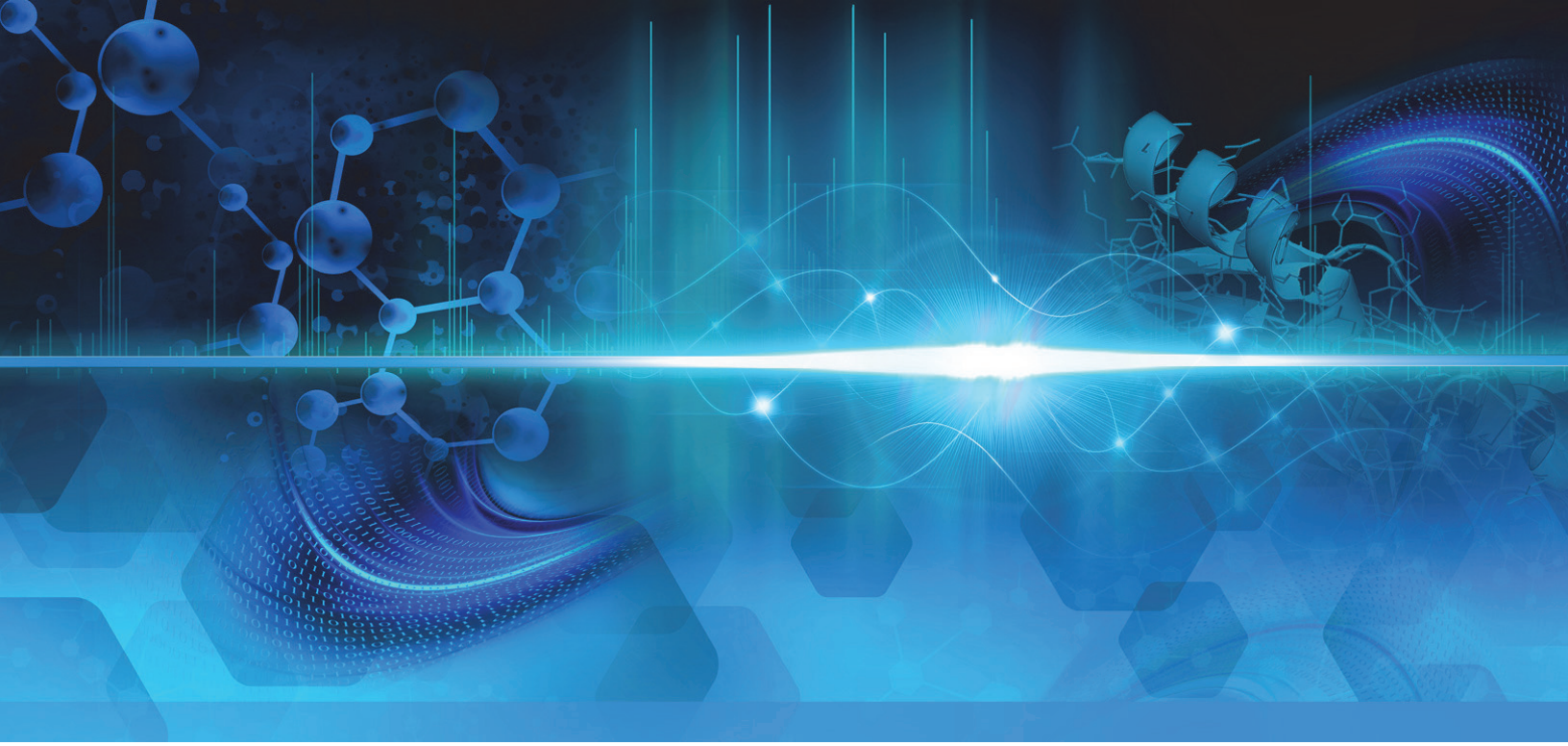

EASY-ETD and EASY-IC

Ion Sources User Guide

For the Orbitrap Fusion Tribrid Mass Spectrometer

80000-97511 Revision A October 2013

DOCUMENTATION SURVEY

Thermo SCIENTIFIC

Release history: Revision A, October 2013

Software version: (Thermo) Foundation 3.0 and later, Xcalibur 3.0 and later, Orbitrap Fusion Tune 1.0 and later

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

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.

Orbitrap Fusion/ETD and Orbitrap Fusion/IC Systems (June 2013)

EMC Directive 2004/108/EC

EMC compliance has been evaluated by TÜV Rheinland of North America.

EN 55011: 2009, A1: 2010

EN 61000-3-2: 2006, A2: 2009

EN 61000-3-3: 2008

EN 61000-4-2: 2009

EN 61000-4-3: 2006, A2: 2010

EN 61000-4-4: 2004, A1: 2010

EN 61000-4-5: 2006

EN 61000-4-6: 2009

EN 61000-4-11: 2004

EN 61326-1: 2006

CISPR 11: 2009, A1: 2010

ICES-003 Issue 5: 2012

CFR 47, FCC Part 15, Subpart B, Class A: 2012

Low Voltage Safety Compliance

The Orbitrap Fusion mass spectrometer complies with Low Voltage Directive 2006/95/EC and harmonized standard EN/UL/CAN 61010-1.

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 the Proper Use of Thermo Scientific Instruments

In compliance with international regulations: This instrument must be used in the manner specified by Thermo Fisher Scientific to ensure protections provided by the instrument are not impaired. Deviations from specified instructions on the proper use of the instrument include changes to the system and part replacement. Accordingly, order replacement parts from Thermo Fisher Scientific or one of its authorized representatives.

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.

CAUTION Symbol	CAUTION	VORSICHT	PRECAUCIÓN	MISE EN GARDE
	**Risk electric shock:** This instrument uses voltages that can cause electric shock and/or personal injury. Before servicing, shut down the instrument and disconnect it from line power. While operating the instrument, keep covers on. Do not remove the protective covers from the printed circuit board assemblies (PCBAs).	**Stromschlaggefahr:** Dieses Gerät arbeitet mit Spannungen, die Stromschläge und/oder Personenverletzungen verursachen können. Vor Wartungsarbeiten muss das Gerät abgeschaltet und vom Netz getrennt werden. Betreiben Sie das Gerät nicht mit abgenommenen Abdeckungen. Nehmen Sie die Schutzabdeckungen von Leiterplatten nicht ab.	**Riesgo de descargas eléctricas:** Este instrumento utiliza voltajes que pueden causar descargas eléctricas y/o lesiones personales. Antes de revisar o reparar el instrumento, apáguelo y desconéctelo de la red eléctrica. Mantenga colocadas las cubiertas mientras se utiliza el instrumento. No retire las cubiertas protectoras del circuito impreso completo (PCBA).	**Risque de choc électrique :** l'instrument utilise des tensions susceptibles de provoquer une électrocution et/ou des blessures corporelles. Il doit être arrêté et débranché de la source de courant avant toute intervention. Ne pas utiliser l'instrument sans ses couvercles. Ne pas enlever les capots de protection des cartes à circuit imprimé (PCBA).
	**Chemical hazard:** Wear gloves and other protective equipment, as appropriate, when handling toxic, carcinogenic, mutagenic, corrosive, or irritant chemicals. Use approved containers and proper procedures to dispose of waste oil and when handling wetted parts of the instrument.	**Gefahr durch Chemikalien:** Tragen Sie beim Umgang mit toxischen, karzinogenen, mutagenen, ätzenden oder reizenden Chemikalien Schutzhandschuhe und weitere geeignete Schutzausrüstung. Verwenden Sie bei der Entsorgung von verbrauchtem Öl und beim Umgang mit medienberührenden Komponenten die vorgeschriebenen Behälter, und wenden Sie ordnungsgemäße Verfahren an.	**Peligro por sustancias químicas:** Cuando manipule sustancias químicas, tóxicas, carcinogénicas, mutágenas, corrosivas o irritantes, utilice guantes y otro equipo de protección. Utilice siempre recipientes homologados y siga los procedimientos adecuados cuando deseche aceite residual o manipule partes mojadas del instrumento.	**Danger lié aux produits chimiques :** porter des gants et d'autres équipements de protection appropriés pour manipuler les produits chimiques toxiques, cancérigènes, mutagènes, corrosifs ou irritants. Utiliser des récipients homologués et des procédures adéquates pour la mise au rebut des huiles usagées et lors de la manipulation des pièces de l'instrument en contact avec l'eau.
	**Hot surface:** Before touching, allow any heated components to cool.	**Heiße Oberflächen:** Lassen Sie heiße Komponenten vor der Berührung abkühlen.	**Superficies calientes:** Antes de tocar los componentes calientes, espere a que se enfríen.	**Surface chaude :** laisser refroidir les composants chauffés avant toute manipulation.
	**Flammable substances hazard:** Use care when operating the system in the presence of flammable substances.	**Gefahr durch entzündbare Substanzen:** Beachten Sie die einschlägigen Vorsichtsmaßnahmen, wenn Sie das System in Gegenwart von entzündbaren Substanzen betreiben.	**Peligro por sustancias inflamables:** Tenga mucho cuidado cuando utilice el sistema cerca de sustancias inflamables.	**Danger lié aux substances inflammables :** agir avec précaution lors de l'utilisation du système en présence de substances inflammables.
	**Risk of eye injury:** Eye injury could occur from splattered chemicals, airborne particles, or sharp objects. (Sharp objects that customers might install in the instrument include fused-silica tubing, the autosampler needle, and so on.) Wear safety glasses when handling chemicals or servicing the instrument.	**Augenverletzungsrisiko:** Verspritzte Chemikalien, Schwebstoffpartikel oder scharfe Objekte können Augenverletzungen verursachen. (Scharfe Objekte, die Kunden möglicherweise im Gerät installieren, sind z. B. Quarzglas-Kapillaren, die Nadel des Autosamplers, usw.) Tragen Sie beim Umgang mit Chemikalien oder bei der Wartung des Gerätes eine Schutzbrille.	**Riesgo de lesiones oculares:** Las salpicaduras de sustancias químicas, las partículas flotantes en el aire y los objetos afilados pueden causar lesiones oculares. (Entre los objetos afilados que los clientes pueden instalar en el instrumento se encuentran tubos de sílice fundida, agujas del muestreador automático, etc.). Para manipular sustancias químicas o realizar tareas de mantenimiento, utilice gafas de seguridad.	**Risque de lésion oculaire :** les projections chimiques, les particules en suspension dans l'air et les objets tranchants peuvent entraîner des lésions oculaires. (Les objets tranchants pouvant être installés par les clients dans l'instrument comprennent les tubes en silice fondue, les aiguilles du passeur automatique, etc.). Porter des lunettes de protection lors de toute manipulation de produit chimique ou intervention sur l'instrument.
	**General hazard:** A hazard is present that is not included in the other categories. This symbol also appears on the instrument. For details about the hazard, refer to the instrument manual. When the safety of a procedure is questionable, contact Technical Support for Thermo Scientific San Jose products.	**Allgemeine Gefahr:** Es besteht eine weitere Gefahr, die nicht in den vorstehenden Kategorien beschrieben ist. Dieses Symbol wird auch auf dem Gerät angebracht. Einzelheiten zu dieser Gefahr finden Sie in den Gerätehandbüchern. Wenn Sie sich über die Sicherheit eines Verfahrens im Unklaren sind, setzen Sie sich, bevor Sie fortfahren, mit dem technischen Support für Thermo Scientific San Jose Produkte in Verbindung.	**Peligro general:** Existen peligros que no se incluyen en las otras categorías. Este símbolo también aparece en el instrumento. Si desea obtener más información sobre estos peligros, consulte el manual del instrumento. En caso de duda sobre la seguridad de un procedimiento, póngase en contacto con el personal de servicio técnico de los productos Thermo Scientific San Jose.	**Danger d'ordre général :** indique la présence d'un risque n'appartenant pas aux catégories citées plus haut. Ce symbole figure également sur l'instrument. Pour plus de détails sur ce danger potentiel, se reporter au manuel de l'instrument. Si la sûreté d'une procédure est incertaine, contacter l'assistance technique pour les produits Thermo Scientific San Jose.

