Thermo Fisher Scientific **LTO Orbitrap™ Series** Preinstallation Requirements Guide

Revision B - 1225821





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LTQ Orbitrap Series Installation Request Form

Please refer to the LTO Orbitrap Series Preinstallation Requirements Guide (1225821) for the complete site requirements. Circle "Yes" or "No" as to whether the site meets the requirements as specified in the Preinstallation Guide. Provide the additional information where requested. 1: Yes All laboratory remodeling has been completed and the space available is sufficient to meet the minimum requirements for the No configuration ordered. Refer to topic "Space and Load Requirements" on page 2-8. • The floor is certified to meet the load requirements of an LTQ Orbitrap Series system with API source (682 kg [1500 lb])? • For an LTQ Orbitrap Series system with option, the floor is certified to meet the additional load requirements: MALDI source (+50 kg [+110 lb]), ETD system (+125 kg [+276 lb])? Your LTQ Orbitrap Series instrument has been delivered and is either in the laboratory or can be delivered immediately on the 2: Yes No arrival of the installation engineer? No Doorways, hallways, and so on have sufficient room for maneuvering the instrument. Refer to topic "Entrance and Movement" 3: Yes on page 2-2. · For an LTQ Orbitrap Series system with API source, the entrance to the laboratory and the route from the loading dock are at least 89 cm (35 in) wide with additional space at corners? For an LTQ Orbitrap Series system with MALDI source, the entrance to the laboratory and the route from the loading dock are at least 110 cm (43 in) wide with additional space at corners? Yes Storage and bench space are sufficient, lighting is adequate? 4: No 5: Yes Floor vibrations and electromagnetic interferences are below the specified levels? Refer to topic "Vibration" on page 3-3. No Yes Main power is installed and in compliance with local electrical codes? 6: No 7: Yes No The power outlets are of the correct configuration? Refer to topic "Available Outlets" on page 4-2. Yes The electrical power has been measured? 8: No Please note voltages: ____ ____ Volts AC phase 1 to ground at output of transformer. Please note voltages: ______ Volts AC phase 2 to ground at output of transformer. _____ Volts AC phase 3 to ground at output of transformer. Please note voltages: ____ Please note voltages: ___ _____ Volts AC neutral 1 to ground at output of transformer. Yes 9: No Power is free from fluctuations due to slow changes in the average voltage or changes due to surges, sags, or transients? Yes Air conditioning is adequate for temperature, humidity, and particulate matter control. The laboratory can be maintained at a 10: No constant temperature, between 15 and 27 °C (59 and 81 °F)? Refer to topic "Temperature" on page 3-2. The key operator will be available during the installation period. Refer to topic "Key Operator" on page 8-6. The person with the 11: Yes No authority to accept the instrument at the end of the installation will also be available to sign the required acceptance document? Please provide the names of these individuals: The relative humidity is between 50% and 80%, with no condensation? Refer to topic "Humidity" on page 3-3. Yes 12: No Yes The system work area is free from magnetic disruption and electrostatic discharge? Refer to topic "Electrostatic Discharge" on 13: No page 3-5. All gases required are on site, gas lines are installed, and appropriate gas regulators are available? Refer to topic "Gases" on page 5-3. 14: Yes No List gases and purity:_ Is there a suitable exhaust system? Refer to topic "Exhaust System" on page 6-2. 15: Yes No 16: Yes No There is a functional telephone close to the system? Phone number _ All relevant local safety regulations have been met and the equipment installed will not affect compliance? 17: Yes No 18: Yes All required chemicals and equipment for installing the system are on site. No · For an LTQ Orbitrap Series system with API source, all material listed in topic "Chemicals Needed for Installation" on page 8-2 is available? · For an LTQ Orbitrap Series instrument with MALDI source, all material listed in topic "Chemical Kits, Equipment, and Consumables for the MALDI Source" on page 8-2 is available? The MALDI Preinstallation material checklist is fulfilled? • For an LTQ Orbitrap Series instrument with ETD system, all material listed in topic "ETD Kits" on page 8-4 is available? Have any special acceptance specifications been agreed within the contract? 19: Yes No If YES, please attach full details of specification. Is there any additional equipment that needs to be interfaced for the system? 20: Yes No If YES, please supply details.

Date: Phone: Fax to: Attn: Local Service Engineer

Note After we receive this checklist, your local Field Service Representative will contact you to schedule installation.

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Übereinstimmungserklärung gemäß ISO/IEC 17050-1:2004

Declaration of conformity according to ISO/IEC 17050-1:2004 Dichiarazione di conformità alla ISO/IEC 17050-1:2004

Name des Herstellers: manufacturers name nome produttore Thermo Fisher Scientific

Adresse des Herstellers: manufacturers address indirizzo produttore Hanna-Kunath-Strasse 11 28199 Bremen Germany

erklärt, dass das Produkt

declares that the following product dichiara che il seguente prodotto

LTQ Orbitrap Discovery

mit den folgenden Produktspezifikationen übereinstimmt:

complies with the following product specifications rispetta le seguenti specifiche del prodotto

EMV (Störemissionen): EMC (emissions) EMC (emissioni)

EMV (Störfestigkeit): EMC (immunity) EMC (immunità)

Elektrische Sicherheit: electrical safety sicurezza elettrica

Ergänzende Informationen: complementary information informazioni complementari EN 61000-6-3 Störemission (08.02) EN 55022, Kl.B (09.03), EN 61000-3-2 (10.98), EN 61000-3-3 (10.98)

EN 61000-6-2 Störfestigkeit (08.02), EN 61000-4-2 (12.01), -3 (03.03), -4 (07.02), -5 (12.01), -6 (12.01), -11 (12.01), EN 50204 (02.96)

EN 61010-1

Dieses Produkt erfüllt die EMV-Richtlinie 89/336/EWG und Niederspannungsrichtlinie 73/23/EWG.

This product complies with EMC directive 89/336/EEC and Low Voltage Directive 73/23/EEC. Questo produtto rispetta la direttiva 89/336/EEC e la direttiva 73/23/EEC.

Bremen, Germany, 5/31/2007



Technischer Leiter: Director of Operations Direttore fabrizione

(Jörg Behrens)

Declaration of conformity according to ISO/IEC 17050-1:2004

Übereinstimmungserklärung gemäß ISO/IEC 17050-1:2004 Dichiarazione di conformità alla ISO/IEC 17050-1:2004

Manufacturers name Name des Herstellers: nome produttore Thermo Fisher Scientific

Manufacturers address Adresse des Herstellers: indirizzo produttore 355 River Oaks Parkway San Jose, CA 95134 U.S.A.

declares that the following product erklärt, dass das Produkt dichiara che il seguente prodotto

LTQ Orbitrap Discovery

complies with the following product specifications mit den folgenden Produktspezifikationen übereinstimmt: rispetta le seguenti specifiche del prodotto

EMC (emissions) EMV (Störemissionen): EMC (emissioni)

EMC (immunity) EMV (Störfestigkeit): EMC (immunità)

electrical safety Elektrische Sicherheit: sicurezza elettrica

complementary information Ergänzende Informationen: informazioni complementari EN 61000-6-3 Störemission (08.02) EN 55022, Kl.B (09.03), EN 61000-3-2 (10.98), EN 61000-3-3 (10.98)

EN 61000-6-2 Störfestigkeit (08.02), EN 61000-4-2 (12.01), -3 (03.03), -4 (07.02), -5 (12.01), -6 (12.01), -11 (12.01), EN 50204 (02.96)

EN 61010-1

This product complies with EMC directive 89/336/EEC and Low Voltage Directive 73/23/EEC. Dieses Produkt erfüllt die EMV-Richtlinie 89/336/EWG und Niederspannungsrichtlinie 73/23/EWG.

Questo produtto rispetta la direttiva 89/336/EEC e la direttiva 73/23/EEC.

San Jose CA, USA, 8/25/2008



Director of Operations: Technischer Leiter Direttore fabrizione

Bret Johnson)

EG-Konformitätserklärung gemäß ISO/IEC 17050-1:2004 **EC Declaration of conformity** according to ISO/IEC 17050-1:2004

Name des Herstellers: manufacturers name	Thermo Fisher Scientific
Adresse des Herstellers: manufacturers address	Hanna-Kunath-Strasse 11 28199 Bremen Germany
Der Hersteller erklärt, dass The manufacturer declares that the f	das Produkt following product
Name des Produkts: product name	Mass Spectrometer
Modell: model number	LTQ ORBITRAP XL
Produktoptionen: product options	inkl. / incl. ETD

mit den folgenden EG Richtlinien und harmonisierten Standards übereinstimmt: is in conformity with the following EC Directives and harmonized standards

EMV-Richtlinie EMC Directive 2004/108/EG

EN 55011 (11.2007) EN 61000-3-2 (10.2006) EN 61000-3-3 (06.2006) EN 61000-4-2 (12.2001) EN 61000-4-3 (12.2006) EN 61000-4-4 (05.2005) EN 61000-4-5 (06.2007) EN 61000-4-6 (04.2008) EN 61000-4-11 (02.2005) EN 61326-1 (10.2006) + Corr. (06.2008)

Niederspannungsrichtlinie Low Voltage Directive 2006/95/EG EN 61010-1 (08.2002)

Ergänzende Informationen: Complementary information

Bremen, Germany, 16. September 2008

Thermo Fisher scientific

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Jörg Behrens Technischer Leiter Director of operations

Declaration of conformity according to ISO/IEC 17050-1:2004

Übereinstimmungserklärung gemäß ISO/IEC 17050-1:2004 Dichiarazione di conformità alla ISO/IEC 17050-1:2004

Manufacturers name Name des Herstellers: nome produttore Thermo Fisher Scientific

Manufacturers address Adresse des Herstellers: indirizzo produttore

355 River Oaks Parkway San Jose, CA 95134 U.S.A.

declares that the following product erklärt, dass das Produkt dichiara che il seguente prodotto

LTQ Orbitrap XL

complies with the following product specifications

mit den folgenden Produktspezifikationen übereinstimmt: rispetta le seguenti specifiche del prodotto

EMC (emissions) EMV (Störemissionen): EMC (emissioni)

EMC (immunity) EMV (Störfestigkeit): EMC (immunità)

electrical safety Elektrische Sicherheit: sicurezza elettrica

complementary information Ergänzende Informationen: informazioni complementari EN 61000-6-3 Störemission (08.02) EN 55022, Kl.B (09.03), EN 61000-3-2 (10.98), EN 61000-3-3 (10.98)

EN 61000-6-2 Störfestigkeit (08.02), EN 61000-4-2 (12.01), -3 (03.03), -4 (07.02), -5 (12.01), -6 (12.01), -11 (12.01), EN 50204 (02.96)

EN 61010-1

This product complies with EMC directive 89/336/EEC and Low Voltage Directive 73/23/EEC. Dieses Produkt erfüllt die EMV-Richtlinie 89/336/EWG und Niederspannungsrichtlinie 73/23/EWG.

Questo produtto rispetta la direttiva 89/336/EEC e la direttiva 73/23/EEC.

San Jose CA, USA, 8/15/2008



Director of Operations: Technischer Leiter Direttore fabrizione

(Bret Johnson)

EG-Konformitätserklärung gemäß ISO/IEC 17050-1:2004 EC Declaration of conformity according to ISO/IEC 17050-1:2004

Name des Herstellers: manufacturers name	Thermo Fisher Scientific
Adresse des Herstellers: manufacturers address	Hanna-Kunath-Strasse 11 28199 Bremen Germany
Der Hersteller erklärt, das The manufacturer declares that the	s das Produkt e following product
Name des Produkts: product name	Mass Spectrometer
Modell: model number	LTQ ORBITRAP VELOS
Produktoptionen: product options	inkl. / incl. ETD

mit den folgenden EG Richtlinien und harmonisierten Standards übereinstimmt: is in conformity with the following EC Directives and harmonized standards

EMV-Richtlinie EMC Directive 2004/108/EG EN 55011 (11.2007) EN 61000-3-2 (10.2006) EN 61000-3-3 (06.2006) EN 61000-4-2 (12.2001) EN 61000-4-3 (12.2006) EN 61000-4-4 (05.2005) EN 61000-4-5 (06.2007) EN 61000-4-6 (04.2008) EN 61000-4-11 (02.2005) EN 61326-1 (10.2006) + Corr. (06.2008)

Niederspannungsrichtlinie Low Voltage Directive 2006/95/EG EN 61010-1 (08.2002)

Ergänzende Informationen: Complementary information

Bremen, Germany, 24. April 2009

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Jörg Behrens Technischer Leiter Director of operations



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 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.

LTQ XL/ETD System (January 2007)

EMC Directives 89/336/EEC

EMC compliance has been evaluated by TUV Rheinland of North America, Inc.

EN 61000-3-2: 1995, A1: 1998, A2: 1998, A14: 2000	EN 61000-4-4:1995, A1: 2000, A2:2001
EN 61000-3-3: 1995, A1:2001	EN 61000-4-5: 1995, A1: 2001
EN 61326-1: 1997, A1:1998, A2:2001, A3:2003	EN 61000-4-6: 2003
EN 61000-4-2: 2001	EN 61000-4-11: 1994, A1: 2001
EN 61000-4-3: 2002	CISPR 11: 1999, A1: 1999, A2: 2002
FCC Class A, CFR 47 Part 15: 2005	

Low Voltage Safety Compliance

Compliance with safety issues is declared under Thermo Fisher Scientific sole responsibility. This device complies with Low Voltage Directive 73/23/EEC and harmonized standard EN 61010-1:2001.

