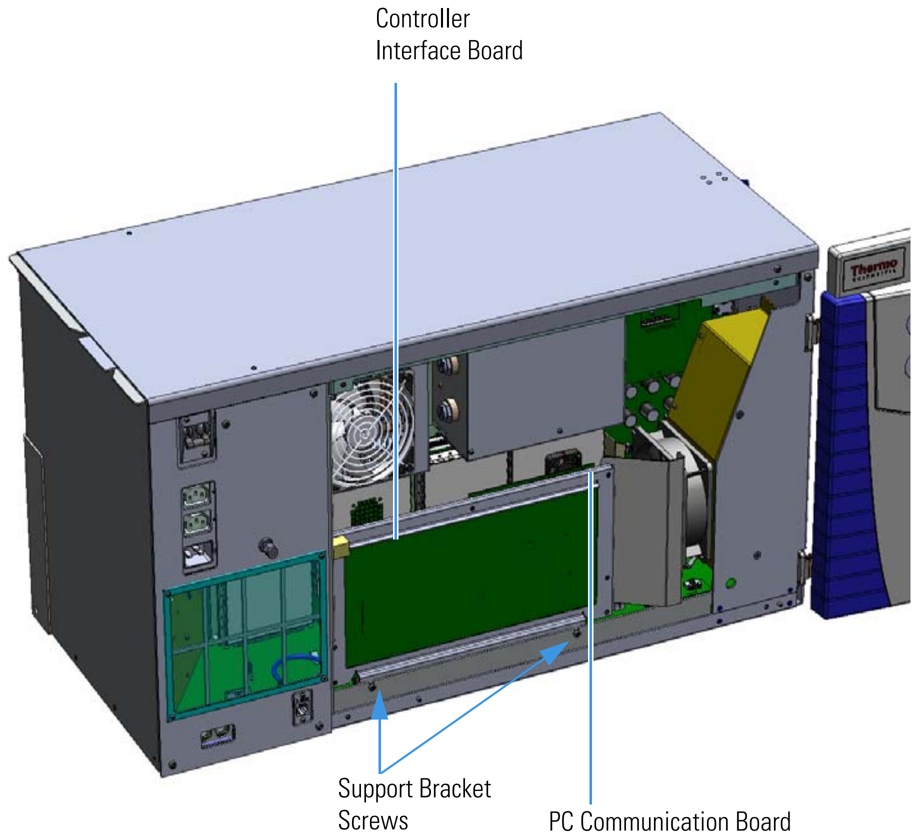


6. Disconnect the Ethernet cable from the PC communication board.

7. Use a T20 Torxhead screwdriver to loosen the two M4 screws holding the controller interface board support bracket to the bottom of the instrument.

8. Remove the controller interface board and PC communication board from the instrument.

Figure 254. Removing the Controller Interface Board Support Bracket

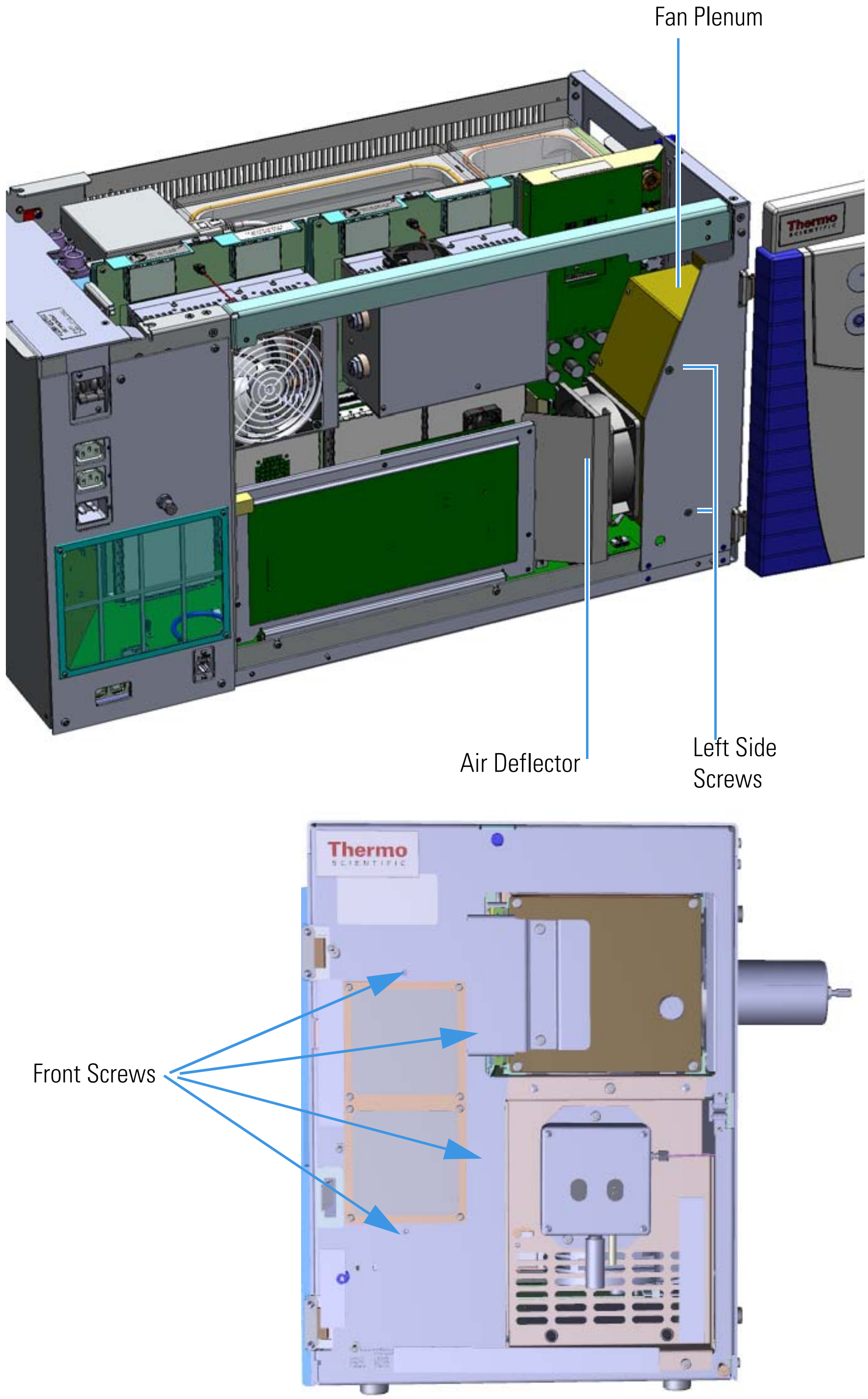


9. Remove the six screws holding the fan plenum to the chassis. Two are on the left side of the instrument, and four are attached to the interior front panel.

10. Disconnect the fan from the distribution board.

11. Remove the entire fan plenum assembly including the fan and air deflector from the instrument.

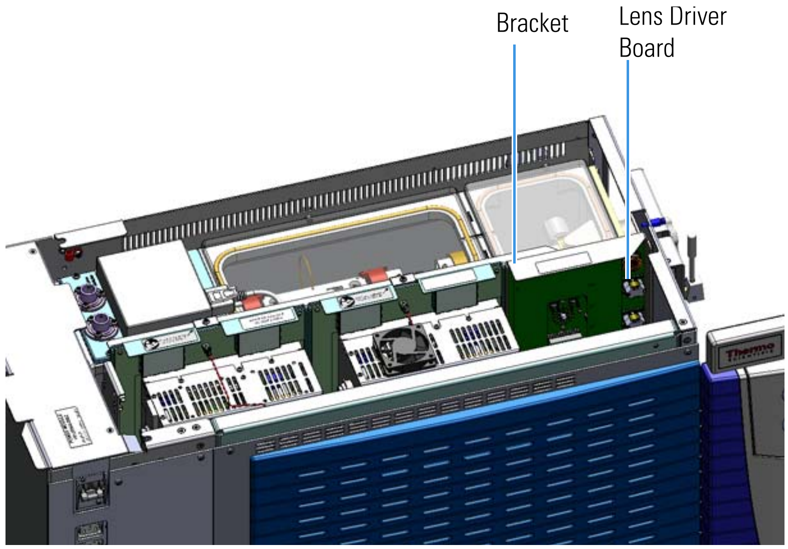
Figure 255. Removing the Chassis Cooling Fan and Pan Plenum



12. Disconnect the fan from the distribution board on the bottom of the instrument.

13. The lens driver board is the first board standing on end in the center of the instrument.

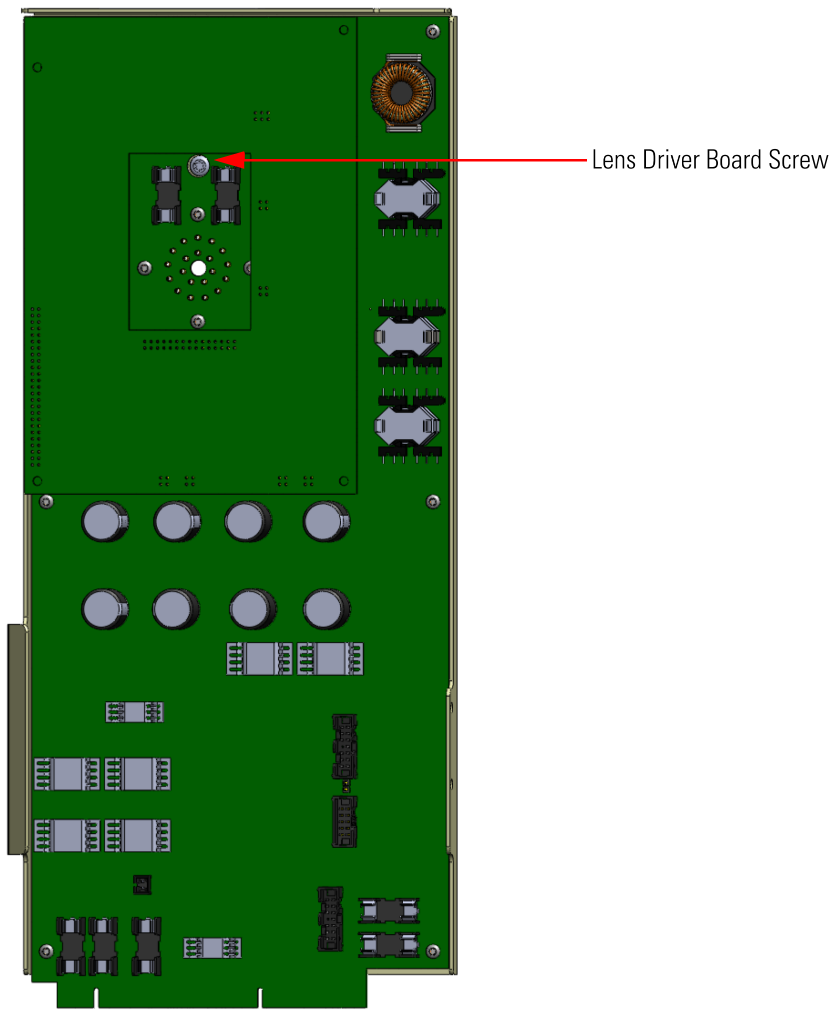
Figure 256. Locating the Lens Driver Board



14. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 257. Removing the Lens Driver Board



15. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove the screw from the board and bracket.

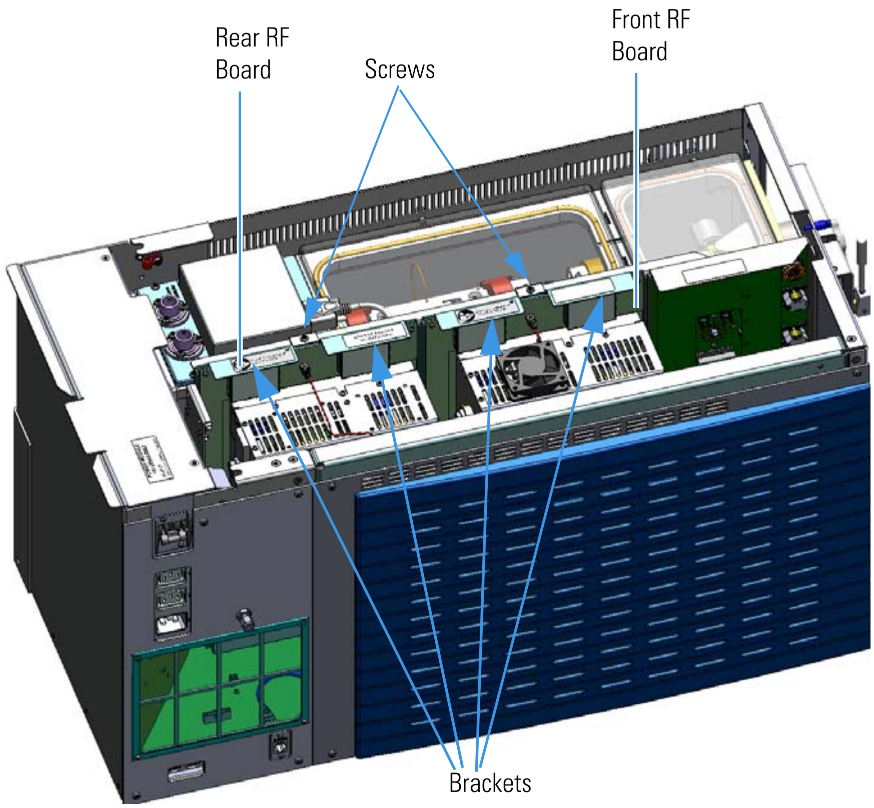
16. Lift the lens driver board out of the instrument. Be careful as space is limited.

Note The steps to remove and replace the front and rear RF board/rod driver kits s are the same. Refer to the images for the proper location of each board.

17. The front RF board is the second board standing on end toward the center of the instrument. The rear RF board is the third board standing on end toward the center of

the TSQ Duo instrument. Use a T20 Torxhead screwdriver to remove the screws holding the board and brackets to the chassis.

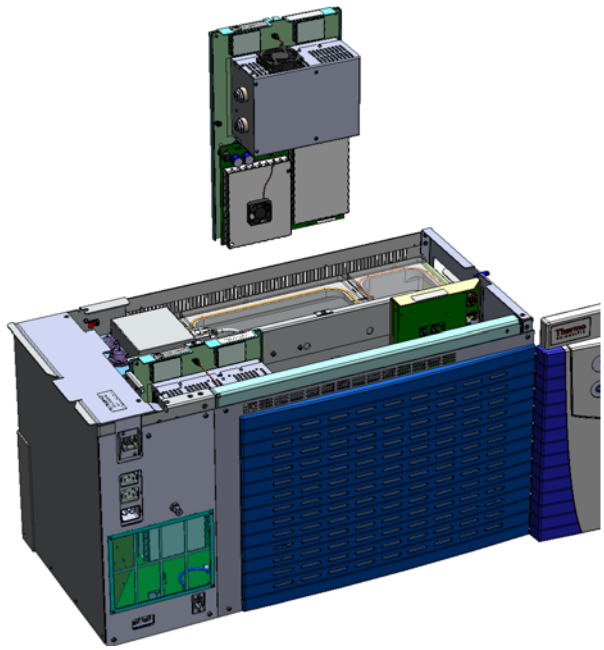
Figure 258. Locating the RF Boards and Brackets



18. To remove the front RF board, use your fingers to pry the brackets of the board away from the chassis and toward the left side of the instrument.

19. Lift the board out of the instrument.

Figure 259. Removing the Front RF Board from the TSQ Duo Instrument

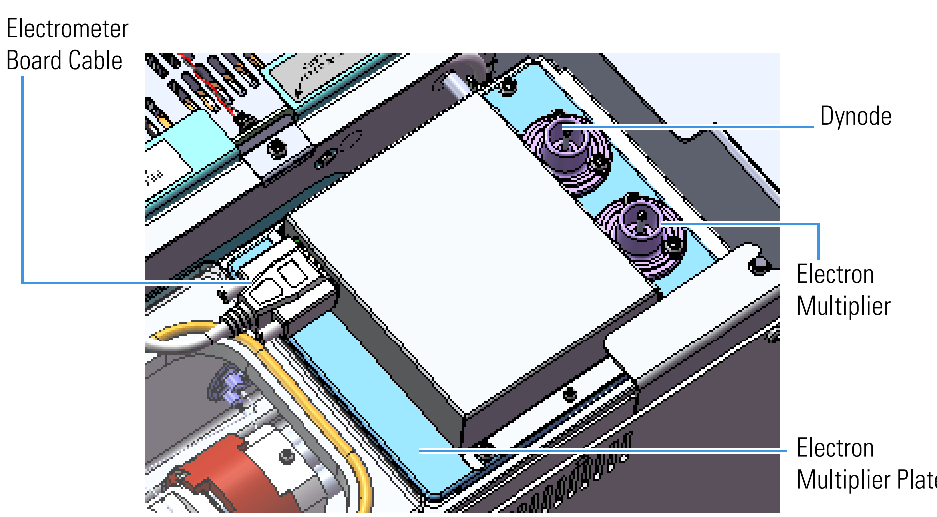


20. To remove the rear RF board, use your fingers to pry the brackets of the board away from the chassis and toward the left side of the instrument.

21. Lift the board out of the instrument.

22. Disconnect the electrometer board cable and large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

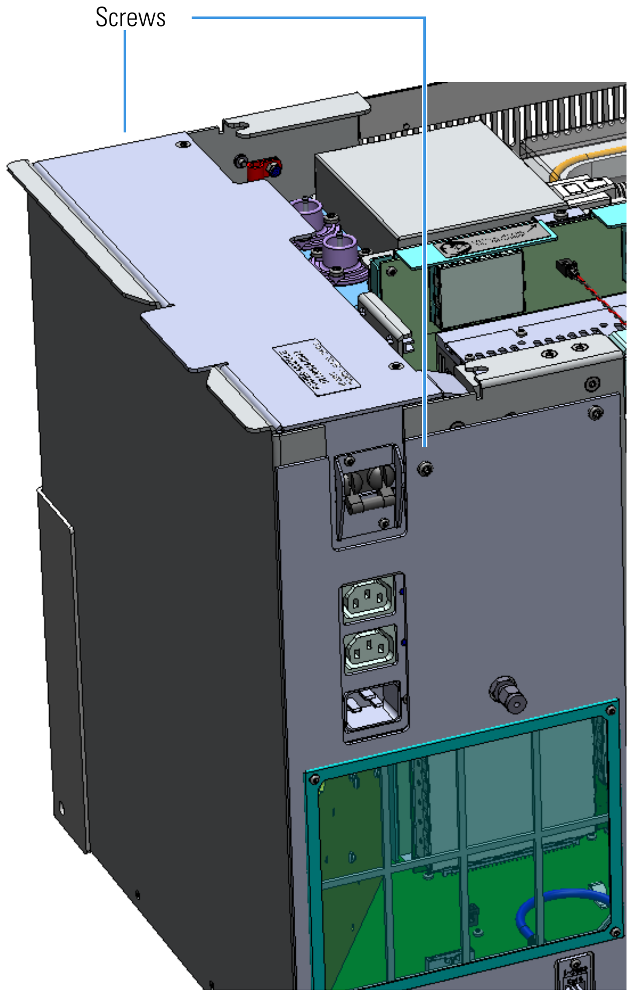
Figure 260. Disconnecting the Electron Multiplier Cables



23. Disconnect the power connections from the TSQ Duo instrument.

24. Use a T20 Torxhead screwdriver to remove the two screws holding the power module to the instrument.

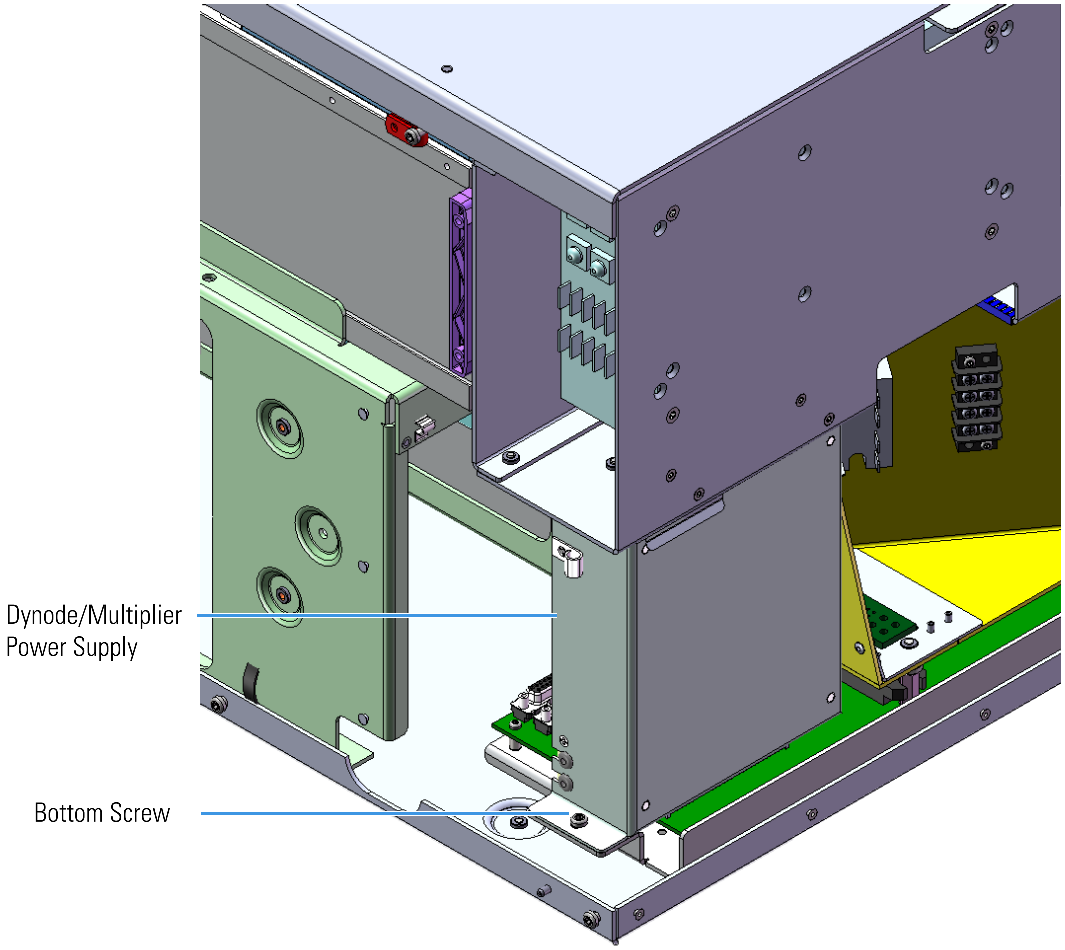
Figure 261. Removing the Power Module Screws



25. Pull the power supply out of the top of the instrument.

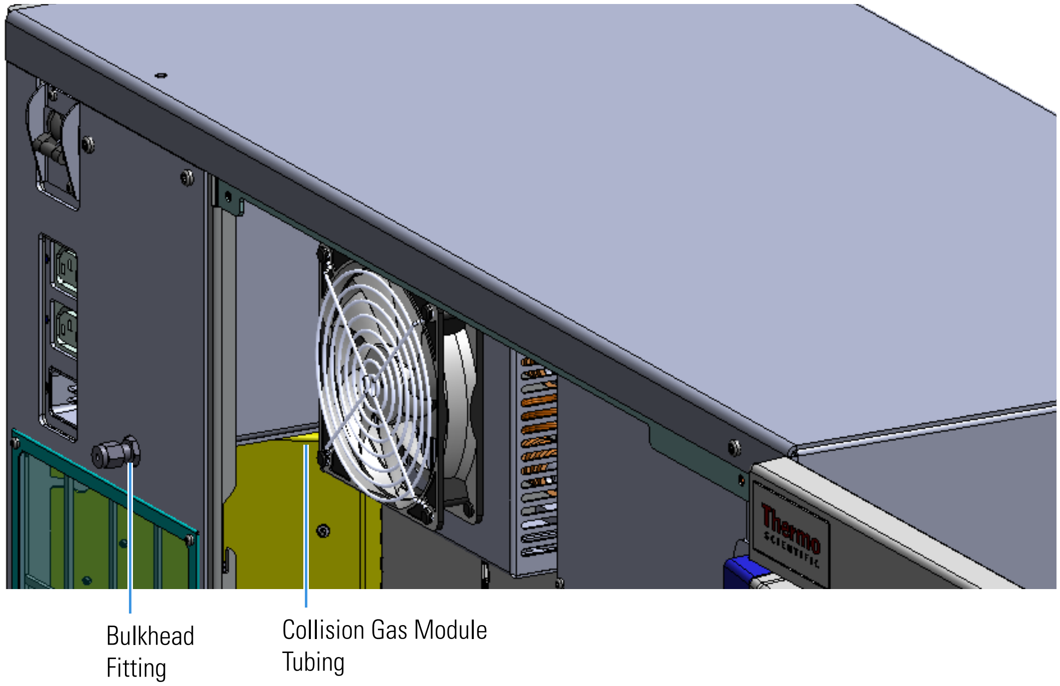
26. Remove the screw that connects the dynode/multiplier power supply to the bottom of the chassis.

Figure 262. Removing the Dynode/Multiplier Power Supply



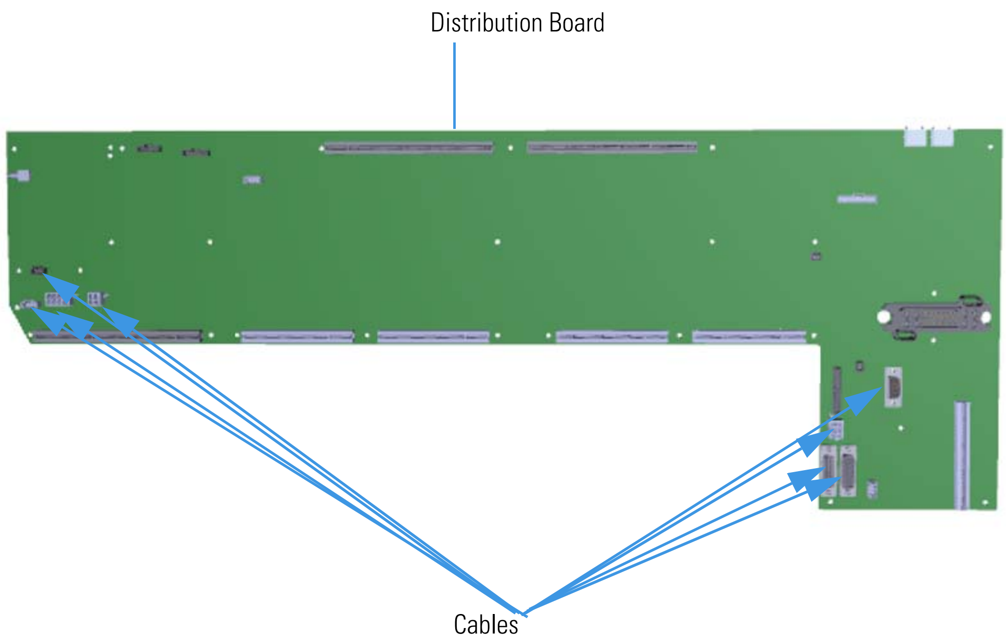
27. Disconnect the 1/16 in. collision gas tubing from the bulkhead compression fitting located on the left hand sub panel.