CAUTION Symbol	CAUTION	VORSICHT	PRECAUCIÓN	MISE EN GARDE
	**Laser hazard:** This instrument uses a laser that is capable of causing personal injury. This symbol also appears on the instrument. For details about the hazard, refer to the instrument manual.	**Gefahr durch Laserstrahlen:** Der in diesem Gerät verwendete Laser kann zu Verletzungen führen. Dieses Symbol wird auch auf dem Gerät angebracht. Einzelheiten zu dieser Gefahr finden Sie in den Gerätehandbüchern.	**Peligro por láser:** Este instrumento utiliza un láser que puede producir lesiones personales. Este símbolo también aparece en el instrumento. Si desea obtener más información sobre el peligro, consulte el manual del instrumento.	**Danger lié au laser :** l'instrument utilise un laser susceptible de provoquer des blessures corporelles. Ce symbole figure également sur l'instrument. Pour plus de détails sur ce danger potentiel, se reporter au manuel de l'instrument.
	**Ultra violet light hazard:** Do not look directly at the ultra-violet (UV) light or into the UV source. Exposure can cause eye damage. Wear UV eye protection.	**Gefahr durch UV-Licht:** Richten Sie Ihren Blick nicht direkt auf ultraviolettes Licht (UV-Licht) oder in die UV-Quelle. Dies kann zu Augenschäden führen. Tragen Sie eine UV-Schutzbrille.	**Peligro por luz ultravioleta:** No mire directamente a una luz ultravioleta (UV) ni a una fuente UV. La exposición puede causar daños oculares. Lleve protección ocular para UV.	**Danger lié aux rayons ultraviolets :** ne jamais regarder directement la lumière ultraviolette (UV) ou la source d'UV. Une exposition peut entraîner des lésions oculaires. Porter des protections oculaires anti-UV.
	**Sharp object:** Avoid physical contact with the object.	**Scharfes Objekt:** Vermeiden Sie den physischen Kontakt mit dem Objekt.	**Objeto puntiagudo:** Evite el contacto físico con el objeto.	**Objet tranchant :** éviter tout contact physique avec l'objet.
	**Pinch point:** Keep hands away from this area.	**Quetschgefahr:** Halten Sie Ihre Hände von diesem Bereich fern.	**Puntos de pinzamiento:** Mantenga las manos apartadas de esta área.	**Risque de pincement :** éloigner les mains de cette zone.
	**Heavy objects:** Never lift or move the instrument by yourself; you can suffer personal injury or damage the equipment. For specific lifting instructions, refer to the instrument manual.	**Schweres Objekt:** Bewegen und heben Sie das Gerät niemals allein an; dies kann zu Verletzungen oder zur Beschädigung des Geräts führen. Spezifische Anweisungen zum Anheben finden Sie im Gerätehandbuch.	**Objeto pesado:** Nunca levante ni mueva el instrumento por su cuenta, podría sufrir lesiones personales o dañar el equipo. Para obtener instrucciones específicas sobre levantamiento, consulte el manual del instrumento.	**Objet lourd :** ne jamais soulever ou déplacer l'instrument seul sous peine de blessure corporelle ou d'endommagement de l'instrument. Pour obtenir des instructions de levage spécifiques, se reporter au manuel de l'instrument.
	**Trip obstacle:** Be aware of cords, hoses, or other objects located on the floor.	**Stolpergefahr:** Achten Sie auf Kabel, Schläuche und andere Objekte auf dem Fußboden.	**Tropiezo con obstáculos:** Tenga en cuenta los cables, mangueras u otros objetos colocados en el suelo.	**Risque de trébuchement :** faire attention aux câbles, tuyaux et autres objets situés sur le sol.
	When the safety of a procedure is questionable, contact Technical Support for Thermo Scientific San Jose products.	Wenn Sie sich über die Sicherheit eines Verfahrens im unklaren sind, setzen Sie sich, bevor Sie fortfahren, mit Ihrer lokalen technischen Unterstützungsorganisation für Thermo Scientific San Jose Produkte in Verbindung.	En caso de duda sobre la seguridad de un procedimiento, póngase en contacto con el personal de servicio técnico de los productos Thermo Scientific San Jose.	Si la sûreté d'une procédure est incertaine, contacter l'assistance technique pour les produits Thermo Scientific San Jose.

CAUTION Symbol	CAUTION	警告	危险警告
	**Risk electric shock:** This instrument uses voltages that can cause electric shock and/or personal injury. Before servicing, shut down the instrument and disconnect it from line power. While operating the instrument, keep covers on. Do not remove the protective covers from the printed circuit board assemblies (PCBAs).	**感電の危険性**: この機器では、感電および / または身体傷害を引き起こすおそれのある電圧を使用しています。整備点検の前には、機器の電源を切り、電源コードを抜いてください。機器の作動中は、カバーを付けたままにしてください。プリント基板アセンブリ (PCBA) から保護カバーを取り外さないでください。	**触电危险：**本仪器所用电压可能导致电击或人身伤害。进行维修服务前，务必关闭仪器电源并断开其电源连接。操作此仪器时，不要卸下顶盖。勿卸下印刷电路板组件 （PCBA）的保护盖。
	**Chemical hazard:** Wear gloves and other protective equipment, as appropriate, when handling toxic, carcinogenic, mutagenic, corrosive, or irritant chemicals. Use approved containers and proper procedures to dispose of waste oil and when handling wetted parts of the instrument.	**化学的危険性**: 毒性、発癌性、変異原性、腐食性、または刺激性のある化学薬品を取り扱うときは、必要に応じて手袋などの保護具を着用します。廃油を処分したり、機器の接液部品を取り扱うときは、認可された容器を使用し、適切な手順に従います。	**化学品危险：**当处理毒性、致癌性、致突变性、腐蚀性或者刺激性化学品时，佩戴手套和其他保护性设备。当处理浸湿的仪器部件以及废油时，使用认可的容器和合适的步骤。
	**Hot surface:** Before touching, allow any heated components to cool.	**高温面**: 触れる前に、加熱した部品を冷ましてください。	**热表面：**待高温部件冷却之后再进行维修。
	**Flammable substances hazard:** Use care when operating the system in the presence of flammable substances.	**可燃性物質の危険性**: 可燃性物質があるところでシステムを作動させる場合は十分注意してください。	**易燃物危险：**在有易燃物质的场地操作该系统时，务必小心谨慎。
	**Risk of eye injury:** Eye injury could occur from splattered chemicals, airborne particles, or sharp objects. (Sharp objects that customers might install in the instrument include fused-silica tubing, the autosampler needle, and so on.) Wear safety glasses when handling chemicals or servicing the instrument.	**眼外傷の危険性**: 飛散した化学薬品、浮遊粒子、または鋭利な物体によって眼外傷を負うおそれがあります (機器に取り付けられる可能性がある鋭利な物体は、ヒューズドシリカ、オートサンプラーニードルなどです)。化学薬品を取り扱ったり、機器を整備点検するときは、保護メガネを着用します。	**眼睛伤害风险：**眼睛受伤可能源自飞溅的化学品、空气中的颗粒，或者锋利的物体。（安装在仪器内的锋利物体包括熔融石英管、自动进样器的进样针等。）处理化学品或对仪器进行维修服务时，务必戴上防护眼镜。
	**General hazard:** A hazard is present that is not included in the other categories. This symbol also appears on the instrument. For details about the hazard, refer to the instrument manual. When the safety of a procedure is questionable, contact Technical Support for Thermo Scientific San Jose products.	**一般的な危険性**: それぞれのカテゴリーに当てはまらない危険があります。この標識記号は機器にも表示されています。この危険の詳細については、機器のマニュアルを参照してください。 手順の安全性にご不明な点がある場合は、Thermo Scientific San Jose 製品のテクニカルサポートまでお問い合わせください。	**普通危险：**未归入其他类别的危险。此符号也会在仪器上出现。有关此危险的详细信息，参阅适当的仪器手册。若对任何步骤的安全事项有疑问，联系 Thermo Scientific San Jose 产品的技术支持中心。

CAUTION Symbol	CAUTION	警告	危险警告
	**Laser hazard:** This instrument uses a laser that is capable of causing personal injury. This symbol also appears on the instrument. For details about the hazard, refer to the instrument manual.	**レーザー光線の危険性**: この機器では、身体傷害を引き起こすおそれのあるレーザーを使用しています。この標識記号は機器にも表示されています。この危険の詳細については、機器のマニュアルを参照してください。	**激光危险：**本仪器所用激光会导致人身伤害。此符号也会在仪器上出现。有关此危险的详细信息，参阅适当的仪器手册。
	**Ultra violet light hazard:** Do not look directly at the ultra-violet (UV) light or into the UV source. Exposure can cause eye damage. Wear UV eye protection.	**紫外光の危険性**: 紫外 (UV) 光または UV 光源を直接見ないでください。照射によって眼損傷を引き起こすおそれがあります。UV 保護メガネを着用します。	**紫外光危险：**不要直视紫外 （UV）光或者紫外光源。直视可能导致眼睛伤害。佩戴紫外线防护眼镜。
	**Sharp object:** Avoid physical contact with the object.	**鋭利な物体**: 物体との身体的接触を避けてください。	**锋利物体：**避免直接接触锋利的物体。
	**Pinch point:** Keep hands away from this area.	**ピンチポイント**: この部分には手を挟まれないようにしてください。	**夹点：**勿将手放在此部位。
	**Heavy objects:** Never lift or move the instrument by yourself; you can suffer personal injury or damage the equipment. For specific lifting instructions, refer to the instrument manual.	**重量物**:1 人で機器を持ち上げたり移動しないでください。身体傷害を負ったり、機器を損傷するおそれがあります。具体的な持ち上げ方法については、機器のマニュアルを参照してください。	**重物：**切勿独自提起或移动本仪器；可能遭受人身伤害或损坏仪器。有关具体的提起说明，参阅仪器手册。
	**Trip obstacle:** Be aware of cords, hoses, or other objects located on the floor.	**作業の障害物**: 床にあるコード、ホース、その他の物体に注意してください。	**绊倒危险：**注意地面上的线、管或其他物品。
	When the safety of a procedure is questionable, contact Technical Support for Thermo Scientific San Jose products.	手順の安全性にご不明な点がある場合は、Thermo Scientific San Jose 製品のテクニカルサポートまでお問い合わせください。	如对安全程序有疑问，联系 Thermo Scientific San Jose 产品的技术支持中心。

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Preface

The *EASY-ETD and EASY-IC Ion Sources User Guide* describes the primary components for the optional EASY-ETD™ or EASY-IC™ ion source system installed in the Thermo Scientific™ Orbitrap Fusion™ Tribrid™ mass spectrometer (MS). It also provides instructions to replace the reagent ion source.

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- Related Documentation
- Cautions and Special Notices
- Contacting Us

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

Complete a brief survey about this document by clicking the button below. Thank you in advance for your help.

Related Documentation

The Orbitrap Fusion mass spectrometer includes complete documentation. In addition to this guide, you can also access the following documents as PDF files from the data system computer:

- *Orbitrap Fusion Preinstallation Requirements Guide*
- *Orbitrap Fusion Getting Connected Guide*
- *Orbitrap Fusion Getting Started Guide*
- *Orbitrap Fusion Hardware Manual*
- *Ion Max NG and EASY-Max NG Ion Sources User Guide*

- *Safety and Regulatory Guide*

  The Orbitrap Fusion also ships with a printed copy of the *Safety and Regulatory Guide*. This guide contains important safety information about Thermo Scientific liquid chromatography (LC) and mass spectrometry (MS) systems. Make sure that all lab personnel have read and have access to this document.

❖ **To view the product manuals**

From the Microsoft™ Windows™ taskbar, do the following:

- For a Thermo Scientific mass spectrometer, choose **Start > All Programs > Thermo Instruments > Thermo Orbitrap Fusion**.
- For an LC instrument controlled by a Thermo software application, choose **Start > All Programs > Thermo Instruments > Manuals > LC Devices** and so on.

The Orbitrap Fusion software also provides Help. To access the Help, click the **Options** icon,  , and then choose **Tune Help**.

Cautions and Special Notices

Make sure that you follow the cautions and special notices presented in this guide. Cautions and special notices appear in boxes; those concerning safety or possible damage also have corresponding caution symbols.

This manual uses the following types of cautions and special notices.

CAUTION Highlights hazards to humans, property, or the environment. Each CAUTION notice is accompanied by an appropriate CAUTION symbol.

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.

The *EASY-ETD and EASY-IC Ion Sources User Guide* contains the following caution-specific symbols (Table 1).

Table 1. Caution-specific symbols and their meanings

Symbol	Meaning
	**Chemical hazard:** Wear gloves and other protective equipment, as appropriate, when handling toxic, carcinogenic, mutagenic, corrosive, or irritant chemicals. Use approved containers and proper procedures to dispose of waste oil and when handling wetted parts of the instrument.
	**Heavy object:** The Orbitrap Fusion mass spectrometer, excluding its workbench, weighs over 227 kg (500 lb). Never try to detach and move the instrument from its workbench; you can suffer personal injury or damage the instrument.
	**Hot surface:** Before touching the API source assembly, allow heated components to cool.
	**Risk of electric shock:** This instrument uses voltages that can cause electric shock and/or personal injury. Before servicing, shut down the instrument and disconnect it from line power. While operating the instrument, keep covers on.
	**Risk of eye injury:** Eye injury could occur from splattered chemicals or airborne particles. Wear safety glasses when handling chemicals or servicing the instrument.
	**Sharp object:** Avoid physical contact with the tip of the syringe needle.

Read and understand the following cautions that are specific to the shutdown of the mass spectrometry system or to the removal of parts for cleaning.

CAUTION If you must turn off the mass spectrometer in an emergency, turn off the main power switch located on the right-side power panel. This switch turns off all power to the mass spectrometer, including the forepump, without harming components within the system. However, do not use this method as part of the standard shutdown procedure. Instead, see "Shutting Down the Mass Spectrometer Completely" on page 26.

To turn off the LC, autosampler, and data system computer in an emergency, use their respective on/off switch or button.

CAUTION To avoid an electrical shock, be sure to follow the instructions in the section "Shutting Down the Mass Spectrometer Completely" on page 26.

CAUTION Do not turn the instrument on if you suspect that it has incurred any kind of electrical damage. Instead, disconnect the power supply cord and contact Thermo Fisher Scientific technical support for a product evaluation. Do not attempt to use the instrument until it has been evaluated. (Electrical damage might have occurred if the system shows visible signs of damage, or has been transported under severe stress.)

CAUTION Do not disconnect the power supply cord at the mass spectrometer while the other end is still plugged into the electrical outlet.

CAUTION Do not place any objects—especially containers with liquids—on top of the instrument, unless instructed to in the documentation (for example, the syringe pump). Leaking liquids might contact the electronic components and cause an electrical short circuit.

