ThermoFisher SCIENTIFIC

Spectra 200

Pre-Installation Manual

PN 1152849

Revision W • 22-APR-2022

thermo scientific

Contents

1 Introduction

CAUTION! **All information in this manual must be treated as confidential.**

This publication is valid for the following system:

1156228: Thermo Scientific ™ Spectra 200

1.1 Purpose of this Pre-Installation Manual

This document describes the requirements and specifications that must be fulfilled for the trouble-free installation and reliable operation of a Thermo Scientific electron microscope system.

Note **All requirements in this document must be fulfilled as specified.**
Any deviation from these specifications can result in installation delays, decreased performance and increased downtime of the microscope.

Note **This document uses the metric system for all measurements and specifications.**
Conversion of a measurement or specification to a local unit is the responsibility of the customer.

Unit conversion tables are available in Appendix 6: Conversion Tables on page 101

1.2 Delegation of Responsibilities

Pre-Installation

Pre-Installation means all the work that has to be done to prepare a room suitable for installation and operation of the microscope system.

This includes preparation of the transportation route and a storage area within the Customer's premises and availability of all services mentioned in this Manual.

Note **Pre-installation is a responsibility of the Customer.**

Site Survey

During a Site Survey a Thermo Fisher Scientific representative is sent to the Customer's site to verify that all preparations have been performed and that the site fully abides all requirements listed in this Manual. During this Survey the Thermo Fisher Scientific representative fills a Pre-Installation Checklist to confirm site readiness. All deviations from Pre-Installation requirements must be marked in the Checklist.

Note **If requirements listed in this Manual are not met, the Appendix 3: Performance Waiver on page 84 must be filled out and signed by the Customer.**

Note **The Sales and Service Division (SSD) is responsible for the organization and execution of the Site Survey.**

1.3 Optional configurations

Some systems can be configured with optional modules or functions. Some of these options affect the requirements to which the site must comply. For details, see: Appendix 5: Optional Configurations on page 86 .

For Spectra 200 systems, the following options are available:

- Ceta-2 camera
- Gatan Image Filter (GIF)
- SEMI S2 Kit and Seismic Restraining Kit
- Vibration Isolation System
  - Integrated Vibration Isolation System (Thermo Scientific iVIS)
  - Active Vibration Isolation System (AVIS)
- Air Cooled Chiller or Water Cooled Chiller
- 3-Phase Transformer

2 Safety and Environmental Requirements

2.1 Machine classification

Europe

Spectra 200 meets the provisions of the following directives:

2006/42/EC	Machinery Directive
2011/65/EU	RoHS Directive
2013/59/EURATOM	Ionizing Radiation Directive
2014/30/EU	Electromagnetic Compatibility Directive

Spectra 200 also conforms to the following standards and normative documents:

EN61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use
EN61326-1	Electrical equipment for measurement, control and laboratory use EMC requirements
NFPA 79-2018	Electrical Standard for Industrial Machinery Optional NRTL safety inspection testing can be ordered by the customer

2014/68/EU	Pressure Equipment Directive
EN 13445-1	Unfired Pressure Vessels

Great Britain

Spectra 200 meets the provision of the following regulations (Great Britain):

Supply of Machinery (Safety) Regulations 2008
Electromagnetic Compatibility Regulations 2016
Ionising Radiation Regulations 2017 (IRR17)
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
Pressure Equipment (Safety) Regulations 2016

The Spectra 200 system has been designed and tested according to SEMI safety and ergonomic assessment guidelines. All test have been performed by an independent testing laboratory.

SEMI S2-0818	Environmental, Health and Safety Guidelines for Semiconductor Manufacturing Equipment
SEMI S8-0218	Safety Guideline for Ergonomics Engineering of Semiconductor Manufacturing Equipment

Each Thermo Fisher Scientific system has a EC Declaration of Conformity and a UK Declaration of Conformity. These declarations are system-specific and are bound to a serial number of the system.

The declarations are delivered with the system and are located in the so-called *Red binder*.

CE regulatory information for the European Union and UK regulation information for Great-Britain

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

This equipment has been tested and found to comply with the Group 1 Class A limits of EN 61326-1.

- Group 1 equipment is all equipment which is not classified as group 2 equipment.
- Group 2 equipment is ISM RF equipment in which radio-frequency energy is intentionally generated and used locally for the treatment of material or for inspection/analysis purposes.
- Class A equipment is equipment suitable for use in commercial and industrial environment.
- Class B equipment is equipment suitable for use in domestic environments.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the receiver into an outlet on a circuit different from that to which the equipment is connected.
- Consult the dealer or experienced radio/TV technician for help

Changes or modifications not expressly approved by the party responsible for compliance could void the users authority to operate the equipment.