Figure 263. Disconnecting the Cable to the Bulkhead Fitting



28. Disconnect the collision gas module cable from the distribution board.
29. Now that all of the components have been removed from the distribution board, you can see that it lies flat on the bottom of the chassis.

Figure 264. Disconnecting the Distribution Board



30. Disconnect all the cables from the distribution board. Also remove the cable that enters the chassis from the back panel.
31. Remove the two flex cables that attach to the inlays on the front door.
32. Remove all 19 T10 Torxhead screws that connect the distribution board to the bottom of the chassis.
33. Tilt the distribution board to one side and lift it out of the instrument.
34. Insert a new distribution board into the instrument and reattach the screws.
35. Reconnect the 1/16 in. collision gas tubing from the bulkhead compression fitting located on the left hand sub panel.
36. Reconnect all the cables.
37. Reattach the dynode/multiplier power supply to the back the chassis by reattaching the screw.
38. Slide the main power supply back down into its slot.
39. Reattach the two screws holding the power supply to the instrument.
40. Reattach the power connectors to the inputs on the left hand sub panel.
41. Reconnect the large feedthrough cables on the electron multiplier plate.

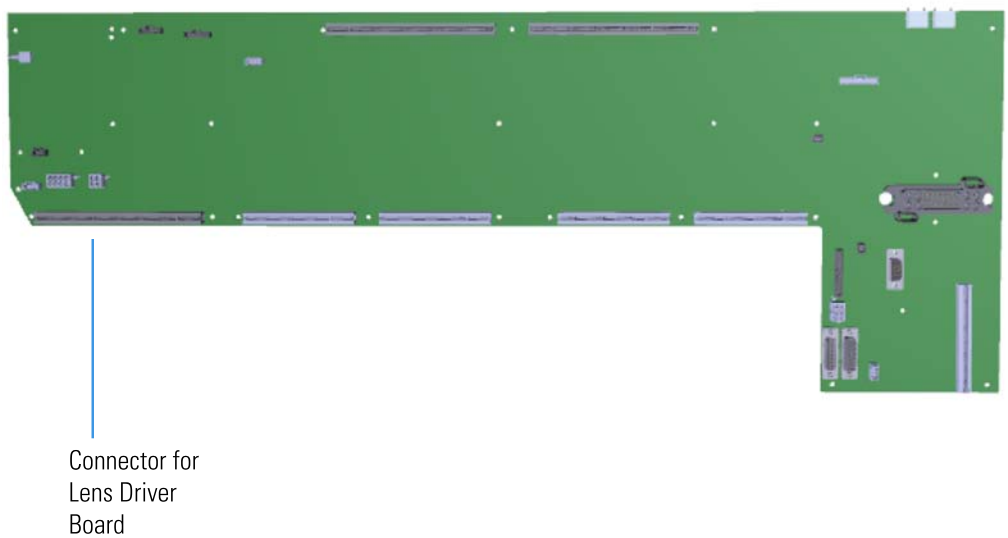
42. Reattach the RF boards by aligning the connectors on the bottom of the board with the connectors on the distribution board beneath it. The boards will drop into their slots when they are in the right position.

43. Gently push the RF board into the instrument, carefully aligning the board over the feedthrough pins, until it stops.

44. Reattach the screw holding the RF board to the bracket.

45. Reinstall the lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will click into place when its in the right position.

Figure 265. Reinstalling the Lens Driver Board



46. Look through the left side of the instrument and use a T20 Torxhead screwdriver to tighten the screw holding the lens driver board in place on the chassis.Reattach the controller interface board by aligning the connectors on the bottom of the board with the

connectors on the distribution board beneath it. It will click into place when its in the right position.

Figure 266. Reinstalling the Controller Interface Board

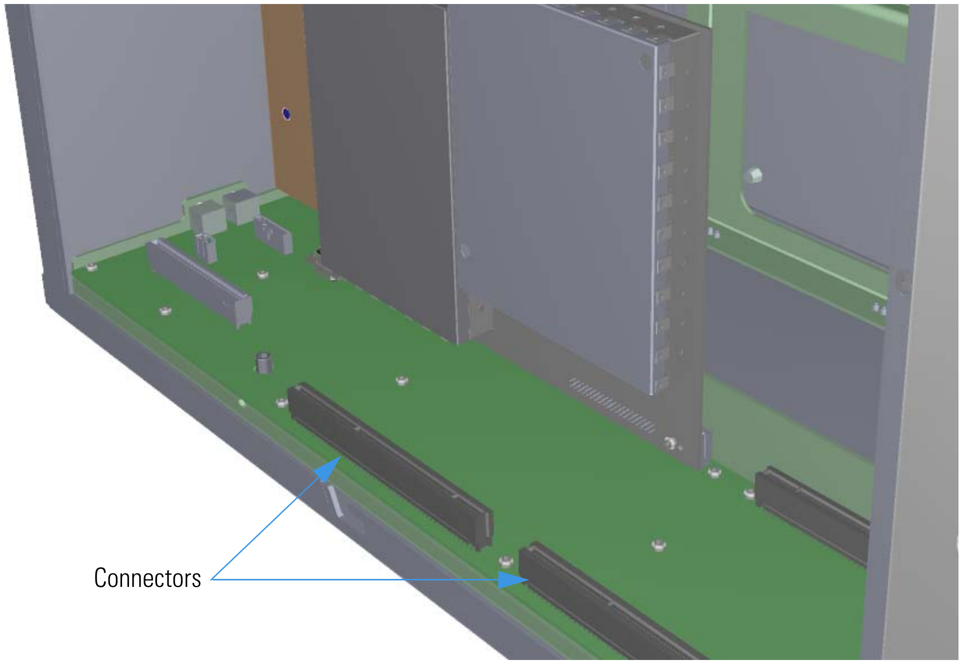
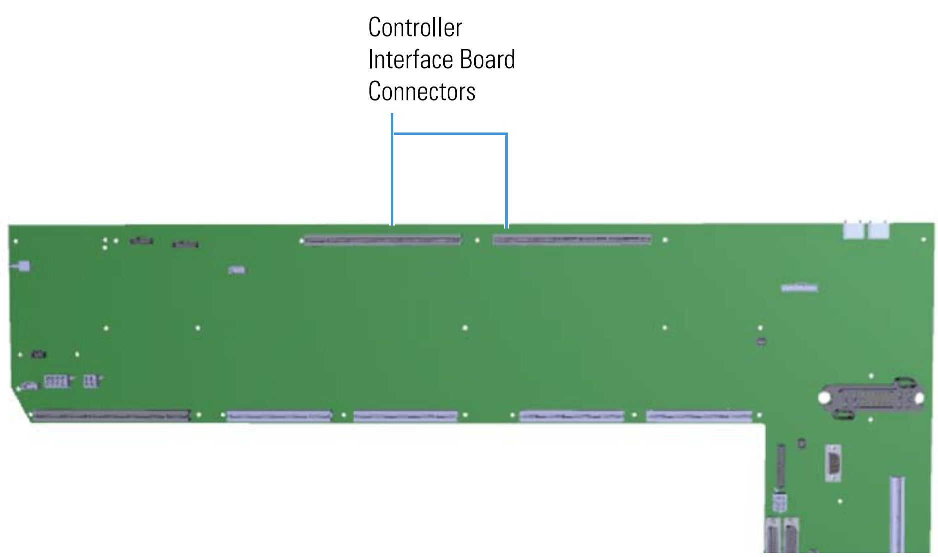


Figure 267. Reinstalling the Controller Interface Board



47. Reattach the support bracket.

48. Reattach the fan plenum and the front interior panel and tighten the screws.

49. Reattach the top cover and left hand front panels and tighten the screws.

50. Restart your system by following the instructions in “Restarting the System” on page 106.

Source Interface Board and Heat Shield

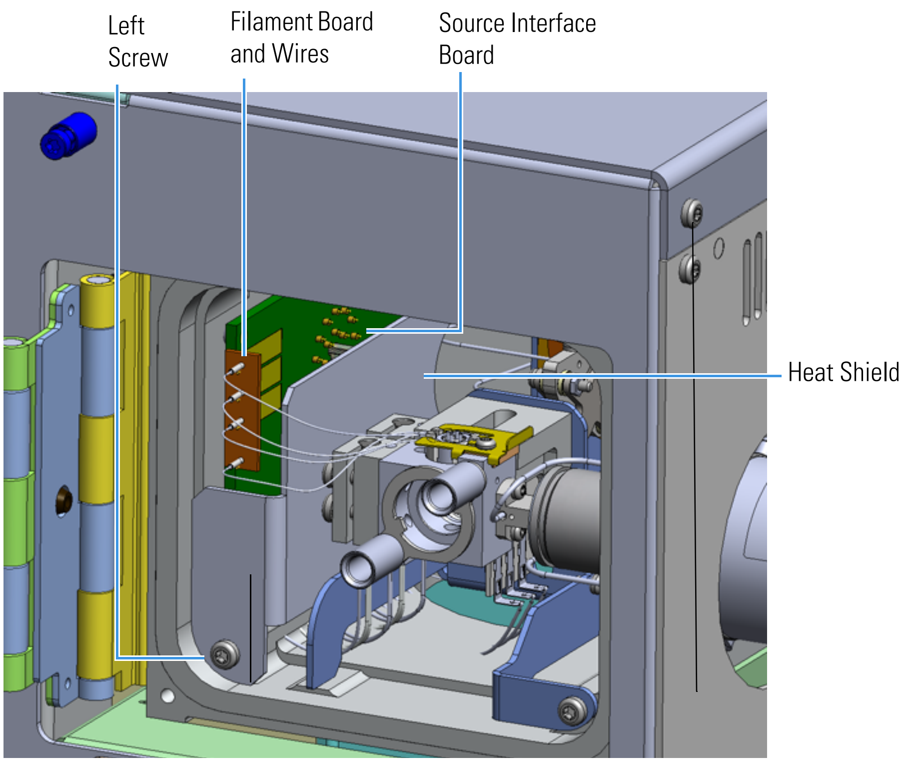
❖ To replace the source interface board and heat shield

Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

2. If you are only replacing the heat shield, you do not need to remove the analyzer tray. Disconnect the filament board and wires from the source interface board and the left screw to remove the heat shield.

Figure 268. Replacing the Heat Shield



Note Keep all manifold parts you remove covered on a clean work surface so they will not accumulate dust.

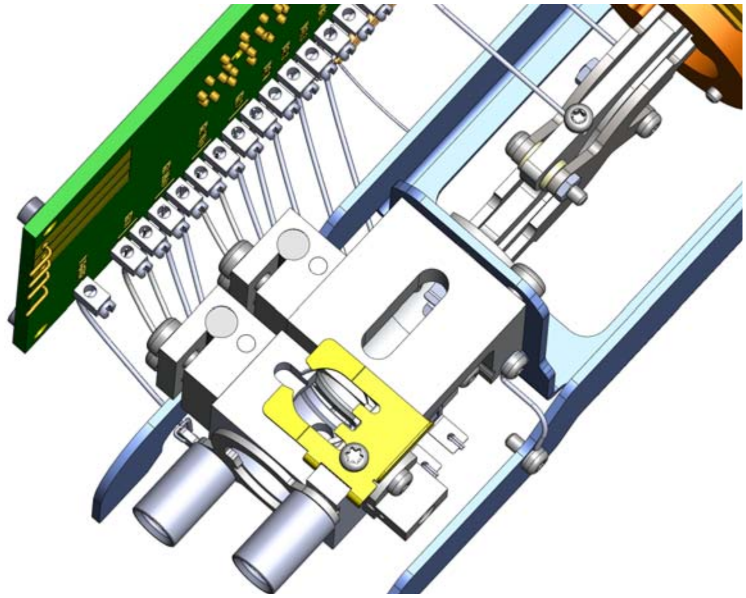
3. Replace the heat shield.

4. Reconnect the filament board and wires to the source interface board.

5. If you are replacing the source interface board, remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.

6. Hold the new source interface board next to the old board.
7. As you remove each of the wires from the old board, connect them to the same connectors on the new board.

Figure 269. Reconnecting the Source Interface Board Wires



8. Once the components are correctly attached to the analyzer tray, follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.
9. Restart your system by following the instructions in "Restarting the System" on page 106.

Electrometer Board Cable

❖ **To replace the electrometer board (15-pin male/female RS-232) cable**

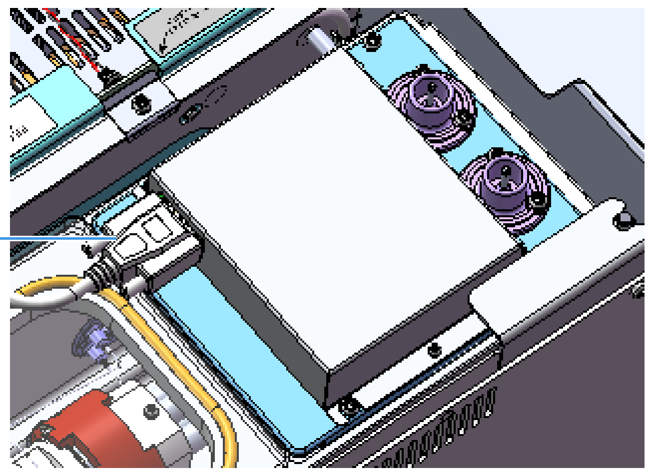
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge or the column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.

3. Disconnect the electrometer board cable

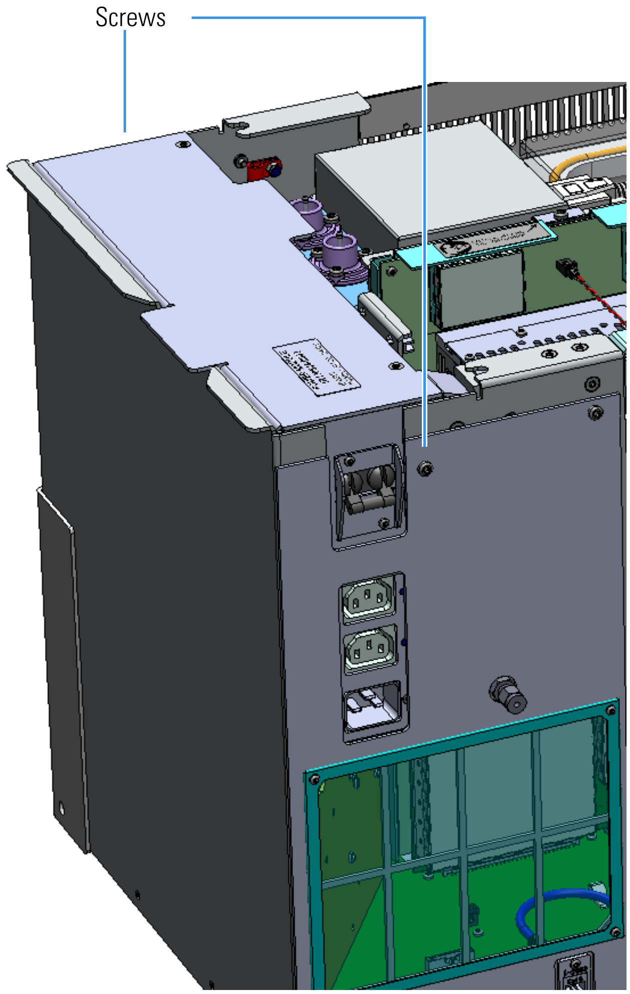
Figure 270. Disconnecting the Electrometer Board Cable



4. Remove all power connections from the TSQ Duo instrument.

5. Use a T20 Torxhead screwdriver to remove the two screws holding the power module to the instrument.

Figure 271. Removing the Power Module Screws



6. Pull the power supply out of the top of the instrument.
7. Disconnect the electrometer board cable from the electrometer board and the distribution board.
8. Replace the electrometer board cable and reattach it to the boards.
9. Reinstall the power module by aligning its connector with the connector on the distribution board beneath it. It will drop into place when its in the right position.
10. Reattach the top cover panel and tighten the screw.
11. Reattach the power connections.
12. Restart your system by following the instructions in "Restarting the System" on page 106.

Electrometer Board and Shield

❖ To replace the electrometer board and shield

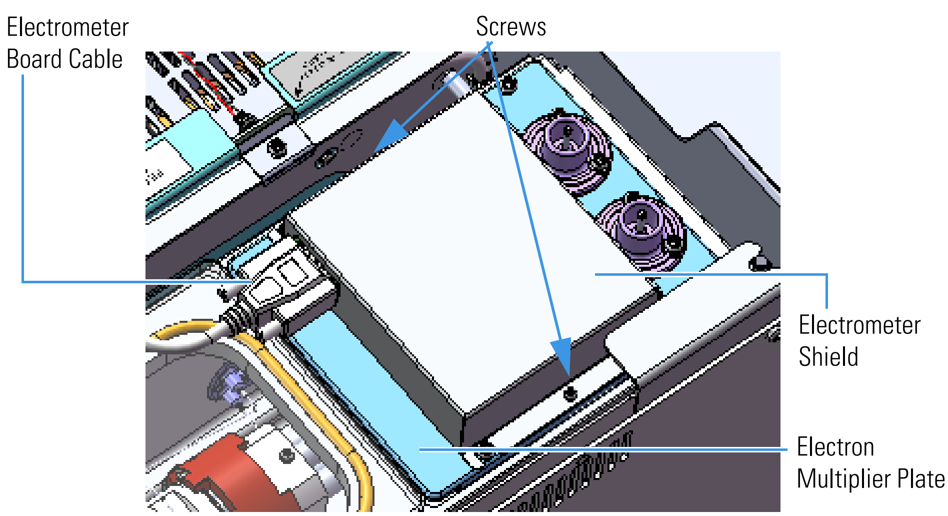
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Disconnect the electrometer board cable.

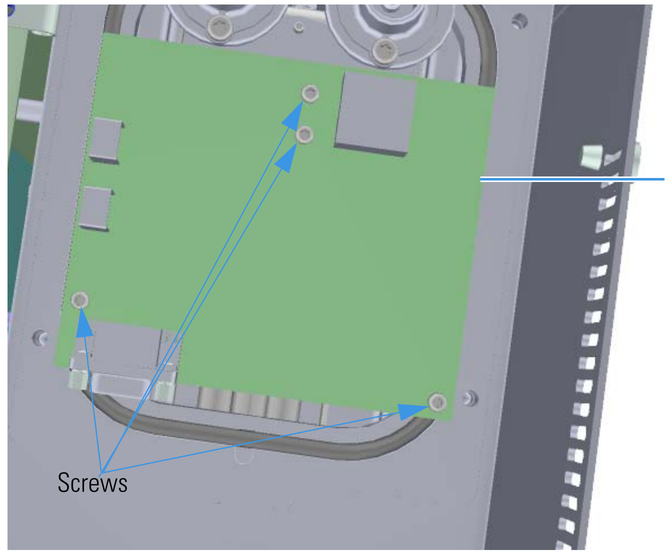
Figure 272. Disconnecting the Electron Multiplier Cables



4. Use a T10 Torxhead screwdriver to remove the two screws holding the electrometer shield in place.
5. Lift off the electrometer shield and replace it if necessary.

6. Remove the four screws holding the electrometer board in place

Figure 273. Replacing the Electrometer Board



7. Remove and replace the electrometer board if necessary.
8. Reattach the screws that hold the electrometer board in place.
9. Reattach the electrometer shield and screws.

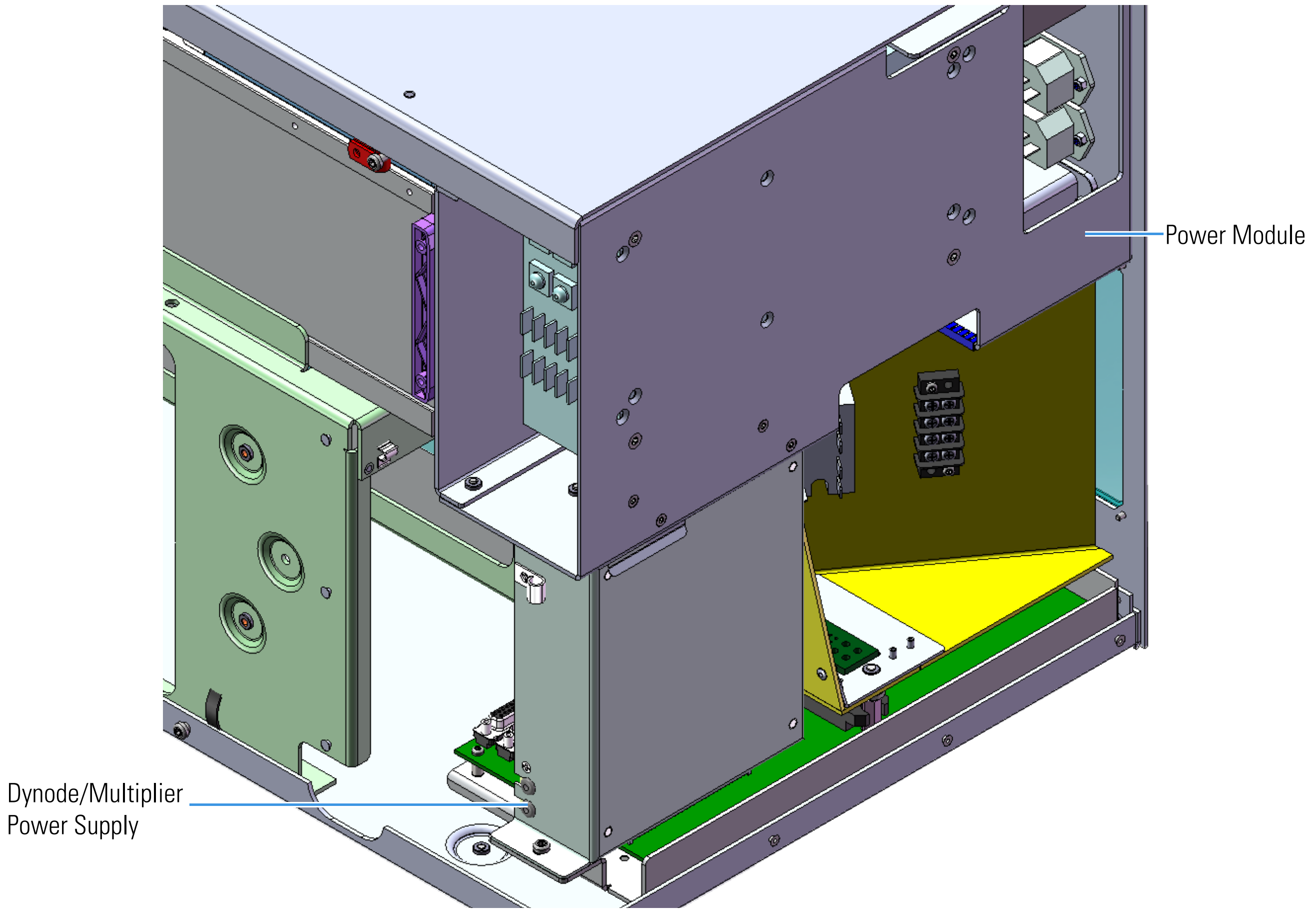
Tip To prevent the screws from falling down into the instrument, place them on the shield before you reattach it to the chassis.

10. Reconnect the electrometer board cable.
11. Reattach the top cover panel and tighten the screw holding it in place.
12. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing the Power Supplies

If the power supplies in your TSQ Duo instrument get damaged, you can use the illustration below to visually locate a power supply and then follow the process to replace it.