CAUTION Hot surface. Allow heated components to cool to room temperature (approximately 20 minutes) before servicing them.

Contacting Us

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

❖ To contact Technical Support

Phone	800-532-4752
Fax	561-688-8736
E-mail	us.techsupport.analyze@thermofisher.com
Knowledge base	www.thermokb.com

Find software updates and utilities to download at mssupport.thermo.com.

❖ To contact Customer Service for ordering information

Phone	800-532-4752
Fax	561-688-8731
E-mail	us.customer-support.analyze@thermofisher.com
Web site	www.thermo.com/ms

❖ To get local contact information for sales or service

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

❖ To copy manuals from the Internet

- Visit the Thermo Scientific Web site dedicated to Orbitrap™ systems:

  PlanetOrbitrap.com

- Go to mssupport.thermo.com, agree to the Terms and Conditions, and then click **Customer Manuals** in the left margin of the window.

❖ 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-lcms@thermofisher.com.

1

Introduction

The Orbitrap Fusion MS is a member of the Thermo Scientific family of mass spectrometers. The optional EASY-ETD or EASY-IC ion source assembly can come factory-installed with the purchase of the Orbitrap Fusion MS, or a Thermo Fisher Scientific field service engineer can install either at a later date as an upgrade.

The information in this guide applies toward both the Internal Calibration (IC) configuration (EASY-IC ion source assembly) and the electron transfer dissociation (ETD) configuration (EASY-ETD ion source assembly), unless otherwise noted. For procedures regarding daily operation, maintenance, and system startup and shutdown, refer to the *Orbitrap Fusion Hardware Manual*.

Contents

- Internal Calibration
- Electron Transfer Dissociation
- Reagent Ion Source
- Calibration Categories and Solutions
- ETD Scan Parameters
- ETD Readback Measurements

Internal Calibration

An Orbitrap Fusion MS with the Internal Calibration configuration (MS/IC system) incorporates a second ion source—the reagent ion source (RIS). The RIS is installed in the ETD/IC source heater interface, which is located in the API source interface just after the S-lens. For additional information about the ETD/IC source heater interface, see Chapter 2, "Functional Description."

The RIS for the IC configuration delivers a regulated number of calibrant ions into the much larger population of analyte ions. The location of the RIS allows the quadrupole mass filter to isolate the internal calibrant (reference) ions. The internal calibrant ions are used as a lock mass (*m/z*) that significantly improves the mass-to-charge ratio (m/z) assignment accuracy to less than 1 ppm (up to *m/z* 1500) in every Fourier transform (FT) mass spectrum.

The instrument software uses the precisely known mass-to-charge ratio of the calibration mass peak to provide real-time fine adjustment of the instrument's mass-to-charge ratio calibration, enabling a correction for otherwise uncompensated errors that are due to temperature changes and scan-to-scan variations in the total charge of the population of ions analyzed.

Electron Transfer Dissociation

Similar to the MS/IC system, an Orbitrap Fusion MS with the ETD configuration (MS/ETD system) incorporates the reagent ion source (RIS) as a second ion source. The RIS is installed in the ETD/IC source heater interface, which is located in the API source interface just after the S-lens. For additional information about the ETD/IC source heater interface, see Chapter 2, “Functional Description.”

The RIS for the ETD configuration generates the necessary reagent anions to perform ETD. The location of the RIS allows the quadrupole mass filter to isolate the reagent anions before the ETD. The MS/ETD system also includes the additional electronics that supply rf voltage to the front and center transfer lenses (TL1 and TL2) in the linear ion trap (LIT) mass analyzer to allow charge sign independent trapping in the LIT.

For each ETD event, the mass spectrometer mixes a regulated number of reagent anions to react with the much smaller population of the precursor analyte ions of the mass-to-charge ratio selected for ETD. The mass spectrometer calibrates the reagent ion population to provide consistent ETD reaction kinetics and consistent reaction completeness (product ion yield) and distribution for a given normalized reaction time setting.

Because the ETD configuration includes the RIS, the ETD configuration includes all features of the IC configuration.

Reagent Ion Source

The RIS has its own dedicated continuous introduction system that delivers a highly stable flow of fluoranthene. The reagent distribution assembly receives an initial charge of fluoranthene upon installation. You can expect this charge to last at least one year under continuous usage. Only a Thermo Fisher Scientific field service engineer can replace the reagent once it is consumed.

The RIS uses a Townsend discharge to produce the thermal electrons used to ionize reagent molecules (by electron capture) to generate ETD reagent (fluoranthene) anions. The RIS does not incorporate a thermionic filament. The addition of the RIS does not compromise performance when compared to the standard Orbitrap Fusion MS (without the RIS).

The RIS stably produces a very intense current of fluoranthene radical anions and a moderate current of fluoranthene radical cations. When you activate the IC option, it uses the radical anions (negative polarity) and cations (positive polarity) of fluoranthene as the internal calibration lock mass. When you activate the ETD option, it uses the fluoranthene radical anions for the ETD reagent ions.

Calibration Categories and Solutions

For instructions on how to calibrate the Orbitrap Fusion mass spectrometer, refer to Chapters 5–7 in the *Orbitrap Fusion Getting Started Guide*. After you complete the positive and negative ion polarity calibrations, run the calibration categories under Internal Calibration or ETD, as applicable (Figure 1). When you set up the MS/IC or MS/ETD system, refer to Table 2 for the required solution for the IC and ETD categories.

Figure 1. Calibration pane in the Tune window showing the IC and ETD categories

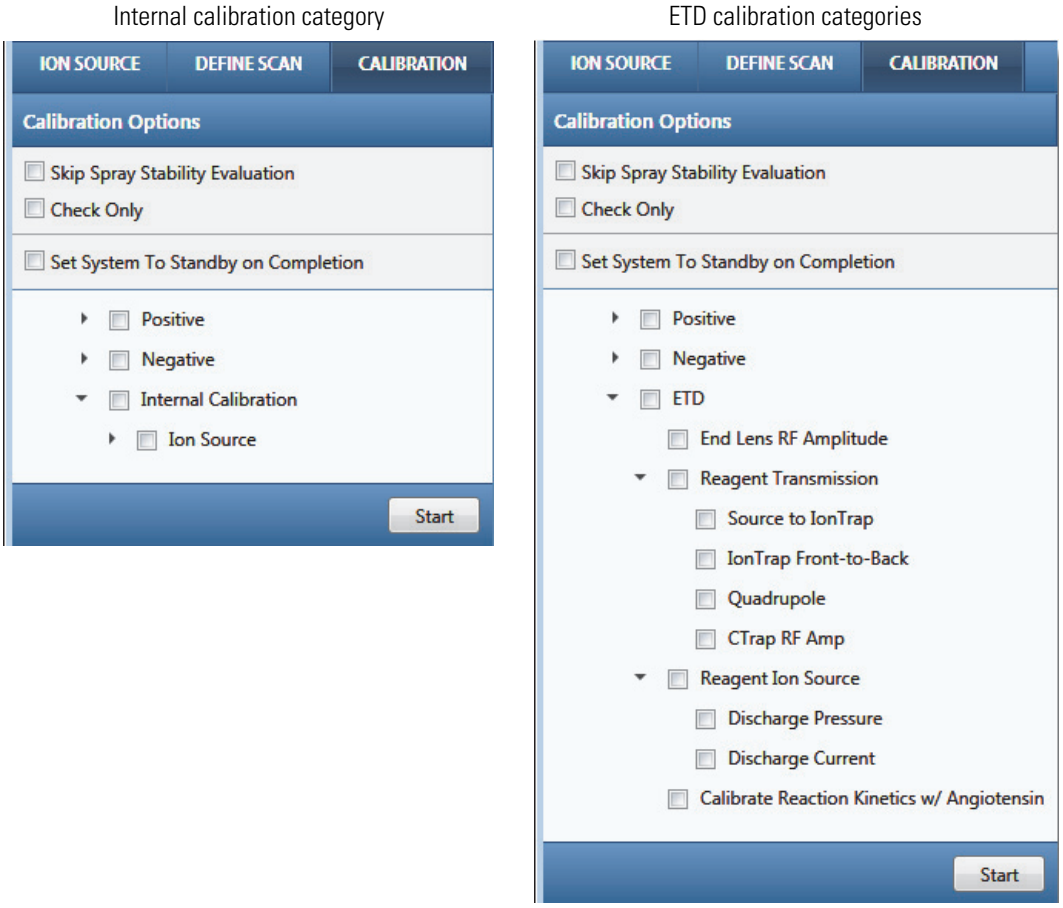


Table 2. Required solutions for the IC and ETD calibration categories

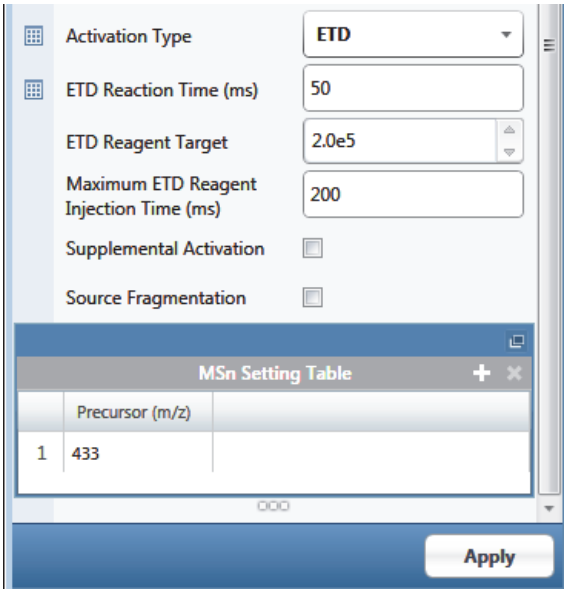
Calibration	Solution
Internal Calibration category	
Ion Source	None. Uses the reagent.
ETD calibration categories	
End Lens RF Amplitude	Positive calibration solution
Reagent Transmission	None. Uses the reagent.
Reagent Ion Source	None. Uses the reagent.
Calibrate Reaction Kinetics w/ Angiotensin	Angiotensin I sample solution

ETD Scan Parameters

Before you acquire ETD data with the Tune application, define the scan parameters in the Define Scan pane. Figure 2 shows the default ETD scan parameters that appear after you select the MS^n scan type and the ETD activation type. These parameters are reasonable for a 3+ charge state.

For instructions on how to acquire data with the Tune application, refer to the *Orbitrap Fusion Getting Started Guide*. For descriptions of the ETD scan parameters, refer to the Define Scan pane topic in the Tune Help.

Figure 2. Define Scan pane in the Tune window showing the ETD scan parameters



ETD Readback Measurements

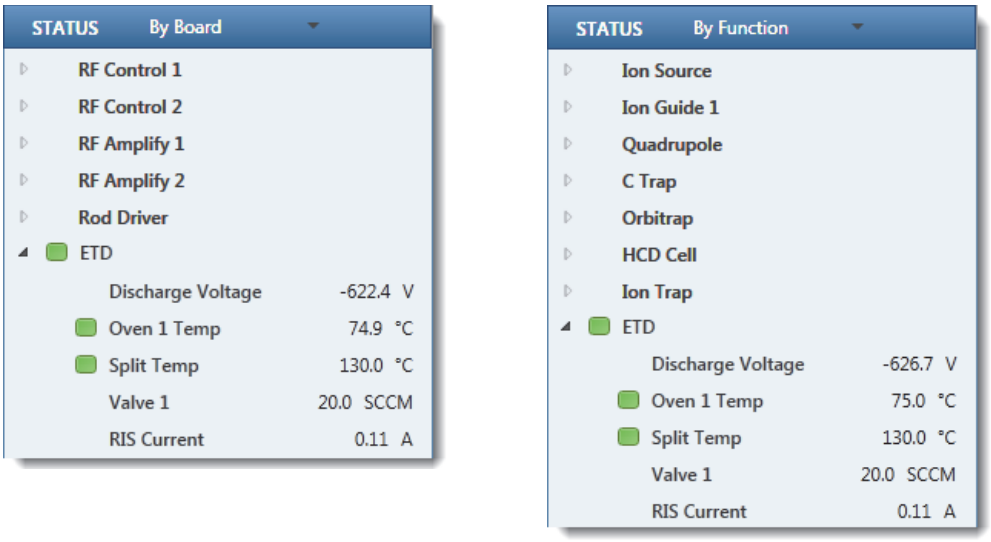
In addition to monitoring the overall system readback status in the Thermo Scientific Tune application, you can monitor individual ETD readback values on the By Board and By Function pages in the Status pane. Table 3 lists the default values for the ETD readback values.

Table 3. Default values for the ETD readbacks

Readback	Default value
Discharge voltage	approx. –700 V
Oven 1 temperature	75 °C
Split temperature	130 °C
Valve 1	15 SCCM
RIS current	0.11 A

Figure 3 shows the ETD readback measurements. Normal readback measurements show a green square ( ).

Figure 3. Status pane in the Tune window showing the ETD readbacks



2

Functional Description

This chapter describes the principal components of the optional IC and ETD configurations for the Orbitrap Fusion MS, and their functions.

Contents

- Electronic Assemblies
- Reagent Distribution Assembly
- ETD/IC Source Heater Interface

Electronic Assemblies

Although the Orbitrap Fusion MS has many electronic assemblies that control its operation, setup for the IC or ETD configuration requires only two or three printed circuit boards (PCBs), respectively.