LTQ Velos/ETD System (November 2008)

EMC Directives 2004/108/EEC

EMC compliance has been evaluated by TUV Rheinland of North America, Inc.

EN 61326-1: 2006	EN 61000-4-4: 2004
EN 55011: 2007	EN 61000-4-5: 2005
EN 61000-3-2: 2006	EN 61000-4-6: 2007
EN 61000-3-3: 2005	EN 61000-4-11: 2004
EN 61000-4-2: 2001	FCC Part 15: 2007
EN 61000-4-3: 2006	

Low Voltage Safety Compliance

Compliance with safety issues is declared under Thermo Fisher Scientific sole responsibility. This device complies with Low Voltage Directive 2006/95/EEC and harmonized standard EN 61010-1:2001.

FCC Compliance Statement

THIS DEVICE COMPLIES WITH PART 18 OF THE FCC RULES.



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/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at <u>www.thermo.com/WEEERoHS</u>.

WEEE Konformität

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



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Conformité DEEE

Ce produit doit être conforme à la directive européenne (2002/96/EC) des Déchets d'Equipements 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 <u>www.thermo.com/WEEERoHS</u>.

Read This First

Welcome to the Thermo Scientific LTQ Orbitrap[™] Series system! LTQ Orbitrap Series instruments are members of the family of LTQ[™] mass spectrometer (MS) detectors.

The LTQ Orbitrap Series includes the following Thermo Scientific mass spectrometers:

- The LTQ Orbitrap Discovery[™], a hybrid mass spectrometer comprising a 2D linear ion trap mass spectrometer and an Orbitrap analyzer.
- The LTQ Orbitrap XL[™], a hybrid mass spectrometer comprising a 2D linear ion trap mass spectrometer and an Orbitrap analyzer.
- The LTQ Orbitrap XL ETD[™] system where the ETD Module is physically coupled to the back of the LTQ Orbitrap XL.
- The LTQ Orbitrap Velos[™], a hybrid mass spectrometer comprising a dual cell linear ion trap and an Orbitrap analyzer.
- The LTQ Orbitrap Velos ETD[™] system where the ETD Module is physically coupled to the back of the LTQ Orbitrap Velos.
- MALDI LTQ Orbitrap Series systems with the MALDI sample and control modules connected to an LTQ Orbitrap Series instrument. The optional API kit provides the hardware for LC MS applications with ESI, APCI, and so forth.

About This Guide

This *LTQ Orbitrap Series Preinstallation Requirements Guide* provides information to assist in planning and preparing your lab site for the system prior to delivery and installation. Read each section carefully to be sure that your laboratory is ready for the installation of your system.

Who Uses This Guide

This *LTQ Orbitrap Series Preinstallation Requirements Guide* is intended primarily for those who are responsible for the site planning of a laboratory in preparation for the installation of a new LTQ Orbitrap Series instrument. This guide should be retained for future guidance if your instrument needs to be relocated in future.

Scope of This Guide

The *LTQ Orbitrap Series Preinstallation Requirements Guide* includes the following chapters:

- Chapter 1: "Introduction" describes the purchaser's responsibilities for installation and maintenance of the system.
- Chapter 2: "Site Preparation" gives details on the physical, electrical, gas, and air conditioning requirements and other laboratory requirements for the MS detector and data system.
- Chapter 3: "Operating Environment" provides additional information about how to prepare your laboratory to provide optimum conditions for instrument operation.
- Chapter 4: "Line Power" gives details on the electrical outlets, power conditioning devices and power supplies required to properly install your system.
- Chapter 5: "Consumables" provides information on the gases and other consumables required to install and operate your system.
- Chapter 6: "Exhaust and Waste" describes how to properly ventilate the laboratory for safe operation of the instrument.
- Chapter 7: "Instrument Arrival" provides information on insurance claims and on domestic and international shipments.
- Chapter 8: "Installation" provides details on the final preparations necessary before the arrival of the Service Engineer for installation of the system.

Related Documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents for LTQ Orbitrap Series instruments:

- LTQ Orbitrap Discovery Hardware Manual, LTQ Orbitrap XL Hardware Manual, LTQ Orbitrap XL ETD Hardware Manual, or LTQ Orbitrap Velos Hardware Manual
- LTQ Orbitrap Discovery Getting Started, LTQ Orbitrap XL Getting Started, or LTQ Orbitrap Velos Getting Started
- LTQ XL manual set or LTQ Velos manual set

You can access PDF files of the documents listed above from the data system computer. The software also provides Help.

Contacting Us

There are several ways to contact Thermo Fisher Scientific.

Assistance

For technical support and ordering information, visit us on the Web:

www.thermo.com/advancedms

Customer Information Service

cis.thermo-bremen.com is the Customer Information Service site aimed at providing instant access to

- latest software updates
- manuals, application reports, and brochures.

Note Thermo Fisher Scientific recommends that you register with the site as early as possible. ▲

To register, visit register.thermo-bremen.com/form/cis and fill in the registration form. Once your registration has been finalized, you will receive confirmation by e-mail.

Changes to the Manual

✤ To suggest changes to this manual

• Please send your comments (in German or English) to:

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Germany

• Send an e-mail message to the Technical Editor at

documentation.bremen@thermofisher.com

You are encouraged to report errors or omissions in the text or index. Thank you.

Typographical Conventions

This section describes typographical conventions that have been established for Thermo Fisher Scientific manuals.

Data Input

Throughout this manual, the following conventions indicate data input and output via the computer:

- Messages displayed on the screen are represented by capitalizing the initial letter of each word and by italicizing each word.
- Input that you enter by keyboard is identified by quotation marks: single quotes for single characters, double quotes for strings.
- For brevity, expressions such as "choose **File > Directories**" are used rather than "pull down the File menu and choose Directories."
- Any command enclosed in angle brackets < > represents a single keystroke. For example, "press <F1>" means press the key labeled *F1*.
- Any command that requires pressing two or more keys simultaneously is shown with a plus sign connecting the keys. For example, "press <Shift> + <F1>" means press and hold the <Shift> key and then press the <F1> key.
- Any button that you click on the screen is represented in bold face letters. For example, "click on **Close**".

Topic Headings

The following headings are used to show the organization of topics within a chapter:

Chapter 1 Chapter Name

Second Level Topics

Third Level Topics

Fourth Level Topics

Safety and EMC Information

In accordance with our commitment to customer service and safety, this instrument has satisfied the requirements for the European CE Mark including the Low Voltage Directive.

Designed, manufactured and tested in an ISO9001 registered facility, this instrument has been shipped to you from our manufacturing facility in a safe condition.

This instrument must be used as described in this manual. Any use of this instrument in a manner other than described here may result in instrument damage and/or operator injury.

Notice on Lifting and Handling of Thermo Scientific Instruments

For your safety, and in compliance with international regulations, the physical handling of this Thermo Scientific instrument *requires a team effort* for lifting and/or moving 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: If this instrument is used in a manner not specified by Thermo Fisher Scientific, the protection provided by the instrument could be impaired.

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.

Safety and Special Notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear different from the main flow of text. Safety and special notices include the following:



Warning Warnings highlight hazards to human beings. Each Warning is accompanied by a Warning symbol. ▲

Caution Cautions highlight information necessary to protect your instrument from damage. ▲

Note Notes highlight information that can affect the quality of your data. In addition, notes often contain information that you might need if you are having trouble. ▲

Identifying Safety Information

This guide contains precautionary statements that can prevent personal injury, instrument damage, and loss of data if properly followed. Warning symbols alert the user to check for hazardous conditions. These appear throughout the manual, where applicable. The most common warning symbols are:



Warning This general symbol indicates that a hazard is present that could result in injuries if it is not avoided. The source of danger is described in the accompanying text. ▲



Warning High Voltages capable of causing personal injury are used in the instrument. The instrument must be shut down and disconnected from line power before service is performed. Do not operate the instrument with the top cover off. Do not remove protective covers from PCBs. \blacktriangle



Warning Treat heated zones with respect. Parts of the instrument might be very hot and might cause severe burns if touched. Allow hot components to cool before servicing them. ▲



Warning Wear gloves when handling toxic, carcinogenic, mutagenic, or corrosive/irritant chemicals. Use approved containers and procedures for disposal of waste solution. ▲



Warning Laser Radiation Avoid eye or skin exposure to direct or scattered radiation!

In addition to the above described, every instrument has specific hazards. So, be sure to read and comply with the precautions described in the subsequent chapters of this guide. They will help ensure the safe, long-term use of your system.

General Safety Precautions

Observe the following safety precautions when you operate or perform service on your instrument:

• Before plugging in any of the instrument modules or turning on the power, always make sure that the voltage and fuses are set appropriately for your local line voltage.

- Only use fuses of the type and current rating specified. Do not use repaired fuses and do not short-circuit the fuse holder.
- The supplied power cord must be inserted into a power outlet with a protective earth contact (ground). When using an extension cord, make sure that the cord also has an earth contact.
- Do not change the external or internal grounding connections. Tampering with or disconnecting these connections could endanger you and/or damage the system.
- The instrument is properly grounded in accordance with regulations when shipped. You do not need to make any changes to the electrical connections or to the instrument's chassis to ensure safe operation.
- Never run the system without the housing on. Permanent damage can occur.
- Do not turn the instrument on if you suspect that it has incurred any kind of electrical damage. Instead, disconnect the power cord and contact a Service Representative for a product evaluation. Do not attempt to use the instrument until it has been evaluated. (Electrical damage may have occurred if the system shows visible signs of damage, or has been transported under severe stress.)
- Damage can also result if the instrument is stored for prolonged periods under unfavorable conditions (e.g. subjected to heat, water, etc.).
- Always disconnect the power cord before attempting any type of maintenance.
- Capacitors inside the instrument may still be charged even if the instrument is turned off.
- Never try to repair or replace any component of the system that is not described in this manual without the assistance of your service representative.
- Shut Down the Laser Before You Perform any Service on the MALDI Source. The MALDI source uses a high-energy ultraviolet laser capable of causing personal injury. Do not operate the source with the cover off the sample module.
- Do not place any objects especially not containers with liquids upon the instrument. Leaking liquids might get into contact with electronic components and cause a short circuit.

Safety Advice for Possible Contamination

Hazardous material might contaminate certain parts of your system during analysis.

To protect our employees, we ask you for some special precautions when returning parts for exchange or repair to the factory.

If hazardous materials have contaminated mass spectrometer parts, Thermo Fisher Scientific can only accept these parts for repair if they have been properly decontaminated. Materials which due to their structure and the applied concentration might be toxic or which in publications are reported to be toxic are regarded as hazardous. Materials that will generated synergetic hazardous effects in combination with other present materials are also concerned.

Your signature on the Repair Covering letter confirms that the returned parts have been de-contaminated and are free of hazardous materials.

Repair covering letters may be downloaded from the Customer Information Service (CIS) site. Please register under http://register.thermo-bremen.com/form/cis.

Parts contaminated by radioisotopes are not subject to return to Thermo Fisher Scientific – either under warranty or the exchange part program. If parts of the system may be possibly contaminated by hazardous material, please make sure the field engineer is informed before he starts working on the system.

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Chapter 1 Introduction

Information in this guidebook will help you to prepare a suitable site for installation of your system. The LTQ Orbitrap Series MS detectors are designed to operate reliably under carefully controlled environmental conditions.

Operating a system or maintaining it in a condition outside the power and operating environment specifications described in this guide might cause failures of many types. The repair of such failures is specifically excluded from the standard warranty and service contract coverage.

Note The purchaser is responsible for providing a suitable location, a suitable operating environment, a source of power of acceptable quality, correct gas and solvent supplies, and proper waste and exhaust systems. ▲

For additional information, request specific preinstallation support directly through your local Thermo Fisher Scientific office.

Chapter 2 Site Preparation

Before your instrument can be installed by the service engineer, the site must be prepared. The hallways and doors must be wide enough to allow passage of the instrument. A telephone must be installed within reach of the workbench.

Note It is your responsibility as the user to provide a suitable location, a source of power of acceptable quality, a suitable operating environment, and a proper exhaust system. ▲

More information on each of the requirements is available under the following topics:

- "Entrance and Movement" on page 2-2
- "Instrument Dimensions" on page 2-5
- "Space and Load Requirements" on page 2-8
- "Telephone" on page 2-12

Entrance and Movement

To allow moving an unpacked LTQ Orbitrap Series instrument, the entrance to your facility and the width of all hallways, elevators, etc., should have a minimum width as indicated in the subsequent topics. However, additional room should be allowed for maneuvering the system around corners, into elevators, or through doorways.

When unpacking the system, consider the additional space that is required for pulling down the ramp.

Note Do not remove the instrument from its shipping container unless authorized by Thermo Fisher Scientific personnel. Be sure that all the contents of the container remain with the instrument. \blacktriangle

Moving an LTQ Orbitrap Series ETD System Along Hallways and Through Doors

When moving an LTQ Orbitrap Series ETD system along hallways, the instrument requires a minimum hallway width of 93 cm (37 in). See Figure 2-4 on page 2-7.

The instrument must be turned by some degrees when passing through a door that is 89 cm wide. Therefore, no obstacles (cabinets, for example) must be located near the door. Figure 2-1 shows how to move the unpacked instrument through laboratory doors.



Figure 2-1. Moving an LTQ Orbitrap Series ETD system through laboratory doors

Box Dimensions and Weights

Transport of the equipment to the site requires wide entrances and hallways. The floors and elevators within the site must be able to support the weight of the equipment.