2.2 Safety Requirements

CAUTION! **The leakage current from mains to earth exceeds 3.5 mA.**

To comply with the European safety standards,
a double permanently connected and separated safety earth must be fitted to the earth rail of the Spectra 200 Power Cabinet.

For electrical connection details, see the specific chapter(s) in this manual.

For detailed information related to safety, please see the Safety Manual that applies to Spectra 200.

Note **If you did not receive this document, please inform your Thermo Fisher Scientific representative.**

Please pay extra attention to the following sections in the Safety Manual:

- High voltage and X-ray
- Liquid nitrogen (LN_2)
- Sulfur Hexafluoride (SF_6)
- Safety Data Sheets (SDS)

3 Materials and Tools

For a successful Pre-Installation and Installation, certain materials and tools have to be prepared by Customer during the Pre-Installation phase.

If any of the items listed in this chapter are not available, please contact your Thermo Fisher Scientific representative to avoid delays in Installation.

3.1 Items shipped to the Customer by Thermo Fisher Scientific

Note **The Customer is responsible for installing the delivered items before the start of the Installation.**

The Pre-Installation Kit contains the following items:

Topic	Shipped item	PN	Qty	Chapter
Anchoring Pre-Install 1177897	Drilling jig CB	1177898	1	
	Wire tie 4.8 x 186 mm	2422 015 05008	10	
	Hammer fixing 6x40	4022 198 80091	10	
	Insert M16x170	4022 198 77781	20	
	Hex. Bolt M16x100 st ZPL	4022 198 77811	1	
	Roughening tool 28	1175421	1	
	Manual dispenser	1032754	1	
	Packing Drilling jig CB	1175578	1	

Topic	Shipped item	PN	Qty	Chapter
Connection Set 1153083	Hose PVC ID 13	1151874	15 m	
	Hose clamp St 15x27	2522 713 01004	6	
	FEP-tube 6x4mm cleanpak	4022 198 28121	15 m	
	PA tube PA 8x6x1mm blue	0822 006 17016	15 m	
	PVC tube 22x16x3 transp	1152739	15 m	
	SLANGPILAAR DIA.15-KF25	4022 260 21191	2	
	Hose cutter dia. 38mm	1150368	1	
	Assy ins. hose 13 15m	1151908	1	
	Male union 12-1/2 NPT	1155042	2	
	Hose nipple A12-13	4022 260 73221	2	
	Loctite 542 (10ml)	4022 265 25151	1	

For safety reasons, the following items are typically *not* delivered with the system. The SSOC will arrange delivery to the customer's site prior to the installation.

Topic	Shipped item	PN	Qty	Chapter
System Anchoring	Epoxy adh.anchor UN pack	1032987/ 4022 198 80912	3	System Anchoring on page 26
Option: Seismic Anchoring	Epoxy adh.anchor UN pack	1032987 / 4022 198 80912	3	S2 Compliance Kit on page 99

If an S2 Kit is ordered with the system, the Facility Connection box **must** be ordered by the FSE and installed by the Customer before the installation starts:

Order Code 1151147

If an S2 Kit is not ordered with the system, the Facility Connection box **can** be ordered by the FSE if there is an agreement with the Customer to have this installed before the installation starts

For details on installation and connection, see workinstruction 104783 .

Internal Hoist

The System is delivered with two Internal Hoists (540 kg and 160 kg) and additional Tools (to do regular service and maintenance work).

External Hoist

No "external" Hoist is needed.

In case the room is equipped with an "external" Hoist the room ceiling height will normally go up by a value depending on the Hoist itself. This value has to be added to the value given in Microscope Room Dimensions on page 23 .

Note **The minimum ceiling height depends on the configuration and size of the enclosure:**
- 3040 mm for the low system enclosure
- 3370 for the medium system enclosure
- 3770 for the high system enclosure.

An "external" Hoist will offer some efficiency advantages during the installation and maintenance if it is possible to lift weights up to 2000 kg. Note that the "external" Hoist then must be capable lifting and lowering loads very slowly. No examples of "external" Hoists are given in the manual. For reach of the "external" Hoist see also Appendix 1: Drawings and Floorplans on page 69 .