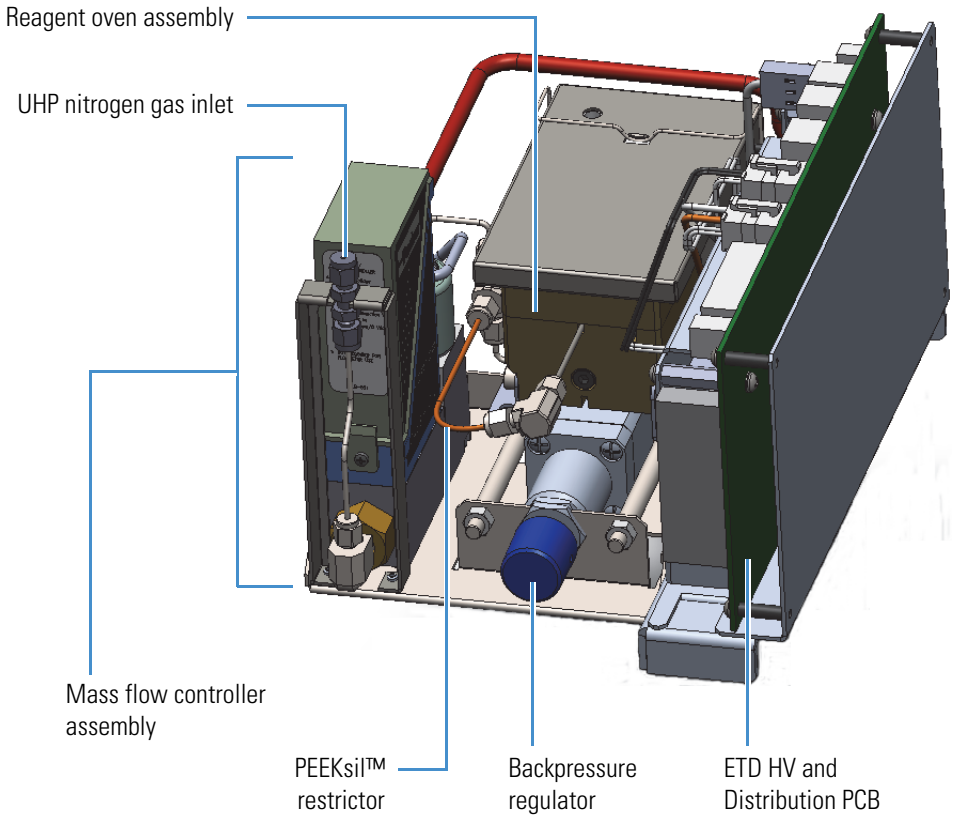
- ETD Source PCB—Controls the reagent distribution assembly (Figure 4) and the ETD/IC source heater interface (Figure 8 on page 13). The Tune application calibrates the discharge pressure and current.
- ETD HV and Distribution PCB—Distributes the signals from the ETD Source PCB to devices such as the heaters and the mass flow controller (MFC), powers the high voltage (HV) power supply unit, and contains a pulser circuit that regulates the output current for the HV power supply unit.
- ETD RF PCB—(For instruments with the ETD configuration only) Generates the rf voltage applied to the LIT front and center lenses (TL1 and TL2) during the charge sign independent trapping, which is necessary to enable the ETD reaction.

You cannot service the electronic assemblies. For assistance, contact your local Thermo Fisher Scientific field service engineer.

Reagent Distribution Assembly

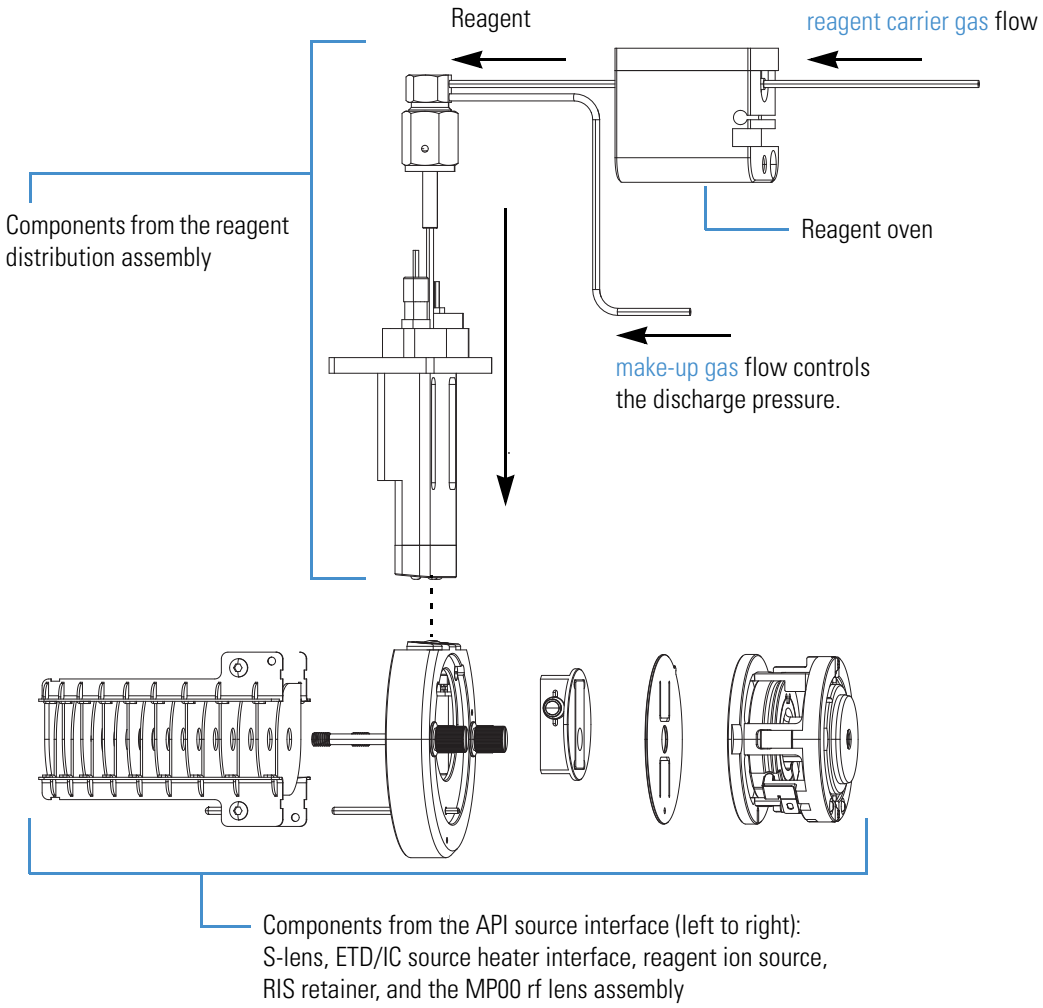
The IC and ETD configurations include the reagent distribution assembly (Figure 4), which includes an MFC, a backpressure regulator, three heaters, and an HV power supply unit. The HV power supply unit supplies the discharge current to the reagent ion source (RIS).

Figure 4. Reagent distribution assembly (back view)



The reagent distribution assembly connects through the vacuum manifold to the terminals of the ETD/IC source heater interface to deliver the neutral reagent (fluoranthene) to the RIS for ionization and further IC or ETD use. Figure 5 shows an expanded view of the reagent's flow path from the reagent oven to the ETD/IC source heater interface. It also shows the relative position of the ETD/IC source heater interface in the API source interface.

Figure 5. Reagent path from the reagent distribution assembly down into the RIS (expanded view)



Mass Flow Controller

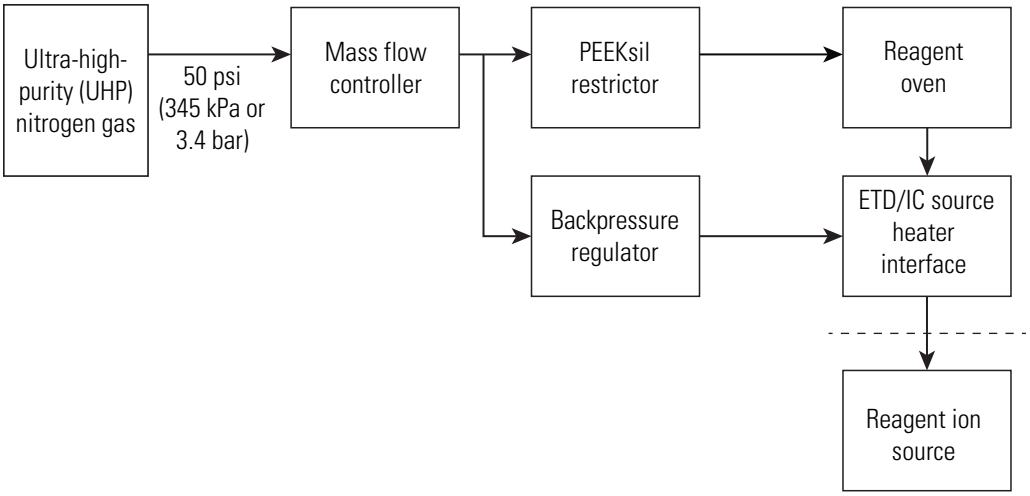
The mass flow controller (MFC) regulates the total gas flow that is delivered to the RIS. The flow splits at the backpressure regulator to serve two functions:

- A constant vapor pressure of the ETD reagent species to the RIS
- The correct pressure of nitrogen gas to the discharge region to allow for a stable discharge

You calibrate the MFC setpoint by using the Discharge Pressure calibration routine (Figure 1 on page 3). The valid range is 0 to 40 sccm, with 15 sccm as the default.

For information about the required gases, refer to the *Orbitrap Fusion Preinstallation Requirements Guide* and the *Orbitrap Fusion Getting Connected Guide*.

Figure 6. Schematic of the gas delivery to the reagent ion source



Backpressure Regulator

The backpressure regulator applies a constant pressure to the PEEKsil restrictor (25 µm × 10 cm red PEEK™ tubing) regardless of the MFC setting. This constant pressure establishes a constant flow of approximately 0.1 sccm of nitrogen gas into the reagent oven assembly. In the reagent oven, the nitrogen gas flow equilibrates with the vapor pressure of the ETD reagent molecule (fluoranthene), and is then subsequently delivered to the RIS as the reagent carrier gas flow.

The Thermo Fisher Scientific factory sets the backpressure regulatory setting. Only Thermo Fisher Scientific field service engineers can adjust the backpressure regulator.

Oven and Heaters

The Orbitrap Fusion MS with the IC or ETD configuration contains the three heaters listed in Table 4. Together, they heat the reagent-flow regions and control the vapor pressure of the reagent delivered from the ETD/IC source heater interface to the RIS.

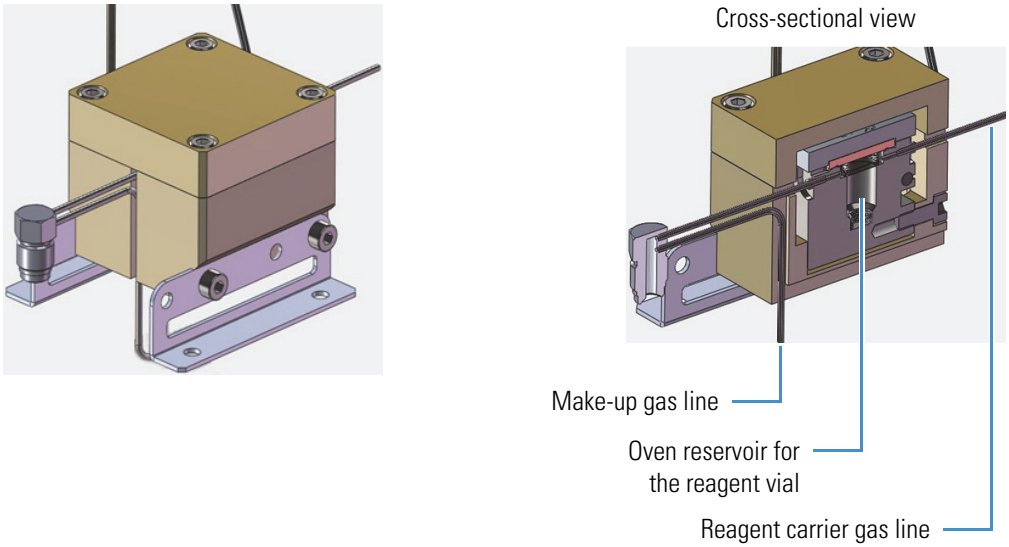
Table 4. Ovens and heaters

Component	Description	Readback[a]
Reagent oven assembly (5 W)	Controls the reagent's vapor pressure by maintaining a constant oven temperature. The amount of gas through the oven is determined by the combination of the PEEKsil restrictor and the backpressure regulator. The amount of reagent vapor delivered to the RIS is determined by the oven temperature setting. Default temperature: 75 °C (167 °F)	Oven 1 Temp
ETD interface heater (80 W)	Heats the reagent gas line to prevent condensation of the reagent. Default temperature: 130 °C (266 °F)	Split Temp
RIS heater (4 W)	Heats the ETD/IC source heater interface to prevent internal condensation. Relies on the default RIS heater current (0.11 A) instead of a temperature sensor to maintain the required temperature.	RIS Current

[a] Displayed in the Status pane in the Tune application

Figure 7 shows the reagent oven assembly along with a cross-sectional view of its internal oven.