Note Owing to the climatic conditions in some tropic regions, some boxes may be replaced by special packings. As a result, the dimensions will differ from those shown in the tables of this section. ▲

Box Dimensions and Weights of LTQ Orbitrap Series Instruments

The LTQ Orbitrap Series basic unit is shipped in a container with the following dimensions: l 174 cm (69 in), w 112 cm (44 in), h 162 cm (64 in). The container and its contents weigh approximately 538 kg (1186 lb). Other modules such as the data system, recirculating chiller, and accessories are shipped in a separate container. Its dimensions and weight are less than that of the container for the basic unit. They are given in Table 2-1.

Table 2-1.Dimensions and weights of packed units of a typical
LTQ Orbitrap Series system

Module	Height		Widt	Width		Length		Weight	
	cm	in	cm	in	cm	in	kg	lb	
Basic unit with linear trap	162	64	112	44	174	69	538	1186	
Auxiliary box	156	62	80	32	120	48	298	657	

Note Some chemicals that are needed for installation will be delivered in a separate package. See topic "Chemicals Needed for Installation" on page 8-2 for details. ▲

Box Dimensions and Weights of Instruments with MALDI Source

To allow moving an unpacked LTQ Orbitrap Series instrument with MALDI source, the entrance to your facility and the width of all hallways, elevators, etc., should have a minimum width of 110 cm (43 in).¹

The LTQ Orbitrap Series basic unit is shipped in a container with the following dimensions: l 201 cm (79 in), w 149 cm (59 in), h 162 cm (64 in). The container and its contents weigh approximately 660 kg (1455 lb). Other modules such as data system, recirculating chiller, and MALDI equipment are shipped in separate containers. Their dimensions and weights are less than that of the container for the basic unit. They are given in Table 2-2 on page 2-4.

¹Your instrument is shipped in a shipping container, the smallest dimension of which is 149 cm (59 in). If the entrance to your laboratory will not accommodate a 149 cm container, you can remove the individual modules from the container before moving them into the room.

Note Some chemicals that are needed for installation will be delivered in a separate package. See topic "Required Chemical and Accessory Kits for MALDI" on page 8-3 for details. ▲

Table 2-2.	Dimensions and weights of packed units of an LTQ Orbitrap
	Series system with MALDI source

Module	Height		Width		Length		Weight	
	cm	in	cm	in	cm	in	kg	lb
Basic unit with linear trap	162	64	149	59	201	79	660	1455
MALDI equipment box	146	58	90	36	124	49	199	439
Auxiliary box	118	47	80	32	120	48	195	430

Box Dimensions and Weights of LTQ Orbitrap Series ETD Instruments

To allow moving an unpacked LTQ Orbitrap Series ETD instrument, the entrance to your facility and the width of all hallways, elevators, etc., should have a minimum width of 110 cm (43 in).¹

The LTQ Orbitrap Series ETD basic unit is shipped in a container with the following dimensions: l 201 cm (79 in), w 149 cm (59 in), h 162 cm (64 in). The container and its contents weigh approximately 660 kg (1455 lb). Other modules such as the data system, recirculating chiller, and accessories are shipped in a separate container. Its dimensions and weight are less than that of the container for the basic unit. They are given in Table 2-3.

Table 2-3.	Dimensions and weights of packed units of an LTQ Orbitrap
	Series ETD system

Module	Height		Width		Length		Weight	
	cm	in	cm	in	cm	in	kg	lb
Basic unit with linear trap	162	64	149	59	201	79	672	1482
Auxiliary box	140	55	80	32	120	48	247	545
Chiller box	87	34	101	40	52	21	75	166

¹Your instrument is shipped in a shipping container, the smallest dimension of which is 149 cm (59 in). If the entrance to your laboratory will not accommodate a 149 cm container, you can remove the individual modules from the container before moving them into the room.
Instrument Dimensions

This section describes the dimensions of the available types of LTQ Orbitrap Series instruments.

Dimensions of an LTQ Orbitrap Series Instrument

The LTQ Orbitrap Series instrument has dimensions of l 1462.5 mm (58 in), w 870 mm (35 in), h 1414 mm (56 in). See Figure 2-2.



Figure 2-2. Dimensions of LTQ Orbitrap Series instruments in mm

Dimensions of an Instrument with MALDI Source

If your LTQ Orbitrap Series instrument is equipped with the MALDI source, a movable bench for the MALDI controller with dimensions of 620 mm × 660 mm (25 × 26 in) is located on the left side of the instrument. The MALDI controller itself has dimensions of l 450 mm (18 in), w 290 mm (11.5 in), h 350 mm (14 in). The complete system has maximum dimensions of l 1462.5 mm (58 in), w 1530 mm (60 in), h 1414 mm (56 in). See Figure 2-3.



Figure 2-3. Important dimensions of instrument with MALDI source

Dimensions of LTQ Orbitrap Series ETD Instruments

In LTQ Orbitrap Series ETD systems, the ETD Module is attached to the rear of the instrument. The instrument has maximum dimensions of l 1705 mm (67 in), w 913 mm (36 in), h 1414 mm (56 in). See Figure 2-4.



Figure 2-4. Important dimensions of LTQ Orbitrap Series ETD instrument

Space and Load Requirements

This section contains the following topics:

- "Minimum Floor Space" on page 2-8
- "Load Distribution" on page 2-10

Minimum Floor Space

Wheels at the bottom side of the instrument facilitate positioning the LTQ Orbitrap Series instrument at the intended place in the laboratory. The instrument is designed to be placed with its rear panel against a wall. To ensure a sufficient airflow for cooling the instrument, spacers on the rear panel provide for minimum distance to the wall.



Figure 2-5. Space requirements for working with your LTQ Orbitrap Series system (dimensions in cm)

The footprint for the LTQ Orbitrap Series system is shown in Figure 2-5. In the laboratory, the position of your instrument should allow easy access to all sides; the figure shows the required minimum clearance. The front panel and the left side panel of the instrument are

mounted on hinges; the right side panel is removable. In addition, consider the layout when all system components are present (data system, recirculating chiller).

Required Space with MALDI Equipment

In case your instrument is equipped with the MALDI source, the table with the laser is positioned on the left hand side. In principle, the space indicated in Figure 2-5 on page 2-8 is sufficient. To give personnel access to the left side of the LTQ Orbitrap Series instrument, allow for sufficient space between the table and the wall, at least 50 cm (20 in).

A tissue imaging kit is available as option for the MALDI system. To provide sufficient space for the scanner, a larger workbench for the data system is required.

Required Space with ETD Equipment

The footprint for an LTQ Orbitrap Series ETD system is shown in Figure 2-6 on page 2-10.

Free access to the rear side of the instrument is required. The fully extended ion probe handle extends 48 cm (19 in) beyond the back panel of the instrument. A *minimum* clearance of 31 cm (12 in) is required between the wall and the fully extended ion probe handle on the back of the ETD Module, or 79 cm (31 in) from the back panel of the instrument to the wall is the minimum clearance. The *recommended* clearance is 46 cm (18 in) between the wall and the fully extended ion probe handle on the back of the ETD Module on the back of the ETD Module, or 94 cm (37 in) from the back panel of the instrument to the wall is the recommended clearance.

Site Preparation

Space and Load Requirements



Figure 2-6. Footprint of an LTQ Orbitrap Series ETD instrument (dimensions in cm)

Load Distribution

The LTQ Orbitrap Series instruments are supported by four height adjustable feet. The floor of your laboratory should be able to carry the weight of the installed LTQ Orbitrap Series instrument with data system and recirculating chiller of about 685 kg (1510 lb). Also, consider the weight of any other option that is added to the system.

Weight of MALDI Equipment

The MALDI ion source for the LTQ Orbitrap Series instrument weighs approximately 50 kg (110 lb) including movable desk and MALDI controller. If you intend to purchase this option, be certain to take the additional weight into account when designing your laboratory.

Weight of ETD System

The components of the ETD system weigh approximately 125 kg (276 lb), including the ETD Module, the transfer mechanics, and the pumps. If you intend to purchase this option, be certain to take the additional weight into account when designing your laboratory.

Telephone

It is recommended that a telephone be installed in your laboratory near the instrument so, if necessary, you can conveniently operate the system while you are working by telephone with a Thermo Fisher Scientific Customer Service Engineer. The voice telephone outlet should be within 2 m (7 ft) of your system.

Note 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. ▲

Chapter 3 Operating Environment

Attention to the operating environment will insure continued high performance of your LTQ Orbitrap Series system. Any expenditures for air conditioning are more than offset by good sample throughput and reduced repair costs. The air conditioning must be capable of maintaining a constant temperature in the immediate vicinity of the system without producing excessive draft.

Note It is your responsibility as the user to provide an acceptable operating environment. ▲

Operating environment includes the following:

- "Temperature" on page 3-2
- "Humidity" on page 3-3
- "Vibration" on page 3-3
- "Lighting" on page 3-4
- "Particulate Matter" on page 3-4
- "Radio Frequencies" on page 3-4
- "Electrostatic Discharge" on page 3-5

Temperature

The laboratory room temperature must be maintained between 15 and 27 °C (59 and 81 °F). The optimum temperature of operation is between 18 and 21 °C (65 and 70 °F).

Note As the laboratory temperature increases, system reliability decreases. All electronic components generate heat while operating. This heat must be dissipated to the surrounding air for the components to continue to operate reliably. ▲

There must be a good flow of room air around the system, and the air conditioning system must be capable of maintaining a constant temperature (within the temperature specification given above) in the immediate vicinity of the system.

We recommend the installation of an air conditioner, if the specified limits will be exceeded due to unfavorable climatic conditions. Preferably, the air conditioner should be equipped with a flow controller valve and PID microprocessor control (available e.g. from Landis & Gyr, Polygyr RWX..., see www.landisgyr.com). This ensures temperature drifts within the limits given above.

Note Do not locate the LTQ Orbitrap Series instrument under an air duct, near windows, or near heating and cooling sources. Temperature fluctuations of 5 °C or more over a 5 min. period of time can effect performance. ▲

The air conditioning load for a typical LTQ Orbitrap Series system (with recirculating chiller and a typical LC) is approximately 6.5 kW (22400 BTU/h). The heat output of an LTQ Orbitrap Series ETD system is 700 W higher. Therefore, the air conditioning load is approximately 7.2 kW (24700 BTU/h). Refer to your LC manual for the heat output of your LC equipment. Table 3-1 shows the approximate heat output of each module.

Module	Heat output [W]	Heat output [BTU/h]
LTQ Orbitrap Series MS detector	2800 (3500)	9550 (11950)
Liquid chromatograph	1080 [*]	3690*
Recirculating chiller	1600*	5460 [*]
Monitor	240*	820*
Computer	470 [*]	1640 [*]
Laser printer	350 [*]	1230 [*]
Total	6540 (7240)	22390 (24720)

Table 3-1. Heat output for typical LTQ Orbitrap Series systems

*Approximate. The actual value depends on your equipment.

Humidity

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Vibration

The relative humidity of the operating environment must be between 50 and 80%, with no condensation. It is recommended that your laboratory be equipped with a temperature/humidity monitor to insure that your laboratory is always within the required temperature and humidity specifications.

Caution Operating an LTQ Orbitrap Series system at very low humidity might cause the accumulation and discharge of static electricity, which can shorten the life of electronic components. Operating the system at high humidity might cause condensation, oxidation, and short circuits, and will also block the filters on the cooling fans. ▲

Floors must be free of vibration caused, for example, by equipment in adjoining locations. Propagation of vibrations and their influence on complex instrumentations are difficult to predict. We encourage you to contact us at support.ftms.bremen@thermofisher.com if you have questions or concerns about your laboratory.

Thermo Fisher Scientific has made vibration measurements of an environment where the LTQ Orbitrap Series instrument is successfully operated. For your information, the data are listed in Table 3-2.¹

Frequency [Hz]	Velocity [mm/s]
48.3	0.09
25.25	0.07
11.0	0.05
10.8	0.06
6.5	0.02
2.5	0.02

Table 3-2. Vibration measurement data

¹The relation between frequency, velocity and acceleration is given by the following equation: Velocity [mm/s] = Acceleration [mm/s²] / Frequency [Hz]

Lighting

	Good lighting makes any work area more enjoyable. Since a lot of work is done on the computer terminal, it may be convenient to have a dimmer switch on the lights to reduce eyestrain. A small, high-intensity lamp is recommended for cleaning MS detector components, source inspection, and manipulation of small components.
Particulate Matter	
	The air in your laboratory must not have excessive dust, smoke, or other particulate matter. For reference, the air should contain fewer than 3500000 particles per cubic meter (100000 particles per cubic foot) in excess of 5 µm.
	Dust can clog the air filters, causing a reduction in airflow around electronic components. Dust will also form a layer on electronic components that will act as an insulating blanket and thus reduce the transfer of heat from the components to the surrounding air.
Radio Frequencies	
	The LTQ Orbitrap Series systems are able to withstand electromagnetic fields of 3 V/m in the frequency range 26 MHz to 1 GHz without any influence to operation.
	If strong radio transmitters are operating close to your laboratory, you

If strong radio transmitters are operating close to your laboratory, you should contact us at support.ftms.bremen@thermofisher.com for advise. Because of the complexity of such influences, no general suggestion can be given in this guide.