CAUTION! **The crate(s) in which the System is delivered have clearance for a standard-sized pallet jack for Euro pallets:**

- **9 cm vertical opening**
- **20 cm open space between forks**
- **17.2 cm fork width**
- **17.2 + 20 + 17.2 = 54.4 cm outside dimension of forks**

3.2 Items to be purchased by the Customer

The following items are necessary for a successful installation of the system but are not delivered by Thermo Fisher Scientific. Items with Order Code can be purchased from Service stock. Contact your Thermo Fisher Scientific representative to order these Thermo Scientific items. The items can also be purchased locally.

Description	Order Code	Requirements and remarks
Additional hose to connect a water cooled chiller to facility water	N/A	Cooling Water Supply on page 56
Dust filter N_2 supply	5322 480 20066	Grade 0.3 µm, Nitrogen (N2) on page 59
Nitrogen Flow regulator	N/A	Liquid Nitrogen (LN2) on page 60
SF_6 (in cylinders)	N/A	Sulfur Hexafluoride (SF6) on page 61
Oxygen detector	N/A	Oxygen Detection on page 64
Plasma Cleaner	N/A	Required for systems with HR-STEM resolution

Description	Order Code	Requirements and remarks
Drill bits, diameter 6 mm	N/A	Required for anchoring of the Microscope
Drill bits, diameter 28 mm	N/A	Required for anchoring of the Microscope

The customer must provide 60 liters of demineralized water. This is needed to prepare the water circuit between microscope and the chiller.

3.3 Items to be purchased by the FSE prior to installation

3.3.1 Items to be purchased by the FSE prior to Installation

Safety Relief Valves (SRV)

The microscope is equipped with several Safety Relief Valves. These will be ordered and replaced by the FSE during the installation of the microscope.

The replacement of these SRVs is necessary, because during the PED certification, it was identified that the SRV is a critical component for pressure vessel safety. To maintain pressure vessel safety, the SRV needs to be periodically replaced by a new one.

At the time of the installation a "Take in operation" inspection can be expected. In the moment the system is handed over to the customer, the SRVs must be younger than 1 year, regardless of whether the customer follows this inspection or not. The inspection is the responsibility of the customer.

The FSE will order the replacement SRVs, as it can be expected that during the system installation, the SRVs have to be exchanged due to their age. The replacement instruction is in the Installation manual, section: Replace the Accelerator Safety Relief Valve and Connect the HT Cable to the HT Tank.

After installation:

The HT tank SRV’s will be changed every four years.

The accelerator SRV will be changed at the time of service, such as a tip change, if the age of the SRV exceeds 4 years (for the first exchange) and then every 6 years.

If the customer requests the SRVs to be changed sooner, it will be at their expense.

Description	Order Code	Location
Assy safety valve 5bar	1124457	HT Tank (2 pieces)
Assy safety valve 6.1bar	1120737	Accelerator Module (1 piece)
Sealing Ring G3/8	1152663	HT Tank (2) and Accelerator Module (1) Order 1 per Safety Relief Valve

3.4 Items that can be pre-ordered, to arrive before the system

Ordering should be initiated by the Field Service Engineer or Manager. They contact the local SSOC to request the correct materials.

The SSOC contacts PD Logistics to request pre-shipment.

Item	Order number	Remarks
Pre-Installation kit for Common Base/G4/G5 systems	1177897 Pre-install CB anchor	● Drill jig, anchors and materials. ● Epoxy is not included,
Pre-install Seismic restraint kit	1199866 Pre-install CB seismic	● Required for SEMI S2 compliance. ● Standard for Metrios, optional for Spectra and Krios. ● Epoxy is not included,
Enclosure	Depends on the system configuration.	● Must be included on the customer order. ● Includes all materials for installation. It is not necessary to pre-order the Toolbox CE.
Either: ● Connection Box Assy ● Connection Set	 FRU 1151147 1153083	 ● Required for SEMI S2 compliance. ● Recommended for all systems.

Note **It is not possible to pre-order the TPEB.**

Safety regulations require that the TPEB is tested as an integral part of the system. This means it is not possible to ship the TPEB before the system is shipped.

3.5 Installation Tools

It is also advised to check availability of the following items on the site. If these are not present, make sure to prepare a suitable alternative for the purpose listed with each item.

The items are divided into tools that should be provided by the customer and tools that should be brought by the Thermo Fisher Scientific FSE that installs the microscope.