Figure 7. Reagent oven assembly (exterior and cross-sectional views)



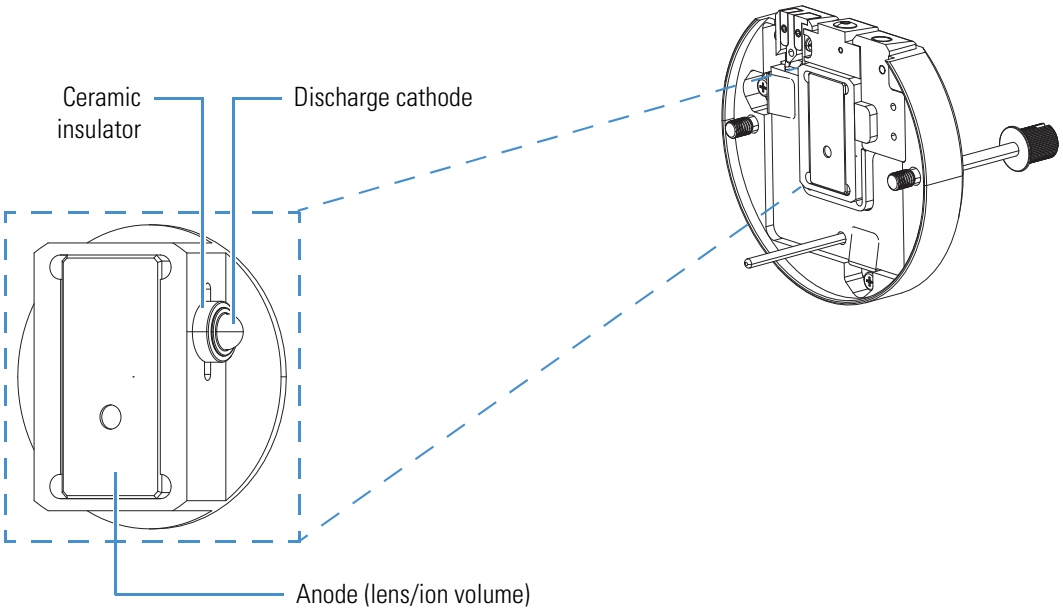
ETD/IC Source Heater Interface

The ETD/IC source heater interface is located in the API source interface region between the S-lens and the MP00 rf lens (Figure 5 on page 9). It consists of a mounting assembly that includes the RIS heater, a gas conduit, an HV contact, and the RIS.

Figure 8 shows the ETD/IC source heater interface with a close-up view of the front of the RIS. The RIS contains the internal ion volume where reagent ion species are created, the discharge cathode, the anode, and a ceramic insulator.

The RIS (P/N 70005-27093) is a consumable part. For replacement instructions, see "Replacing the Reagent Ion Source" on page 26.

Figure 8. Close-up view of the reagent ion source in the ETD/IC source heater interface



ETD Infusion Experiment

This chapter describes how to set up the Orbitrap Fusion/ETD system for an ETD infusion experiment using the angiotensin I sample solution.

Contents

- Setting Up the Syringe Pump for Direct Infusion
- Setting Up the MS/ETD System for an ETD Experiment
- Calibrating the ETD Reaction Kinetics

Setting Up the Syringe Pump for Direct Infusion

Use the syringe pump to infuse the angiotensin I sample solution directly into the API source.

IMPORTANT To minimize the possibility of cross-contamination, use a different syringe and length of PEEK tubing for each type of solution.

❖ **To set up the syringe pump for direct infusion of the sample solution**

1. Turn on the syringe pump's power switch.

   The power switch is located on the back of the device.

2. In the Tune window, place the mass spectrometer in **Standby** mode.
3. Load a clean, 500 µL syringe with the angiotensin I sample solution.

   For instructions on how to prepare the sample solution, see Appendix B, "Angiotensin I Solutions."

CAUTION Sharp object. The syringe needle can puncture your skin. Handle it with care.

4. Plumb the inlet for direct infusion.

   For instructions, refer to Chapter 3 in the *Orbitrap Fusion Getting Started Guide*.

Setting Up the MS/ETD System for an ETD Experiment

Before you run the ETD experiment, set up the operational parameters and verify the infusion of the angiotensin I sample solution.

Follow these procedures:

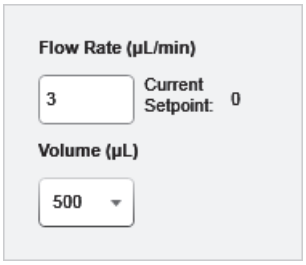
- To set up the mass spectrometer for an ETD experiment
- To define the scan parameters for the angiotensin I sample solution
- To verify that the reagent anion intensity is sufficient, on page 18

CAUTION Before beginning normal operation of the mass spectrometer each day, verify that there is sufficient nitrogen for the API source. If you run out of nitrogen, the mass spectrometer automatically turns off to prevent atmospheric oxygen from damaging the source. The presence of oxygen in the source when the mass spectrometer is on can be unsafe. In addition, if the mass spectrometer turns off during an analytical run, you might lose data.

❖ To set up the mass spectrometer for an ETD experiment

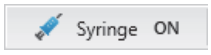
1. In the Tune window, place the mass spectrometer in **On** mode.
2. Open the Ion Source page in the Ion Source pane, and in the Current LC Flow (µL/min) box, enter **3**.
3. Set the syringe pump parameters as follows:
   a. Click the dropdown arrow, , next to the Syringe On/Off button to open the syringe parameters box (Figure 9).

   Figure 9. Syringe parameters box

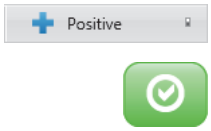
   

   b. In the Flow Rate (µL/min) box, type **3**.
   c. In the Volume (µL) list, select **500**.

      The Tune application automatically sets the internal diameter (ID) for the syringe volume.

   d. Click **Syringe On (Off)** to start the syringe pump.



4. Click **Positive (Negative)** to select the positive ion polarity mode.
5. Verify that the system readback is normal.

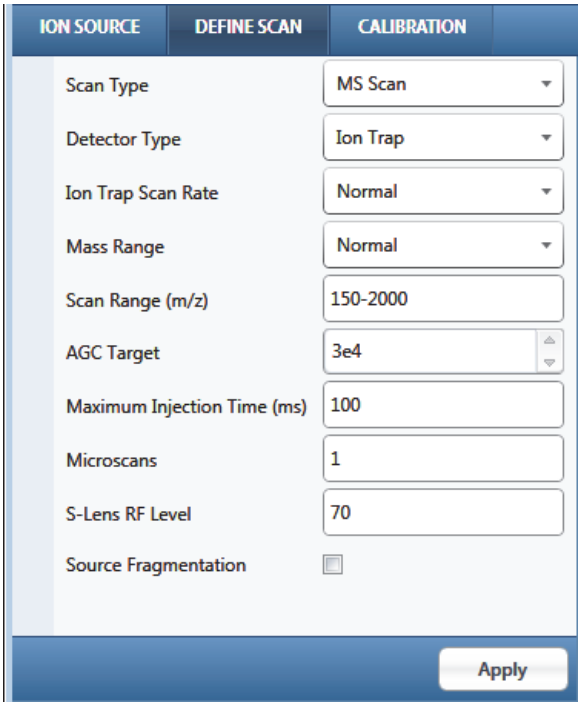
❖ To define the scan parameters for the angiotensin I sample solution

1. In the Tune window, click **Define Scan** to open the Define Scan pane.
2. Set the full-scan parameters as listed in Table 5 and shown in Figure 10.

Table 5. Full-scan parameters (angiotensin example)

Parameter	Value	Parameter	Value
Scan Type	MS Scan	Scan Range (*m/z*)	150–2000
Detector Type	Ion Trap	AGC Target	3e4
Ion Trap Scan Rate	Normal	S-Lens RF Level	70
Mass Range	Normal		

Figure 10. Scan parameter settings for the sample solution



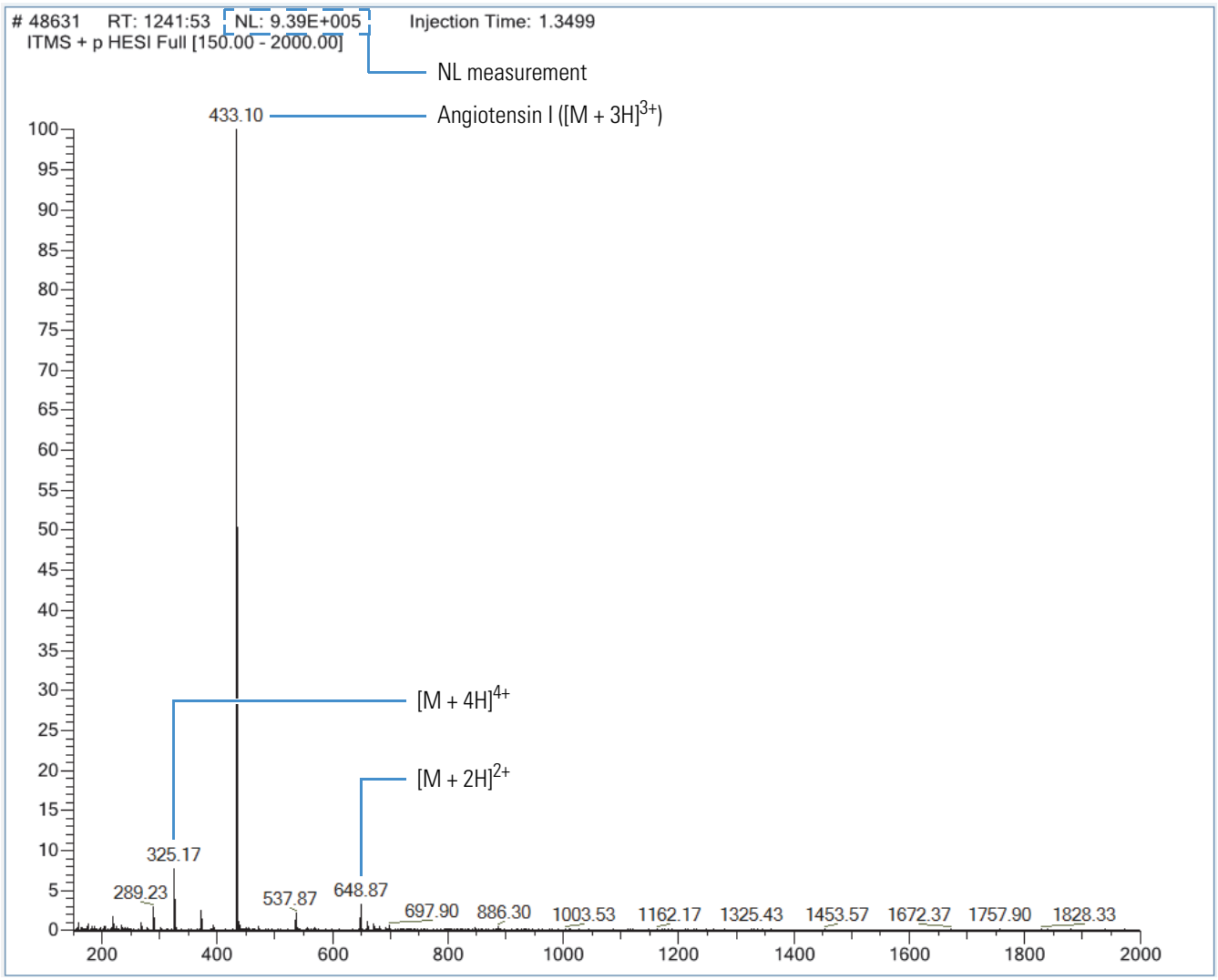
3. Click **Apply**.

   The MS scan starts and the mass spectrum appears.

4. In the profile mode spectrum, verify that the normalization level (NL) for the triply charged ions (*m/z* 433) is between 1×10^5 and 2×10^6 (Figure 11). If the NL value is outside this range, recalibrate the mass spectrometer.

   For calibration instructions, refer to the *Orbitrap Fusion Getting Started Guide*.

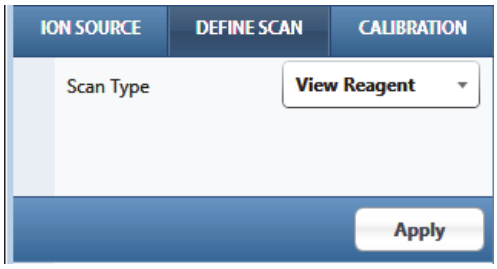
Figure 11. Full-scan spectrum of the angiotensin I sample solution (profile mode)



❖ To verify that the reagent anion intensity is sufficient

1. In the Tune window, click **Define Scan** to open the Define Scan pane.
2. In the Scan Type list, select **View Reagent** (Figure 12).