Figure 274. Replaceable Power Supply Components



Power Module

❖ To replace the power module

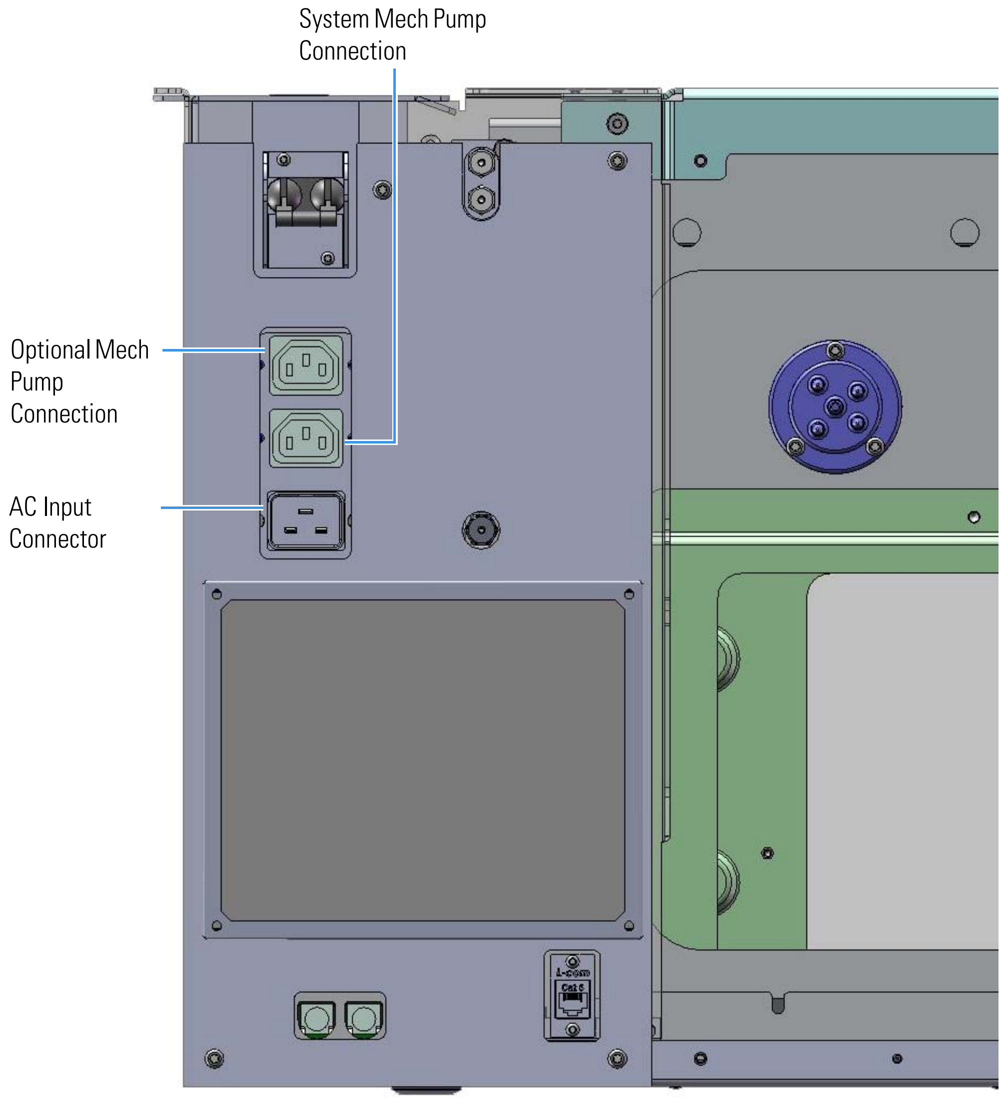
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or the column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

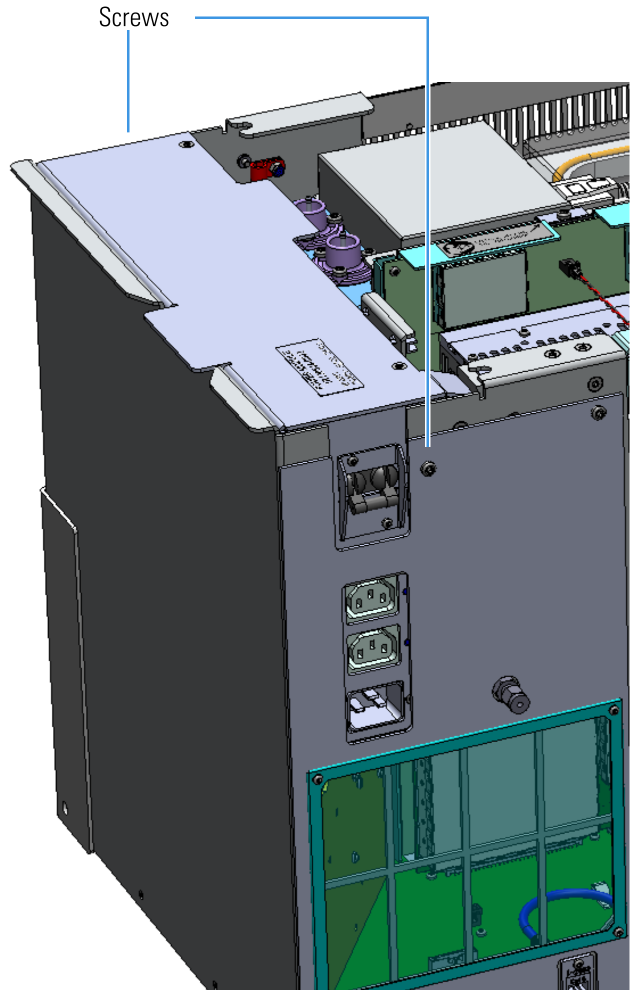
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Disconnect the power cables from the side of the instrument.

Figure 275. Locating the TSQ Duo System Power Cables



4. Use a T20 Torxhead screwdriver to remove the two screws holding the power supply system to the top of the back panel.

Figure 276. Removing the Power Module Screws



5. Make sure the electrometer board cable is not in the way when you remove the power module.

6. Grasp the power supply system and lift it out of the instrument. It fits snugly, so you may have to gently shake it as you lift it out.

7. Reinstall the power module by aligning its connector with the connector on the distribution board beneath it. It will drop into the connector when it is in the right position.

8. Make sure the new module is flush against the top of the chassis and the screw holes line up.

9. Reattach the two screws holding the power module to the instrument.

10. Reconnect the power cables on the left side of the instrument. Make sure you attach the cables properly. The foreline pump connects to the System Mech Pump connector on the left of the instrument.

11. Reattach the top cover panel and tighten the screw holding it in place. Reattach the hydrogen safety screws if you are using hydrogen.

12. Restart your system by following the instructions in "Restarting the System" on page 106.

Dynode and Multiplier Power Supply

❖ To replace the dynode and multiplier power supply

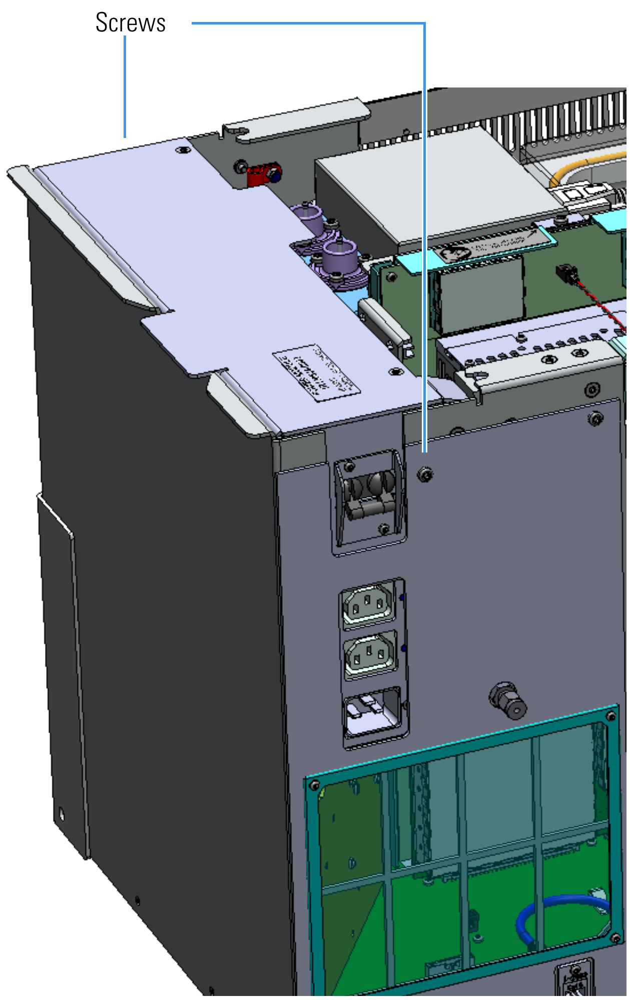
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Remove all power connections from the TSQ Duo instrument.
4. Use a T20 Torxhead screwdriver to remove the two screws holding the power supply system to the top of the back panel.

Figure 277. Removing the Power Module Screws

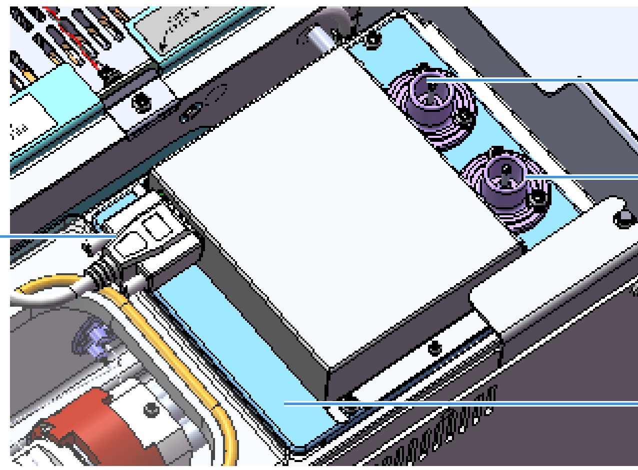


5. Make sure the electrometer board cable is not in the way when you remove the power module.

6. Grasp the power supply system and lift it out of the instrument. It fits snugly, so you may have to gently shake it as you lift it out.

7. Disconnect the large feedthrough cables labeled **Dynode** and **Electron Multiplier**.

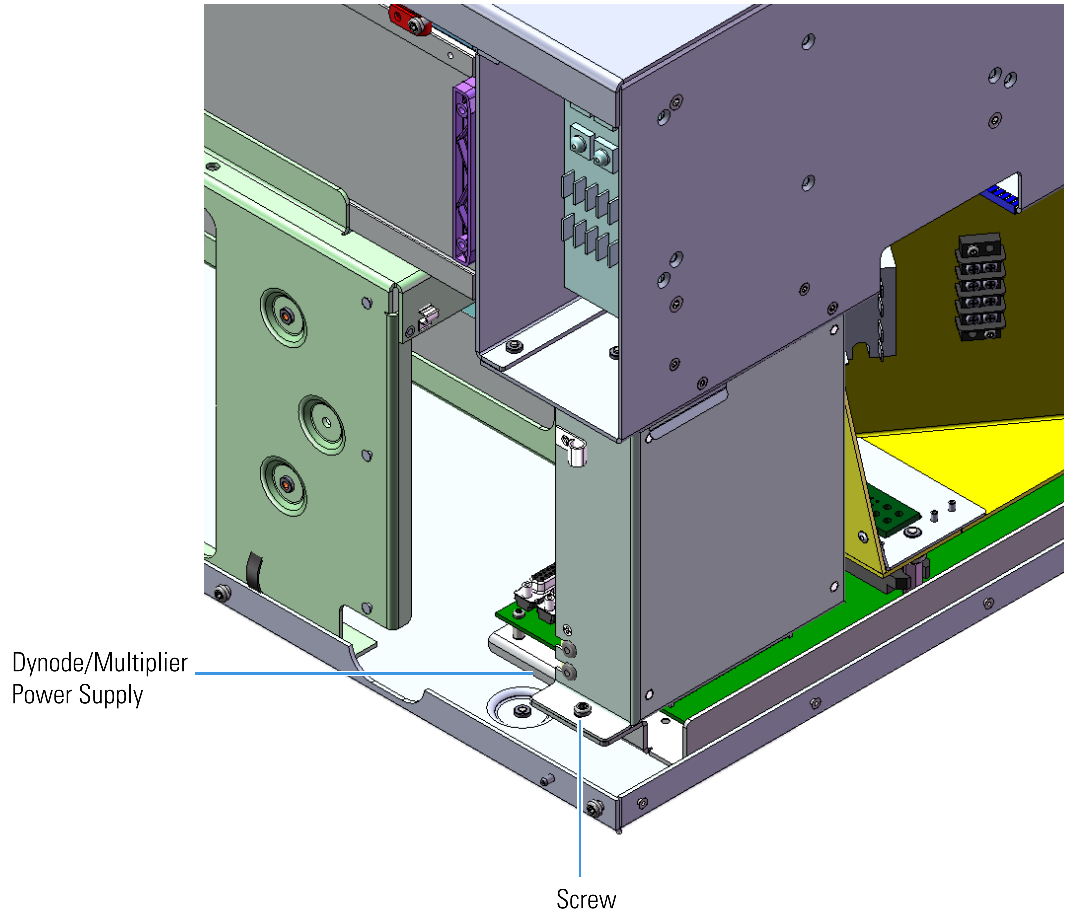
Figure 278. Disconnecting the Electron Multiplier Cables



8. Disconnect the cables from the clips attached to the chassis.

9. Use a T20 Torxhead screwdriver to remove the screw connecting the dynode/multiplier power supply to bottom of the chassis.

Figure 279. Removing the Controller Interface Board Support Bracket

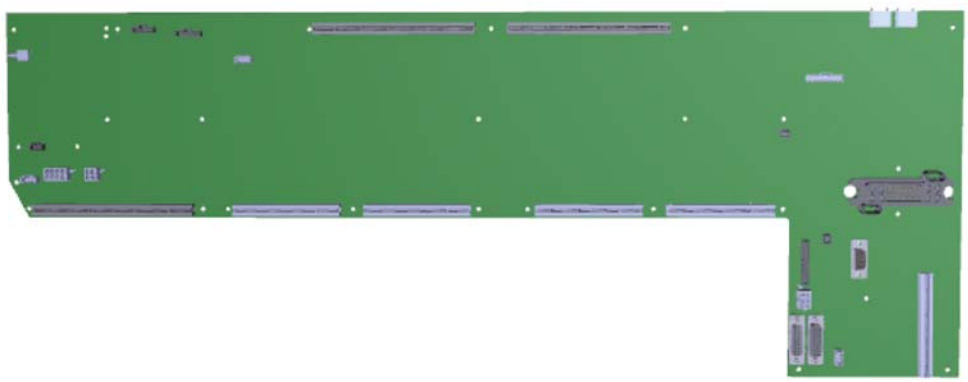


10. Pull the dynode power supply straight up and away from the distribution board on the bottom of the chassis.

11. Replace the dynode/multiplier power supply and install it by aligning its connector with the connector on the distribution board beneath it. It will drop into place when it is in the right position.

> **Note** A new dynode/multiplier power supply may have a right angle bracket attached to the top of the supply. Remove this bracket before placing the supply into the TSQ Duo instrument.

Figure 280. Replacing the Dynode/Multiplier Power Supply

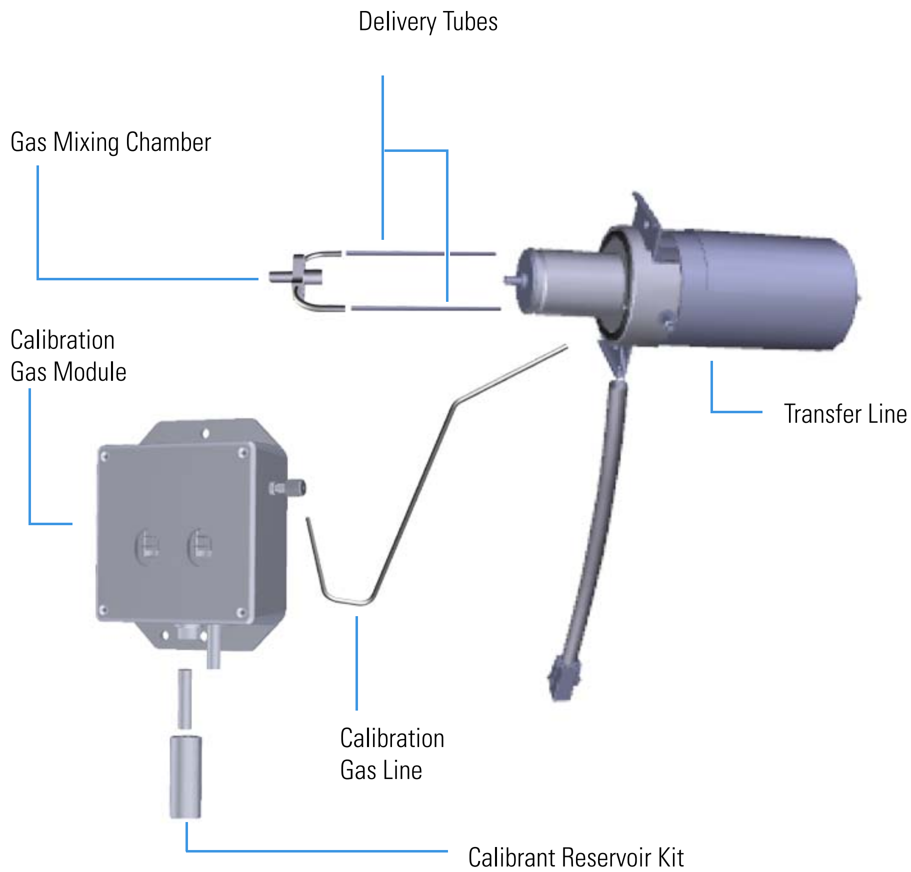


12. Reattach the screw holding the dynode and multiplier power supply in place.
13. Connect the cables to the clips attached to the chassis
14. Connect the large feedthrough cables.
15. Replace the main power supply.
16. Reattach the top cover panel and tighten the screw.
17. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing the Calibration Gas Components

If the calibration gas components of your TSQ Duo instrument get damaged, you can use the illustration below to visually locate a component and then follow the process to replace it.

Figure 281. Replaceable Calibration Gas Components



Calibration Gas Module

The EI calibration gas module requires little maintenance, except to refill the calibrant in the reservoir. Your calibration gas controller may need to be replaced if you add too much calibrant and you contaminate the system. The process is the same for replacing a single- or dual-flow calibration gas module.

❖ To replace the EI calibration gas module

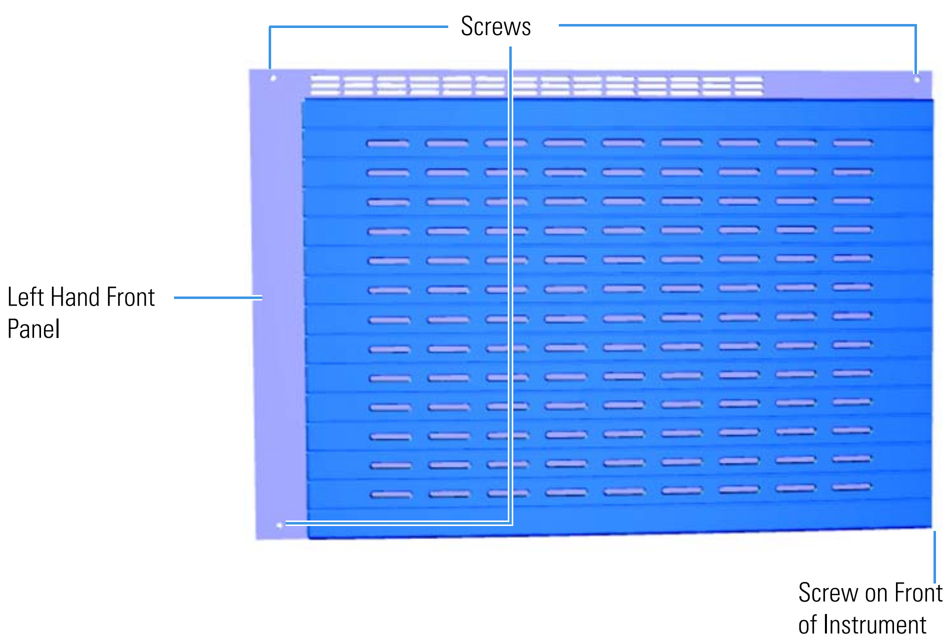
Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column.

2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

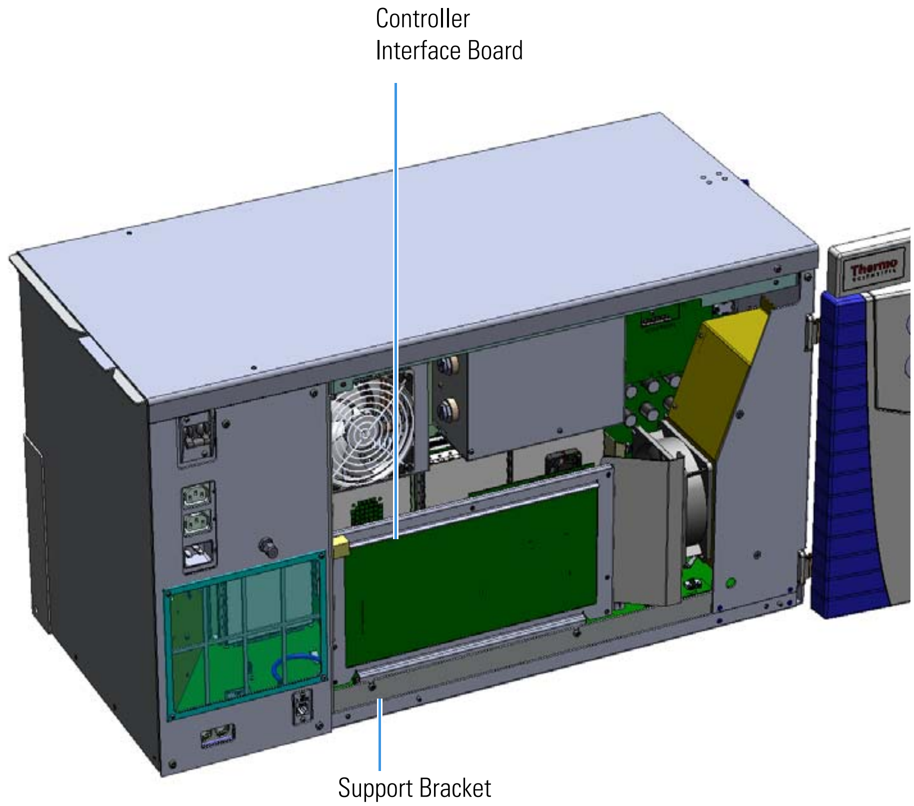
Figure 282. Locating the Left Hand Front Panel Screws



4. Lift the left hand front panel off the instrument.

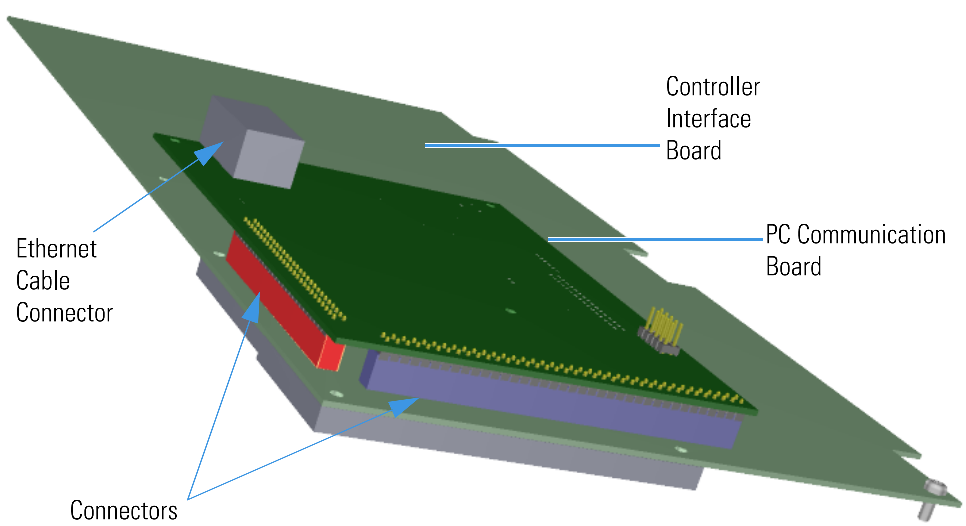
5. Use a T20 Torxhead screwdriver to loosen the two screws holding the support bracket to the bottom of the instrument.

Figure 283. Removing the Controller Interface Board Support Bracket



6. Disconnect the Ethernet cable from the PC communication board.

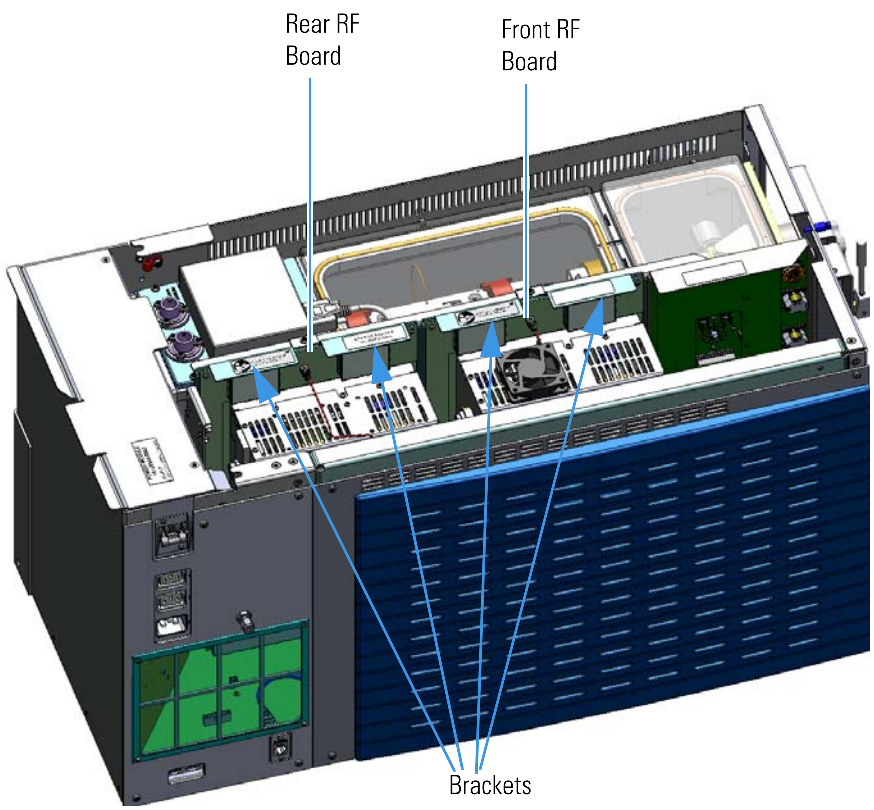
Figure 284. Disconnecting the Ethernet Cable from the PC Communication Board



7. Remove the controller interface board from the instrument.

8. Look through the top of the instrument and locate both RF boards. The front RF board is the second board standing on end toward the center of the instrument. The rear RF board is the third board standing on end toward the center of the TSQ Duo instrument. Use a T20 Torxhead screwdriver to remove the screw holding the board and bracket to the chassis.

Figure 285. Locating the RF Boards and Brackets

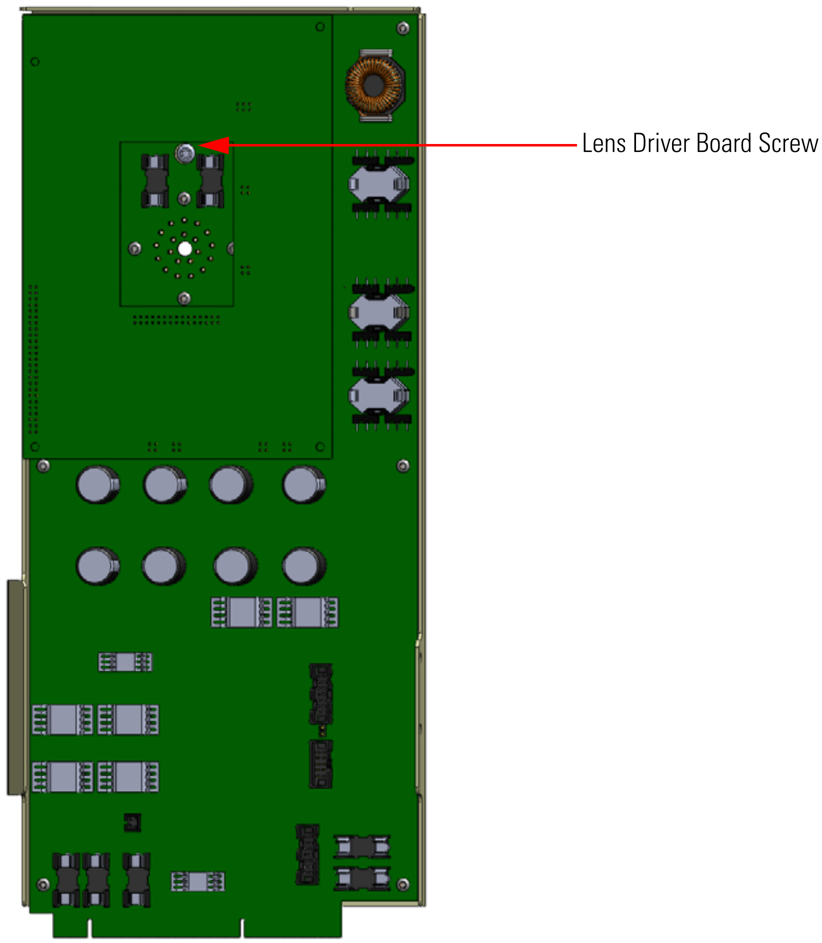


9. Use your fingers to pry the bracket of the board away from the chassis and toward the left side of the instrument. Lift the RF boards out of the instrument and set them aside.

10. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the lens driver board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 286. Removing the Lens Driver Board



11. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove it from the board and bracket.

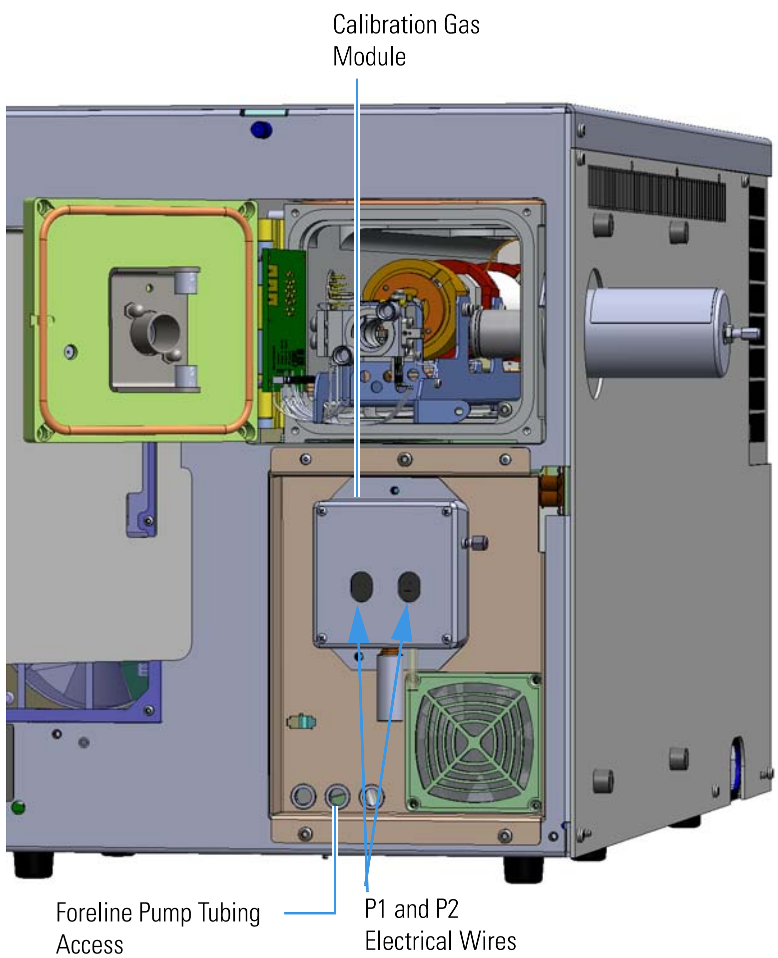
12. Lift the lens driver board out of the instrument. Be careful as space is limited.

CAUTION - INSTRUMENT DAMAGE Limit handling of the boards as much as possible. Do not touch any board components. Hold the board by the sheet metal bracket only.

13. Reach through the left side of the instrument and disconnect the vacuum line tubing that goes from the foreline connector to the calibration gas module.

14. Pull the tubing out through the access hole in the interior front panel.

Figure 287. Disconnecting the Calibration Gas Controller



Note If you are using CI, you will have P1 and P2 electrical wires.

15. Disconnect the P1 and P2 electrical wires from the front of the calibration gas controller.

Note If you have a single-level calibration gas controller, your instrument only has a P1 connector.

16. Use a 5/16 in. wrench to disconnect the stainless steel tubing.

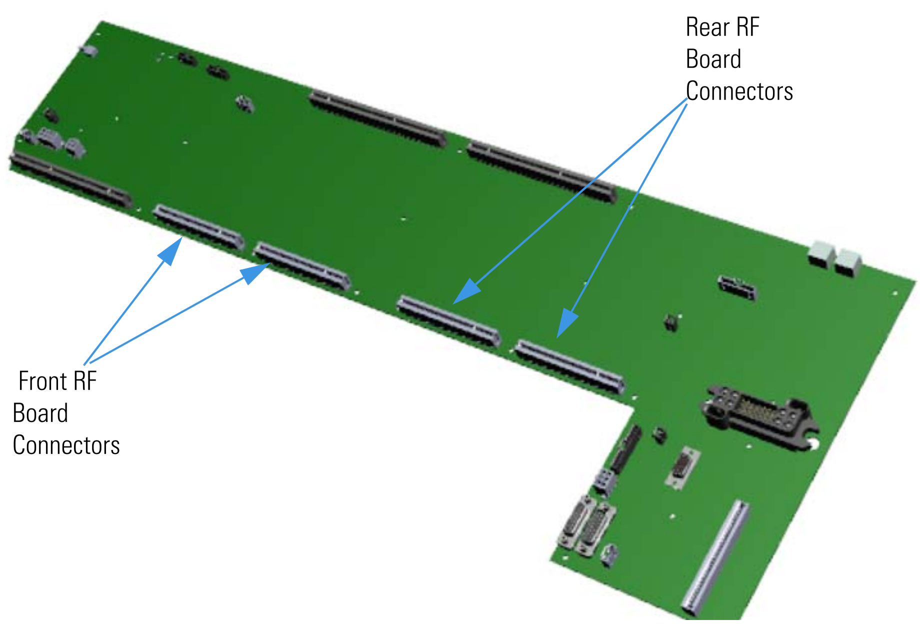
17. Use a T20 Torxhead screwdriver to remove the two screws holding the module to the interior front panel. The tubing will come off with it.

18. Remove the calibration gas module from the front panel and attach a new one.

Note The calibrant reservoir on the new calibration gas module is not filled with calibrant. Fill the new calibrant reservoir by following the instructions in "Refilling the Calibrant Reservoir" on page 42.

19. Reattach the two screws that connect the new calibration gas module to the interior front panel.
20. Reconnect the vacuum line tubing that goes from the foreline connector to the calibration gas module.
21. Reconnect the P1 and P2 electrical wires to the front of the calibration gas controller.
22. Reinstall the RF board by aligning the connectors on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 288. Reinstalling the RF Boards

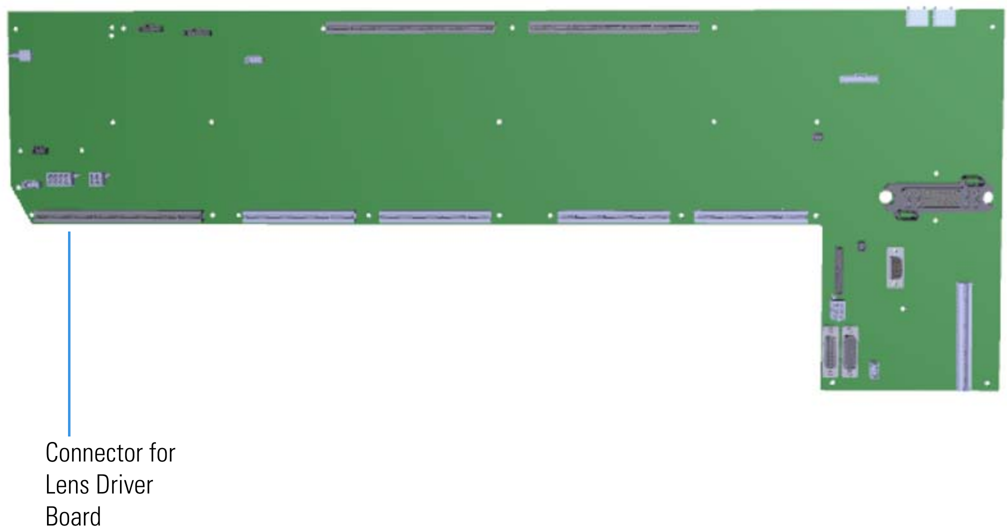


23. Push the board down into the connectors.
24. Gently push the RF board toward the instrument, carefully aligning the board over the feedthrough pins, until it stops.
25. Reattach the screw holding the RF board to the bracket.

Note This screw is required for good ground contact.

26. Reinstall the lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 289. Reinstalling the Lens Driver Board

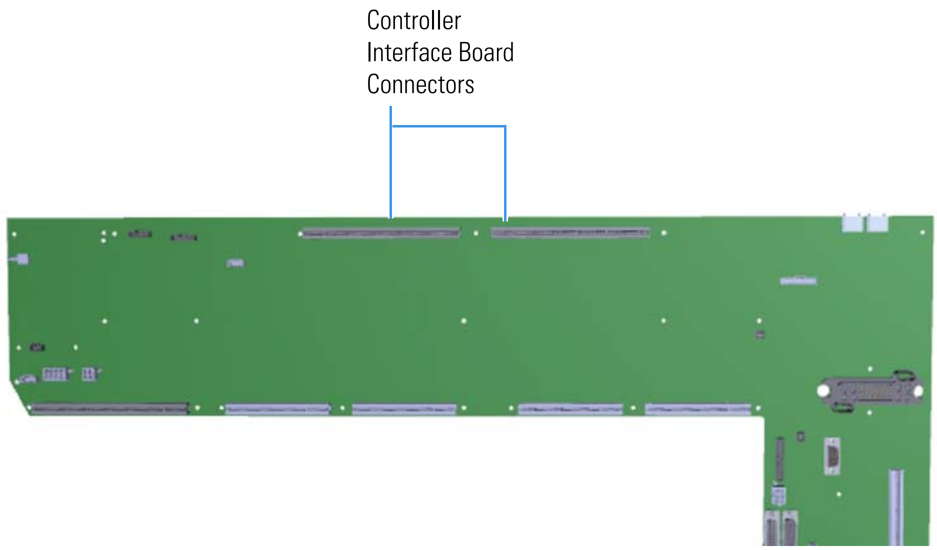


27. Push the board down into the connectors.

28. Look through the left side of the instrument and use a T20 Torxhead screwdriver to reattach the screw holding the lens driver board in place on the chassis.

29. Reinstall the controller interface board by aligning the two connectors on the bottom of the board to the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.

Figure 290. Reinstalling the Controller Interface Board



30. Push the board down into the connectors.

31. Tighten the screws attached to the support bracket.

32. Reconnect the Ethernet cable to the controller interface board.

33. Reattach the top cover and left hand front panels and tighten the screws. If you are using hydrogen, reattach the hydrogen safety screws.

34. Restart your system by following the instructions in “Restarting the System” on page 106.

Calibrant Reservoir Kit

❖ **To replace the calibrant reservoir kit, which consists of the calibrant reservoir and its cover**

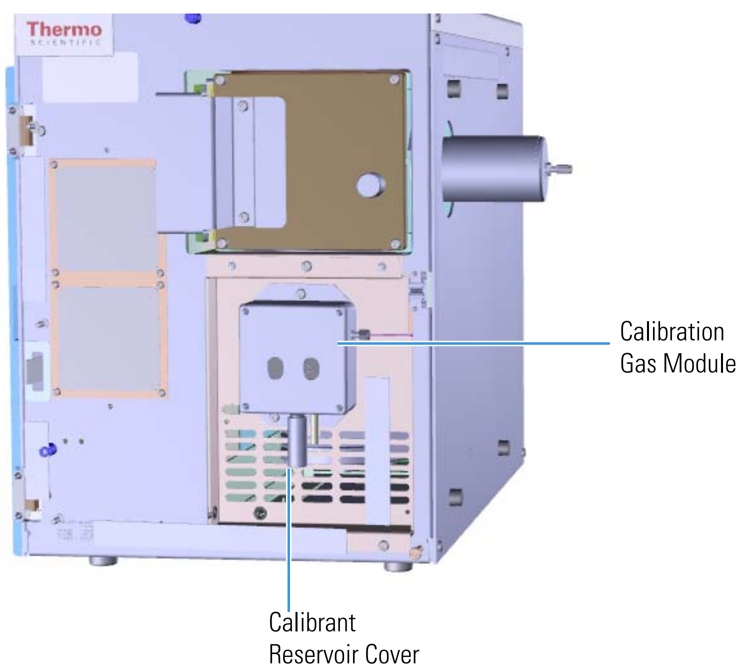
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components. If you just need to refill the calibrant reservoir and not replace it, see Refilling the Calibrant Reservoir.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Unscrew the hydrogen safety screw.
3. Open the front door of the TSQ Duo instrument.
4. Twist the calibrant reservoir cover counter-clockwise and remove it from the calibration gas module.

Figure 291. Removing the Calibrant Reservoir Cover



5. Attach a new calibrant reservoir to the calibration gas module.

Figure 292. Replacing the Calibrant Reservoir and Cover

6. Fill the calibrant reservoir of the new module by following the instructions in “Refilling the Calibrant Reservoir” on page 42.
7. Reattach the calibrant reservoir cover.
8. Close the front door of the instrument.
9. If you are using hydrogen as a carrier gas, attach the hydrogen safety screws and restart your GC by following the instructions in “Restarting the System” on page 106.

Gas Mixing Chamber

❖ To replace the gas mixing chamber

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

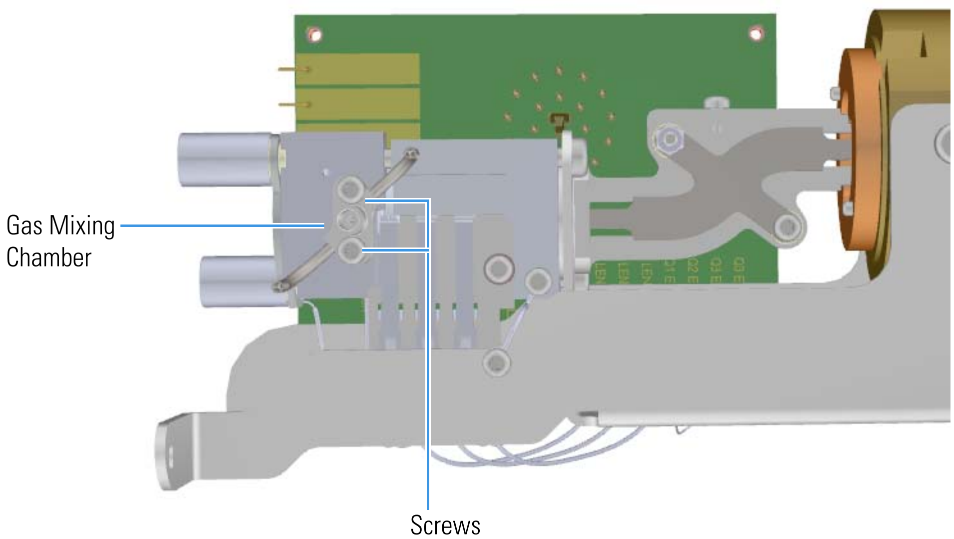
1. Remove the analyzer tray from the instrument by following the instructions in "Removing the Analyzer Tray from the TSQ Duo Instrument" on page 95.

2. Use a T10 Torxhead screwdriver to remove the two screws holding the gas mixing chamber to the ion source block.

3. Replace the gas mixing chamber.

4. Replace the two screws holding the gas mixing chamber to the ion source block.

   Figure 293. Replacing the Gas Mixing Chamber



5. Follow the instructions in "Replacing the Analyzer Tray in the TSQ Duo Instrument" on page 104 to replace the tray in the TSQ instrument.

6. Restart your system by following the instructions in "Restarting the System" on page 106.

Transfer Line

❖ To replace the transfer line and ferrule

IMPORTANT Be sure to install the transfer line correctly or the ion source will not align correctly.

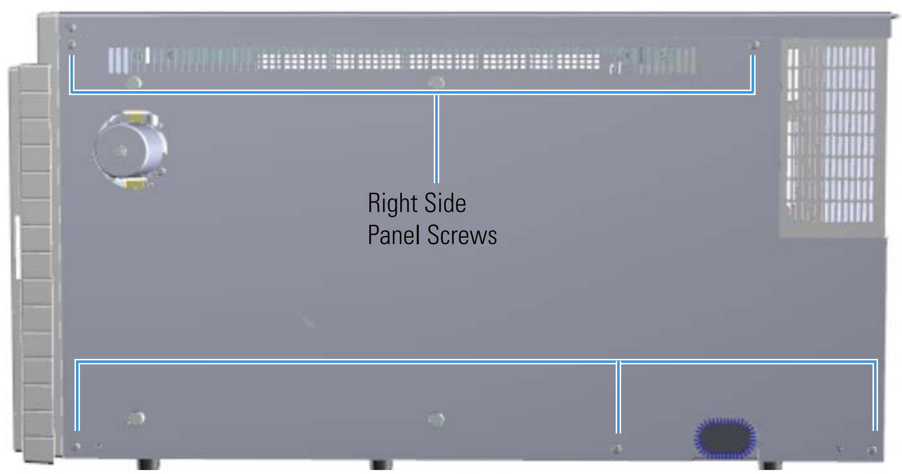
Note See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Open the front door of the GC and disconnect the column and transfer line nut.
3. Move the TSQ Duo instrument away from the GC so you can access the transfer line on the right side.

WARNING BURN HAZARD: The transfer line may be hot, so be careful.

4. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

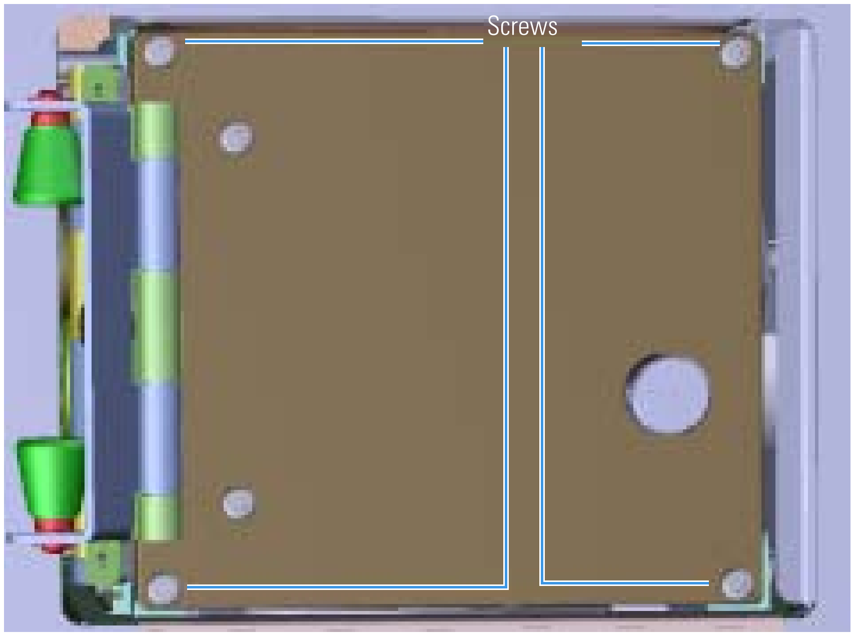
Figure 294. Removing the Right Side Panel Screws



5. Slide the right side panel to the right of the instrument and lift it off.
6. Use a T20 Torxhead screwdriver to remove the four screws around the manifold door.

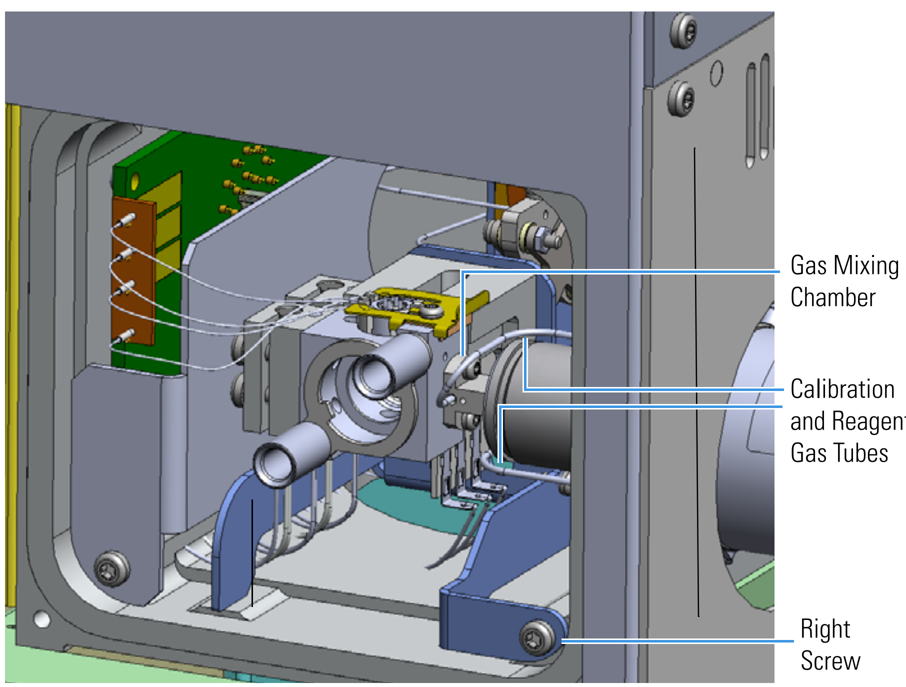
Note Remove the screws completely so that they do not scratch the manifold when you close the door.

Figure 295. Opening the Manifold Door



7. Open the manifold door.
8. Disconnect the calibration and reagent gas tubes from the gas mixing chamber.
9. Remove the screw on the lower right side that is holding the analyzer tray to the manifold.

Figure 296. Disconnecting the Analyzer Tray from the Instrument

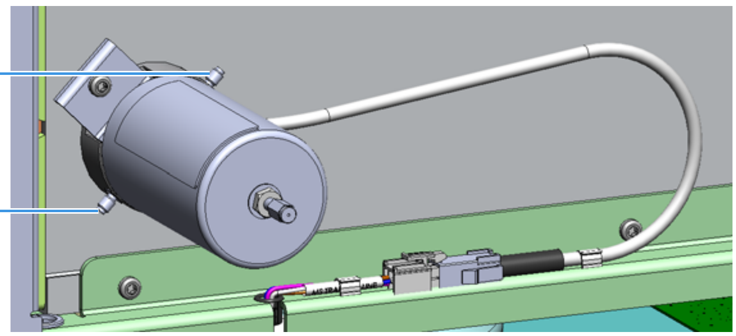


Note Keep all manifold parts you remove covered on a clean work surface so they will not accumulate dust.

10. Slide the analyzer tray to the left.

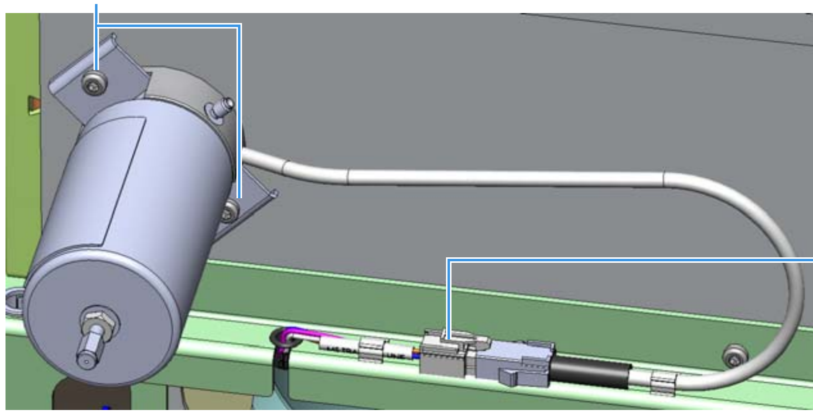
11. Use a 5/16 in. wrench to disconnect the stainless steel tubing from the two fittings on each side of the transfer line.

Figure 297. Disconnecting the Transfer Line Tubing



12. Disconnect the electrical cable from the connector.

Figure 298. Disconnecting the Transfer Line Electrical Cable



13. Use a T20 screwdriver to remove the two screws holding the transfer line to the chassis.

14. Pull the transfer line straight away from the instrument so you do not damage it. Make sure the o-ring is removed as well. Replace the o-ring, if necessary.

15. Attach a new transfer line.

Note The reagent gas and calibration gas tubes in the manifold conduct gas to the mixing chamber. Make sure these two tubes are attached to the transfer line and mixing chamber before proceeding.

CAUTION - INSTRUMENT DAMAGE The electrical wires fit in a groove in the transfer line. Do not pinch these wires between the sheet metal and edges of the groove when tightening the screws to mount the transfer line to prevent electrical shorts.

16. Reattach the two screws holding the transfer line to the chassis. Position the analyzer tray back on the transfer line.

17. Tighten the screw holding the analyzer tray to the transfer line.

Note Check the alignment of the transfer line. If it is not seated properly, adjust its position.

Tip At this point, check that the ion source cartridge insertion and removal is smooth. If it is not, adjust the position of the transfer line.

18. Reconnect the electrical cable to the connector.

19. Reconnect the two compression nuts to the fittings on each side of the transfer line.

20. Close the front door of the manifold and reattach the four screws.

21. Slide the right side panel back onto the instrument and reattach the screws.

22. Reposition the TSQ Duo instrument closer to the GC.

23. Reinsert the column to the proper length and tighten the transfer line nut. See “Replacing a Column” on page 13 for more information.