Electrostatic Discharge

Electrostatic discharge (ESD) can damage the electronic components of your LTQ Orbitrap Series system. Thermo Scientific instruments are designed to withstand electrostatic discharges (ESD) up to 4 kV (air discharge) and 4 kV (contact discharge) with all panels in place. However, if the panels are removed and the PCBs are handled without proper precautions, the electronic components might be damaged or fail prematurely. Static electricity can develop in a variety of ways. A few examples of how electrostatic charge can develop are as follows:

- When walking across a carpet in a room that is at 20% relative humidity, as much as 35000 V of electrostatic potential can be generated on the surface of your body. This same motion in a room at 80% relative humidity generates about 1500 V of electrostatic potential.
- Sitting and working in a chair padded with polyurethane foam in a room at 20% relative humidity can cause as much as 18000 V of electrostatic potential to develop on your skin or 1500 V at 80% relative humidity.
- Working in laboratory coats and clothing made of synthetic fibers can cause the accumulation of static electricity on your skin.
- Styrofoam cups and packing materials typically have a considerable electrostatic charge on them.

The discharge of static electricity is not perceptible to a human being until the potential is at least 4000 V. Many electronic components can be damaged by a discharge of electrostatic potential of as little as 50 V. ESD damage can be catastrophic causing your system to cease functioning. More commonly, however, ESD damage might cause latent problems that are detrimental to sensitive electrical components, causing premature failures. Therefore, Thermo Fisher Scientific recommends the following precautions, especially when you are operating your system at the lower end of the relative humidity specification listed above:

- Use a static-dissipating floor covering (such as tile or conductive linoleum) in the room that houses your instrument.
- Use laboratory chairs covered with natural fiber or other static dissipating material.
- When operating the instrument, wear laboratory coats and clothing made of natural fiber or other static-dissipating material.
- Keep Styrofoam cups or packing materials away from the instrument.

Chapter 4 Line Power

The performance and longevity of your system can be affected by the quality of line power delivered to the system. To ensure that your instrument performs optimally and that is not damaged by line power fluctuations, please verify that you comply with all power quality requirements.

Note It is your responsibility as the user to provide a source of power of acceptable quality for the operation of your system. ▲

More information on each of the requirements is available under the following topics:

- "Available Outlets" on page 4-2
- "Connecting the MS Detector and Modules to Wall Outlets" on page 4-4
- "Quality of Power" on page 4-6
- "Power Monitoring Devices" on page 4-7
- "Power Conditioning Devices" on page 4-8
- "Uninterruptible Power Supply" on page 4-8
- "Delta-to-Y Conversion Transformer" on page 4-9
- "Technical Assistance" on page 4-10

Available Outlets

The LTQ Orbitrap Series instruments are designed to operate at a nominal voltage of 230 V ac, 50/60 Hz. The minimum and maximum voltage tolerances are in compliance with IEC 950, Amend 2, 1993, paragraph 1.6.5, as follows:

"Equipment intended to operate directly from the main supply shall be designed for a minimum supply tolerance of +6% and -10%. If the rated voltage is 230 V ac single phase or 400 V ac three phase, the equipment shall operate safely within a minimum supply tolerance of $\pm 10\%$."

The basic power requirements for a LTQ Orbitrap Series system consist of the following:

- A wall outlet for the mass spectrometer:
 - Nominal voltage of 230 V ac, ±10%, frequency of 50/60 Hz
 - Three phases, 5-wire system in Y configuration (neutral wire connected to earth). Refer to topic "Delta-to-Y Conversion Transformer" on page 4-9 for further information.
 - Each phase fused with 15 A (tripping characteristic B).
- A wall outlet for the recirculating chiller as specified in Table 4-2 on page 4-4.
- Additional single-phase wall outlets (for computer, monitor, and printer) Nominal voltage 230 V ±10%, 50 or 60 Hz ac, fused with 10 A.

Note The LTQ Orbitrap Series system must have an earth ground hard-wired to the main panel. The interconnected power outlets for the LTQ Orbitrap Series system are to have a common point to one ground connector. If there are two such points, each of which is connected to separate external ground, they will cause noise current to flow through the ground system via the ground loop that is formed. ▲

Note Power is to remain on. The LTQ Orbitrap Series system should remain on and pumping continuously for optimum performance. ▲

Power Cables, Connectors

The power cables to the LTQ Orbitrap Series instruments are 5 m (16 ft) long. The cables from the personal computer, monitor, and printer are approximately 2 m (6 ft) long.

The LTQ Orbitrap Series instruments are shipped with the 16 A version of a 5 pole CEE male connector which is rated at 3×16 A and 230 V ac. See left photo in Figure 4-1 on page 4-3. The right photo in Figure 4-1 shows the wall receptacle required for the LTQ Orbitrap Series instruments (IP 44; 5 poles; 380 Volt; 50/60 Hz; red; CEE-Norm IEC 309.1 and 309.2). The receptacle is provided by Thermo Fisher Scientific as part of the Preinstallation Kit.



Figure 4-1. Connector and wall receptacle for the LTQ Orbitrap Series

Local codes in your area may require another type of plug and receptacle be installed. The Thermo Fisher Scientific Field Engineer for your country will provide the appropriate power plugs.

Connecting the MS Detector and Modules to Wall Outlets

Take care to ensure that the wall outlet specifications are not exceeded. The LTQ Orbitrap Series instrument must have a separate "clean" line leading to a main fuse to guarantee disturbance-free operation. Locally supplied personal computer hardware must use the same power line and ground connection as the LTQ Orbitrap Series instrument.

The electrical wall outlet for the main power of the LTQ Orbitrap Series instrument should be located at the wall near the intended location of the instrument.

Power Supply for Chiller and other Modules

Additional power outlets might be required for test and cleaning equipment, such as an oscilloscope and ultrasonic bath. The maximum load for a 230 V ac fourplex outlet is typically 16 A. We recommend at least six (6) spare 230 V ac outlets behind the system and three (3) close to the workbench space within your laboratory.

Electric power for linear ion trap and liquid chromatograph is provided by the LTQ Orbitrap Series instrument. In LTQ Orbitrap Series ETD instruments, the ETD Module is connected to the power outlet for peripheral devices and the data system is connected to a wall outlet. In all other LTQ Orbitrap Series instruments, the mass spectrometer provides the electric power for the data system. See Table 4-1.

Table 4-1. Electric power supply for data system

System	Power for data system supplied by
(MALDI) LTQ Orbitrap Discovery	mass spectrometer
(MALDI) LTQ Orbitrap XL	
LTQ Orbitrap Velos	
LTQ Orbitrap XL ETD	wall outlet
LTQ Orbitrap XL ETD	

For the recirculating chiller and all other additional devices, please use wall outlets instead. The NESLAB ThermoFlex 900 recirculating chiller requires a dedicated power outlet that complies with the specifications listed in Table 4-2.

Table 4-2.	Power outlet req	uirements fo	or NESLAB	ThermoFlex 900
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Voltage [V ac]	Frequency [Hz]	Phase	Receptacle Rating [A]
115	60	1Ø	15
230	50	1Ø	15

Note All single-phase auxiliary wall outlets should use the same ground as power line of the instrument. ▲

The specifications on the individual modules might vary from those in this guide. The power specifications on the module and in the respective manual always supersede those in this guide.

Note Refer to your LC equipment manual for power requirements and specifications. ▲

Quality of Power

The quality of power supplied to your LTQ Orbitrap Series system is very important. The quality of line voltage must be stable and within the specifications listed in this guide. The line voltage must be free of fluctuations due to slow changes in the average voltage, surges, sags, or transients.

Below are definitions for the most common voltage disturbances:

- **Harmonic distortion** is a high-frequency disturbance that may affect operation of your LTQ Orbitrap Series instrument. This disturbance appears as distortion of the fundamental sine wave.
- **Slow average** is a gradual, long-term change in average root mean square (RMS) voltage level, with typical durations greater than 2 s.
- **Sags and surges** are sudden changes in average RMS voltage level, with typical durations between 50 µs and 2 s.
- **Transients** (or impulses) are brief voltage excursions of up to several thousand volts with durations of less than 50 µs.

Harmonic distortion causes noise in the power supply lines and degrades instrument performance. Constant high line voltage, impulses, or surges in voltage can cause overheating and component failures. Constant low line voltage or sags in voltage can cause the system to function erratically or not at all. Transients, even of a few microseconds duration, can cause electronic devices to fail catastrophically or to degrade and eventually shorten the lifetime of your system. Therefore, it is important to establish the quality of the line voltage in your laboratory before your LTQ Orbitrap Series system is installed.

Power Monitoring Devices

A variety of devices is available to monitor the quality of your line power. The power line disturbance analyzers are capable of detecting and recording most types of power supply problems. These instruments provide a continuous record of line performance by analyzing and printing out information on three types of voltage disturbances:

- Slow average
- Sag and surge
- Transient

In the first two cases, the duration as well as the amplitude of the disturbance is indicated by time interval recording.

The power line must be monitored continuously for seven consecutive days, 24 hours a day. If inspection of the printout indicates disturbances, the test should be terminated and corrective action taken. Then, the power should be monitored again as described above.

Line monitors can be rented from electrical equipment suppliers (see topic "Technical Assistance" on page 4-10). If necessary, your local Thermo Fisher Scientific office can assist in interpretation of the results and recommend appropriate corrective measures.

Power Conditioning Devices

Various line voltage conditioning devices are available that can correct your line voltage problem. If you have good regulation but the power line disturbance analyzer shows transient voltages, then an isolation/noise suppression transformer should be adequate to resolve the problem. If there are transient and regulation problems, then you should consider power conditioners, which control both of these problems.

The conditioning transformer that would be installed between your laboratory power and the instrument requires your electrician to install a circuit with current rating (ampacity) for the power conditioner power requirements which are 60 amps, 60 Hz, 3-phase, 208–240 volt, North America (phase-to-phase) AC, 4 conductor (3 phase plus ground) power feed for its hard-wired input.

When nominal voltage is free from voltage sags, surges, and impulses but more than $\pm 10\%$ outside the required 230 V, the supply voltage can be lowered (bucked) or raised (boosted) using a buck/boost transformer. Buck/boost transformers are available from Thermo Fisher Scientific.

Your electrician should install the buck/boost transformer before the installation of your system is started.

Additional information can be obtained by contacting your local Service Technician.

Note For compliance and safety, ensure that your power conditioning devices are certified by recognized domestic and international organizations (for example, UL, CSA, TÜV, and VDE). ▲

Uninterruptible Power Supply

If your local area is susceptible to corrupted power or power disruptions, then an uninterruptible power supply (UPS) should be installed in your laboratory. Take the values listed in Table 3-1 on page 3-2 as guideline for dimensioning an UPS.

Note For compliance and safety, ensure that your uninterruptible power supply (UPS) devices are certified by recognized domestic and international organizations (for example, UL, CSA, TÜV, and VDE). ▲

Delta-to-Y Conversion Transformer

In case of a Delta configuration in your location (ask the responsible electrician), an isolation transformer is required that steps up the three phases 120 V ac (Delta) to 230 V ac (Y) with respect to ground. A suitable transformer is available from Thermo Fisher Scientific. Line conditioners have beside other advantages the same capability.



Figure 4-2. Delta-to-Y conversion

Note In Y configuration, the nominal voltage 230 V ac must be measured phase to ground; between the phases 400 V ac is measured. ▲

Technical Assistance

Occasionally, Thermo Fisher Scientific encounters line-voltage sources of unacceptable quality that adversely affect the operation of the mass spectrometer. Rectifying such power-supply problems is the user's responsibility. However, (upon request) Thermo Fisher Scientific will attempt to assist in diagnosis, but does not undertake to isolate and correct power-supply quality problems.

Contact your Thermo Fisher Scientific office for assistance in monitoring the line voltage in your laboratory, in selecting a line conditioner, or in locating a power consultant in your area.

Specifying power conditioning equipment is a complex task that is best handled by a company or consultant specializing in that field. A selection of such companies¹ is listed below:

General Electric Company (Worldwide distribution network) Internet: www.ge.com

JOVYATLAS Groninger Str. 29-37 26789 Leer / Ostfriesland Phone: +49 (491) 6002 0 Fax: +49 (491) 6002 10 Internet: www.jovyatlas.de

OnLine Power, Inc. (Conform to all applicable standards, worldwide) Internet: www.onlinepower.com

POWERVAR, INC. Internet: www.powervar.com

SOLA / HEVI-DUTY Internet: www.sola-hevi-duty.com

Warner Electric Motors and Controls division Internet: www.warnernet.com

¹Thermo Fisher Scientific does not endorse any manufacturer, nor does it endorse products other than its own. Companies and products listed in this guide are given as examples only.

Chapter 5 **Consumables**

Your instrument requires gases and solvents that must meet defined purity specifications. The Service Engineer might also require certain solvents for the installation verification of your system.

Note It is your responsibility as the user to provide correct gas and solvent supplies for the operation of your system. ▲

More information on each of the requirements is available under the following topics:

- "Fittings and Parts" on page 5-2
- "Gases" on page 5-3
- "Solvent Recommendations" on page 5-7
- "Cooling Water" on page 5-8
- "Cleaning Agents" on page 5-9

Fittings and Parts

Table 5-1 lists the minimum parts that are required to connect your LTQ Orbitrap Series instrument to your gas delivery system. Your connections and gas delivery system might vary, and it is your responsibility to supply any fittings or connections necessary during installation.