3.5.1 Generic tools, parts and consumables to be provided by the customer

Purpose	Tool
Unloading and internal transport	Pallet truck with prolonged forks. Max. load: > 2100 kg
Unpacking	Battery powered screwdriver with drill function: ● Power: > 450 W ● Torque: > 40 Nm ● Battery: > 18 V ● Left and right rotation
	Small crowbar
Installation	Measuring tape: > 200 cm
	Spirit level: 3 mm/m
Cleaning	Vacuum cleaner, only to be used for cleaning the microscope.
	Laboratory quality ethanol or iso-propanol
	Wash bottle
	Particle and lint free cleaning tissues
Miscellaneous	Stable, clean table. Max. load: > 200 kg
	2 x Power extension box incl. cable
	Optical light microscope
	Disposable hand gloves: non-latex, not powdered
	Clean plastic bags

3.5.2 Installation tools to be provided by the FSE

Service Tooling	Content

Standard Toolbox	Screwdriver and key sets:
	● Flat head: 1 - 2 - 3 - 4 - 5
	● Pozidrive: 1 - 2 - 3 - 4
	● Ball head: 2.5 - 3 - 4 - 6 mm
	● Hexagonal (Allen) keys: 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 4.5 - 5 - 5.5 - 6 - 8 - 10 mm
	● Adapter and bit sets:
	  ● Pozidrive 1 - 2 - 3 - 4
	  ● Hexagonal (Allen) key 6 - 8 - 10 mm

	Pliers: ● Long-nosed pliers ● Side-cutting pliers ● Polygrip pliers
	Ratchet and sockets: ● Ratchet: 1/2" type ● Sockets: 17 and 30 mm ● Ratchet and sockets set: 4 to 13mm ● Drill head adapter and socket, 8mm
	Spanners and wrenches: ● Box and open-ended spanners: 5 - 5.5 - 6 - 7 - 8 - 10 - 13 - 14 - 17 - 19 - 24 mm ● Torque wrench from 2 to 20 Nm (1/2" type)
	Electrical wiring tools: ● Cable knife ● Wire stripper ● AMP clamp pliers: 0.25 - 6 mm
	Tweezers
	Small flashlight
	Thermometer: 5 to 50° C
	Nylon gloves

Service Tooling	Content
Additional Service Tooling	Multi meter and/or Oscilloscope
	ESD Field Service Kit: 1040798
	X-Ray Leak Check Instrument (order at Thermo Fisher Scientific)
	Clean Way of Working Kit ● Size M: 1166295 ● Size XL: 1166294
	SF6 Detector: 9425 060 09000, 1284273 - new
	SF6 Recycling Kit: 1033024 (Enervac GTU) If required by local laws and regulations, or desired by the customer.

SF6 Detector: 9425 060 09000 (left), 1284273 - new (right)

SF6 Recycling Kit: 1033024 (Enervac GTU)

4 Room Access and Size

This chapter lists the ambient specifications that must be met at the Customer's site. If you are in doubt about any of the listed requirements, please contact your local Thermo Fisher Scientific representative.

4.1 Pre-Installation Survey

The specifications given in section Room Access and Size on page 18 are going to be verified before the beginning of the installation during a site survey. This survey is fully organized and performed by Thermo Fisher Scientific personnel.

Note **No customer actions are required.**

For more details about the site survey procedure, see Pre-Installation Site Survey on page 78 .

4.2 Delivery Properties

The System is delivered in several crates. It is the Customer's responsibility to provide sufficient storage space and safe means to transport the crates from the unloading area to the final System location.

4.2.1 Spectra 200 Specific Dimensions and Weight

The accelerator module is always removed before shipment, and ships in a special crate

Spectra 200 **X-CFEG 200**	**Crated**		**Uncrated**	
	Weight (kg)	Dimensions (L x W x H (mm))	Weight (kg)	Dimensions (L x W x H (mm))
Console + Column (Weights below are without Accelerator)		1700 x 1670 x 2560		Physical Data of the Microscope (Internal Transport) on page 21
Basic with filter	1810		1610	
Basic without filter	1720		1520	
Single Corrector with filter	1965		1765	
Single Corrector, no filter	1875		1675	
CFEG	360	1350 x 840 x 1270	260	
	• Crate weight is estimated at 200 kg. • The wheels will add 5 mm to the total height during the move of the microscope			