Figure 12. Define Scan pane in the Tune window showing the View Reagent scan type



3. Click **Apply**.

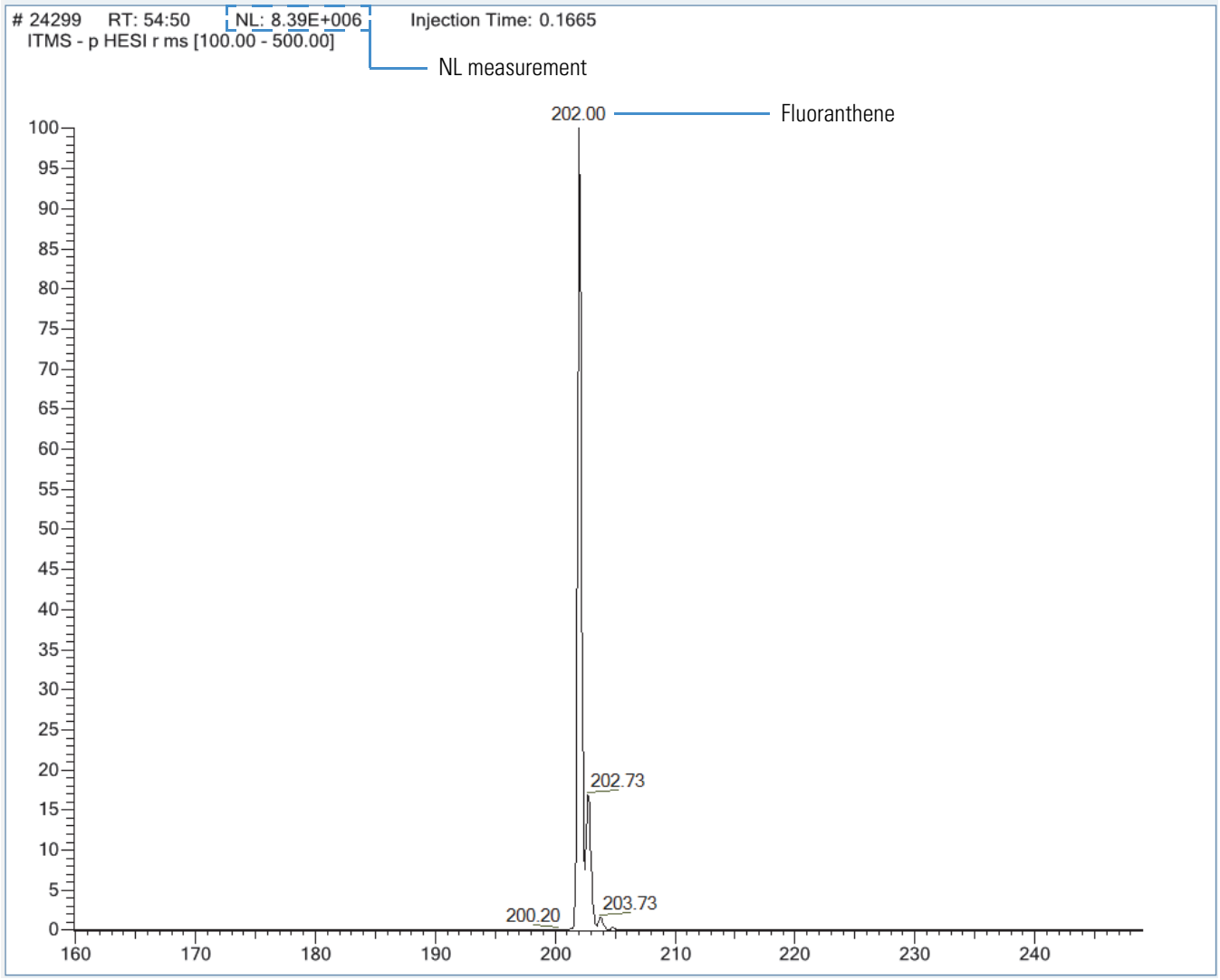
   The mass spectrum of the reagent appears.

4. In the profile mode spectrum, verify that the NL value for the reagent anions is between 1×10^6 and 2×10^7 (Figure 13). If the profile mode NL is below this value, run the ETD reagent related calibrations.

   For a new RIS, the NL abundances for *m/z* 202 is above 5×10^6 (profile mode). The attainable reagent ion abundance decays slowly with the source usage due to the gradual contamination of the RIS. When execution of the appropriate calibrations no longer restores the reagent ion abundance to at least 1×10^6 in profile mode, you might need to replace the RIS (see "Replacing the Reagent Ion Source" on page 23).

   For calibration instructions, refer to the *Orbitrap Fusion Getting Started Guide*.

Figure 13. Spectrum of the ETD reagent anion (*m/z* 202, profile mode)



Calibrating the ETD Reaction Kinetics

Before you run an ETD experiment, use the angiotensin I sample solution to calibrate the ETD reaction kinetics.

❖ To calibrate the ETD reaction kinetics

1. In the Tune window, click **Calibration** to open the Calibration pane.
2. Verify that the **Skip Spray Stability Evaluation** check box is clear so that this test runs.
3. (Optional) Select the **Set System to Standby on Completion** check box.
4. Click the arrow next to the **ETD** check box to display the calibration categories.
5. Select the **Calibrate Reaction Kinetics w/ Angiotensin** check box, and then click **Start**.

   The calibration takes a few minutes to determine the ETD reagent target and reaction time (Figure 14). The plots shown on the following pages appear while the calibration is in progress. When the calibration finishes, you have the option to save the data to a calibration report.

   You can now go to the Xcalibur™ data system to set up and run an ETD experiment. For additional information, refer to the Xcalibur Help.

Figure 14. Calibrate Reaction Kinetics with Angiotensin in progress

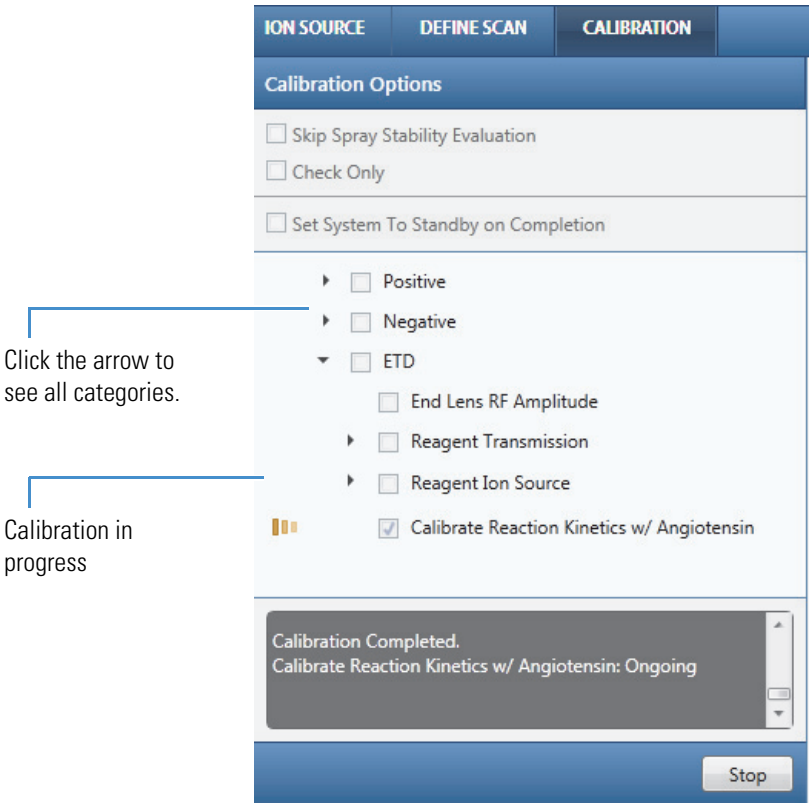


Figure 15 shows an example of the spray stability results that appear for a few seconds before the calibration starts.

Figure 15. Plots for calibrating the ETD reaction kinetics (1 of 4)

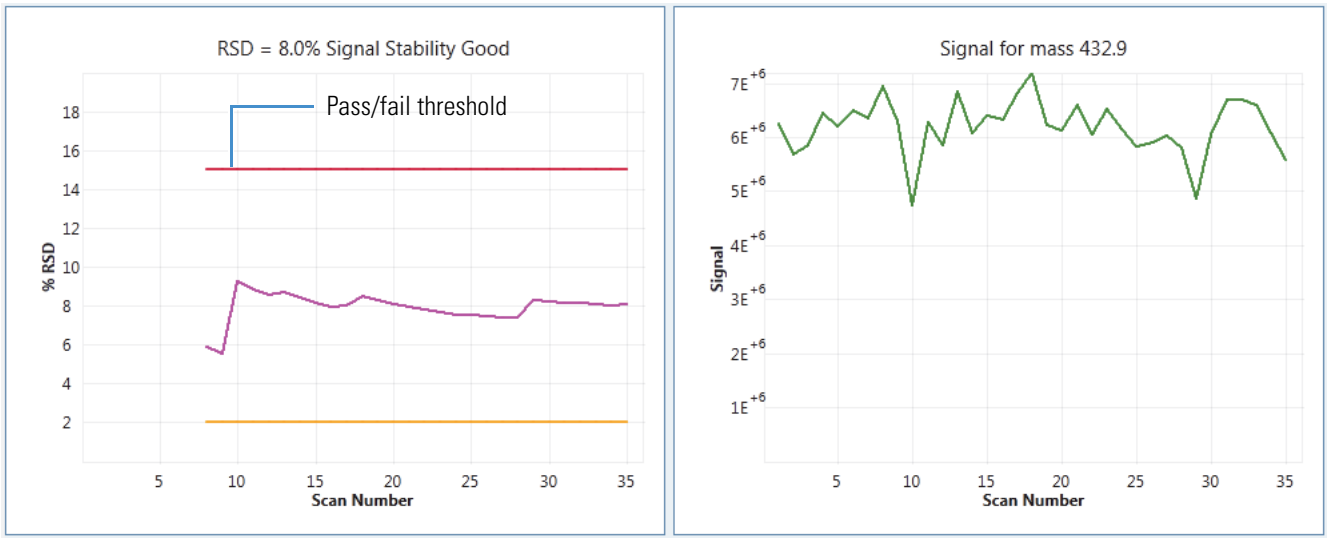
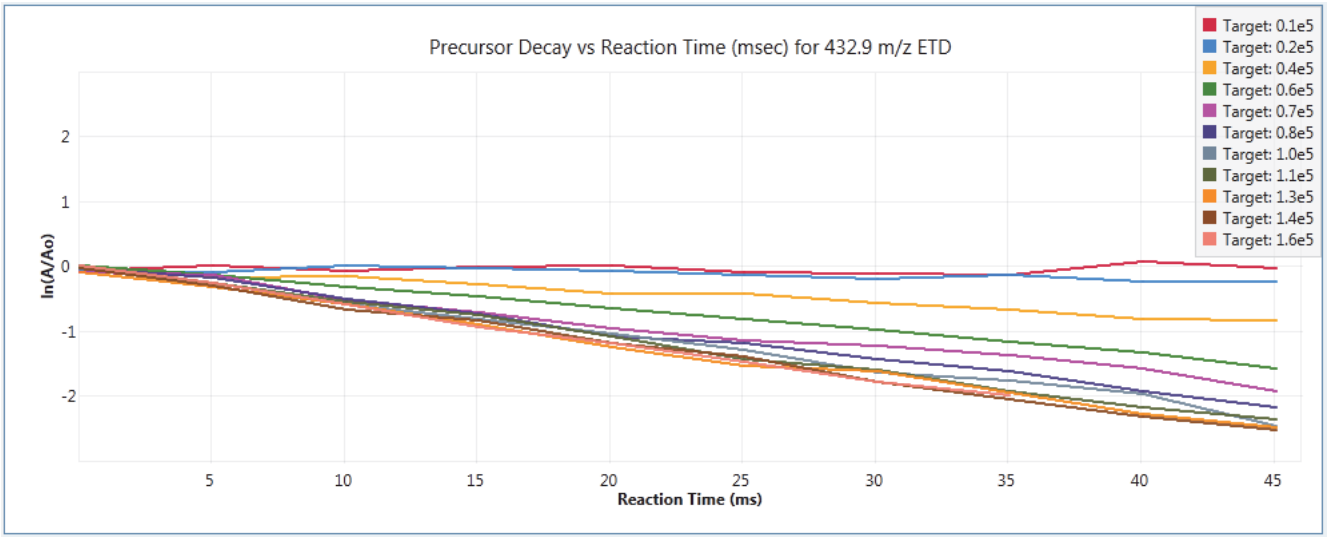


Figure 16 shows several of the many measurements of the angiotensin *m/z* 433 precursor's decay versus the preset target reaction times. These plot lines represent the natural logarithm base *e* of the final reagent population divided by the initial reagent population, written as "$\ln(A/A_0)$," and are used to determine the reaction rate coefficient.

Figure 16. Plots for calibrating the ETD reaction kinetics (2 of 4)



The plot shown on the left side in Figure 17 uses the results from the previous plot (Figure 16 on page 21) to calculate both a model slope and an actual slope of the reaction rate versus reagent target data. From these two plot lines, the vertical line indicates the ideal reagent target at the onset of reagent saturation.