Table 5-1	Gas conn	ection	hardware	required
	003 00111	JULION	naruvaru	requireu

	Description		LTQ Orbitrap Series P/N (in Accessory kit P/N 97055-62003)
u	6×1 mm OD Teflon	[®] hose (P/N 0690280)	2 m (6 ft) provided. You might require additional length.
Nitroge	Connection for the source	opposite end of the Teflon hose to the nitrogen gas	Not provided in kit. You supply these parts.
	1/8-in OD copper t	ubing	2 m (6 ft) provided. You might require additional length.
*	Brass Swagelok-ty	/pe 1/8-in nut	00101-15500
lium	2-piece brass 1/8-	in ID ferrule	00101-08500 (front)
He			00101-02500 (back)
	Connection for the	opposite end of the tubing to the helium gas source	Not provided in kit. You supply these parts.
For LTQ Orbitrap Series instruments equipped with HCD collision cell:			
as	Argon (optional):	6×1 mm OD Teflon hose	Not provided in kit. You supply this part.
Collision g	Nitrogen:	T-piece (P/N 1128140)	provided
For	LTQ Orbitrap Seri	es instruments equipped with ETD system:	
	One 10 ft. length c installation might	of 1/8-in OD pre-cleaned copper tubing is provided. Your require an additional length of tubing.	00301-22701
gas	Brass Swagelok-ty	/pe 1/8-in nut	00101-15500
rrier	2-piece brass 1/8-	in ID ferrule	00101-08500 (front)
nt ca			00101-02500 (back)
eage	Stainless steel Sw	/agelok 1/8-in ID nut	00101-07-00004
ETD r	2-piece stainless s	steel 1/8-in ID ferrule set	00101-08-00009
	Connection for the source	opposite end of the tubing to the UHP nitrogen gas	Not provided in kit. You supply these parts.

*For helium, it is recommended to use stainless steel tubing and stainless steel nut and ferrules, if available.

	Your system can use large amounts of gases during daily operations. It is essential that the gases be delivered with the necessary pressure and purity. Refer to the following topics for information on the purity and pressure that your system requires:	
	• "Helium" on page 5-3	
	• "ETD Reagent Carrier Gas" on page 5-5	
	• "Nitrogen" on page 5-4	
	• "Argon" on page 5-6 (optionally for HCD collision gas)	
	Caution Contaminates introduced during the installation of house lines used for gas delivery can cause damage to the system. Ensure that all gas lines used with your system have been cleaned of all particulates and oils. You are responsible for any damage to the instrument caused by contaminates introduced from your gas delivery system. ▲	
	Caution Do not store gas cylinders where they can damage cables or gas lines, and secure them in accordance with standard safety practices. \blacktriangle	
Helium		
	The LTQ Orbitrap Series instrument uses helium as the collision gas for the linear trap. The helium supply must be ultra-high purity (99.999%) with less than 1.0 ppm each of water, oxygen, and total hydrocarbons. The required gas pressure is 275 ± 70 kPa (2.75 ± 0.7 bar, 40 ± 10 psi). Because particulate filters can be a source of contamination, Thermo Fisher Scientific does not recommend their use.	
	Helium can be dispensed from a tank containing 245 ft ³ of gas using Matheson regulator #3104C or equivalent tank and regulator. ¹	
	Gas lines for helium should be stainless steel. All gas lines should be free of oil and preferably flame dried. Helium gas supply lines should terminate with 1/8 inch, female, Swagelok [®] -type connectors.	
	Note Do not shut off the helium gas. A continuous flow of helium is required for the optimum performance of the MS detector. Thermo Fisher Scientific recommends installing a separate helium supply for the LTQ Orbitrap Series instrument that is independent of a possibly available centralized supply. ▲	
	If you intend to use helium for sparging your LC solvents, a second tank and regulator is required.	

¹For more information, visit www.matheson-trigas.com or consult a regulator supplier of your choice.

Nitrogen

LTQ Orbitrap Series instruments use nitrogen as the API sheath gas, API auxiliary/sweep gas, Orbitrap[™] bath gas – and HCD collision gas for instruments equipped with an HCD collision cell. MALDI LTQ Orbitrap Series systems use nitrogen gas to maintain the pressure in the upper sample chamber of the MALDI source at 75 mTorr. The LTQ Orbitrap XL ETD and the LTQ Orbitrap XL ETD use nitrogen gas for cooling the reagent vials when the reagent ion source is turned off. The nitrogen supply must be high purity (99%). The required gas pressure is 690 ± 140 kPa (6.9 ± 1.4 bar, 100 ± 20 psi).

The nitrogen gas supply line should terminate with a 6 mm (1/4-in), female, Swagelok[®]-type connector. Because particulate filters can be a source of contamination, Thermo Fisher Scientific does not recommend them.

Note You must provide a regulator for the nitrogen supply that is adjustable over the specified pressure range.¹ \blacktriangle

Typical nitrogen gas consumption (nitrogen on 24 hours per day) of a LTQ Orbitrap Series instrument is 5560 L (200 ft³) per day. Using the MALDI source in MALDI LTQ Orbitrap Series systems will reduce the nitrogen consumption. In case you intend to use nitrogen as HCD collision gas for LTQ Orbitrap Series instruments equipped with HCD collision cell, add the gas consumption that is specified in topic "Argon" on page 5-6 to calculate the total nitrogen consumption.

Thermo Fisher Scientific recommends that nitrogen be supplied from one of the following sources:

 A large, sealed, thermally insulated cylinder containing liquid nitrogen, from which the nitrogen is boiled off. The 230 psi model is recommended. The 35 and 80 psi models do not provide sufficient gas pressure. A typical cylinder of size 240 L yields 143850 L (5080 ft³) of gas. The replacement frequency is approximately once every month.

¹For more information, visit www.matheson-trigas.com or consult a regulator supplier of your choice.

Liquid nitrogen conversion factors:

- 1.0 lb of liquid nitrogen = 0.5612 L
- 1.0 kg of liquid nitrogen = 1.237 L
- A nitrogen generator with minimum capacity of 5560 L (200 ft³) per day at 99% purity with 100 psi at the side panel. Worst case consumption of nitrogen gas is 30 L/min (56 Standard Cubic Feet per Hour). Nitrogen generators require an air compressor. Some models of air compressors are quite noisy; therefore, be careful to select a quiet compressor. A generator is a continuous source with no replacement required.

Note When you turn on the LTQ Orbitrap Series system, the initial nitrogen surge might exceed the capacity of the nitrogen generator. This sudden surge causes a flow rate drop that can trigger a low nitrogen warning from the LTQ Orbitrap Series system. If low nitrogen warnings happen frequently, call your Thermo Fisher Scientific field service engineer. ▲

ETD Reagent Carrier Gas

The ETD Module requires an additional ultra high-purity reagent carrier gas that is connected to the triple (oxygen/water/hydrogen) gas filter supplied in the ETD Accessory Kit (P/N 98000-62002) and then to the rear of the ETD Module as shown in the *LTQ Series Getting Connected Guide*.

Thermo Fisher Scientific strongly recommends a mixture of 25% helium and 75% nitrogen. This gas mixture must be ultra high-purity (minimum purity 99.999%) with less than 3.0 ppm each of water, oxygen, and total hydrocarbons. The required gas pressure is 690 ± 140 kPa (6.9 ± 1.4 bar, 100 ± 20 psi). This mixture is available in the United States from Airgas (P/N X02NI75C200F464). Another supplier is Air Liquide.

The ETD Module consumes less than 1 mL per minute (1.5 L or 88 in³ per day) of reagent carrier gas (gas on 24 hours per day), so a standard large bottle (245 ft^3) of gas lasts approximately two years.

The helium in this mixture serves as a tracer gas to enable leak checking of gas connections using conventional thermal conductivity-based leak detectors, which are widely used to check leaks in gas chromatography equipment.

If the helium/nitrogen mixture is not available, then use a nitrogen supply that is ultra high-purity (99.999%) with less than 3.0 ppm each of water, oxygen, and total hydrocarbons. The required gas pressure is 690 ± 140 kPa (6.9 ± 1.4 bar, 100 ± 20 psi).

Note A nitrogen generator does not produce nitrogen of a sufficient purity to be used as the ETD reagent carrier gas. \blacktriangle

The triple gas filter, when installed between the regulator on the gas source and the ETD Module, further ensures that the reagent carrier gas (either nitrogen or helium/nitrogen) is better than 99.999% pure with much less than 1 ppm of oxygen, water, and hydrocarbons.

Refer to the filter manufacturer's instructions for information about how to monitor the color changes in the filters that indicated when the filters need to be replaced, as well as information about where to order new filters. If there are no leaks in the reagent carrier gas plumbing, you can expect the filters to last a year or more. Thermo Fisher Scientific strongly recommends that a Thermo Fisher Scientific field service engineer replace the gas filters.

You must provide a regulator for either gas supply that is suitable for such ultra high-purity grade gas. Generally, a two-stage regulator with a machined brass body and an elastomer-free metal diaphragm is adequate. The regulator should be able to stably output the specified nominal pressure of 100±20 psig (relative to atmosphere) and have a 1/8 inch Swagelok-type compression fitting output connection. Your gas supplier should be able to recommend a suitable regulator that connects to the high pressure connection on their gas bottles. The ETD Accessory Kit contains pre-cleaned copper tubing to connect this carrier gas supply to the gas filter and the gas filter to the rear of the ETD Module. If your installation requires more copper tubing than is supplied in the kit, use only GC-cleaned copper tubing or flame dried stainless steel tubing.

Note Do not shut off the reagent carrier gas. Optimum performance of the LTQ Orbitrap Series mass spectrometer requires a continuous flow of reagent carrier gas. ▲

Argon

LTQ Orbitrap XL and LTQ Orbitrap Discovery instruments can optionally use argon as HCD collision gas. The argon supply should be high purity (99.99%). The required gas pressure is 690 ± 140 kPa (6.9 ± 1.4 bar, 100 ± 20 psi).

The argon gas supply line should terminate with a 6 mm (1/4-in), female, Swagelok[®]-type connector. Particulate filters can be a source of contamination, they are not recommended.

Typical argon gas consumption (argon on 24 hours per day) is 30 L (1 ft^3) per day.

Solvent Recommendations

The solvents listed in Table 5-2 are useful in operating and maintaining your LTQ Orbitrap Series instrument. Installation of the instrument requires LCMS grade methanol and water. Solvent modifiers might also be required during the installation of some systems.

Some solvent impurities are transparent to UV/VIS detectors. Therefore, some LCMS grade solvents might contain contaminants that interfere with the performance of the mass spectrometer. For operation of your LTQ Orbitrap Series instrument, choose high purity solvents with minimum contamination. You can order specific chemicals from Thermo Fisher Scientific, which are sold under its Fisher Chemical brand. As specified in Table 5-2 use only LCMS grade chemicals for operating your LTQ Orbitrap Series system.

Solvent / Reagent	Specifications	Fisher Chemical P/N
Methanol	LCMS grade	A456-4
Acetonitrile	LCMS grade	A955-4
Water	LCMS grade	W6-4
Isopropyl alcohol	LCMS grade	A461-4
Acetic acid (modifier)	LCMS grade	A507-500 or A35-500
Formic acid (modifier)	99–100% (This acid must be supplied in a glass bottle.)	A117-50

Table 5-2.Recommended solvents and reagents

For a complete selection of LCMS-grade consumables from Fisher Scientific, visit www.FisherLCMS.com.

Note Do not filter solvents. Filtering solvents can introduce contamination. \blacktriangle

Note For some MALDI applications or high sensitivity analysis in MALDI, Thermo Fisher Scientific suggests using highest purity grade water stored in appropriate plastic bottles (no glass). ▲

Store and handle all chemicals in accordance with standard safety procedures.

Cooling Water

The LTQ Orbitrap Series instrument is delivered with a NESLAB ThermoFlex 900 recirculating chiller with closed circuit, cooled by a refrigerating device. The chiller makes the mass spectrometer independent from any cooling water supply.

Technical Data Recirculating Chiller

	Cooling capacity:	0.90 kW (60 Hz), 0.75 kW (50 Hz)
	Water temperature:	5–40 °C (41–104 °F)
	Stability of temperature regulation:	±0.1 °C (±32.2 °F)
	Unit dimensions $(h \times w \times l)$:	69.4 cm × 35.7 cm × 62.4 cm (27 5/16 in × 14 1/16 in x 24 9/16 in)
	Unit weight:	57.2 kg (126 lb)
Connecting the Chiller		
Water Conditions	Use a wall outlet to provide the Table 4-2 on page 4-4 for spec internal diameter 9 mm, wall t 3 m (~10 ft) are delivered with to the ports at the right side of	e electric power for the chiller. (See ifications.) Two water hoses (black), hickness 3 mm, length approximately the instrument. The hoses are connected the MS.
water Conditions		
	The water temperature is not c. 25 °C (68 to 77 °F). Lower tem atmospheric water vapor. It is r than de-ionized water due to lo residual organic matter.	ritical, but should be in the range of 20 to operatures could lead to a condensation of ecommended to use distilled water rather ower concentration of bacteria and
	The water should be free of sus cooling circuit. In special cases guarantee consistent water qua	spended matter to avoid clogging of the , an in-line filter is recommended to lity.
	The cooling water should meet	t the following requirements:
	Hardness:	<0.05 ppm
	Resistivity:	$1-3 \text{ M}\Omega/\text{cm}$
	Total dissolved solids:	<10 ppm
	pH:	7–8

Cleaning Agents

We recommend having the following cleaning agents available:

- A solvent like acetone (in accordance with your local safety practices).
- A detergent, e.g. RBS 50 (trade name of Messrs. Carl Roth, Karlsruhe, Germany).
- Several liters of distilled water.