4.2.2 Common Base dimensions and weights

Item	Crated		Uncrated	
	Weight	Dimensions (L x W x H)	Weight	Dimensions (L x W x H)
Common Base Enclosure				
Frame	1150 kg	2900 x 2050 x 1450 mm		N/A
Panels	609 kg	2300 x 850 x 1950 mm		N/A
Enclosure size (m): • 3.0 (also known as 2.97) • 3.3 • 3.7 *	• 700 kg • 800 kg • 860 kg	2700 x 950 x 1950 mm		N/A
Cabinets				
TEM Cabinet • without EMPAD electronics • with EMPAD electronics	• 330 kg • 345 kg	950 x 1030 x 2200 mm	• 256 kg • 271 kg	Appendix 1: Drawings and Floorplans on page 69
Optics Cabinet	335 kg	820 x 1000 x 2020 mm	250 kg	Appendix 1: Drawings and Floorplans on page 69
Power Cabinet	405 kg	950 x 1030 x 2200 mm	243 kg	Appendix 1: Drawings and Floorplans on page 69
Accessories Cabinet (option)	300 kg	950 x 1030 x 2200 mm	250 kg	Appendix 1: Drawings and Floorplans on page 69
Corrector Cabinet (option)	363 kg	950 x 1030 x 2200 mm	275 kg	Appendix 1: Drawings and Floorplans on page 69
Gatan Cabinet (option)	332 kg	1016 x 813 x 2159 mm	244 kg	864 x 610 x 1321 mm
Condensor Lenses (Reduced Height NSR only)	170 kg	850 x 1100 x 1270 mm	130 kg	450 x 650 x 382 mm

Item	Crated		Uncrated	
	Weight	Dimensions (L x W x H)	Weight	Dimensions (L x W x H)
Acoustic Server Cabinet (option)	400 kg		250 kg	1460 x 835 x 1280 mm
HT Tank				
300 kV HT Tank		1030 x 1280 x 2200 mm	415 kg	Appendix 1: Drawings and Floorplans on page 69
200 kV HT Tank		1030 x 1280 x 2200 mm	375 kg	Appendix 1: Drawings and Floorplans on page 69
Accessories, Tools, Miscellaneous				
3 Phase matching transformer (optional)	290 kg	1280 x 860 x 1160 mm	250 kg	Appendix 1: Drawings and Floorplans on page 69
Water Chiller unit box (Air or Water chiller)	130 kg	850 x 930 x 1050 mm	116 kg	670 x 850 x 860 mm
Titan accessory crate (Holders and Options)	Variable	620 x 1020 x 850 mm	Variable	N/A
Toolbox CE CB **	397 kg	1960 x 910 x 1480 mm	312 kg	
Green items (install related items)	Variable	1620 x 1020 x 850 mm	Variable	N/A
Keybox (documentation and tools)	105 kg	930 x 820 x 900 mm	70 kg	N/A

*: The 3.7 enclosure is only applicable for Double Corrected Spectra systems.

**: Store the Toolbox CE CB as close as possible to the Microscope Room.
The Toolbox CE CB contains (among others) tools for the internal hoists.

4.2.3 Physical Data of the Microscope (Internal Transport)

System	Transport Height	Highest Point	Shipping
Double Corrected (C3 on)	2325 mm	C3 module	C1/C2 & FEG removed
Image Corrector only	2247 mm	IGP read switch	FEG removed
Probe Corrector only	2247 mm for X-FEG 2260 mm for CFEG	IGP read switch	FEG removed
Uncorrected system	1942 mm for X-FEG 1955 mm for CFEG	IGP read switch	FEG removed

- Internal transport height includes the transportation wheels
- Only Spectra 300 can be Double Corrected
- Spectra 200 is only available with CFEG

Minimum door width	1500 mm
Weight distribution: ● No Filter, No Corrector ● Filter, No Corrector ● Filter, 1 corrector ● Filter, 2 correctors (Spectra 300 only)	 ● 1544 kg/m^2 ● 1636 kg/m^2 ● 1793 kg/m^2 ● 1952 kg/m^2
Four round feet supporting area of base frame	90 mm in diameter
Surface area of one Microscope foot	63.6 cm^2
Maximum point loading basic System with Filter Maximum point loading basic System without Filter Maximum point loading System with one Corrector and Filter Maximum point loading System with one Corrector and without Filter Maximum point loading System with two Correctors and Filter Maximum point loading System with two Correctors and without Filter (Spectra 300 only)	8.8 kg/cm^2 8.3 kg/cm^2 9.6 kg/cm^2 9.1 kg/cm^2 10.4 kg/cm^2 10.0 kg/cm^2