24. Restart your system by following the instructions in “Restarting the System” on page 106.

Replacing the Collision Gas Components

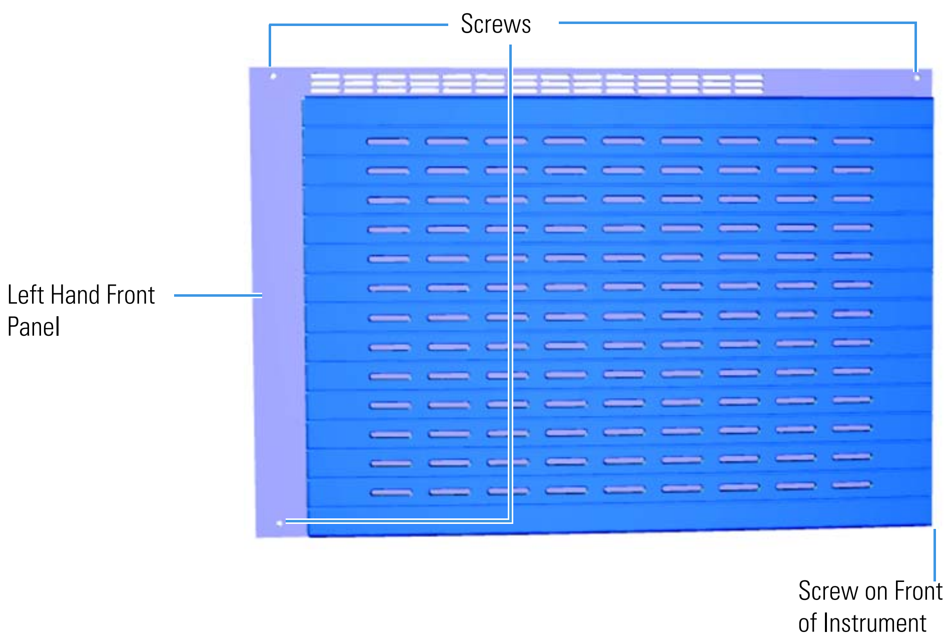
The collision gas components you can order and replace in the TSQ Duo system are the collision gas module, the collision gas tubing, the tee that connects the collision gas tubing to the foreline adapter, and the foreline adapter itself.

❖ **To replace the collision gas module, collision gas tubing, tee, and foreline adapter**

> **Note** See the *TSQ Duo Spare Parts Guide* for information about ordering these components.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.
2. Slide the top cover panel off the instrument.
3. Slide the top cover panel toward the back of the instrument and lift it off.
4. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

Figure 299. Locating the Left Hand Front Panel Screws



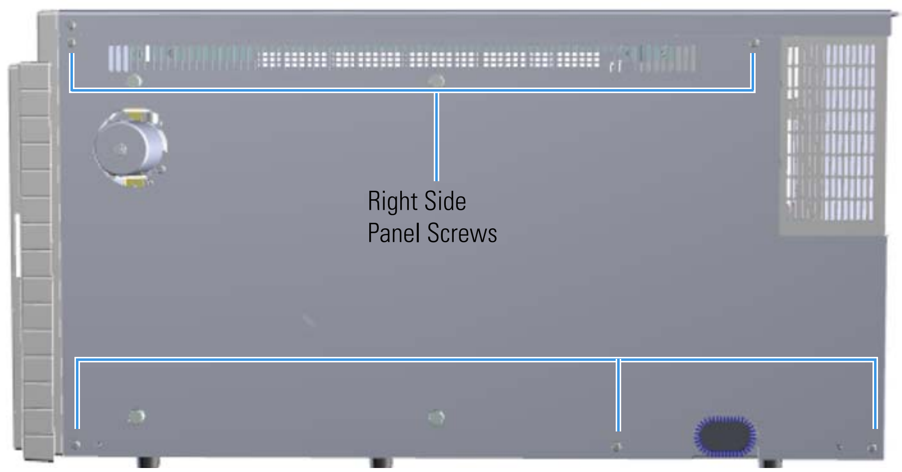
5. Lift the left hand front panel off the instrument.
6. Open the front door of the GC and disconnect the column and transfer line nut.

7. Move the TSQ Duo instrument away from the GC so you can access the transfer line on the right side.

WARNING BURN HAZARD: The transfer line may be hot, so be careful.

8. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

Figure 300. Removing the Right Side Panel Screws

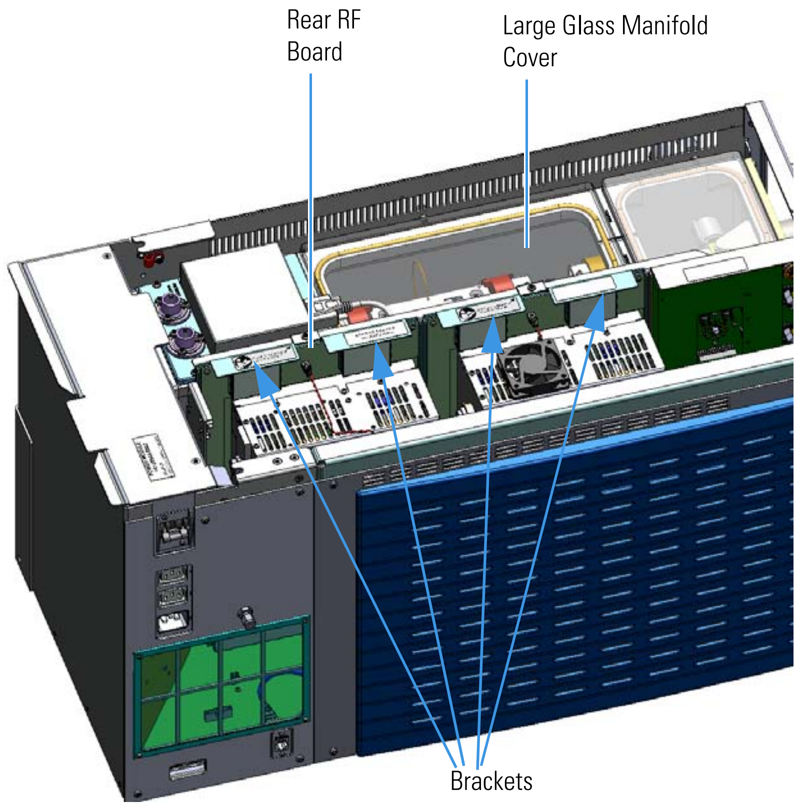


9. Slide the right side panel to the right of the instrument and lift it off.

10. Remove the rear RF board. The rear RF board is the third board standing on end toward the center of the TSQ Duo instrument. Use a T20 Torxhead screwdriver to remove the screw holding the board and bracket to the chassis.

CAUTION - INSTRUMENT DAMAGE Do not touch the components of the boards. Hold the boards by the sheet metal bracket.

Figure 301. Locating the RF Boards and Brackets

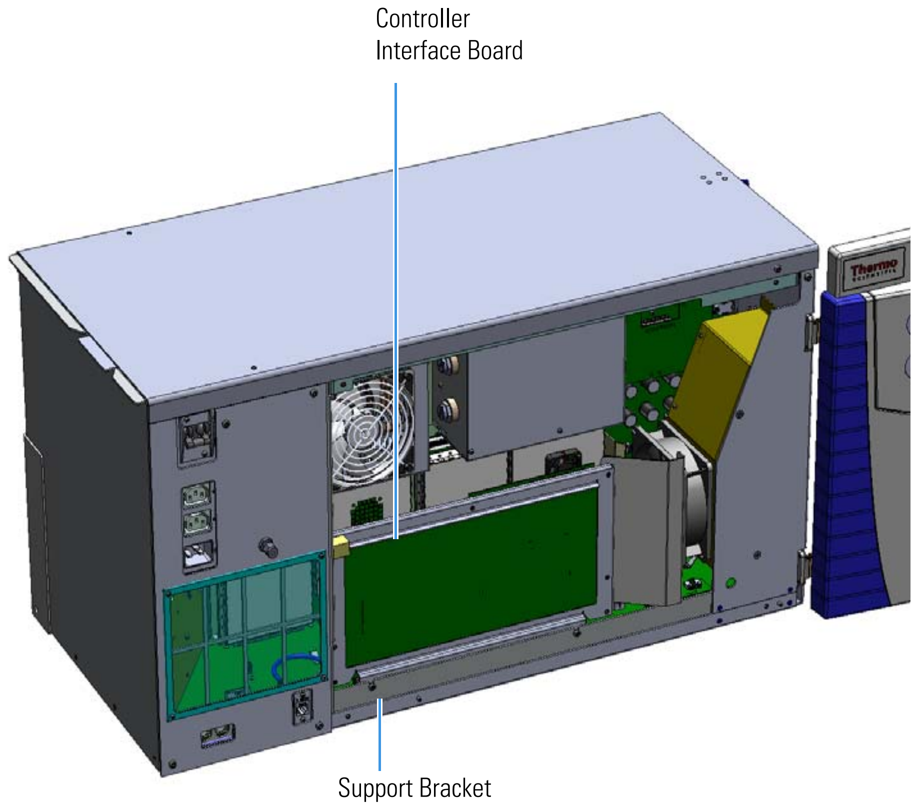


11. To remove the rear RF board, use your fingers to pry the brackets of the board away from the chassis and toward the left side of the instrument.

12. Lift the board out of the TSQ Duo instrument.

13. Use a T20 Torxhead screwdriver to loosen the two screws holding the support bracket to the bottom of the instrument.

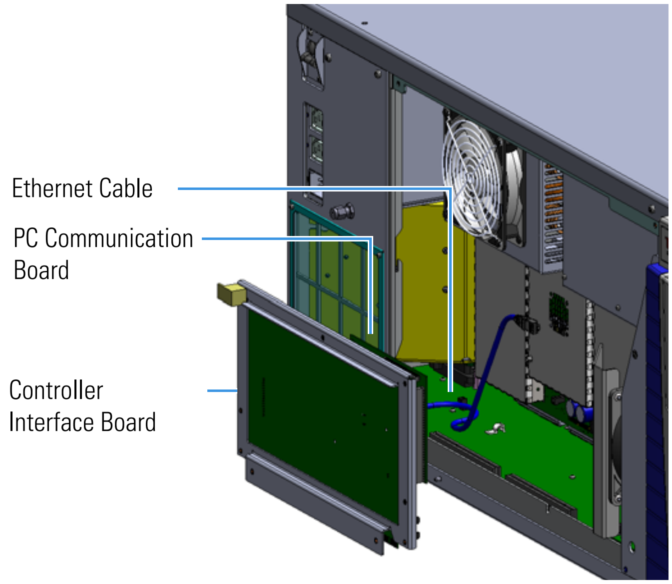
Figure 302. Removing the Controller Interface Board Support Bracket



14. Remove the controller interface board and PC communication board from the instrument. The boards are attached together.

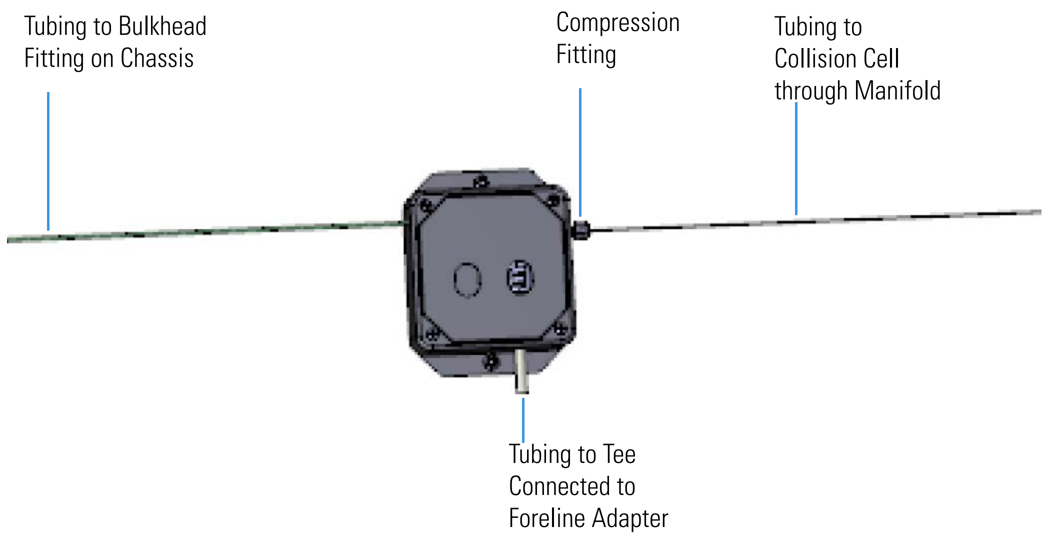
15. Disconnect the Ethernet cable from the PC communication board.

Figure 303. Disconnecting the Controller Interface Board



16. Disconnect the tubing from the tee connecting the collision gas module to the foreline adapter. The tubing is connected at the tee with a compression fitting.

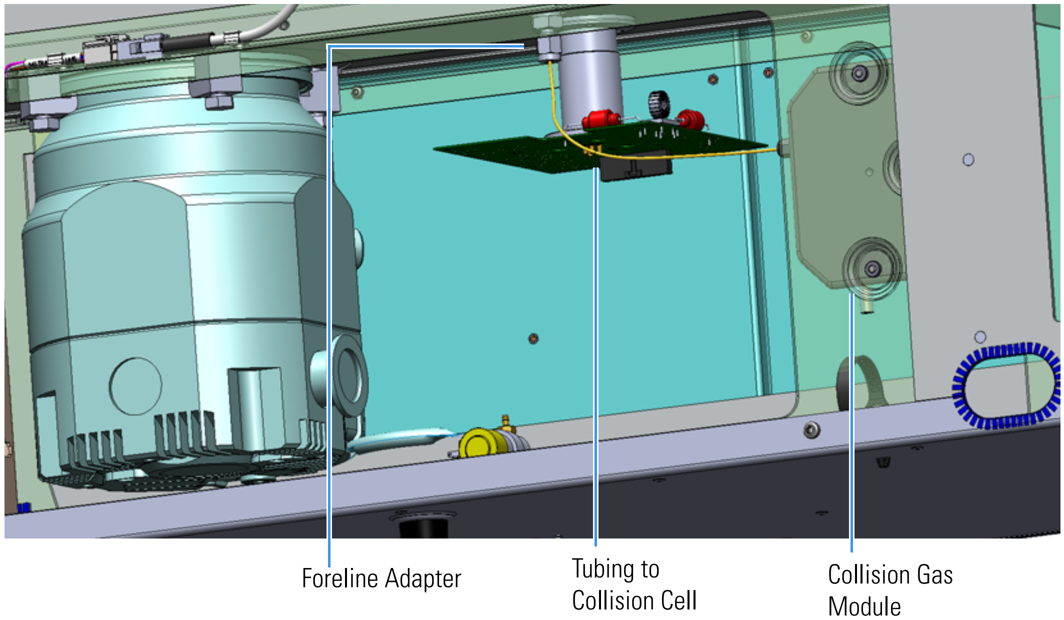
Figure 304. Identifying the Tubes on the Collision Gas Module



17. If you need to replace the tee, unscrew it from the foreline adapter and replace it. You may also replace the foreline adapter if necessary.

18. Disconnect the collision gas tubing from the module. The tubing is secured to the module using a compression fitting.

Figure 305. Locating the Collision Gas Module

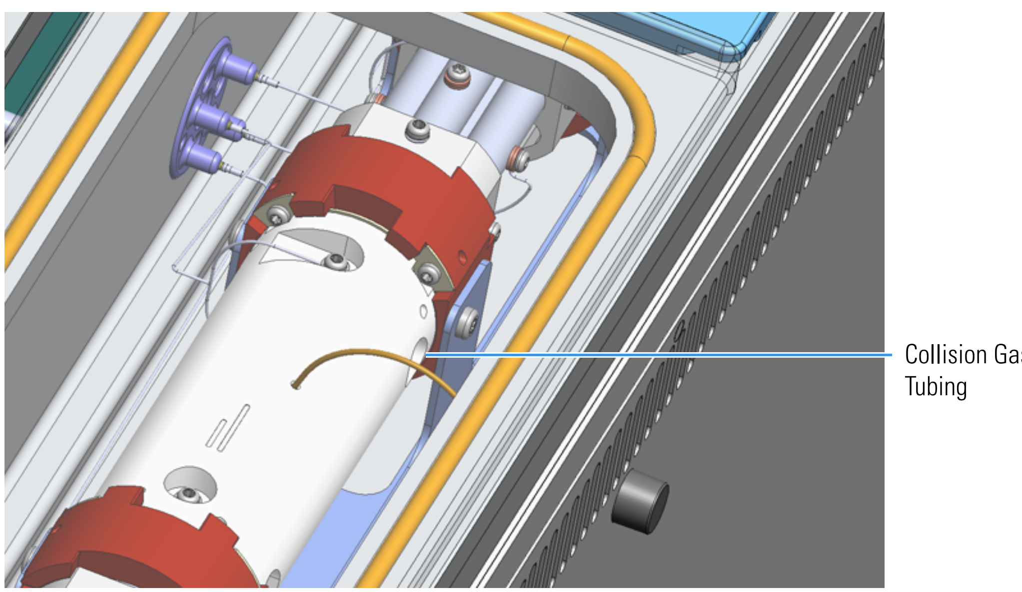


19. Remove the large glass manifold cover.

> **Note** You may skip this step if you are not removing the collision gas tubing from the collision cell.

20. If you are replacing the collision gas module and do not need to replace the tubing to the collision cell, you may leave the tubing attached to the manifold and collision cell and remove the tubing from the collision gas module only. If you are replacing the tubing to the collision cell, disconnect the collision gas tubing from the collision cell and from the compression fitting on the manifold.

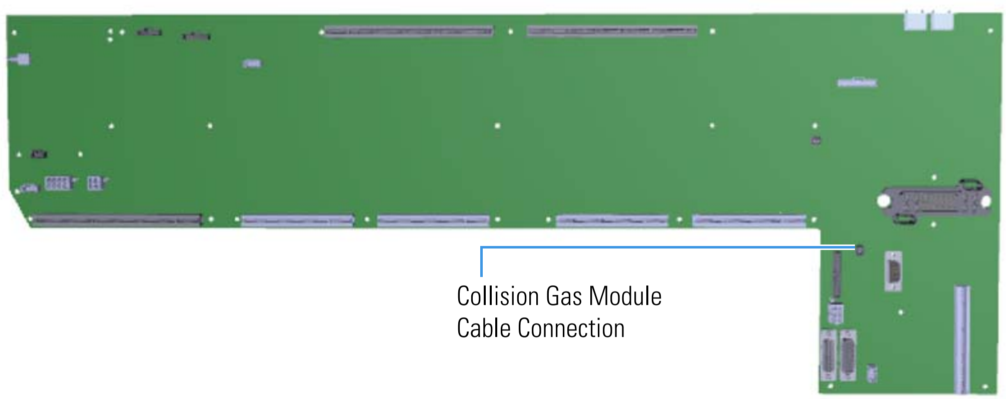
Figure 306. Disconnecting the Tubing from the Collision Cell



21. Pull the tubing out of the manifold. Replace if necessary.

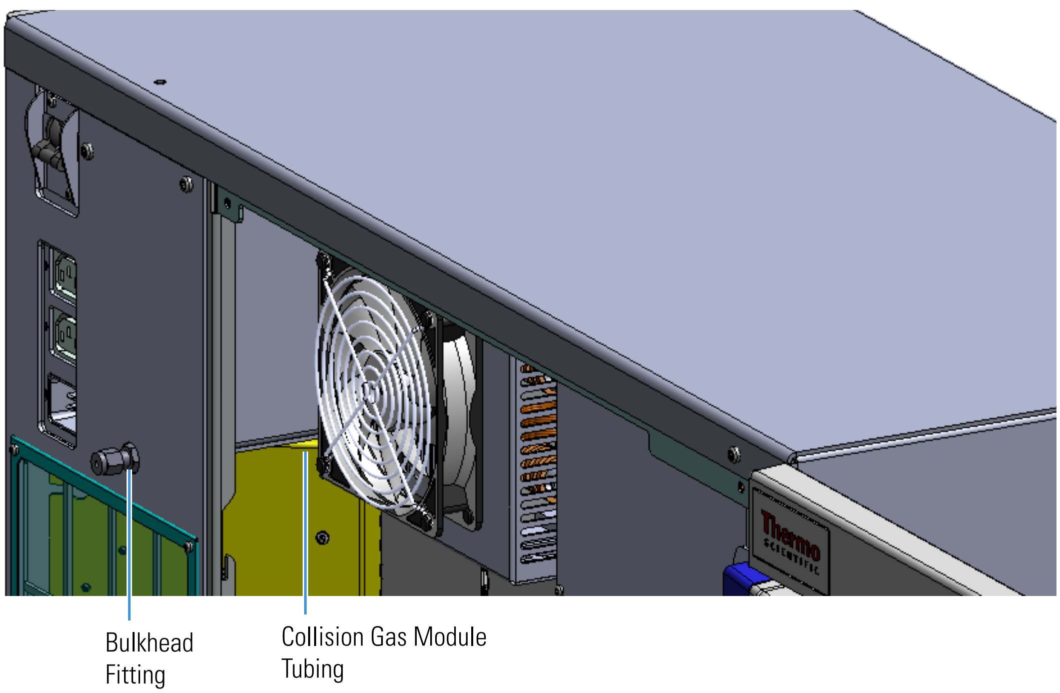
22. Disconnect the collision gas module cable from the distribution board.

Figure 307. Disconnecting the Collision Gas Module Cable from the Distribution Board



23. Disconnect the 1/16 in. tubing from the bulkhead compression fitting located on the left hand sub panel.

Figure 308. Disconnecting the Cable to the Bulkhead Fitting



24. Use a T20 Torxhead screwdriver to remove the two screws on the collision gas module.

25. Remove the collision gas module and replace if necessary.

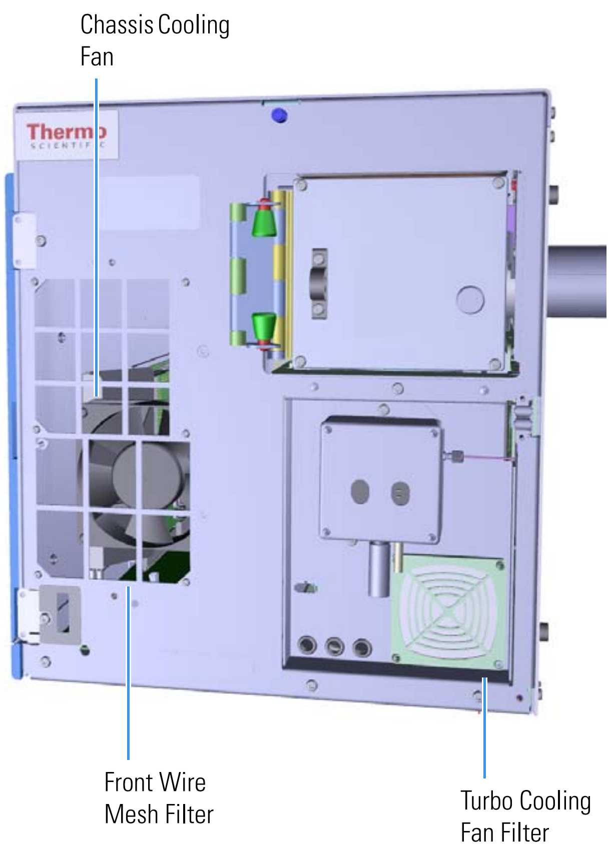
26. Reconnect the collision gas module to the instrument with the two screws.
27. Reconnect the 1/16 in. tubing to the bulkhead fitting through the a graphite Vespel ferrule.
28. Reconnect the collision gas tubing to the collision gas module at the compression fitting.
29. If you removed it from the manifold, replace the collision gas tubing through the compression fitting in the manifold.
30. Reconnect the collision gas tubing to the collision cell.
31. Replace the large glass manifold cover.
32. Reconnect the collision gas module cable to the distribution board.
33. Reconnect the tubing to the tee connected to the foreline adapter.
34. Replace the controller interface board and PC communication board and reconnect the Ethernet cable.
35. Replace the rear RF board.
36. Replace the top, left hand front, and right side panels and secure with screws.
37. Move the TSQ Duo next to the GC.
38. Restart your system by following the instructions in "Restarting the System" on page 106.

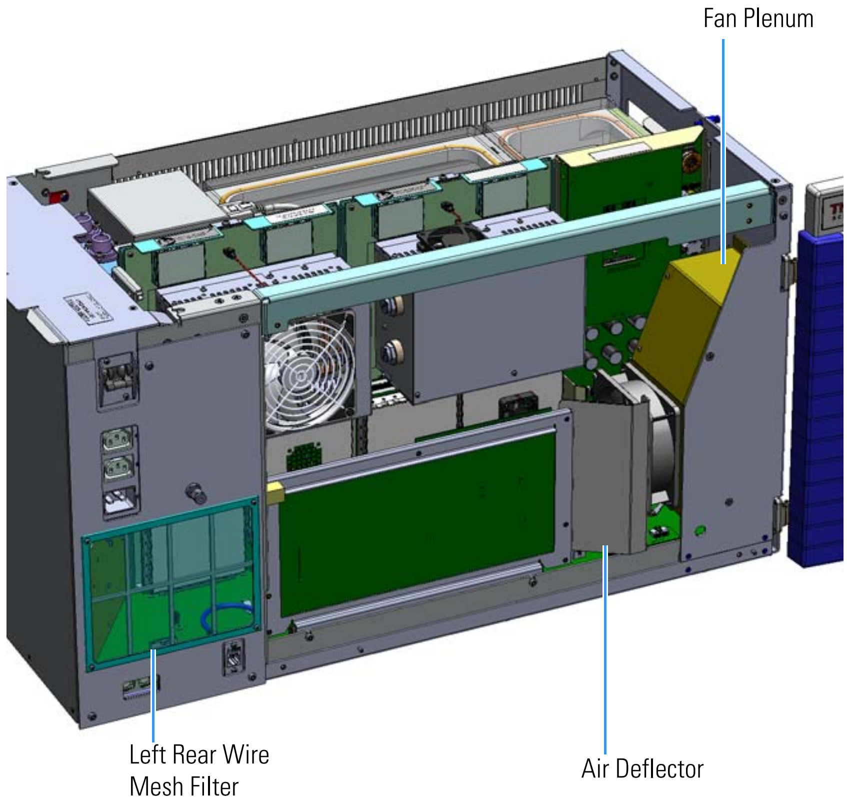
Replacing Fans and Filters

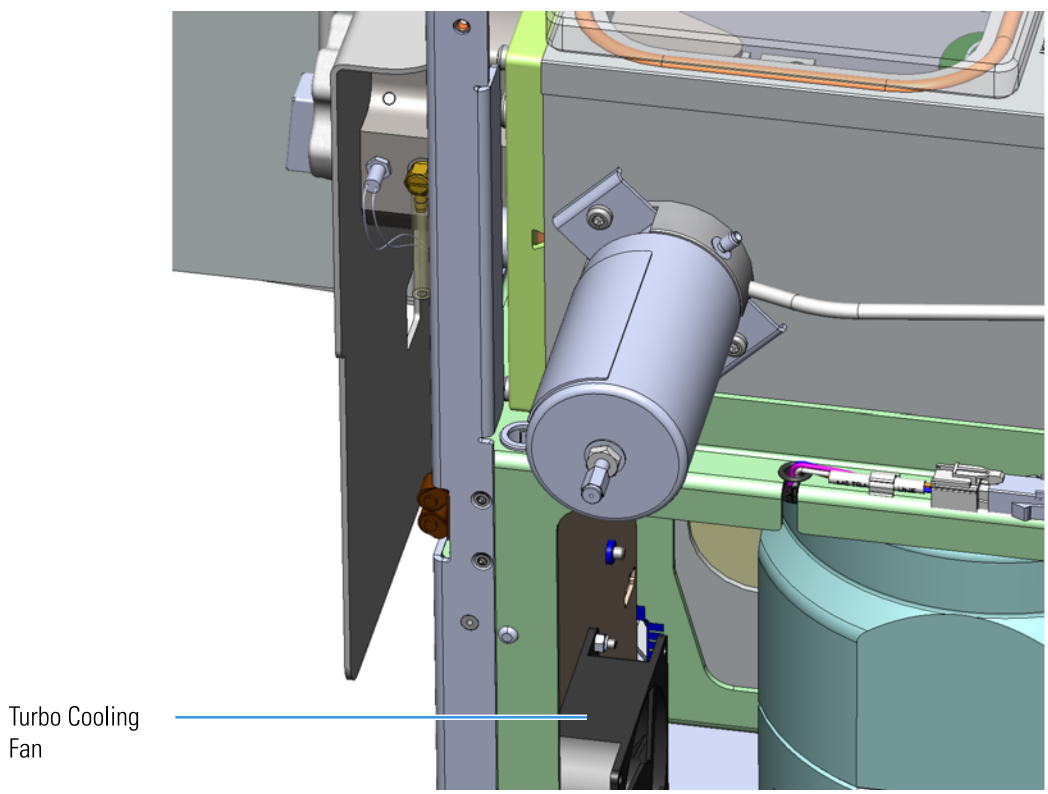
To efficiently cool the TSQ Duo instrument while it is being used, air must be allowed to flow in through the front of the instrument and out the back. The instrument is equipped with a fan that keeps the air flowing and filters that minimize the amount of dust that enters the system. Dust can cause problems by insulating electronic components, which can lead to overheating. To keep the instrument as cool as possible, we require that you keep all the covers of the instrument attached while it is in use.