Chapter 6 Exhaust and Waste

The proper performance of your system can be affected by the waste and exhaust arrangements for the instrument. Vacuum and solvent wastes must be vented separately, and wastes must be collected and disposed of properly.

Note It is your responsibility as the user to provide proper waste and exhaust systems for the operation of your system. ▲

More information on each of the requirements is available under the following topics:

- "Exhaust System" on page 6-2
- "Solvent Waste" on page 6-3

Exhaust System

Thermo Fisher Scientific strongly recommends connecting the forepumps to a fume exhaust system. The forepumps eventually exhaust much of what is introduced into the mass spectrometer, including the small amount of oil vapor that mechanical pumps can emit. It is your responsibility to provide an adequate exhaust system.

Note An efficient fume exhaust system is required for the proper operation of your forepumps. Most API applications contribute to the accumulation of solvents in the forepumps. These solvents must be purged from the mechanical pump oil periodically by opening the ballast valves located on the top of the pumps. When the ballast valves are opened, a large volume of volatile solvent waste might enter the fume exhaust system. Therefore, your fume exhaust system must be able to accommodate the periodic purging of the solvents. The frequency of the purging is dependent on the throughput of your system. ▲

The forepumps have two functions: (1) providing a vacuum for the capillary skimmer of the API source, (2) providing backing pressure for the turbomolecular pumps.

The exhaust port of the rotary pumps should be connected to an exhaust gas line leading out of the building or exhaust system. The inner diameter of the pipe should be at least 25 mm (1 in). An exhaust hose for connecting the forepump to the exhaust system comes with the system (P/N 0690720) and is 5 m (16 ft) long. It has dimensions of 13 mm (1/2 in) ID and 20 mm (25/32 in) OD. The exhaust system for the forepumps must be able to accommodate an initial inrush flow rate of 3 L/min and a continuous flow rate of 1 L/min.

Note Do not route exhaust tubing from the pumps vertically toward the ceiling. To maintain pump integrity, route the tubing from the exhaust port down to the floor. ▲

Note The exhaust hose should travel at floor level for a minimum of two meters (78.5 in) before it reaches the external exhaust system. This tubing acts as a trap for exhaust fumes that would otherwise recondense in the forepump oil. \blacktriangle

Ventilation

Most of the nitrogen that is introduced into the API source (about 5000 L or 180 ft^3 per day) escapes into the laboratory atmosphere. Therefore, provide for good air exchange to prevent accumulation of gaseous nitrogen in the laboratory.
Solvent Waste

Because the Ion Max API source can accommodate high flow rates, you must collect the waste solvent in a manner that avoids pressure buildup in the source. The Ion Max API source is fitted with a 25.4-mm (1.0-in) OD outlet for solvent drainage. A 25.4-mm to 12.7-mm (1-in to 0.5-in) reducing fitting (P/N 00101-03-00001) connects to a waste container (P/N 00301-57020), both of which come with the system. To avoid pressure buildup in the source, make sure that the 1-inch diameter hose from the API source drain to the reducing fitting (P/N 00101-03-00001) is as long as possible. The 25.4-mm (1-in) diameter Tygon[™] tubing (P/N 00301-01-00020) that comes with the system is 1.52 m (5 ft) long.



Warning The interior of the Ion Max API source housing contains parts that might be at high temperatures or high voltages. To prevent users from inadvertently touching such parts, always operate the Ion Max API source with the drain tubing assembly mounted to the source housing drain. ▲

Caution Do **not** vent the drain tubing (or any vent tubing connected to the waste container) to the same fume exhaust system to which you have connected the forepump. ▲

Chapter 7 Instrument Arrival

When your lab site preparation is completed, the "LTQ Orbitrap Series Installation Request Form" has been mailed or faxed to your Thermo Fisher Scientific office, and the system is delivered, please call your Thermo Fisher Scientific office to arrange for an installation date. Refer to the Installation Request Form at the beginning of this guide. Telephone and fax numbers for Thermo Fisher Scientific offices are listed immediately following the Installation Request Form.

LTQ Orbitrap Series instruments are transported either by carriers who specialize in the handling of delicate machinery, or for long distance shipment by airfreight. Occasionally, however, equipment inadvertently does get damaged in transit.

Please take the following precautions when receiving material:

- Check carefully for obvious damage or evidence of rough handling.
- If external damage is apparent, take photographs, note this fact on all copies of the receiving documents and describe briefly the extent of the damage. The driver should sign (or initial) next to your comments to signify agreement with your observations.
- Contact the appropriate local Thermo Fisher Scientific office to report the damage and please let the Thermo Fisher Scientific people check for further damage.

Note Freight insurance requires that obvious damage be noted on the receiving documents. Thermo Fisher Scientific will not accept liability for damage if materials are received with obvious damage and the damage is not recorded on the receiving documents. ▲

When your system arrives, move it to a protected location indoors, preferably the installation site. Take the specifications described in topic "Temperature" on page 3-2 as a guideline for the temperature in the storage room. If you have questions about moving your system, contact your local Thermo Fisher Scientific Office.

Transportation Risk

Transportation risk depends on the terms of delivery agreed. The terms of shipment determine who has responsibility for filing a claim against the carrier if the system is damaged in transit.

Chapter 8 Installation

Prior to installation, make sure that all preparations described in the previous chapters are complete.

Note If the instrument shipping container, Shock Watch, or other indicator shows any evidence of damage or mishandling during shipment, do NOT open the container. Call your Thermo Fisher Scientific representative for instructions on what to do. If the system arrives safely, proceed with the following instructions. ▲

When your lab site preparation is completed, the "LTQ Orbitrap Series Installation Request Form" has been mailed or faxed to your local office for Thermo Scientific products, and the system is delivered, please call your Thermo Fisher Scientific office to arrange for an installation date. Refer to the Installation Request Form at the beginning of this guide. Telephone and fax numbers for offices for Thermo Scientific products are listed immediately following the Installation Request Form.

More information on each of the requirements is available under the following topics:

- "Preparing the Installation" on page 8-2
- "Advanced Training Courses" on page 8-7
- "Preventive Maintenance" on page 8-8

Preparing the Installation

This topic provides advice for preparing the installation of the instrument.

Caution Store the instrument in a protected location indoors. Take the specifications described in topic "Temperature" on page 3-2 as a guideline for the temperature in the storage room. ▲

Chemicals Needed for Installation

The chemicals listed in Table 8-1 are needed for installation. They are not contained in the LTQ Orbitrap Series package but will be delivered in a separate package as part of the Preinstallation Kit.

Note The installation will not begin until the arrival of all chemicals listed in Table 8-1! ▲

Table o-1. Calibration compounds for LFC Orbitrap Series instrument	Table 8-1.	Calibration	compounds	for LTQ	Orbitrap	Series	instrument
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Description	Quantity	Sigma-Aldrich Product Number
Sodium Dodecyl Sulfate	10 g	L4509-10G
Sodium Taurocholate Hydrate	250 mg	T4009-250MG
Caffeine Methanol Solution	1 mL	C6035-1ML

To order more of these compounds, contact:

Sigma Chemical Company P. O. Box 14508 St. Louis, Missouri, USA 63178-9916 Phone (800) 325-3010 (in the USA or Canada) (314) 771-3750 (outside the USA or Canada)

Web site www.sigma-aldrich.com

Chemical Kits, Equipment, and Consumables for the MALDI Source

If your LTQ Orbitrap Series instrument is equipped with the MALDI source, ensure that you have these items available before your system is installed. The equipment and materials listed in this topic are also required for many routine operational tasks.

Required Chemical and Accessory Kits for MALDI

	The required chemical and accessory kits are the following:
	 ProteoMass[™] Calibration Kit available from Thermo Fisher Scientific (P/N HAZMAT-01-0033) or Sigma-Aldrich[™] (P/N MSCAL4, call 1-800-325-5832), which contains the chemicals needed to tune and calibrate the instrument in the MALDI mode. The MALDI Preinstallation material checklist contains ordering information.
	Note Because the kit contains protein mixes that require refrigeration, make sure that you specify a shipping location where the appropriate personnel are available to receive the kit. ▲
	• MALDI Accessory Kit (P/N 97155-62025), which contains laser protective eye wear, tools, swabs, gloves, and other items and is shipped with the MALDI system.
Optional Kits for MALDI	
	The following kits may be required for installing optional devices for the LTQ Orbitrap Series/MALDI system:
	• Tissue Imaging Kit for the LTQ Orbitrap Series/MALDI system
	• API Kit for the LTQ Orbitrap Series/MALDI system (P/N 97155-97123), which contains the necessary parts to convert the system to the API mode.
Equipment for MALDI	
	The following equipment is required for installing the LTQ Orbitrap Series/MALDI system:
	• Sonication bath large enough to hold 1 L beaker
	• Microcentrifuge ¹
	• Vortexer ¹
	- Pipettors (2.5 $\mu L,$ 200 $\mu L,$ and 1000 μL recommended; additional sizes may be useful.)^1

- Analytical balance
- Refrigerator for storing the ProteoMass Calibration Kit

¹Available from Thermo Fisher Scientific, see www.thermo.com.

Consumables for MALDI

The following consumables are required for installing the LTQ Orbitrap Series/MALDI system:

- Microcentrifuge tubes (500 µL)
- Disposable tips for pipettors¹
- Optical lens wipes or soft clean room wipes
- Can of compressed difluoroethane (sold as "compressed air" for dust removal)
- Amber vials to store light sensitive chemicals

Chemicals and Solvents for MALDI

The following chemicals and solvents are required for installing the LTQ Orbitrap Series/MALDI system:

- Water
- Isopropyl alcohol
- Methanol
- Acetonitrile
- Acetone
- Trifluoroacetic acid (TFA)
- 28 to 30% Ammonium hydroxide solution

Note All chemicals and solvents should be HPLC grade or better. ▲

ETD Kits

The following chemicals and solvents are required for installing the LTQ Orbitrap Series ETD system:

- ETD Accessory Kit for the ETD Module (P/N 98000-62002), which contains filaments and other items as well as the gas filter kit, pre-cleaned copper tubing, and fittings to connect it to the ETD Module and the reagent carrier gas supply.
- ETD Ship Kit for the ETD Module (P/N 98000-620004)
- Reagent Kit for the ETD Module (P/N 98000-62008)

¹Available from Thermo Fisher Scientific, see www.thermo.com.

Fluoranthene

Fluoranthene is used as the Electron Transfer Dissociation (ETD) reagent in the ETD Module portion of an LTQ Orbitrap Series ETD system. The fluoranthene radical anion is generated according to the reaction shown in Figure 8-1.



Figure 8-1. ETD Reagent (fluoranthene radical anion) generation from fluoranthene

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

Note Store and handle all chemicals in accordance with standard safety procedures. The Material Safety Data Sheet (MSDS) describing the chemicals being used should be freely available to lab personnel for them to examine at any time. Material Safety Data Sheets (MSDSs) provide summarized information on the hazard and toxicity of specific chemical compounds. The MSDS also provides information on the proper handling of compounds, first aid for accidental exposure, and procedures for cleaning spills or dealing with leaks. Producers and suppliers of chemical compounds are required by law to provide their customers with the most current health and safety information in the form of an MSDS. Read the MSDS for each chemical you use. Dispose of all laboratory reagents in the appropriate way (see the MSDS). ▲

The fluoranthene contained in the ETD Reagent Kit (P/N 98000-62008) is Sigma/Aldrich Supelco #48535. The fluoranthene MSDS is obtained from the MSDS link at:

www.sigmaaldrich.com/catalog/search/ProductDetail/SUPELCO/48535

Thermo Scientific supplies fluoranthene as a two vial kit. One vial contains 150 mg of fluoranthene and the other is the required empty vial.

Unpacking the System

It is the policy of Thermo Fisher Scientific that the customer should not unpack the system or accessory items prior to installation of the system. Two exceptions to this policy are as follows: You are encouraged to locate the Operating Manuals and to begin to become familiar with the operation of the instrument. Where buck / boost transformers or power conditioning units are supplied, it is the customers responsibility to have these units installed by an electrician prior to instrument installation. Installing the System When your new LTQ Orbitrap Series system is on site and ready for installation, a Thermo Fisher Scientific Field Service Engineer will install it. During the installation, the Field Engineer will demonstrate the following: The basics of equipment operation and routine maintenance. The marketing specifications that are in force at the time of the purchase of the system. To receive maximum benefit from this on-site training opportunity, the key operator should be available during the entire installation process. **Note** Consumables sent with the system are intended for use by the service engineer during the installation. It is the responsibility of the customer to replace any consumables used during the installation. ▲ Do not plan to use your new system for sample analysis until the installation is complete and you have signed the Acceptance Form. **Key Operator** Experience has shown that the maximum benefit can be derived from a scientific instrument if there is one person, a key operator, who has major responsibility for that instrument. It is recommended that you designate a key operator to oversee the operation and maintenance of the system in your laboratory. This person will also be the key figure in

the communication between your laboratory and Thermo Fisher

Scientific.

Advanced Training Courses

Thermo Fisher Scientific provides both introductory and advanced training courses in analytical techniques, together with specialized operation and maintenance courses for Thermo Scientific products.

It is also recommended that some months after your LTQ Orbitrap Series system has been installed, the key operator receive an advanced training for the operation and maintenance of the system from Thermo Fisher Scientific. After this training, the key operator can conduct an in-house training program on your site for your own people and certify others to operate the instrument.