Figure 17. Plots for calibrating the ETD reaction kinetics (3 of 4)

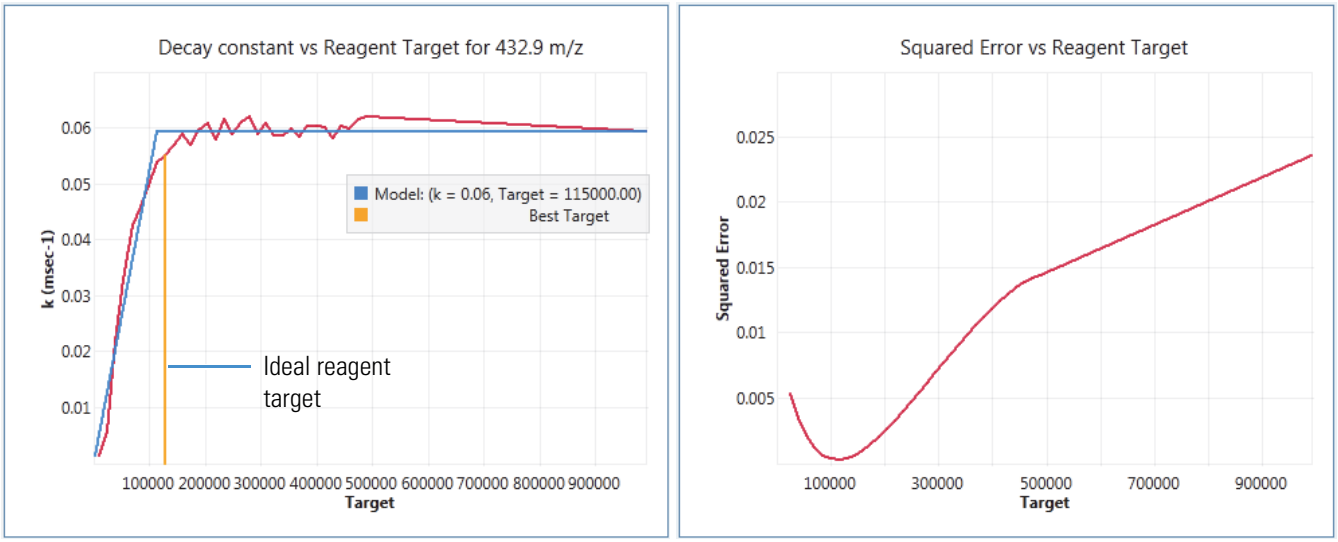
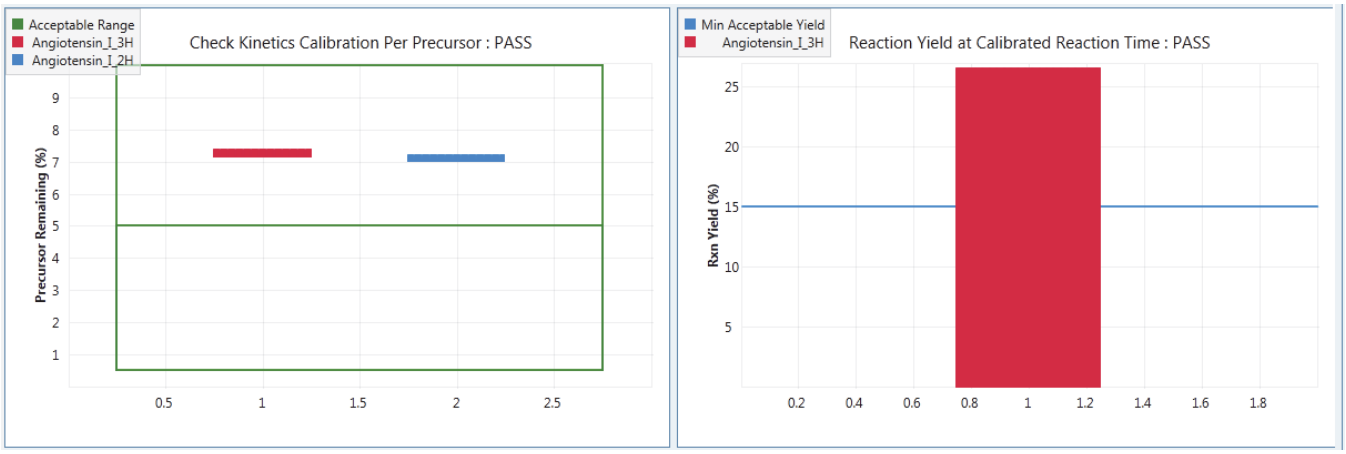


Figure 18 shows the example calibration results.

Figure 18. Plots for calibrating the ETD reaction kinetics (4 of 4)



4

Replacing the Reagent Ion Source

Over time, the ion signal from the reagent ion source (RIS) decreases as the internal components become dirty, need to be recalibrated, or both.

Replace the RIS under these conditions:

- For instruments with the IC configuration—When the Orbitrap mass analyzer cannot lock to the internal calibrant mass and the injection time for the internal calibrant exceeds 10 msec for a target of 200 internal calibration ions. (Assumes that the instrument has had a full calibration in positive, negative, and IC modes, and that the Orbitrap mass accuracy is within specification.)
- For instruments with the ETD configuration—When a full instrument calibration (positive, negative, and ETD modes) does not result in a reagent anion signal above 1×10^6 profile intensity in the View Reagent mode (see "To verify that the reagent anion intensity is sufficient" on page 18).

The expected lifetime of the RIS is six months to one year.

Note You can service (replace) the reagent ion source, but you cannot service the reagent vial. For information about replacing the reagent, see Appendix A, "Fluoranthene."

Contents

- Work Area Preparation
- Guidelines
- Supplies
- Replacing the Reagent Ion Source

Work Area Preparation

CAUTION Heavy object. The Orbitrap Fusion mass spectrometer, excluding its workbench, weighs over 227 kg (500 lb). Never try to detach and move the instrument from its workbench; you can suffer personal injury or damage the instrument. For additional information, contact your local Thermo Fisher Scientific field service engineer.

❖ **To prepare the work area**

Do the following:

- Make sure that the surrounding area is neat and clean.
- Prepare a clean work surface by covering the area with lint-free paper or a large sheet of clean aluminum foil.
- Have nearby the necessary supplies and replacement parts.

Guidelines

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

- Proceed methodically.
- Always wear a new pair of lint- and powder-free gloves when handling internal components. Never reuse gloves after you remove them because the surface contaminants on them recontaminate clean parts.
- Always wear protective eye wear when you handle the internal parts.
- Always place the components on a clean, lint-free work surface.

IMPORTANT

- Put on a new pair of lint- and powder-free gloves before starting each removal and reinstallation procedure.
- Make sure that you do not introduce any scratches or surface abrasions while handling the internal components. Even small scratches can affect performance if they are close to the ion transmission path. Avoid using tools, such as metal pliers, that might scratch these components.

Supplies

The Orbitrap Fusion MS requires very few tools to perform routine maintenance procedures. Table 6 lists the supplies for replacing the RIS.

CAUTION Avoid exposure to potentially harmful materials.

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

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

Table 6. Supplies

Description	Part number
Aluminum foil, heavy gauge	Fisher Scientific: 01-213-104
Gloves, lint-free and powder-free	Fisher Scientific: • 19-120-2947A (size small) • 19-120-2947B (size medium) • 19-120-2947C (size large) • 19-120-2947D (size X-large) Thermo Scientific: • 23827-0008 (size medium) • 23827-0009 (size large)
Industrial tissues, lint-free	–
Methanol, LC/MS-grade	Fisher Scientific: A456-1
Protective eye wear	–
Reagent ion source	70005-20793

Replacing the Reagent Ion Source

The RIS is a consumable part—do not attempt to clean and reuse it. To replace the RIS, follow these procedures:

1. Shutting Down the Mass Spectrometer Completely
2. Removing the API Source Interface
3. Removing the RIS on page 28
4. Installing the New RIS on page 30
5. Reinstalling the API Source Interface on page 32

Note Before you continue, read the precautions in "Cautions and Special Notices" on page xvi.

IMPORTANT

- Prepare a clean work surface by covering the area with lint-free paper or a large sheet of clean aluminum foil.
- Put on a new pair of lint- and powder-free gloves before starting the removal and reinstallation procedures.

Shutting Down the Mass Spectrometer Completely

Shut down the Orbitrap Fusion MS completely before you perform any maintenance or service.

❖ To shut down the mass spectrometer completely

1. Place the mass spectrometer in **Standby** mode.
2. Place the electronics service switch in the Service Mode (down) position.

   This turns off the power to the nonvacuum system electronics.
3. Turn off the Main Power switch.

   The following occurs:

   - All power to the mass spectrometer, including the turbomolecular pumps and forepump, turn off. All LEDs on the front panel are off.
   - After approximately 5 seconds, power to the vent valve solenoid shuts off, the vent valve opens, and the vacuum manifold vents with dry nitrogen. You can hear a hissing sound.
   - After about 2 minutes, the vacuum manifold is at atmospheric pressure.

4. Unplug the mass spectrometer's power supply cord from the electrical outlet.

CAUTION Do not disconnect the power supply cord at the mass spectrometer while the other end is still plugged into the electrical outlet.

Removing the API Source Interface

❖ **To remove the API source interface**

1. Follow the procedure "To shut down the mass spectrometer completely," vent the system, and let it cool to room temperature.

   Venting the mass spectrometer can take several minutes.

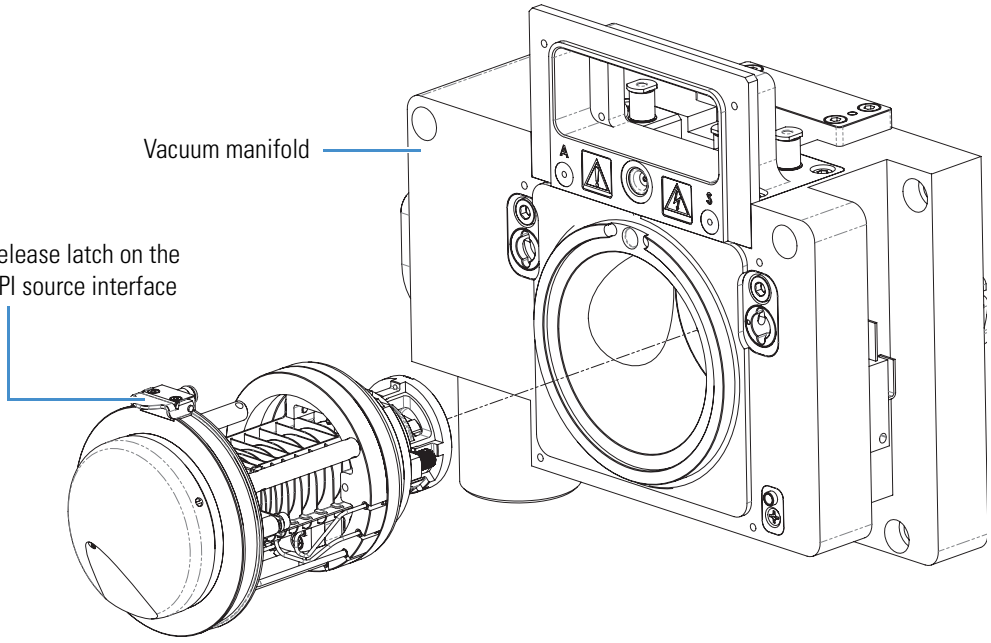
CAUTION Hot surface. Allow heated components to cool to room temperature (approximately 20 minutes) before you touch or service them.

2. Remove the API source interface housing from the mass spectrometer.

   For instructions, refer to Chapter 2 in the *Orbitrap Fusion Getting Started Guide*.

3. Lift up the release latch (Figure 19), grasp the API source interface with your fingers, and then carefully pull it out of the vacuum manifold.

Figure 19. API source interface removed from the vacuum manifold



Removing the RIS

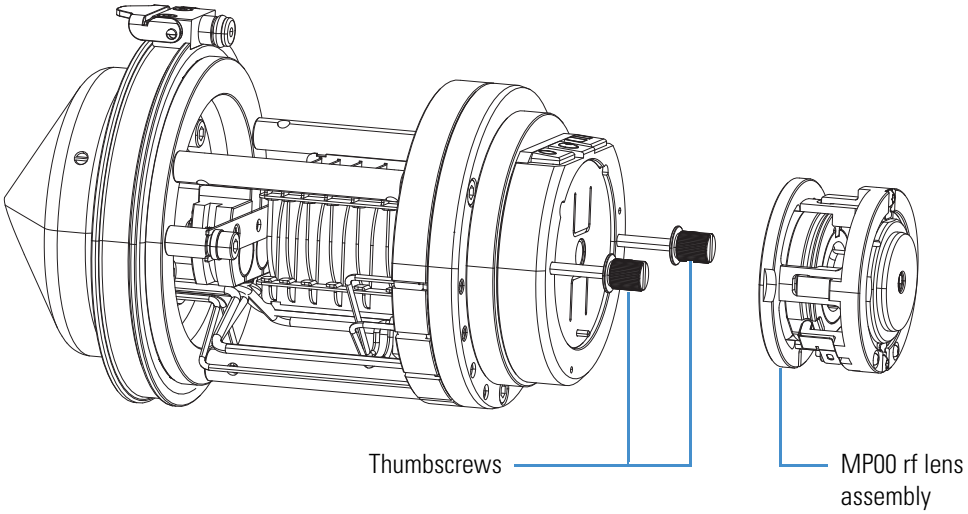
To remove the RIS, follow these procedures:

1. To remove the ETD/IC source heater interface
2. To remove the RIS, on page 30

❖ To remove the ETD/IC source heater interface

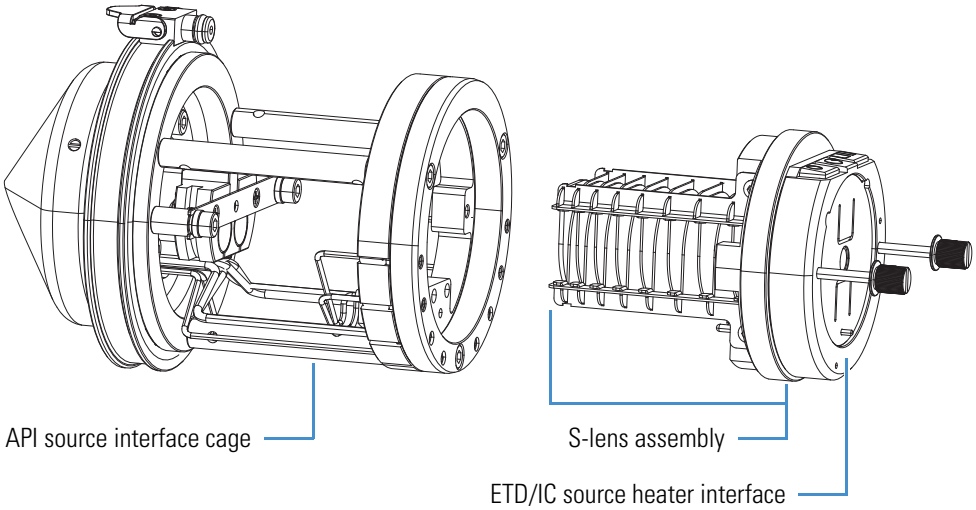
1. Remove the API source interface (see page 27).
2. Loosen and extend the two thumbscrews on the back of the API source interface, and then remove the MP00 rf lens assembly (Figure 20).