If the fan or filters in your TSQ Duo instrument get damaged, use the illustrations below to visually locate a component and then follow the process to replace it. If your filters are dirty, but do not need to be replaced, see Cleaning the Filters.

Figure 309. Replaceable Fan and Filter Components of the TSQ Duo System




Fan Plenum
Left Rear Wire
Mesh Filter
Air Deflector


Turbo Cooling
Fan

Front Wire Mesh Filter

❖ To replace the front wire mesh filter

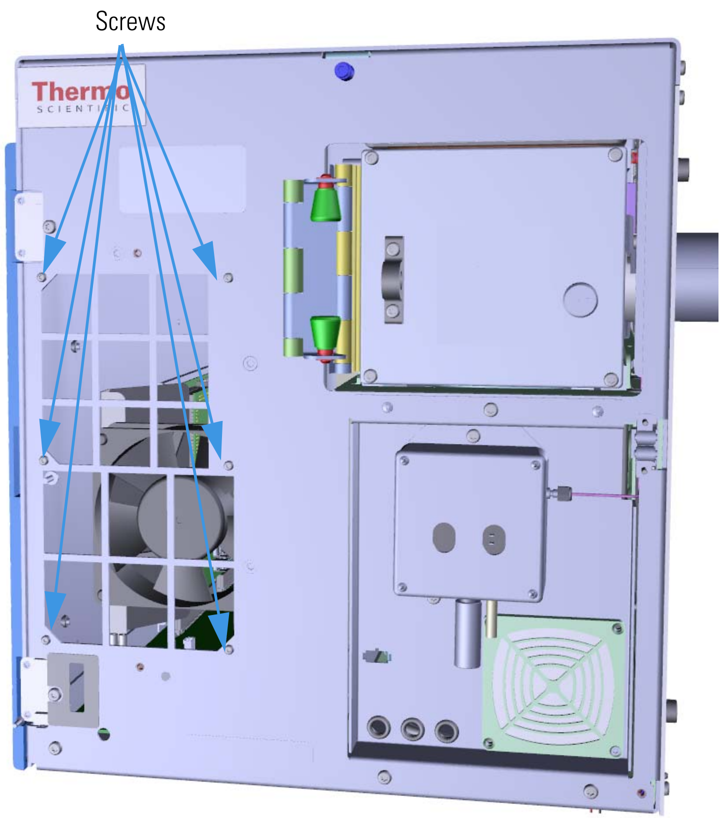
Note If needed, you can order an additional dust filter. See the *TSQ Duo Spare Parts Guide* for ordering information.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Use a T10 Torxhead screwdriver to remove the six screws holding the front wire mesh filter to the interior front panel.
3. Remove and replace the front wire mesh filter.
4. Reattach the six screws holding the front wire mesh filter to the interior front panel.

Figure 310. Replacing the Front Wire Mesh Filter



5. Restart your system by following the instructions in "Restarting the System" on page 106.

Left Rear Wire Mesh Filter

❖ To replace the left rear wire mesh filter

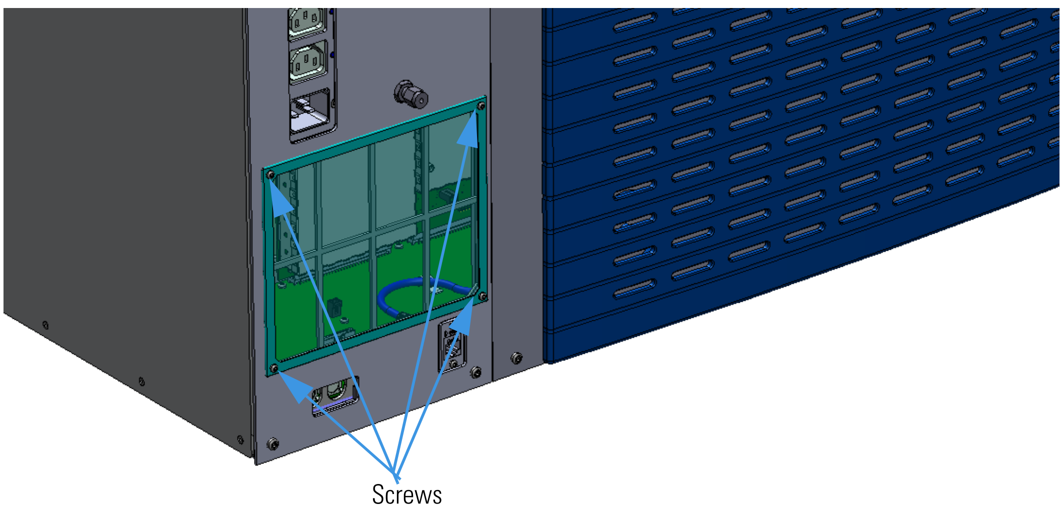
Note See the *TSQ Duo Spare Parts Guide* for ordering information.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Use a T10 Torxhead screwdriver to remove the four screws holding the left rear wire mesh filter to the left hand sub panel.

Figure 311. Replacing the Left Rear Wire Mesh Filter



3. Remove and replace the left rear wire mesh filter.
4. Reattach the four screws holding the left rear wire mesh filter to the left hand sub panel.
5. Restart your system by following the instructions in "Restarting the System" on page 106.

Chassis Cooling Fan and Fan Plenum

❖ To replace the chassis cooling fan and fan plenum

Note See the *TSQ Duo Spare Parts Guide* for information about ordering this component.

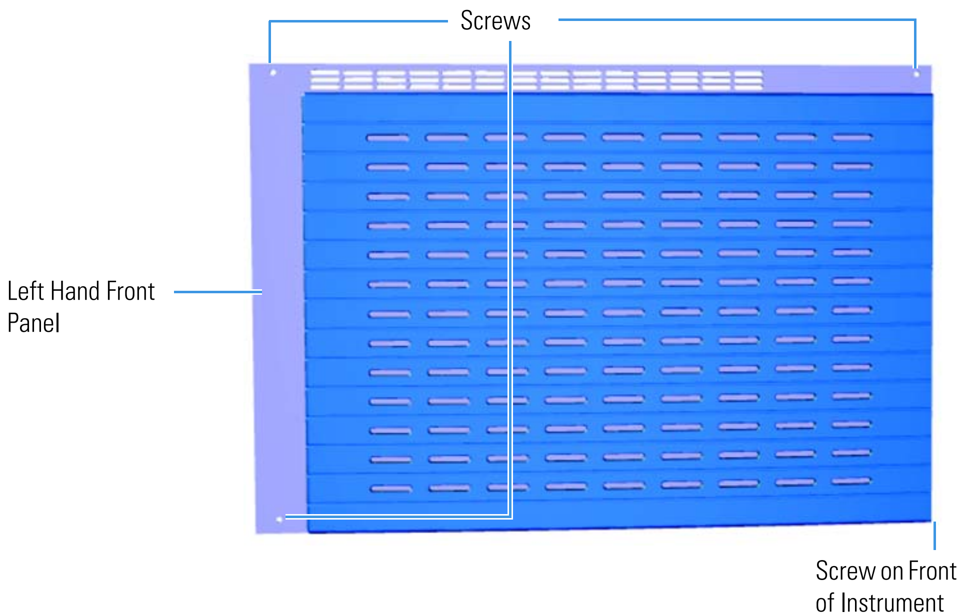
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93.

Note You do not have to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Use a T20 Torxhead screwdriver to loosen the top cover panel screw from the front panel. If you are using hydrogen you must also remove the hydrogen safety screws. Slide the top cover panel toward the back of the instrument and lift it off.

3. Remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

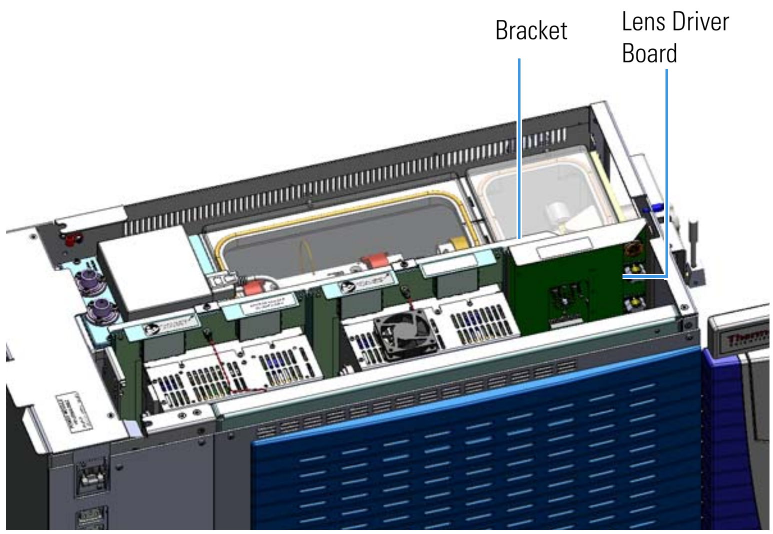
Figure 312. Locating the Left Hand Front Panel Screws



4. Lift the left hand front panel off the instrument.

5. The lens driver board is the first board standing on end in the center of the instrument

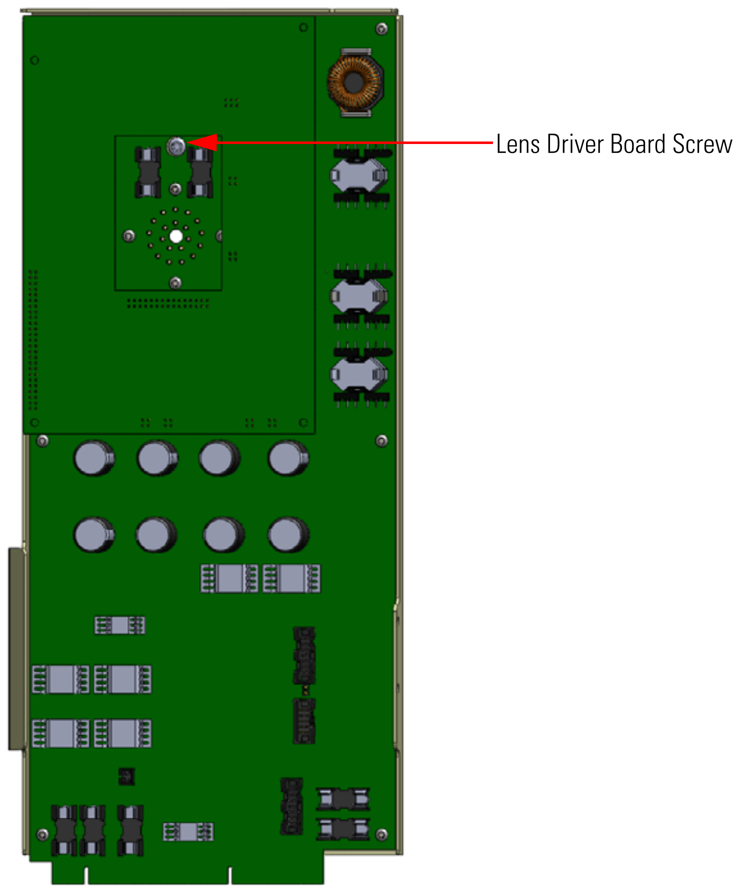
Figure 313. Locating the Lens Driver Board



6. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

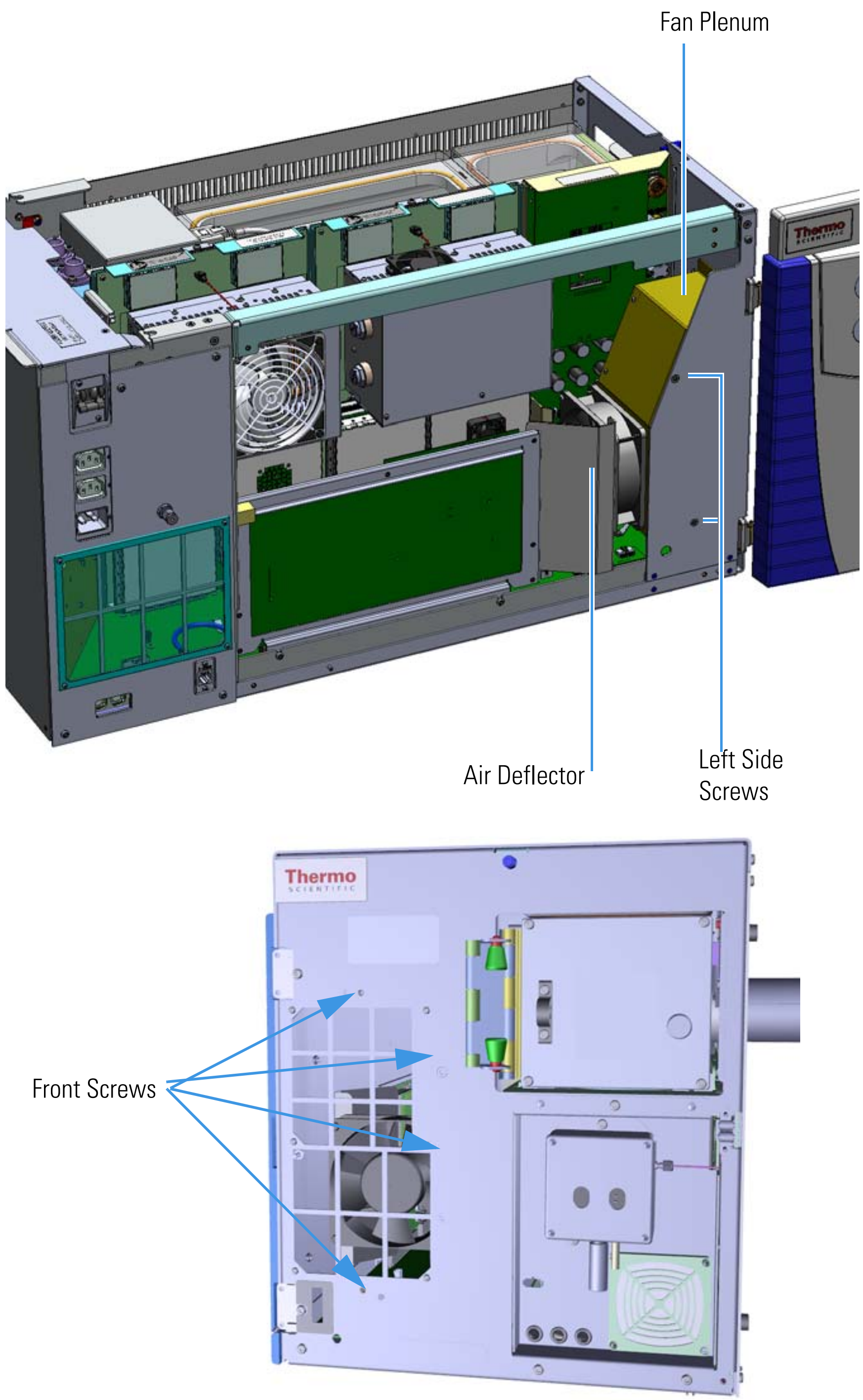
Figure 314. Removing the Lens Driver Board



7. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove it from the board and bracket.
8. Lift the lens driver board out of the instrument. Be careful as space is limited.

CAUTION - INSTRUMENT DAMAGE Limit handling of the boards as much as possible. Do not touch any board components. Hold the board by the sheet metal bracket only.

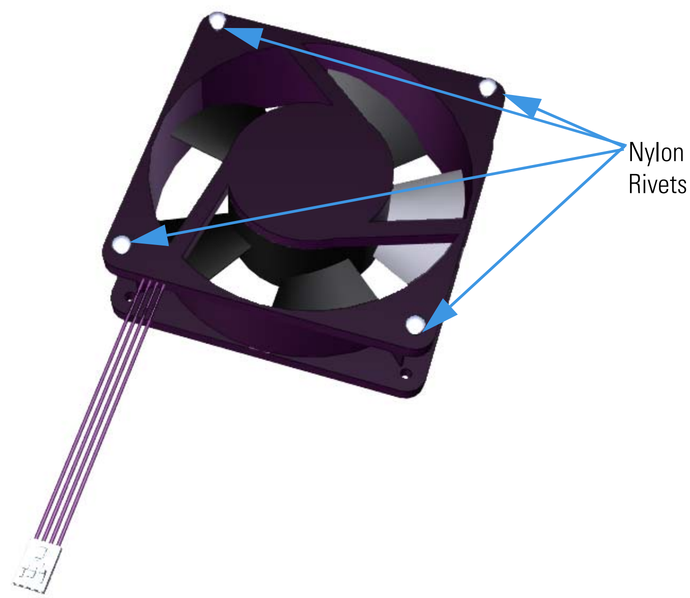
Figure 315. Removing the Chassis Cooling Fan and Pan Plenum



9. Remove the six screws holding the fan plenum to the chassis. Two are on the left side of the instrument, and four are attached to the interior front panel.

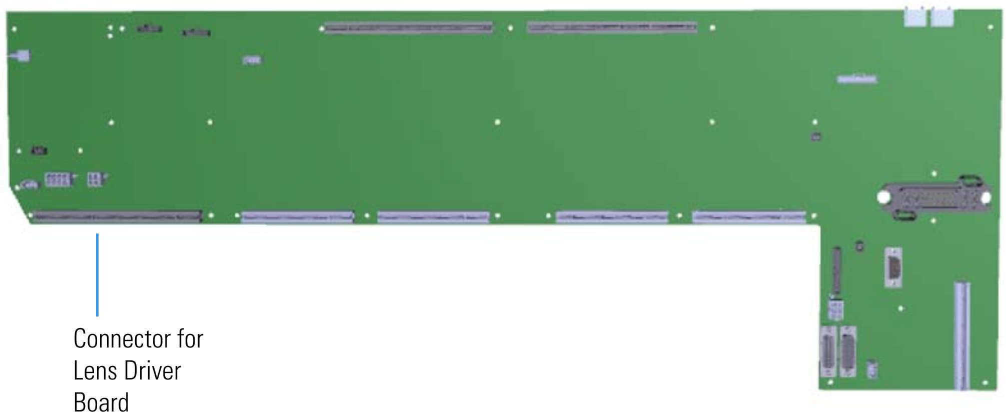
10. Disconnect the fan from the distribution board on the bottom of the instrument.
11. Remove the entire fan plenum assembly including the fan and air deflector out of the instrument.
12. Remove the four nylon rivets holding the chassis cooling fan to the fan plenum.

Figure 316. Locating the Nylon Rivets on the Chassis Cooling Fan



13. Remove and replace the chassis cooling fan or the fan plenum as necessary.
14. Transfer the air deflector to the new fan using two nylon rivets.
15. Reattach the two screws connecting the chassis cooling fan to the air deflector.
16. Reattach the four nylon rivets holding the chassis cooling fan to the fan plenum.
17. Connect the fan to the distribution board.
18. Reattach the six screws connecting the fan plenum to the chassis.
19. Replace the lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.
20. Push the lens driver board down into the connector.

Figure 317. Reinstalling the Lens Driver Board



21. Look through the left side of the instrument and use a T20 Torxhead screwdriver to tighten the screw holding the lens driver board in place on the chassis.
22. Reattach the left hand front panel and tighten the four screws holding it in place.
23. Reattach the top cover panel and tighten the screw holding it in place.
24. Restart your system by following the instructions in “Restarting the System” on page 106.

Air Deflector

❖ To replace the air deflector

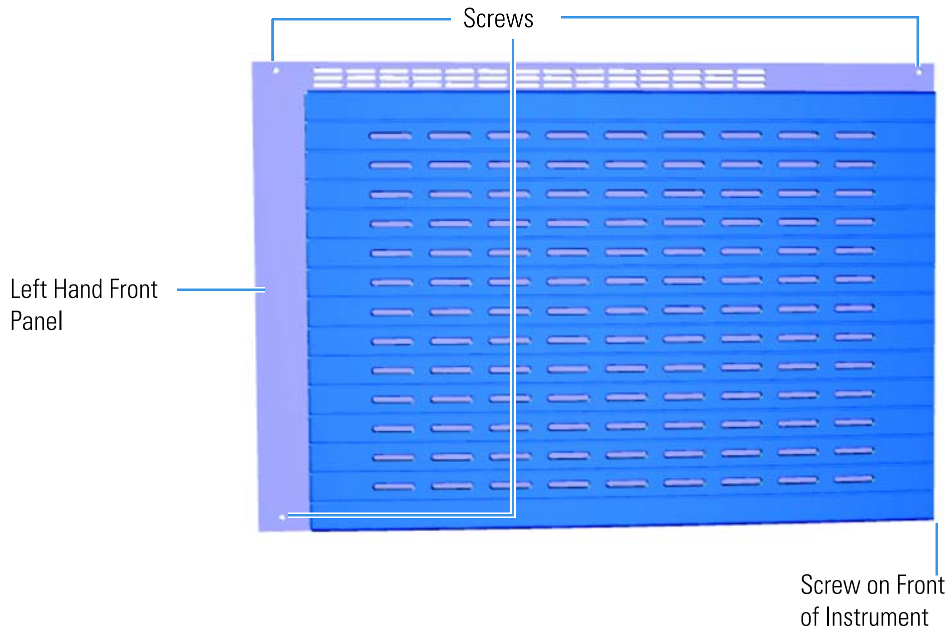
Note See the *TSQ Duo Spare Parts Guide* for ordering information.

1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93. You do not need to remove the ion source cartridge or column or vent the instrument. If you are using hydrogen as a carrier gas, power off the GC.

2. Slide the top cover panel toward the back of the instrument and lift it off.

3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

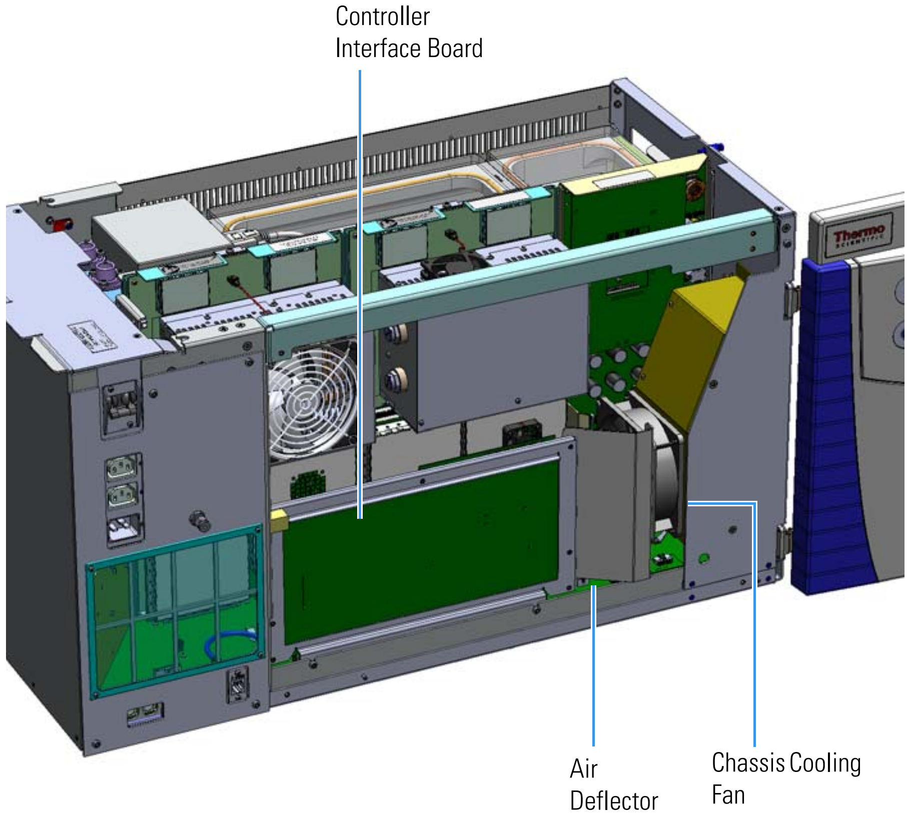
Figure 318. Locating the Left Hand Front Panel Screws



4. Lift the left hand front panel off the instrument.

5. Remove the two rivets holding the air deflector to the chassis cooling fan.

Figure 319. Replacing the Air Deflector



6. Lift the air deflector carefully out of the instrument and replace it.
7. Carefully replace the air deflector so that it is positioned correctly behind the controller interface board.
8. Reattach the two rivets holding the air deflector to the chassis cooling fan.
9. Reattach the four screws securing the left hand front panel to the chassis.
10. Restart your system by following the instructions in "Restarting the System" on page 106.