Note **The values below are with the FEG module mounted on the system**

	Weight (kg)	**Center of Gravity (vertical) (values for 3.7 enclosure)**
Acoustic Enclosure ● 3 version ● 3.3 version ● 3.7 version	(total, uncrated) ● 1373 ● 1502 ● 1658	2241 mm from the floor
Standard System + GIF	1520 kg 1610 kg	1456 mm from the floor 1385 mm from the floor
System with Probe Corrector + GIF	1675 kg 1765 kg	1509 mm from the floor 1442 mm from the floor
System with Image Corrector + GIF	1675 kg 1765 kg	1460 mm from the floor 1396 mm from the floor
System with two Correctors + GIF (Spectra 300 only)	1830 kg 1920 kg	1508 mm from the floor 1447 mm from the floor

4.3 Unloading Area

Make sure the unloading area is easily accessible and ready to accommodate the delivery. Keep in mind that some parts of the delivery have exceptional dimensions. Also make sure the floor can support heavy loads. For detailed information about the weights and dimension of delivered crates see Delivery Properties on page 18 .

In case the delivery cannot be moved to storage or final System location straight away, ensure a dry and secure environment is available.

4.4 Transportation Route

Make sure the full transportation route from the unloading area to the System space is suitable for transport of each of the microscope parts.

The parts can be transported either in the crates or when the transport route dimensions are not sufficient the parts can be taken out of the crates in the unloading area.

Especially check all surfaces, corners and lifts (weight limit and dimensions) on the transport route.

During the transportation the system is positioned on four swivel wheels. To prevent floor damage and to move the system safely all floors on the internal transportation routes must comply to the following specifications :

- All floors must be able to support a load of 10 kg/cm^2.
- All floors must have a hard surface.
  Carpet or other soft flooring materials are not allowed.
- The entire transportation route:
  - Must be free from obstacles, such as door steps or door stoppers, that may block safe passage of the console on its swivel wheels.

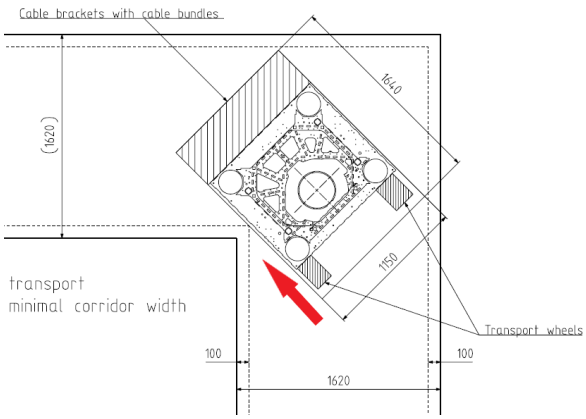
- Must be flat and horizontal.
  There must be no slopes.

The system and its parts can be moved:

- By hand, on its swivel wheels.
- On a fork lift or pallet truck, but only when the system sits on the original transport pallet on which the system is shipped.

Note **Dimensions of all corridors and doors must meet these requirements**

Note **The frame of the main hoist can be transported on its side, for example to pass low doors or hallways. This does not alter the required dimensions for the transportation route.**



4.5 Room Dimensions

In principle two spaces are obligatory for a good set up. First is the space for the System which has the strictest conditions. Apart from that, an additional space for the equipment has to be prepared.

The additional space must be separated from the System space for safety, ambient conditions and requirements, see General Requirements of a Site on page 32 .

In this section the floor-layout incl. NFPA safety dimensions and detailed space requirements are given.