For information concerning course schedules and fees, please contact the following address or your local Thermo Fisher Scientific office:

Thermo Fisher Scientific Hanna-Kunath-Str. 11 28199 Bremen

Germany

Phone: +49 (0) 421 - 54 93 0 Fax: +49 (0) 421 - 54 93 426 E-mail: training.bremen@thermo.com

MALDI Training Courses

In case you have your LTQ Orbitrap Series instrument equipped with a MALDI source, it is recommended to receive a MALDI training first and then to get a LTQ Orbitrap Series instrument training.

For information concerning course schedules and fees for MALDI training courses, please contact the following address or your local Thermo Fisher Scientific office:

Thermo Fisher Scientific 355 River Oaks Parkway San Jose, California 95134

USA

Preventive Maintenance

Routine and preventive maintenance of LTQ Orbitrap Series MS detector and data system is in the user's responsibility. Included in this category are exchange of pump oil, replacement of filters, etc. on a regular basis. Please refer also to the manufacturers manuals delivered with the instrument – especially for the maintenance of mechanical pumps and turbopumps.

Regular preventative maintenance is essential. Regular preventive maintenance will increase the life of the system, result in maximum uptime of your system, and provide you with optimum system performance. Maintenance techniques are covered in the following manuals:

- LTQ Orbitrap Discovery Hardware Manual, LTQ Orbitrap XL Hardware Manual, LTQ Orbitrap XL ETD Hardware Manual, or LTQ Orbitrap Velos Hardware Manual
- LTQ XL Hardware Manual or LTQ Velos Hardware Manual
- Manuals that come with your data system computer and other modules of your system

In case your instrument is equipped with the MALDI source, see also the following manuals for maintenance advice:

- MALDI Source Hardware Manual
- MALDI Source Getting Started

Glossary

This section lists and defines terms used in this manual. It also includes acronyms, metric prefixes, symbols, and abbreviations.

В D Ε F G н J Κ Μ Ν 0 R S U V W X Υ Ζ C L 0 Ρ т

A

A ampere

ac alternating current

ADC analog-to-digital converter

- **adduct ion** An ion formed by the joining together of two species, usually an ion and a molecule, and often within the ion source, to form an ion containing all the constituent atoms of both species.
- **AGC[™]** See Automatic Gain Control[™] (AGC).
- **APCI** See atmospheric pressure chemical ionization (APCI).
- **APCI corona discharge current** The ion current carried by the charged particles in the APCI source. The voltage on the APCI corona discharge needle supplies the potential required to ionize the particles. The APCI corona discharge current is set; the APCI corona discharge voltage varies, as required, to maintain the set discharge current.

See also corona discharge and APCI corona discharge voltage.

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

See also APCI spray current.

APCI manifold The manifold that houses the APCI sample tube and nozzle, and contains the plumbing for the sheath and auxiliary gas.

APCI needle, corona discharge A needle to which a sufficiently high voltage (typically ±3 to ±5 kV) is applied to produce a chemical ionization plasma by the corona discharge mechanism.

See also chemical ionization (CI), chemical ionization (CI) plasma, atmospheric pressure chemical ionization (APCI), and corona discharge.

APCI nozzle The nozzle in the APCI probe that sprays the sample solution into a fine mist.

See also atmospheric pressure chemical ionization (APCI).

APCI sample tube A fused silica tube that delivers sample solution to the APCI nozzle. The APCI sample tube extends from the sample inlet to the APCI nozzle.

See also atmospheric pressure chemical ionization (APCI), and API stack.

APCI source Contains the APCI probe assembly, APCI manifold, and API stack.

See also atmospheric pressure chemical ionization (APCI), APCI manifold, and API stack.

- **APCI spray current** The ion current carried by the charged particles in the APCI source. The APCI corona discharge voltage varies, as required, to maintain the set spray current.
- **APCI vaporizer** A heated tube that vaporizes the sample solution as the solution exits the sample tube and enters the atmospheric pressure region of the APCI source.

See also atmospheric pressure chemical ionization (APCI).

API See atmospheric pressure ionization (API).

- **API atmospheric pressure region** The first of two chambers in the API source. Also referred to as the spray chamber.
- **API capillary-skimmer region** The area between the capillary and the skimmer, which is surrounded by the tube lens. It is also the area of first-stage evacuation in the API source.
- **API heated capillary** A tube assembly that assists in desolvating ions that are produced by the ESI or APCI probe.

See also API heated capillary voltage.

API heated capillary voltage The dc voltage applied to the heated capillary. The voltage is positive for positive ions and negative for negative ions.

See also API source and API heated capillary.

API ion transfer capillary A tube assembly that assists in desolvating ions that are produced by the ESI, NSI, or APCI probe.

See also API ion transfer capillary offset voltage and API ion transfer capillary temperature.

API ion transfer capillary offset voltage A dc voltage applied to the ion transfer capillary. The voltage is positive for positive ions and negative for negative ions.

See also API source and API ion transfer capillary.

API ion transfer capillary temperature The

temperature of the ion transfer capillary, which should be adjusted for different flow rates.

See also API source and API ion transfer capillary.

API source The sample interface between the LC and the mass spectrometer. It consists of the API probe (ESI or APCI) and API stack.

See also atmospheric pressure ionization (API), ESI source, APCI source, ESI probe, and API stack.

API spray chamber The first of two chambers in the API source. In this chamber the sample liquid exits the probe and is sprayed into a fine mist (ESI or NSI) or is vaporized (APCI) as it is transported to the entrance end of the ion transfer capillary.

API spray shield A stainless steel, cylindrical vessel that, in combination with the ESI or APCI flange, forms the atmospheric pressure region of the API source.

See also atmospheric pressure ionization (API).

API stack Consists of the components of the API source that are held under vacuum and includes the API spray shield, API ion transfer capillary, API tube lens, skimmer, the ion transfer capillary mount, and the tube lens and skimmer mount.

See also atmospheric pressure ionization (API) and API source.

API tube lens A lens in the API source that separates ions from neutral particles as they leave the ion transfer capillary. A potential applied to the tube lens focuses the ions toward the opening of the skimmer and helps to dissociate adduct ions.

See also API tube lens offset voltage, API source, API ion transfer capillary, and adduct ion.

- **API tube lens and skimmer mount** A mount that attaches to the heated capillary mount. The tube lens and skimmer attach to the tube lens and skimmer mount.
- **API tube lens offset voltage** A DC voltage applied to the tube lens. The value is normally tuned for a specific compound.

See also API tube lens, adduct ion, and source CID.

APPI See Atmospheric Pressure Photoionization (APPI).

ASCII American Standard Code for Information Interchange

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. A reagent gas forms, which efficiently produces positive and negative ions of the analyte through a complex series of chemical reactions.

See also electrospray ionization (ESI).

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

Atmospheric Pressure Photoionization (APPI) A soft ionization technique in which an ion is generated from a molecule when it interacts with a photon from a light source.

Automatic Gain Control[™] (AGC) Sets the ion injection time to maintain the optimum quantity of ions for each scan. With AGC on, the scan function consists of a prescan and an analytical scan.

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 APCI, ESI, or H-ESI nozzle.

auxiliary gas flow rate The relative rate of flow of auxiliary gas (nitrogen) into the API source reported in arbitrary units.

auxiliary gas inlet An inlet in the API probe where auxiliary gas is introduced into the probe.

See also auxiliary gas and atmospheric pressure ionization (API).

auxiliary gas plumbing The gas plumbing that delivers outer coaxial nitrogen gas to the ESI or APCI nozzle.

auxiliary gas valve A valve that controls the flow of auxiliary gas into the API source.

В

b bit

B byte (8 b)

baud rate data transmission speed in events per second

BTU British thermal unit, a unit of energy

C

°C degrees Celsius

CE central electrode (of the Orbitrap)

cfm cubic feet per minute

- **chemical ionization (CI)** The formation of new ionized species when gaseous molecules interact with ions. The process can involve transfer of an electron, proton, or other charged species between the reactants.
- **chemical ionization (CI) plasma** The collection of ions, electrons, and neutral species formed in the ion source during chemical ionization.

See also chemical ionization (CI).

CI See chemical ionization (CI).

CID See collision-induced dissociation (CID).

CLT curved linear trap

cm centimeter

cm³ cubic centimeter

- **collision gas** A neutral gas used to undergo collisions with ions.
- **collision-induced dissociation (CID)** An ion/neutral process in which an ion is dissociated as a result of interaction with a neutral target species.
- **consecutive reaction monitoring (CRM) scan type** A scan type with three or more stages of mass analysis and in which a particular multi-step reaction path is monitored.
- **Convectron[™] gauge** A thermocouple bridge gauge that is sensitive to the pressure as well as the thermal conductivity of the gas used to measure pressures between X and Y.
- **corona discharge** In the APCI source, an electrical discharge in the region around the corona discharge needle that ionizes gas molecules to form a chemical ionization (CI) plasma, which contains CI reagent ions.

See also chemical ionization (CI) plasma and atmospheric pressure chemical ionization (APCI).

CPU central processing unit (of a computer)

CRM See consecutive reaction monitoring (CRM) scan type.

C-Trap curved linear trap

<Ctrl> control key on the terminal keyboard

D

d depth

Da dalton

DAC digital-to-analog converter

- **damping gas** Helium gas introduced into the ion trap mass analyzer that slows the motion of ions entering the mass analyzer so that the ions can be trapped by the RF voltage fields in the mass analyzer.
- **data-dependent scan** A scan mode that uses specified criteria to select one or more ions of interest on which to perform subsequent scans, such as MS/MS or ZoomScan.
- dc direct current
- **divert/inject valve** A valve on the mass spectrometer that can be plumbed as a divert valve or as a loop injector.
- DS data system
- DSP digital signal processor

Ε

ECD See electron capture dissociation (ECD).

EI electron ionization

electron capture dissociation (ECD) A method of fragmenting gas phase ions for tandem mass spectrometric analysis. ECD involves the direct introduction of low energy electrons to trapped gas phase ions.

See also electron transfer dissociation (ETD) and infrared multiphoton dissociation (IRMPD).

- **electron multiplier** A device used for current amplification through the secondary emission of electrons. Electron multipliers can have a discrete dynode or a continuous dynode.
- electron transfer dissociation (ETD) A method of fragmenting peptides and proteins. In electron transfer dissociation (ETD), singly charged reagent anions transfer an electron to multiply protonated peptides within the 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.

See also fluoranthene.

electrospray ionization (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.

EMBL European Molecular Biology Laboratory

<Enter> Enter key on the terminal keyboard

- ESD electrostatic discharge
- ESI See electrospray ionization (ESI).
- **ESI flange** A flange that holds the ESI probe in position next to the entrance of the heated capillary, which is part of the API stack. The ESI flange also seals the atmospheric pressure region of the API source and, when it is in the engaged position against the spray shield, compresses the high-voltage safety-interlock switch.
- **ESI probe** A probe that produces charged aerosol droplets that contain sample ions. The ESI probe is typically operated at liquid flows of 1 μ L/min to 1 mL/min without splitting. The ESI probe includes the ESI manifold, sample tube, nozzle, and needle.

ESI source Contains the ESI probe and the API stack.

See also electrospray ionization (ESI), ESI probe, and API stack.

- **ESI spray current** The flow of charged particles in the ESI source. The voltage on the ESI spray needle supplies the potential required to ionize the particles.
- **ESI spray voltage** The high voltage that is applied to the spray needle in the ESI source to produce the ESI spray current. In ESI, the voltage is applied to the spray liquid as it emerges from the nozzle.

See also ESI spray current.

ETD See electron transfer dissociation (ETD).

eV electron volt

external lock mass A lock that is analyzed in a separate MS experiment from your sample. If you need to run a large number of samples, or if accurate mass samples will be intermingled with standard samples, you might want to use external lock masses. These allow more rapid data acquisition by eliminating the need to scan lock masses during each scan.

See also internal lock mass.

F

```
f femto (10^{-15})
```

°F degrees Fahrenheit

.fasta file extension of a SEQUEST[®] search database file

ft foot

Fast Fourier Transform (FFT) An algorithm that performs a Fourier transformation on data. A Fourier transform is the set of mathematical formulae by which a time function is converted into a frequency-domain function and the converse.

FFT See Fast Fourier Transform (FFT).

fluoranthene A reagent anion that is used in an electron transfer dissociation (ETD) experiment.

- **firmware** Software routines stored in read-only memory. Startup routines and low-level input/output instructions are stored in firmware.
- **forepump** The pump that evacuates the foreline. A rotary-vane pump is a type of forepump.
- Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) A technique that determines the mass-to-charge ratio of an ion by measuring its cyclotron frequency in a strong magnetic field.

fragment ion A charged dissociation product of an ionic fragmentation. Such an ion can dissociate further to form other charged molecular or atomic species of successively lower formula weights.

fragmentation The dissociation of a molecule or ion to form fragments, either ionic or neutral. When a molecule or ion interacts with a particle (electron, ion, or neutral species) the molecule or ion absorbs energy and can subsequently fall apart into a series of charged or neutral fragments. The mass spectrum of the fragment ions is unique for the molecule or ion.

FT Fourier Transformation

FT-ICR MS See Fourier Transform - Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS).

- FTMS Fourier Transformation Mass Spectroscopy
- **full-scan type** Provides a full mass spectrum of each analyte or parent ion. With the full-scan type, the mass analyzer is scanned from the first mass to the last mass without interruption. Also known as single-stage full-scan type.

FWHM Full Width at Half Maximum

G

g gram

G Gauss; giga (10^9)

GC gas chromatograph; gas chromatography

GC/MS gas chromatography / mass spectrometer

GUI graphical user interface

Η

 $\boldsymbol{h} \ \text{hour}$

b height

handshake A signal that acknowledges that communication can take place.