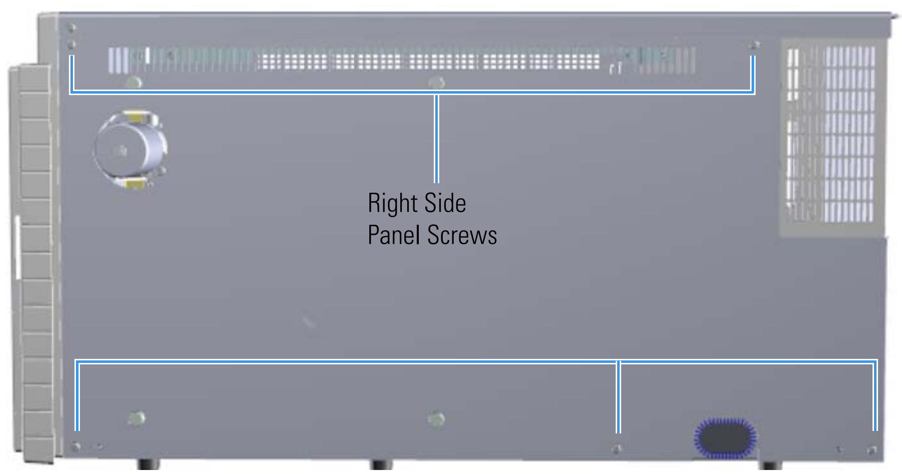
Turbo Cooling Fan and Turbo Cooling Fan Filter

❖ To replace the turbo cooling fan and turbo cooling fan filter

Note See the *TSQ Duo Spare Parts Guide* for ordering information.

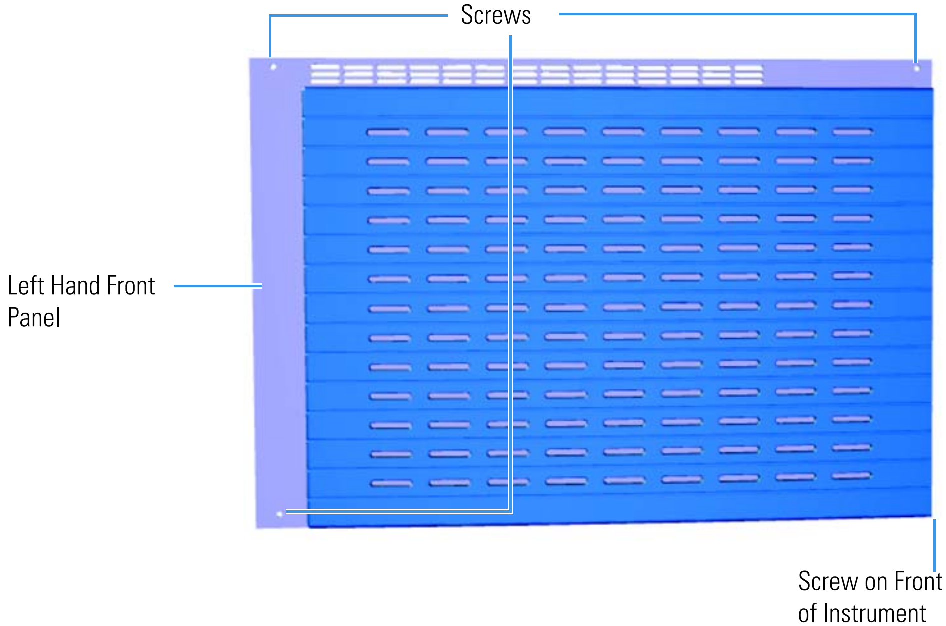
1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not need to remove the ion source cartridge.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Move the GC away from the TSQ Duo instrument.
4. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

   Figure 320. Removing the Right Side Panel Screws



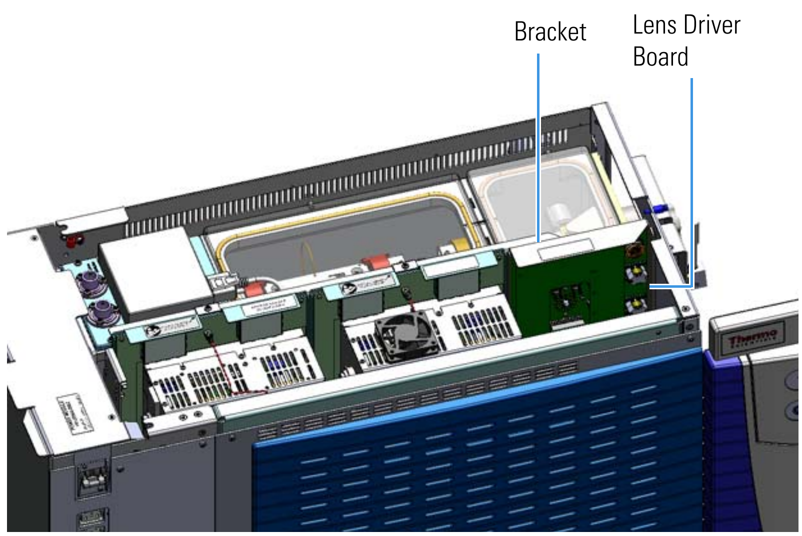
5. Lift the right side panel off the instrument.
6. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

Figure 321. Locating the Left Hand Front Panel Screws



7. Lift the left hand front panel off the instrument.
8. The lens driver board is the first board standing on end in the center of the instrument.

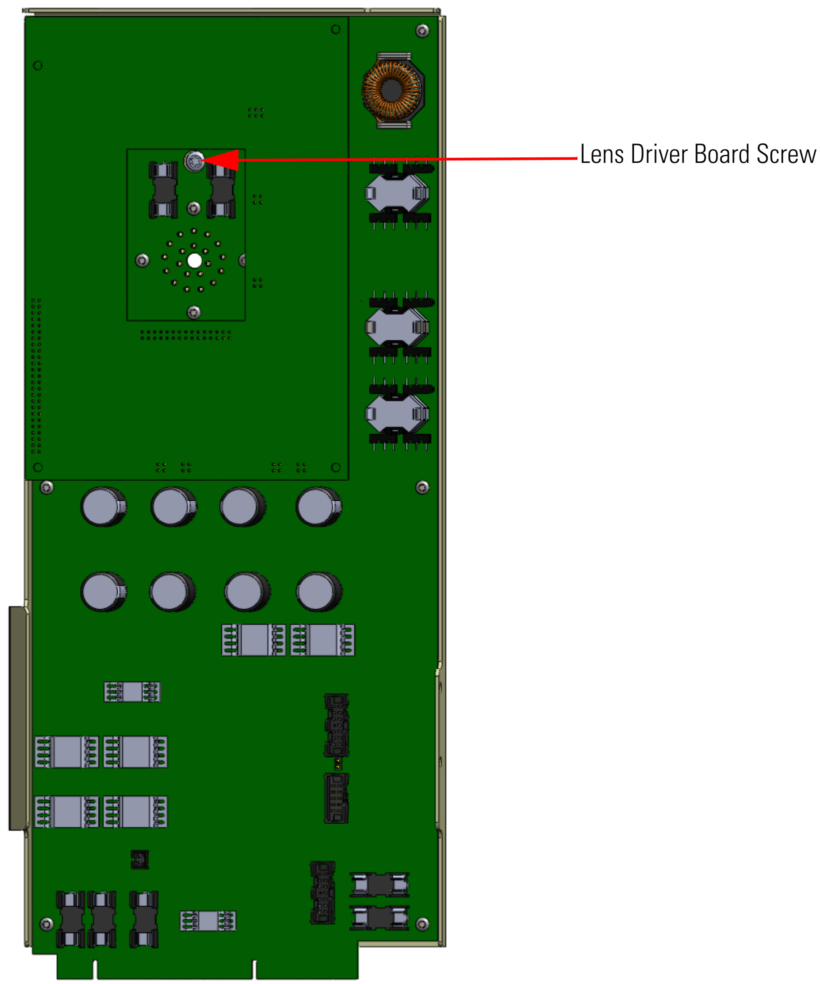
Figure 322. Locating the Lens Driver Board



9. Look through the left side of the instrument and use a T20 Torxhead screwdriver to loosen the screw holding the board to the chassis.

Tip The bracket has a white diagram describing the location of this screw. It is approximately two inches from the top of the board directly under the white label.

Figure 323. Removing the Lens Driver Board

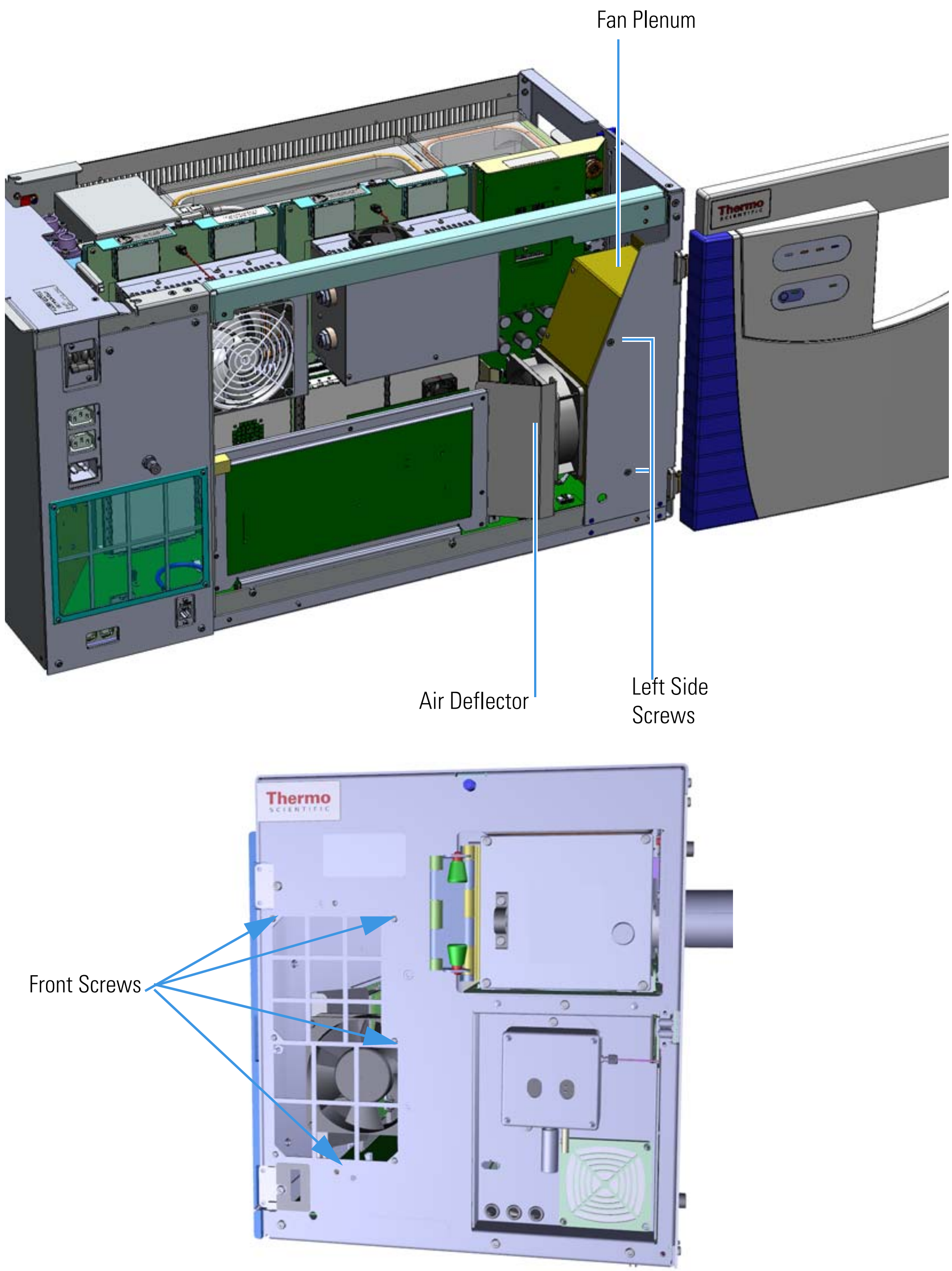


10. Loosening the screw will separate the board from the instrument. The screw is captured, so do not attempt to completely remove it from the board and bracket.

11. Lift the lens driver board out of the instrument. Be careful as space is limited.

CAUTION - INSTRUMENT DAMAGE Limit handling of the boards as much as possible. Do not touch any board components. Hold the board by the sheet metal bracket only.

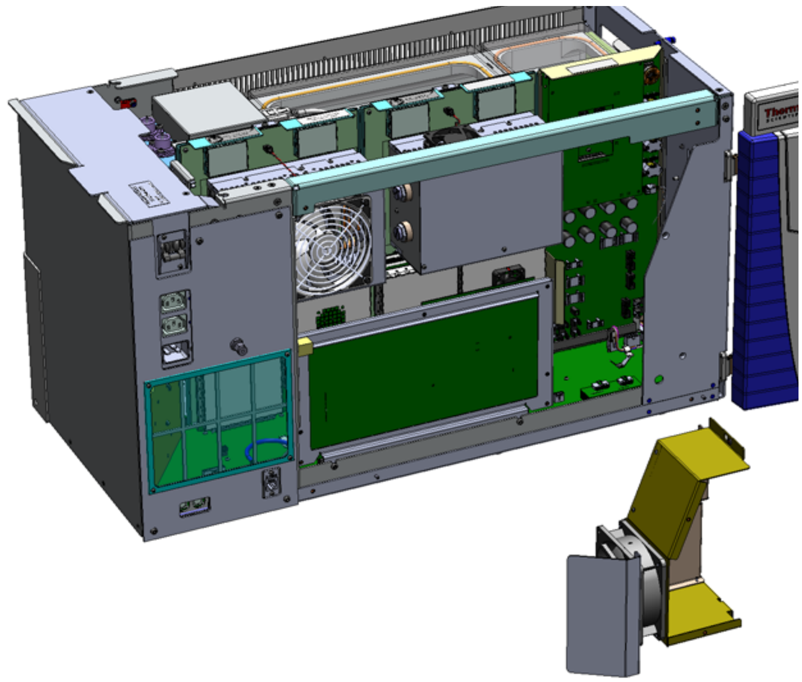
Figure 324. Locating the Screws Connecting the Fan Plenum to the Instrument



12. Remove the six screws holding the fan plenum to the chassis. Two are on the left side of the instrument, and four are attached to the interior front panel.

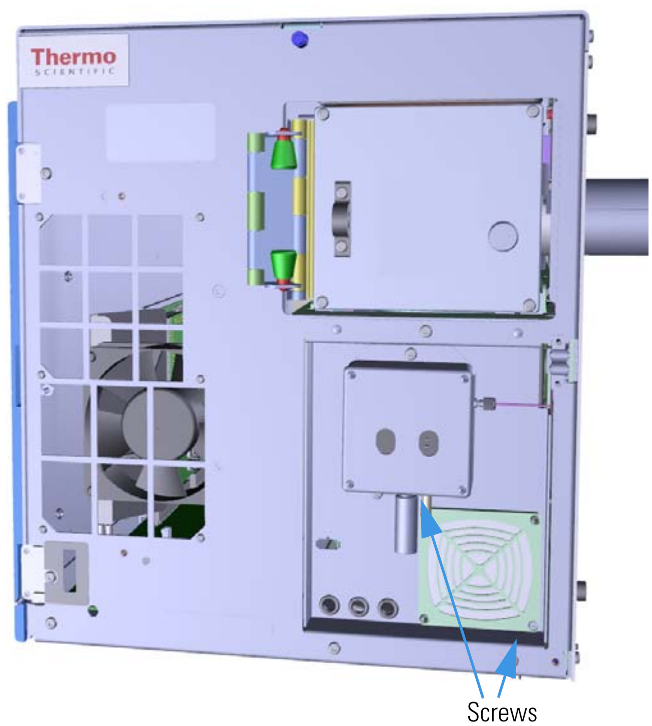
13. Disconnect the fan from the distribution board on the bottom of the instrument.
14. Lift the fan plenum and chassis cooling fan out of the instrument.

Figure 325. Removing the Fan Plenum and Chassis Cooling Fan



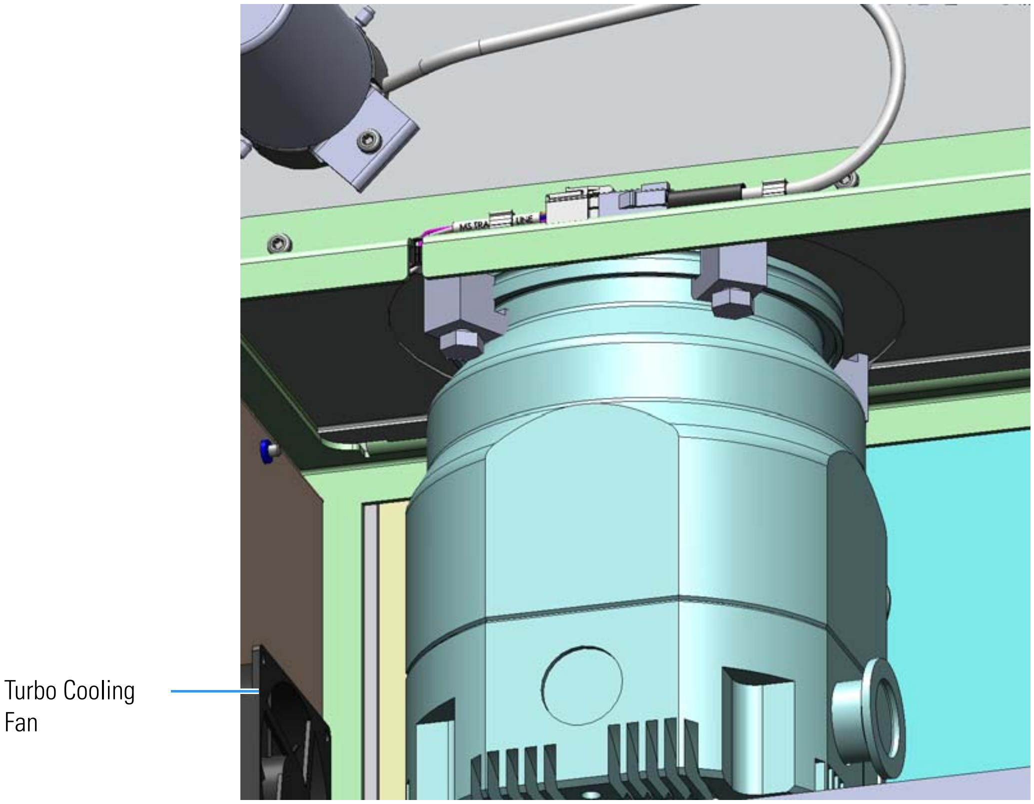
15. Disconnect the cable to the turbo cooling fan from the distribution board.
16. Remove the two corner M3 flat head screws from the turbo cooling fan and replace the fan.
17. If you need to replace the turbo cooling fan filter, use a T10 Torxhead screwdriver to remove the four screws holding the turbo cooling fan filter to the interior front panel.
18. Remove and replace the turbo cooling fan filter.

Figure 326. Replacing the Turbo Cooling Fan Filter



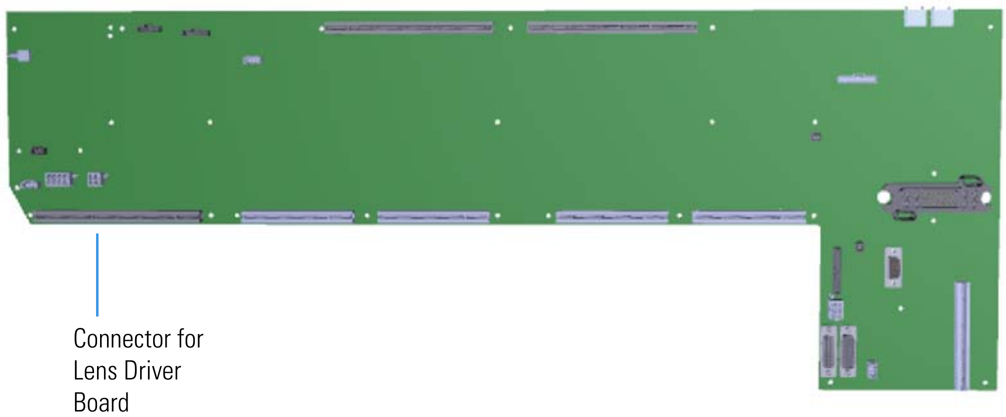
19. Reattach the two screws holding the turbo cooling fan filter to the interior front panel.

Figure 327. Replacing the Turbo Cooling Fan



20. Reconnect the turbo cooling fan cable to the distribution board.
21. Replace the fan plenum, chassis cooling fan, and air deflector assembly into the instrument.
22. Reattach the six screws securing the fan plenum to the chassis.
23. Reconnect the cable on the chassis cooling fan to the distribution board.
24. Replace the lens driver board by aligning the connector on the bottom of the board with the connectors on the distribution board beneath it. It will drop into the slot when it is in the right position.
25. Push the lens driver board down into the connector.

Figure 328. Reinstalling the Lens Driver Board



26. Look through the left side of the instrument and use a T20 Torxhead screwdriver to tighten the screw holding the lens driver board in place on the chassis.
27. Replace the right side panel and reattach the four screws.
28. Replace the left hand front panel and reattach the four screws.
29. Replace the top cover panel and reattach the top cover panel screw.
30. Reattach the GC.
31. Restart your system by following the instructions in "Restarting the System" on page 106.

Replacing the Turbomolecular Pump

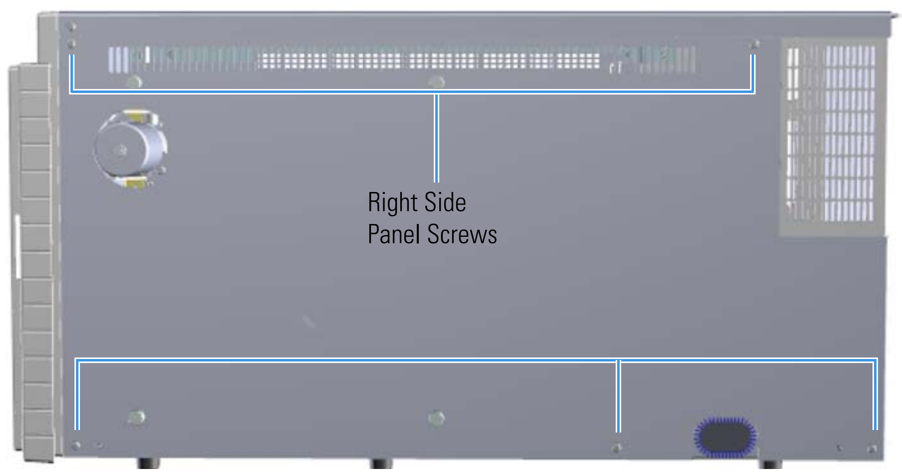
The turbomolecular pump is a multi-stage axial-flow turbine in which high-speed rotating blades provide compression by increasing the probability of gas molecules moving in the pumping direction. The turbomolecular pump is optimized for molecular flow conditions and requires the use of a rough pump to exhaust to the atmosphere.

❖ To install or replace the turbomolecular pump

Note See the *TSQ Duo Spare Parts Guide* for ordering information.

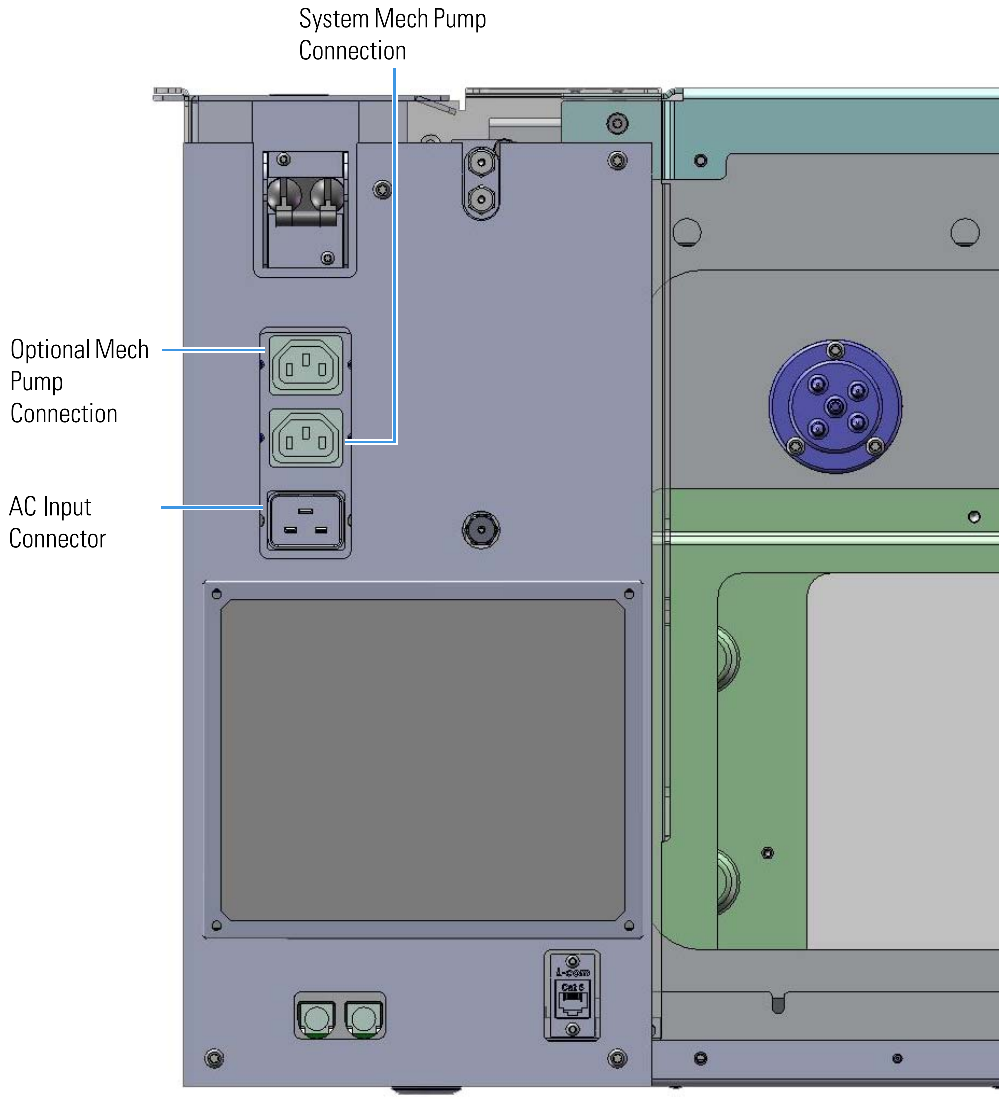
1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93. You do not have to remove the ion source cartridge.
2. Use a T20 Torxhead screwdriver to loosen the top cover panel screw from the front panel. If you are using hydrogen you must also remove the hydrogen safety screws. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

   Figure 329. Removing the Right Side Panel Screws



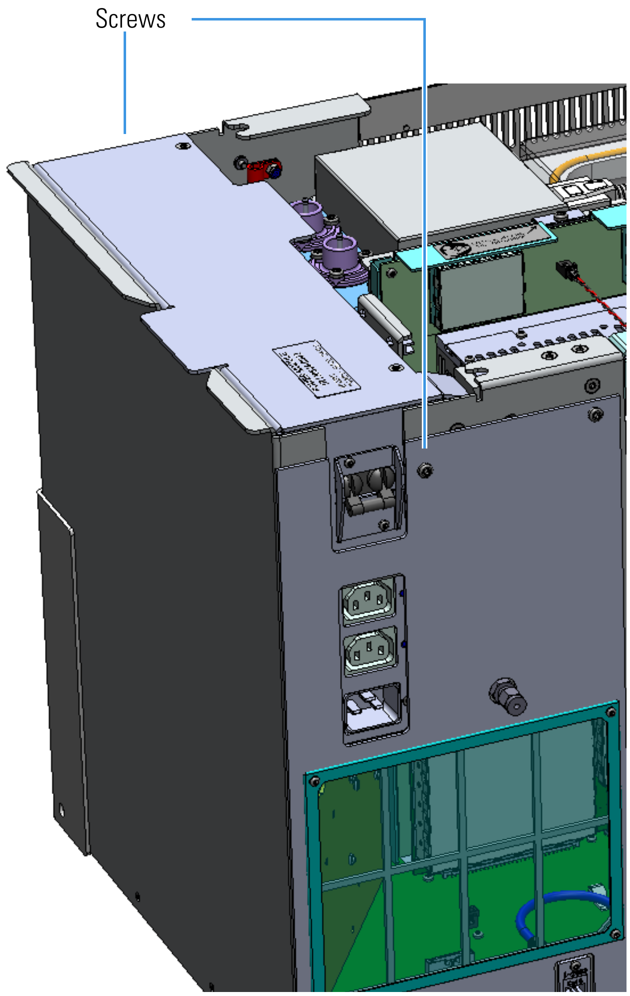
4. Make sure the electrometer board cable is not in the way when you remove the power module.
5. Disconnect the power cables from the side of the TSQ Duo instrument.