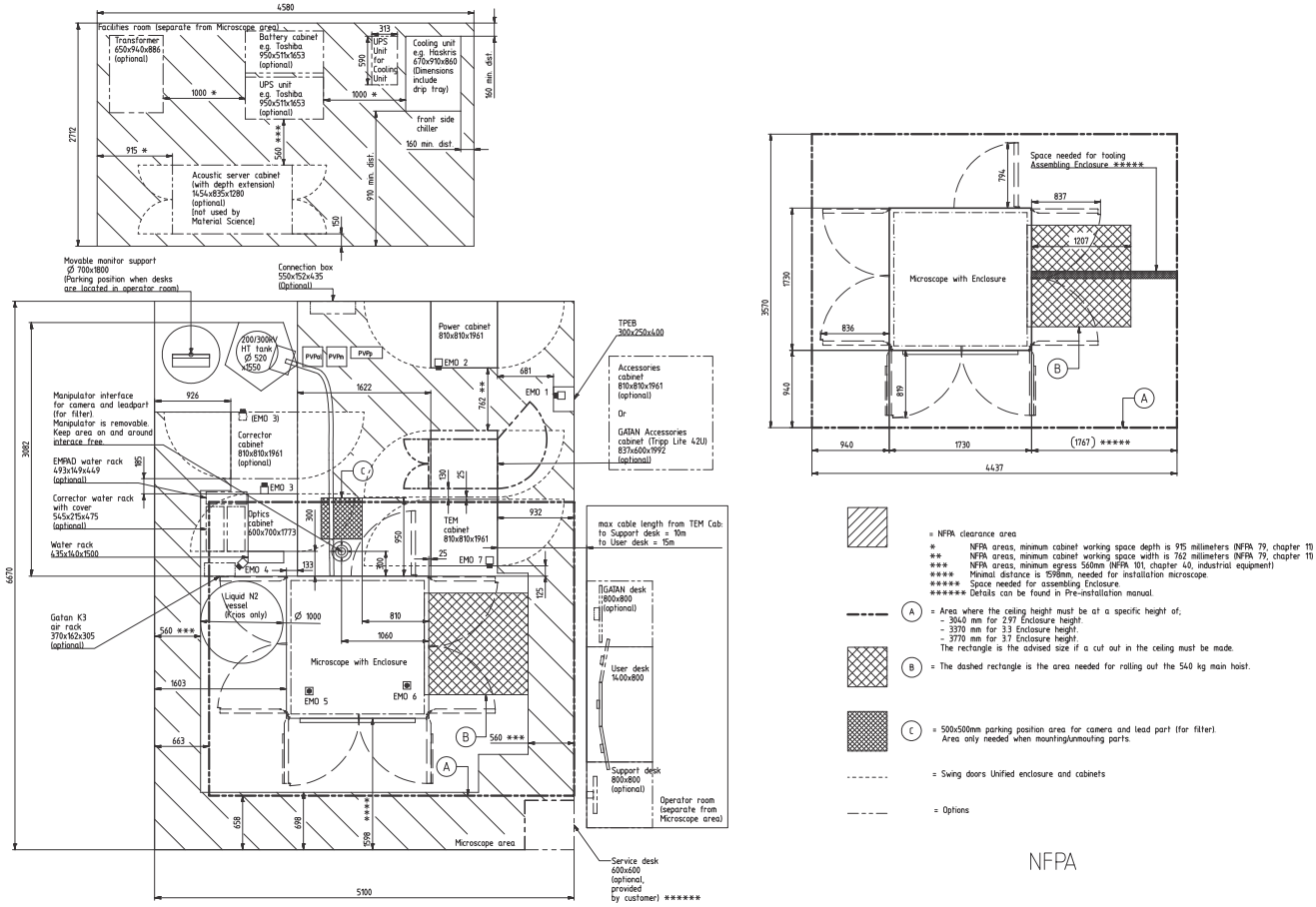
The minimal size of the Facility Room must be sufficient to accommodate all ordered accessories, see Facility Room Dimensions on page 25 .

Note **Special attention must be paid to the space requirements of the Microscope in relation to other equipment, especially equipment generating magnetic fields, or mechanical and acoustic vibrations, but at the same time the location of the extension cabinet and accessories is limited in distance due to cable length.**

4.5.1 Microscope Room Dimensions

To meet the safety and installation requirements, the Microscope Room must meet or exceed the dimensions in the floorplan below.

Note **All measurements are in millimeters.**



For a high resolution PDF version of this floorplan, see: 1155895-110-02

Note **If the Microscope Room does not meet the Microscope Room dimensions, then the room must be approved by the Thermo Fisher Scientific Technical and Safety Group before the installation begins.**

Note **If the ceiling height does not meet the minimum specification, then it may not be possible to successfully install or maintain the system.**

If an optional additional hoist is used for installation and/or maintenance actions, then the ceiling height must be increased with the additional height that the additional hoist requires for safe operation.

Note **To fulfill the NFPA79 safety requirements, the cable between the TPEB and the Power Cabinet must be shorter than 7 meters.**

Note **To prevent earth loops, there must be no metal pipes or conduits near the microscope console that may come in contact with the microscope console.**

See also: Appendix 1: Drawings and Floorplans on page 69 .