HCD Higher Energy Collision Induced Dissociation

- **header information** Data stored in each data file that summarizes the information contained in the file.
- **H-ESI source** Heated-electrospray ionization (H-ESI) converts ions in solution into ions in the gas phase by using electrospray ionization (ESI) in combination with heated auxiliary gas.

high performance liquid chromatography (HPLC)

Liquid chromatography in which the liquid is driven through the column at high pressure. Also known as high pressure liquid chromatography.

HPLC See high performance liquid chromatography (HPLC).

HV high voltage

Hz hertz (cycles per second)

I

ICR ion cyclotron resonance

ID inside diameter

IEC International Electrotechnical Commission

IEEE Institute of Electrical and Electronics Engineers

in inch

infrared multiphoton dissociation (IRMPD) In

infrared multiphoton dissociation (IRMPD), multiply charged ions consecutively absorb photons emitted by a infrared laser until the vibrational excitation is sufficient for their fragmentation. The fragments continue to pick up energy from the laser pulse and fall apart further to ions of lower mass.

See also electron capture dissociation (ECD).

- **instrument method** A set of experiment parameters that define Xcalibur operating settings for the autosampler, liquid chromatograph (LC), mass spectrometer, divert valve, syringe pump, and so on. Instrument methods are saved as file type .meth.
- **internal lock mass** A lock that is analyzed during the same MS experiment as your sample and is contained within the sample solution or infused into the LC flow during the experiment. Internal lock masses provide the most accurate corrections to the data.

See also external lock mass.

I/O input/output

ion gauge Measures the pressure in the mass analyzer region (high vacuum region) of the vacuum manifold.

- **ion optics** Focuses and transmits ions from the API source to the mass analyzer.
- **ion source** A device that converts samples to gas-phase ions.

IRMPD See infrared multiphoton dissociation (IRMPD).

К

k kilo (10³, 1000)

K kilo (2¹⁰, 1024)

KEGG Kyoto Encyclopedia of Genes and Genomes

kg kilogram

L

l length

L liter

LAN local area network

lb pound

LC See liquid chromatography (LC).

LC/MS See liquid chromatography / mass spectrometry (LC/MS).

LED light-emitting diode

LHe liquid helium

liquid chromatography (LC) A form of elution chromatography in which a sample partitions between a stationary phase of large surface area and a liquid mobile phase that percolates over the stationary phase.

liquid chromatography / mass spectrometry

(LC/MS) An analytical technique in which a high-performance liquid chromatograph (LC) and a mass spectrometer (MS) are combined.

LN2 liquid nitrogen

lock mass A known reference mass in the sample that is used to correct the mass spectral data in an accurate mass experiment and used to perform a real-time secondary mass calibration that corrects the masses of other peaks in a scan. Lock masses with well-defined, symmetrical peaks work best. You can choose to use internal lock mass or external lock mass.

log file A text file, with a .log file extension, that is used to store lists of information.

Μ

- μ micro (10⁻⁶)
- **m** meter; milli (10^{-3})
- **M** mega (10^6)
- \mathbf{M}^{+} molecular ion
- **MALDI** See matrix-assisted laser desorption/ionization (MALDI).

matrix-assisted laser desorption/ionization

- (MALDI) Ionization by effect of illumination with a beam of laser generated light onto a matrix containing a small proportion of analyte. A mass spectrometric technique that is used for the analysis of large biomolecules.
- MB Megabyte (1048576 bytes)
- \mathbf{MH}^{+} protonated molecular ion
- min minute
- mL milliliter
- mm millimeter
- **MRFA** A peptide with the amino acid sequence methionine–arginine–phenylalanine–alanine.
- MS mass spectrometer; mass spectrometry
- **MS** MS^n power: where n = 1
- **MS scan modes** Scan modes in which only one stage of mass analysis is performed. The scan types used with the MS scan modes are full-scan type and selected ion monitoring (SIM) scan type.

MSDS Material Safety Data Sheet

- **MS/MS** Mass spectrometry/mass spectrometry, or tandem mass spectrometry is an analytical technique that involves two stages of mass analysis. In the first stage, ions formed in the ion source are analyzed by an initial analyzer. In the second stage, the mass-selected ions are fragmented and the resultant ionic fragments are mass analyzed.
- **MSn scan mode** The scan power equal to 1 to 10, where the scan power is the power n in the expression MSn. MSn is the most general expression for the scan mode, which can include the following:
 - The scan mode corresponding to the one stage of mass analysis in a single-stage full-scan experiment or a selected ion monitoring (SIM) experiment
 - The scan mode corresponding to the two stages of mass analysis in a two-stage full-scan experiment or a selected reaction monitoring (SRM) experiment
 - The scan mode corresponding to the three to ten stages of mass analysis (n = 3 to n = 10) in a multi-stage full-scan experiment or a consecutive reaction monitoring (CRM) experiment.

See also MS scan modes and MS/MS.

- **multipole** A symmetrical, parallel array of (usually) four, six, or eight cylindrical rods that acts as an ion transmission device. An RF voltage and dc offset voltage are applied to the rods to create an electrostatic field that efficiently transmits ions along the axis of the multipole rods.
- m/z Mass-to-charge ratio. An abbreviation used to denote the quantity formed by dividing the mass of an ion (in u) by the number of charges carried by the ion. For example, for the ion $C_7H_7^{2+}$, m/z=45.5.

Ν

n nano (10⁻⁹)

- **nanospray ionization (NSI)** A type of electrospray ionization (ESI) that accommodates very low flow rates of sample and solvent on the order of 1 to 20 nL/min (for static nanospray) or 100 to 1000 nL/min (for dynamic nanospray).
- **NCBI** National Center for Biotechnology Information (USA)

NIST National Institute of Standards and Technology (USA)

NMR Normal Mass Range

NSI See nanospray ionization (NSI).

octapole An octagonal array of cylindrical rods that acts as an ion transmission device. An RF voltage and dc offset voltage applied to the rods create an electrostatic field that transmits the ions along the axis of the octapole rods.

0

OD outside diameter

OT Orbitrap

OVC outer vacuum case

 Ω ohm

Ρ

p pico (10^{-12})

Pa pascal

PCB printed circuit board

- **PDA detector** Photodiode Array detector is a linear array of discrete photodiodes on an integrated circuit chip. It is placed at the image plane of a spectrometer to allow a range of wavelengths to be detected simultaneously.
- PE protective earth

PID proportional / integral / differential

P/N part number

p-p peak-to-peak voltage

ppm parts per million

PQD pulsed-Q dissociation

psig pounds per square inch, gauge

PTM posttranslational modification

0

quadrupole A symmetrical, parallel array of four hyperbolic rods that acts as a mass analyzer or an ion transmission device. As a mass analyzer, one pair of opposing rods has an oscillating radio frequency (RF) voltage superimposed on a positive direct current (dc) voltage. The other pair has a negative dc voltage and an RF voltage that is 180 degrees out of phase with the first pair of rods. This creates an electrical field (the quadrupole field) that efficiently transmits ions of selected mass-to-charge ratios along the axis of the quadrupole rods.

R

RAM random access memory

- **raw data** Uncorrected liquid chromatograph and mass spectrometer data obtained during an acquisition. Xcalibur and Xcalibur-based software store this data in a file that has a .raw file extension.
- **resolution** The ability to distinguish between two points on the wavelength or mass axis.
- **retention time (RT)** The time after injection at which a compound elutes. The total time that the compound is retained on the chromatograph column.

RF radio frequency

- **RF lens** A multipole rod assembly that is operated with only radio frequency (RF) voltage on the rods. In this type of device, virtually all ions have stable trajectories and pass through the assembly.
- **RF voltage** An ac voltage of constant frequency and variable amplitude that is applied to the ring electrode or endcaps of the 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.

RMS root mean square

ROM read-only memory

rotary-vane pump A mechanical vacuum pump that establishes the vacuum necessary for the proper operation of the turbomolecular pump. (Also called a roughing pump or forepump.)

- **RS-232** An accepted industry standard for serial communication connections. This Recommended Standard (RS) defines the specific lines and signal characteristics used by serial communications controllers to standardize the transmission of serial data between devices.
- **RT** An abbreviated form of the phrase *retention time (RT)*. This shortened form is used to save space when the retention time (in minutes) is displayed in a header, for example, RT: 0.00-3.75.

S

- s second
- **selected ion monitoring (SIM) scan type** A scan type in which the mass spectrometer acquires and records ion current at only one or a few selected mass-to-charge ratio values.

See also selected reaction monitoring (SRM) scan type.

selected reaction monitoring (SRM) scan type A scan type with two stages of mass analysis and in which a particular reaction or set of reactions, such as the fragmentation of an ion or the loss of a neutral moiety, is monitored. In SRM a limited number of product ions is monitored.

SEM secondary electron multiplier

Serial Peripheral Interface (SPI) hardware and firmware communications protocol

- **serial port** An input/output location (channel) for serial data transmission.
- **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 ESI or APCI nozzle.
- **sheath gas flow rate** The rate of flow of sheath gas into the API source. A measurement of the relative flow rate (in arbitrary units) that needs to be provided at the sheath gas inlet to provide the required flow of sheath gas to the ESI or APCI nozzle.

sheath gas inlet An inlet in the API probe where sheath gas is introduced into the probe.

- **sheath gas plumbing** The gas plumbing that delivers sheath gas to the ESI or APCI nozzle.
- **sheath gas pressure** The rate of flow of sheath gas (nitrogen) into the API source. A measurement of the relative flow rate (in arbitrary units) that needs to be provided at the sheath gas inlet to provide the required flow of inner coaxial nitrogen gas to the ESI or APCI nozzle. A software-controlled proportional valve regulates the flow rate.

See also sheath gas.

- **sheath gas valve** A valve that controls the flow of sheath gas into the API source. The sheath gas valve is controlled by the data system.
- **signal-to-noise ratio (S/N)** The ratio of the signal height (S) to the noise height (N). The signal height is the baseline corrected peak height. The noise height is the peak-to-peak height of the baseline noise.

SIM See selected ion monitoring (SIM) scan type.

- **skimmer** A vacuum baffle between the higher pressure capillary-skimmer region and the lower pressure region. The aperture of the skimmer is offset with respect to the bore of the ion transfer capillary.
- **source CID** A technique for fragmenting ions in an atmospheric pressure ionization (API) source. Collisions occur between the ion and the background gas, which increase the internal energy of the ion and stimulate its dissociation.

SPI See Serial Peripheral Interface (SPI).

SRM See selected reaction monitoring (SRM) scan type.

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.

See also sweep gas flow rate.

sweep gas flow rate The rate of flow of sweep gas into the API source. A measurement of the relative flow rate (in arbitrary units) to provide the required flow of nitrogen gas to the sweep cone of the API source.

See also sweep gas.

syringe pump A device that delivers a solution from a syringe at a specified rate.

Т

T Tesla

target compound A compound that you want to identify or quantitate or that a specific protocol (for example, an EPA method) requires that you look for. Target compounds are also called analytes, or target analytes.

TIC See total ion current (TIC).

TMP See turbomolecular pump.

Torr A unit of pressure, equal to 1 mm of mercury and 133.32 Pa.

total ion current (TIC) The sum of the ion current intensities across the scan range in a mass spectrum.

tube lens offset The voltage offset from ground that is applied to the tube lens to focus ions toward the opening of the skimmer.

See also source CID.

Tune Method A defined set of mass spectrometer tune parameters for the ion source and mass analyzer. Tune methods are defined by using the Exactive Tune, Tune Plus (LCQ Series, LXQ, and LTQ), or Tune Master (TSQ Quantum) window and saved as the file type .mstune, .LCQTune, .LTQTune, or .TSQTune, respectively.

A tune method stores tune parameters only. (Calibration parameters are stored separately, not with the tune method.)

tune parameters Instrument parameters whose values vary with the type of experiment.

turbomolecular pump A vacuum pump that provides a high vacuum for the mass spectrometer and detector system.

TWA time weighted average

U

u atomic mass unit

UHV ultra high vacuum

Ultramark 1621 A mixture of

perfluoroalkoxycyclotriphosphazenes used for ion trap calibration and tuning. It provides ESI singly charged peaks at m/z 1022.0, 1122.0, 1222.0, 1322.0, 1422.0, 1522.0, 1622.0, 1722.0, 1822.0, and 1921.9.

UMR Universal Mass Range

V

V volt

Vac volts alternating current

V dc volts direct current

- **vacuum manifold** A thick-walled, aluminum chamber with machined flanges on the front and sides and various electrical feedthroughs and gas inlets that encloses the API stack, ion optics, mass analyzer, and ion detection system.
- **vacuum system** Components associated with lowering the pressure within the mass spectrometer. A vacuum system includes the vacuum manifold, pumps, pressure gauges, and associated electronics.
- **vent valve** A valve that allows the vacuum manifold to be vented to air or other gases. A solenoid-operated valve.

vol volume

W

w width

W watt

WEEE European Union Waste Electrical and Electronic Equipment Directive. Provides guidelines for disposal of electronic waste.

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00101-03-00001 6-3 00301-01-00020 6-2-6-3 00301-22922 6-3 00301-57020 6-3 0690280 5-2 0690720 6-2 1128140 5-2 97055-62003 5-2 97155-62025 8-3 97155-97123 8-3 98000-620004 8-4 98000-62002 5-5, 8-4 98000-62008 8-4-8-5

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