Figure 330. Locating the TSQ Duo System Power Cables



6. Use a T20 Torxhead screwdriver to remove the two screws holding the power supply system to the top of the back panel.

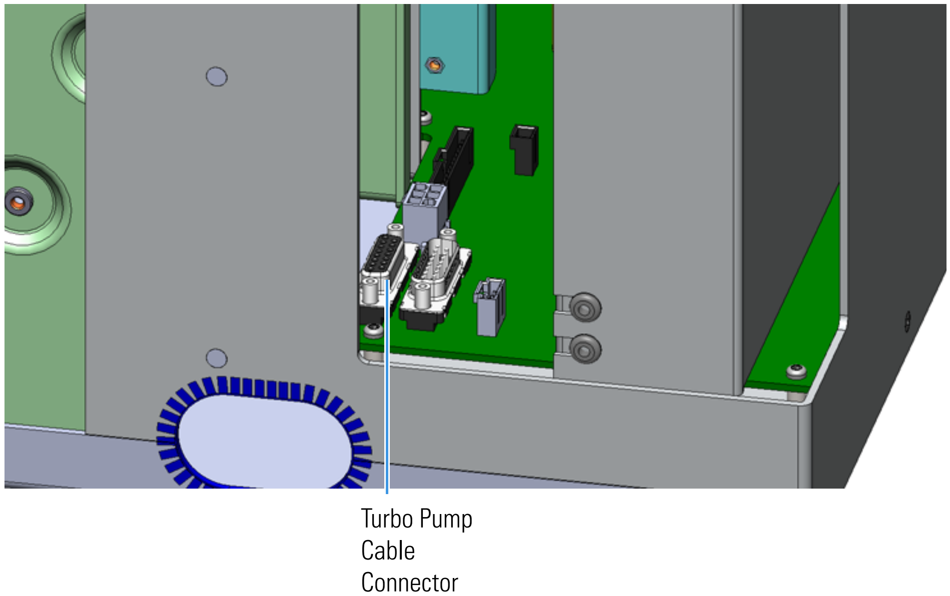
Figure 331. Removing the Power Module Screws



7. Grasp the power supply system and lift it out of the instrument. It fits snugly, so you may have to gently shake it as you lift it out.

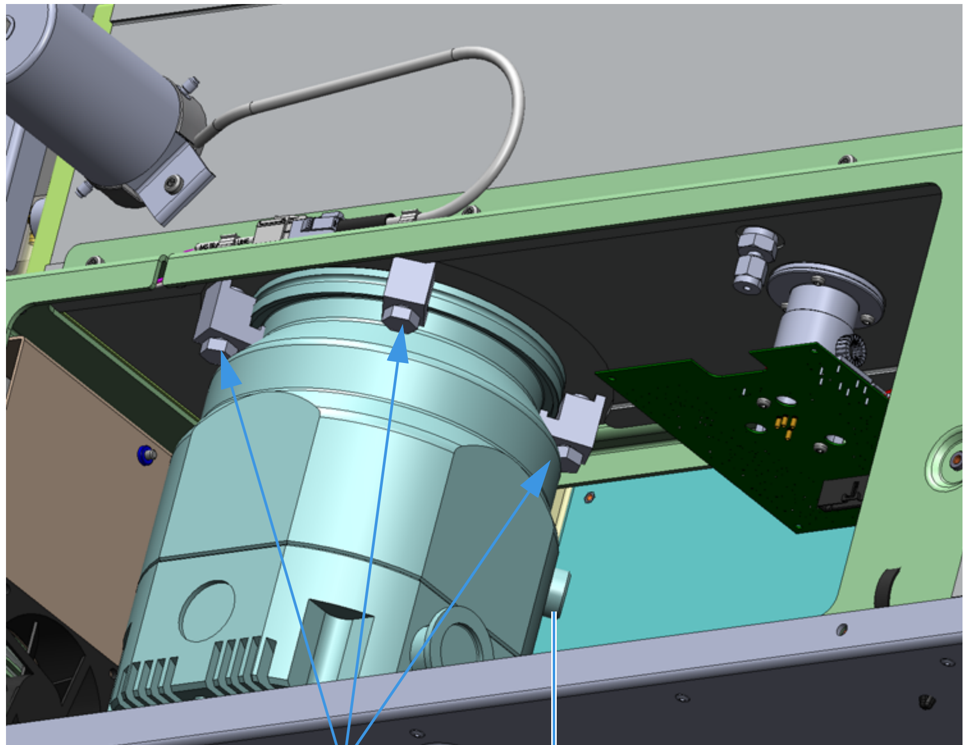
8. Disconnect the turbo pump cable from the distribution board.

Figure 332. Disconnecting the Turbo Pump Cable from the Distribution Board



9. Remove the N25 connector that connects the foreline adapter to the turbomolecular pump.
10. Pull the adapter away from the turbomolecular pump.
11. Use a 13 mm wrench to loosen the four clamps at the top of the turbomolecular pump.
12. Remove the two clamps that hold the turbomolecular pump to the manifold on the transfer line side.

Figure 333. Removing the Turbomolecular Pump



13. Lift the turbomolecular pump away from the remaining clamps.

14. Remove the turbomolecular pump from the chassis. You may have to tilt the turbo pump to get it out of the chassis.

15. Insert a new turbomolecular pump into the chassis.

Note There is a centering ring with an o-ring seal that must be correctly placed between the pump and the vacuum manifold.

Figure 334. Installing the Turbomolecular Pump

16. Lift the turbomolecular pump up and onto the support clamps.

Note You may need assistance to lift the pump up and onto the clamps. The turbo pump is large, heavy and awkward to hold with one hand while you are tightening the clamps with a wrench. If you remove the left hand front panel, control board, lens driver board, and RF board, it is easier for the other person to hold the pump as you tighten the clamps.

17. Reattach the remaining clamps.
18. Tighten all the bolts holding the turbomolecular pump to the chassis.
19. Attach the adapter to the turbo pump and clamp it in place.
20. Reconnect the turbomolecular pump cable to the distribution board.
21. Reinstall the power module by aligning its connector with the connector on the distribution board beneath it. Make sure it is flush against the top of the chassis and the screw holes line up. It will click into place when its in the right position.
22. Reattach the two screws holding the power module to the instrument.
23. Reconnect the power cables on the left side of the instrument. Make sure you attach the cables properly. The foreline pump connects to the System Mech Pump connector on the left hand sub panel of the instrument.
24. Replace the right side panel and tighten the five screws.
25. Replace the top cover panel and tighten the screw.
26. Reattach the GC.
27. Restart your system by following the instructions in “Restarting the System” on page 106.

Convectron Gauge and Foreline Adapter with Hose

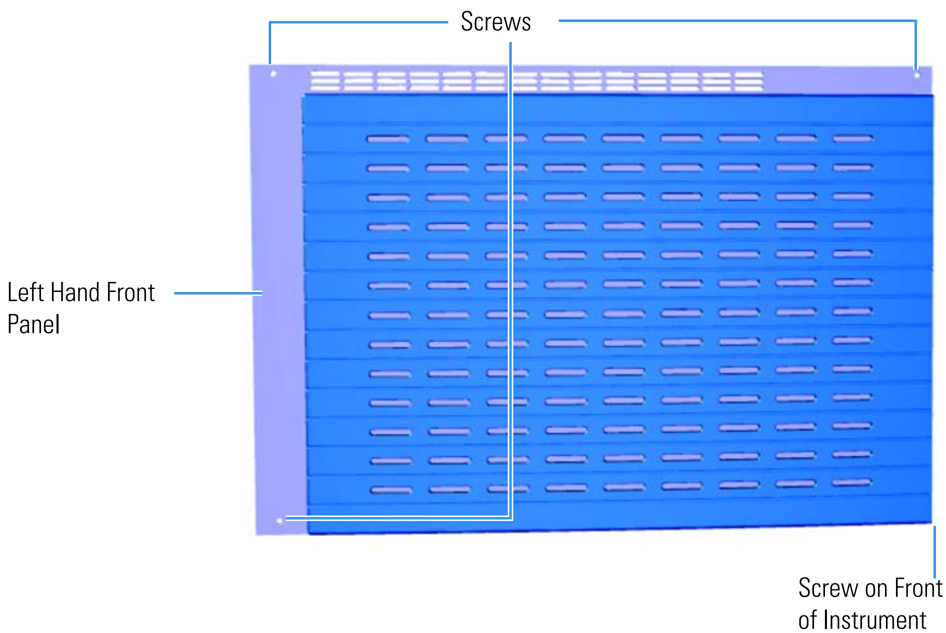
A convectron gauge measures and controls the pressure in the foreline that is connected to the turbomolecular pump and rough pump. If the foreline pressure gets too high, the convectron gauge decreases the power going to the turbomolecular pump. The convectron gauge and foreline adapter are connected to the foreline hose, which is connected to the turbomolecular pump.

❖ To replace a convectron gauge and foreline adapter with hose

Note See the *TSQ Duo Spare Parts Guide* for ordering information.

1. Shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not have to remove the ion source cartridge.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Use a T20 Torxhead screwdriver to remove the four screws securing the left hand front panel to the chassis. One of the screws is located on the interior front panel of the instrument.

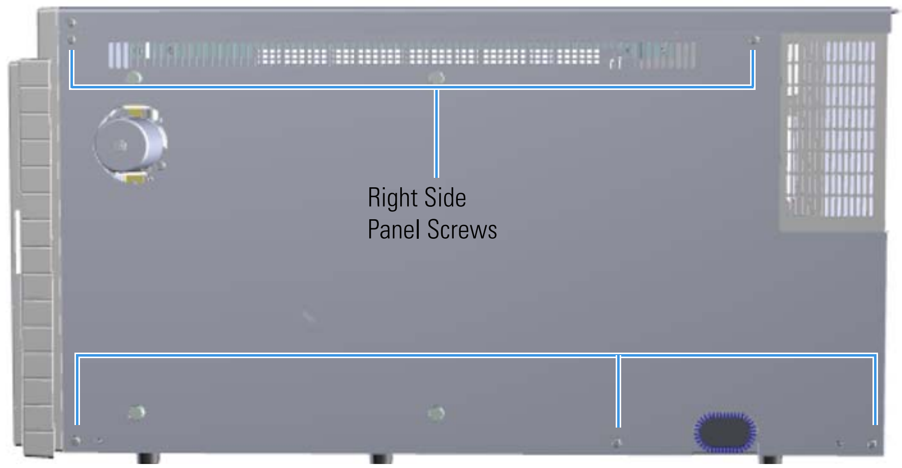
   Figure 335. Locating the Left Hand Front Panel Screws

4. Lift the left hand front panel off the instrument.
5. Move the GC away from the TSQ Duo instrument.

6. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

Figure 336. Removing the Right Side Panel Screws

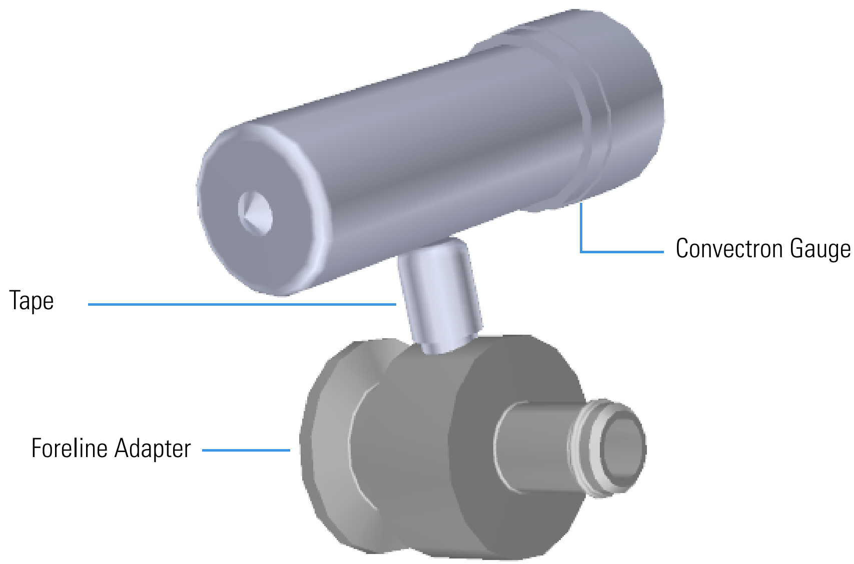


7. Disconnect the vacuum hose from the adapter on the foreline pump.
8. Remove the rough pump clamp on the turbomolecular pump and the adapter.

9. Insert and twist the convectron gauge into the threaded hole on the foreline adapter.

> **Note** Before you insert the convectron gauge in the hole, wrap Teflon tape around the part to be inserted. The tape prevents vacuum leaks.

Figure 337. Installing the Foreline Adapter to the Convectron Gauge



10. Attach the foreline hose on the adapter.
11. Use the rough pump clamp to attach the adapter to the turbo pump.
12. Attach the cable to the distribution board and convectron gauge.
13. Reattach the right side panel and the screws holding it in place.
14. Replace the top cover panel and tighten the screw.
15. Reattach the GC.
16. Restart your system by following the instructions in “Restarting the System” on page 106.

4

Upgrade Equipment

This chapter describes how to install the equipment upgrades that are available for the TSQ Duo mass spectrometer. See the *TSQ Duo Spare Parts Manual* for information about ordering the equipment in this chapter.

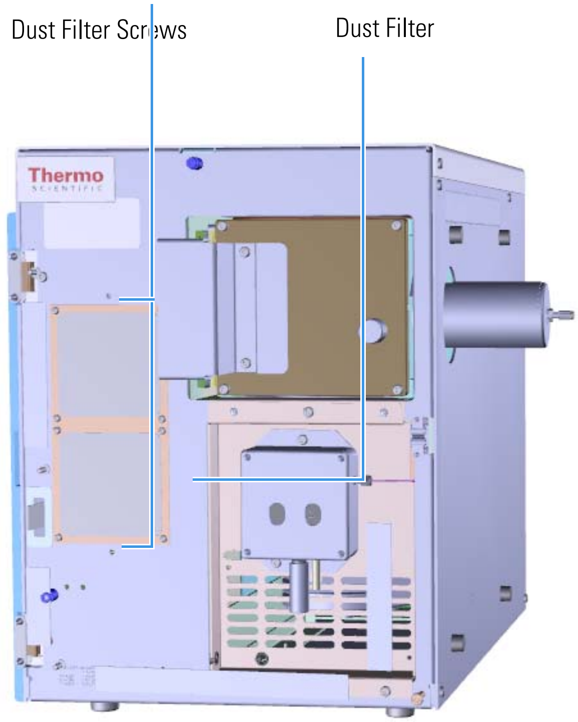
Contents

Dust Filter

An optional dust filter is available for the TSQ Duo system. It helps prevent dust from accumulating on the electrical components and damaging your system. If you have a particularly dusty environment, the dust filter will help your instrument operate at a cooler temperature for a longer period of time.

1. Unless you are using hydrogen as a carrier gas, you do not have to shut down the GC, simply open the front door of the TSQ Duo instrument.
2. If you are using hydrogen, shut down your system by following the steps in "Shutting Down the TSQ Duo System" on page 93. You do not need to remove the ion source cartridge or column or vent the instrument.
3. Remove the two screws holding the dust filter to the interior front panel.
4. Remove and replace the dust filter.
5. Reattach the two screws holding the dust filter to the interior front panel.

Figure 338. Replacing the Dust Filter



6. If necessary, restart your system by following the instructions in "Restarting the System" on page 106.

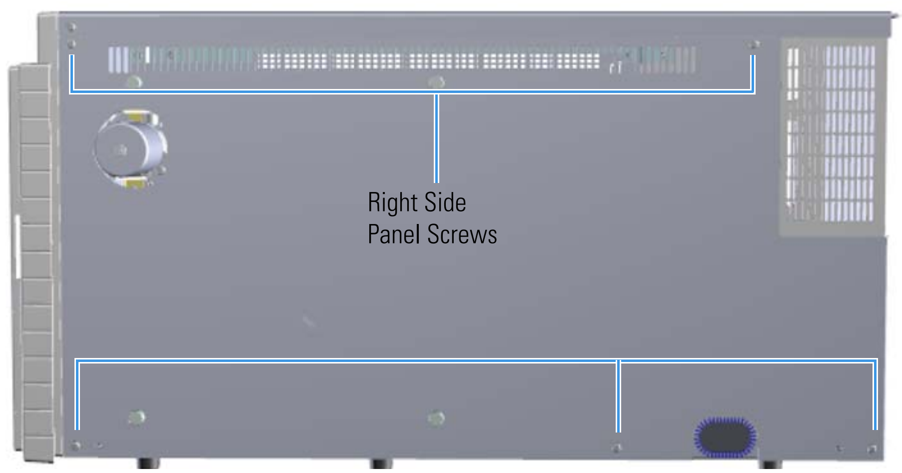
Ion Gauge and Tube Shield

An ion gauge measures the pressure inside the vacuum manifold and produces energetic electrons to ionize molecules. Positive ions formed in the ion gauge are attracted to a collector. If you have an ion gauge, it must be powered on and the pressure must be less than 1x10-3 Torr to turn on the filament, electron multiplier, or conversion dynode. This pressure setting protects these components from being damaged.

To install an ion gauge and tube shield

1. Shut down your system by following the steps in “Shutting Down the TSQ Duo System” on page 93.
2. Slide the top cover panel toward the back of the instrument and lift it off.
3. Move the GC away from the TSQ Duo instrument.
4. Use a T20 Torxhead screwdriver to remove the five screws on the right side panel.

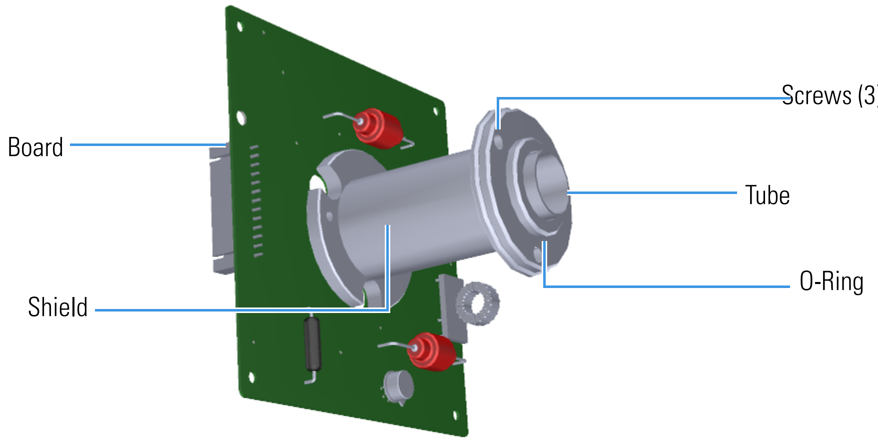
Figure 339. Removing the Right Side Panel Screws



5. Lift the right side panel off the instrument.
6. Attach the ion gauge shield and tube to the board, as shown in the figure below.

> **Note** The metal tube can be placed on the board in two different ways. Only one of the orientations will allow the tube to attach correctly to the manifold.

Figure 340. Assembling the Ion Gauge

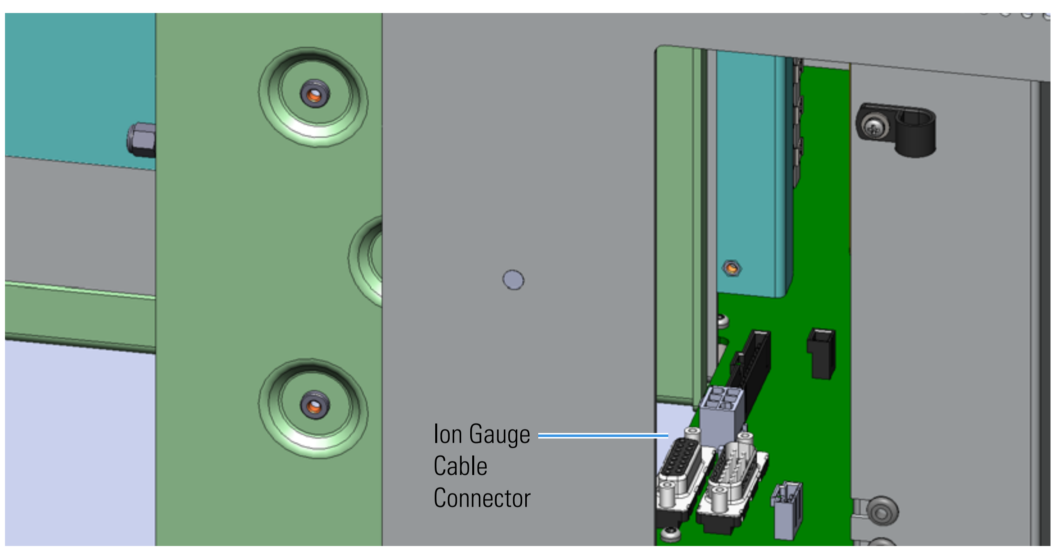


7. Use a T10 Torxhead screwdriver to attach the screws holding the metal ion gauge shield to the board.
8. Attach the glass ion gauge tube to the shield so the open end is facing away from the board. There is only one way to fit the tube's electrical connectors onto the board.

Tip Insert the tube until there is good electrical contact and ample room on the open end for the o-ring to fit securely. This will prevent the o-ring from sliding off when the assembly is being put on the manifold.

9. Attach the 14-pin cable to the distribution board and ion gauge board.

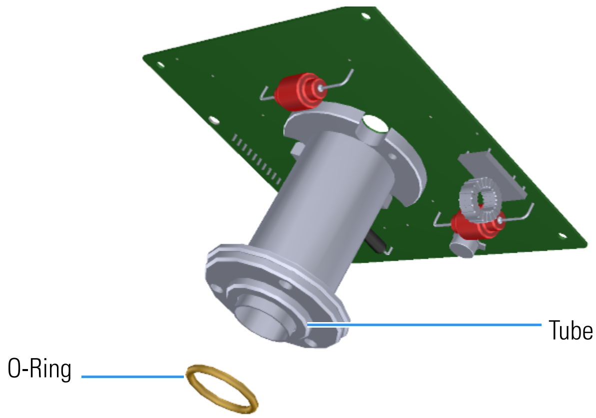
Figure 341. Connecting the Ion Gauge Cable to the Distribution Board



10. Remove the plug on the bottom of the manifold.

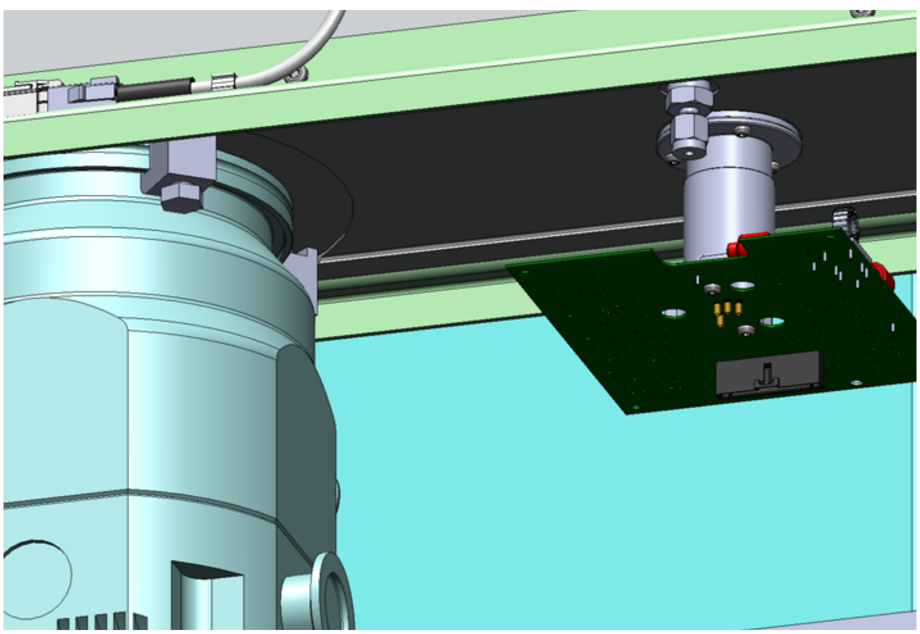
11. Place the o-ring from the plug on top of the tube.

Figure 342. Attaching the O-Ring to the Ion Gauge Tube



12. Use a T20 Torxhead screwdriver to attach the ion gauge to the instrument.

Figure 343. Installing the Ion Gauge



13. Replace the right side panel and attach the screws holding it in place.
14. Reattach the top cover panel and tighten the screw holding the top cover panel in place.
15. Restart your system by following the instructions in "Restarting the System" on page 106.

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