Figure 20. MP00 rf lens assembly removed from the API source interface



3. Loosen the two thumbscrews further and use them to carefully pull out the S-lens assembly from the API source interface cage (Figure 21).

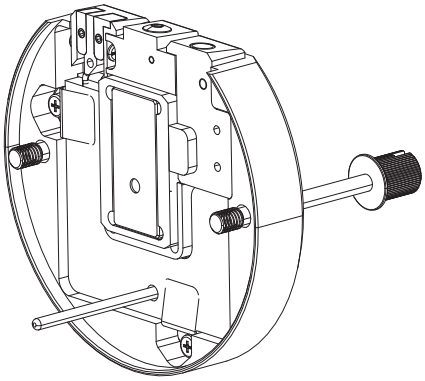
Figure 21. S-lens removed from the API source interface cage



4. Loosen the two thumbscrews even further and use them to pull out the ETD/IC source heater interface (Figure 22).

   Hold the heater interface with the thumbscrews facing upward to prevent the RIS from falling out of the ETD/IC source heater interface.

Figure 22. ETD/IC source heater interface (front view)

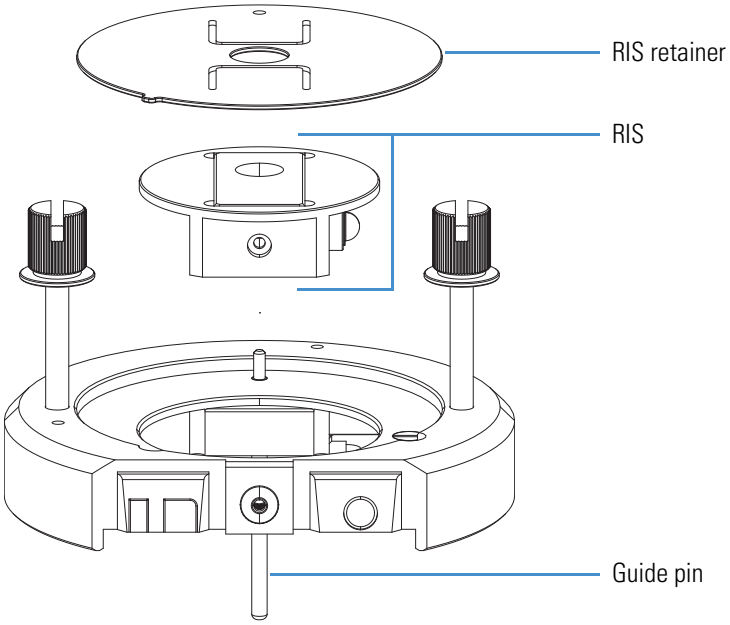


❖ **To remove the RIS**

1. Hold the ETD/IC source heater interface with the thumbscrews facing up.
2. From the bottom, press upward with your fingers to remove the RIS retainer and the RIS (Figure 23).

   To dispose of the old RIS, see "WEEE Compliance" on page v.

Figure 23. RIS removed from the ETD/IC source heater interface



Installing the New RIS

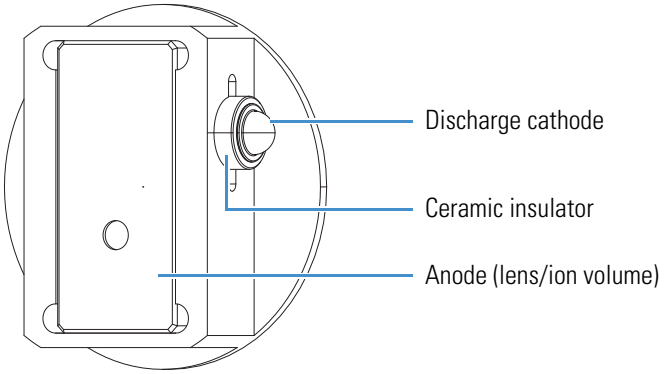
To install the RIS, follow these procedures:

1. To install the new RIS
2. To reinstall the S-lens and ETD/IC source heater interface
3. To reinstall the MP00 rf lens assembly

❖ To install the new RIS

1. Make sure that the discharge cathode is fully inserted into the ceramic insulator (Figure 24).

Figure 24. RIS



2. Align the RIS and the RIS retainer as shown in Figure 23 on page 30, and then reinstall them into the ETD/IC source heater interface.

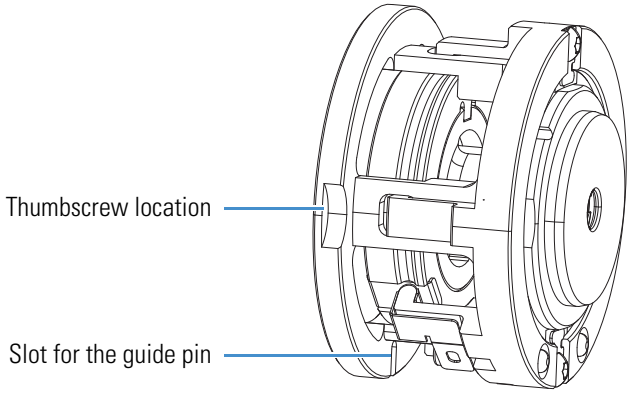
❖ To reinstall the S-lens and ETD/IC source heater interface

1. Align the guide pin on the ETD/IC source heater interface (Figure 23 on page 30) with the guide pin socket on the S-lens, and then firmly press the heater interface until it snaps into place.
2. Tighten the two thumbscrews a few turns into the S-lens.
3. Orient the S-lens as shown in Figure 21 on page 29, and then carefully slide it into the API source interface cage.
4. Tighten the two thumbscrews a few turns into the API source interface cage.

❖ To reinstall the MP00 rf lens assembly

1. Align the bottom slot on the MP00 rf lens assembly (Figure 25) with the guide pin on the ETD/IC source heater interface (Figure 22 on page 29), and then carefully push the MP00 rf lens onto the heater interface.

   Figure 25. Alignment slot and thumbscrew locations on the MP00 rf lens assembly



2. Tighten the two thumbscrews so that they are fingertight against the MP00 rf lens assembly.

Reinstalling the API Source Interface

❖ To reinstall the API source interface

1. Orient the API source interface with the release latch at the top (Figure 19 on page 27).
2. Carefully insert the API source interface into the vacuum manifold.
3. Reinstall the API source interface housing.
4. Start up the system as described in the section "Starting the System after a Complete Shutdown" in Chapter 6 of the *Orbitrap Fusion Hardware Manual*.

Fluoranthene

The Orbitrap Fusion/IC and Orbitrap Fusion/ETD systems use fluoranthene as the reagent species. The Thermo Fisher Scientific factory installs the 0.15 g of fluoranthene, which is contained within a stainless steel vial, in the reagent oven assembly (Figure 7 on page 12).

With continuous operation of the mass spectrometer, the reagent is estimated to last for at least one year. Contact your local Thermo Fisher Scientific field service engineer when it is time to replace the reagent vial. Only a Thermo Fisher Scientific field service engineer can order the ETD Reagent Fluoranthene Kit (P/N 70005-62033) and replace the reagent vial.

Fluoranthene is potentially hazardous. Use it in accordance with its MSDS or SDS.

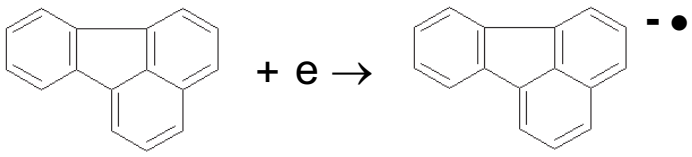
CAUTION Avoid exposure to potentially harmful materials.

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

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

The fluoranthene radical anion is generated according to the reaction shown in Figure 26.

Figure 26. ETD reagent (fluoranthene radical anion) generation from fluoranthene



Fluoranthene

Angiotensin I Solutions

This appendix describes how to prepare solutions containing angiotensin I (human acetate hydrate). Dilute a stock solution to make a sample solution (1 pmol/µL), which you use to demonstrate the application of the Orbitrap Fusion MS/ETD system and to optimize the reagent ion reaction time.

Angiotensin I is potentially hazardous. Use it in accordance with its MSDS or SDS.

CAUTION Avoid exposure to potentially harmful materials.

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

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

You can identify the 1 mg vial of angiotensin I (P/N 00301-15517) in the ETD Chemical Kit (P/N 80000-62047) as Sigma-Aldrich™ #A9650.

The procedures in this section include use of other potentially hazardous chemicals, including glacial acetic acid and methanol. Handle these chemicals according to their MSDS or SDS guidelines.

Follow these two procedures:

- To prepare the angiotensin I stock solution
- To prepare the angiotensin I sample solution

❖ To prepare the angiotensin I stock solution

1. Remove the 1 mg vial of angiotensin I from the ETD Chemical Kit.
2. Add the following to the angiotensin I vial (1 mg):
   - 382 µL of water
   - 382 µL of methanol
   - 8 µL of glacial acetic acid
3. Mix the solution thoroughly.

❖ To prepare the angiotensin I sample solution

1. Pipet 100 µL of the stock solution (1 nmol/µL) of angiotensin I into a clean, polypropylene microcentrifuge tube.
2. Add 900 µL of 50:50 methanol/water (0.1% acetic acid) to the tube.
3. Mix the solution (100 pmol/µL) thoroughly.
4. Pipet 19.8 mL of 0.1% acetic acid 50:50 methanol/water into a clean, 20 mL glass scintillation vial.
5. Add 200 µL of the 100 pmol/µL solution into the scintillation vial to bring the final volume to 20 ml.
6. Mix the solution (1 pmol/µL) thoroughly.
7. Store this sample solution (1 pmol/µL) in a refrigerator until it is needed.

Glossary

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

A

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

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

atmospheric pressure ionization (API) Ionization performed at atmospheric pressure by using atmospheric pressure chemical ionization (APCI), heated-electrospray (H-ESI), or nanospray ionization (NSI).

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

C

charge sign independent trapping Simultaneous, mutual confinement of positive and negative ions such as the multiply charged analyte precursor cations and the ETD reagent anions in the high-pressure cell of the linear ion trap mass analyzer during ETD.

chemical ionization gas *See* make-up gas.

collision gas A neutral gas used to undergo collisions with ions.

collision-induced dissociation (CID) A method of fragmentation where molecular ions are accelerated to high-kinetic energy and then allowed to collide with neutral gas molecules such as helium or nitrogen. The collisions break the bonds and fragment the ions into smaller pieces.

E

electron transfer dissociation (ETD) A method of fragmenting peptides and proteins. In ETD, singly charged reagent anions transfer an electron to multiply protonated peptides within the linear ion trap mass analyzer. This leads to a rich ladder of sequence ions derived from cleavage at the amide groups along the peptide backbone. Amino acid side chains and important modifications such as phosphorylation are left intact.

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

electrospray ionization (ESI) *See* electrospray (ESI).

F

Fourier transform (FT) The mathematical operation that converts the image current signal detected in an ICR trap or Orbitrap mass spectrometer to a set of *m/z* values. The Fourier components correspond to ion mass and the Fourier coefficients correspond to ion abundance.

Fourier Transform - Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS [or FTMS]) A technique that determines the mass-to-charge ratio of an ion by measuring its cyclotron frequency in a strong magnetic field.

H

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

heated-electrospray ionization (H-ESI) *See* heated-electrospray (H-ESI).

I

ion optics Focuses and transmits ions from the ion source to the mass analyzer.

L

lens A metal disk with a circular hole in the center that allows the ion beam to pass.

M

make-up gas The gas associated with the optional EASY-IC or EASY-ETD ion source assembly that flows from the mass flow controller to the reagent distribution assembly.

mass spectrum A graphical representation (plot) of measured ion abundance versus mass-to-charge ratio. The mass spectrum is a characteristic pattern for the identification of a molecule and is helpful in determining the chemical composition of a sample.

mass-to-charge ratio (*m/z*) An abbreviation used to denote the quantity formed by dividing the mass of an ion (in Da) by the number of charges carried by the ion. For example, for the ion $C7H7^{2+}$, $m/z = 45.5$.

R

reagent carrier gas Ultra-high-purity nitrogen gas used to transfer the reagent to the reagent ion source that is regulated by the backpressure regulator.

rf voltage (linear ion trap) An ac voltage of constant frequency and variable amplitude that is applied to the quadrupole rods of a linear ion trap mass analyzer or to the rods of a multipole. Because the frequency of this ac voltage is in the radio frequency (rf) range, it is referred to as rf voltage.

S

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

source *See* API source.

sweep gas Nitrogen gas that flows out from behind the sweep cone in the API source. Sweep gas aids in solvent declustering and adduct reduction.

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