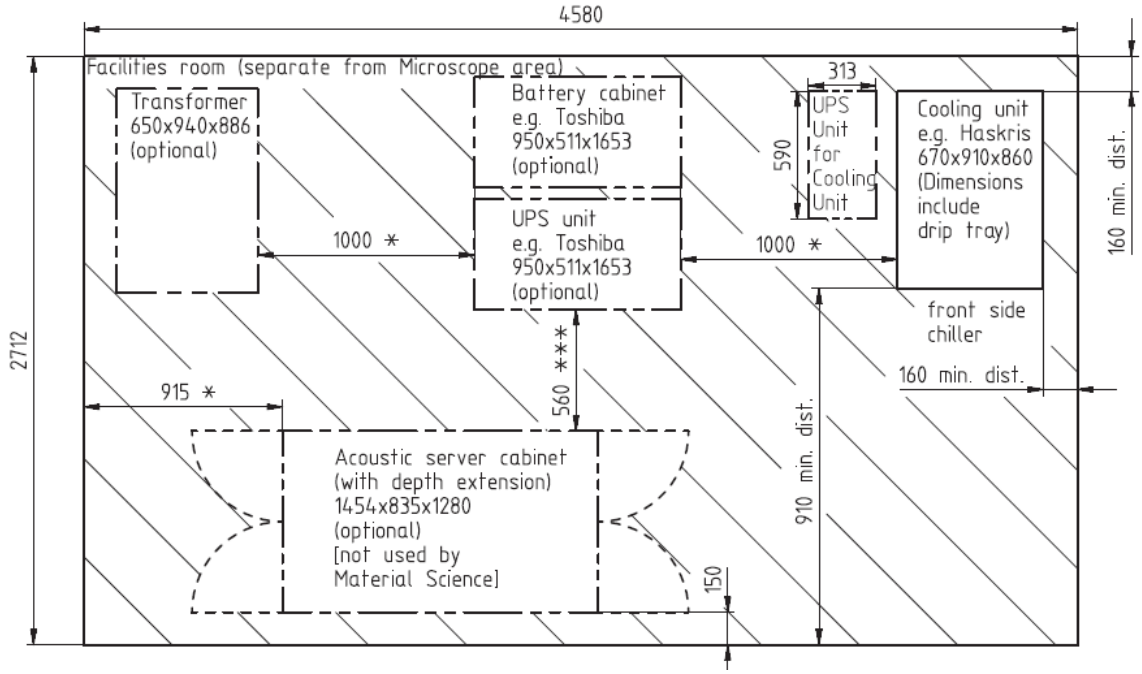
4.5.2 Facility Room Dimensions

The specifications for the Facility Room are based on the presence of all items in the floorplan below. Whether or not an item is present depends on the system configuration. If items are omitted, then please contact GTS for guidance about the recommended room dimensions and layout.

The location, dimensions and layout of the Facility Room must meet the following requirements:

- The free space around the equipment and the distance between neighboring equipment meets the specification in the floorplan below.
- The distance between the equipment in the Facility Room and the microscope column in the Microscope Room meets the specifications in Appendix 1: Drawings and Floorplans on page 69 .

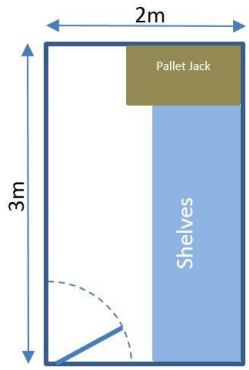
Note **All measurements are in millimeters (mm).**



The Spectra 200 system comes with tooling and parts that require additional storage space:

- Hoisting tools (can be stored in the supplied crate (2000 x 1000 x 1500 mm) or on shelves.
- Moving and positioning tool (wheels, brackets, etcetera).
- Service tooling.
- Spare parts.

Item	Requirement	Remarks
Dimensions	±6 m^2	The longest wall must be long enough for the longest items.
Location	Near the Microscope Room	Can be a separate storage room, or additional space in the Facility Room.
Climate control	Humidity controlled	Prevent corrosion of metal tooling and parts.



4.5.3 Operator Room Dimensions

The system is delivered with:

- An operator desk.
- Cables (15 m) to connect the keyboard, mouse, monitor(s) and Hand Panels to the Microscope PC.

The distance from the Microscope Room to the Microscope Control Room must be short enough to comfortably and properly route the cables from the Microscope PC, which is in the TEM Cabinet, to the top of the operator desk, which is in the Microscope Control Room. To achieve this, the Microscope Control Room is preferably located next to the Microscope Room.

Besides the operator desk, the system is also delivered with a movable microscope control stand for service purposes in the Microscope Room.

4.6 System Anchoring

Note **All drilling and preparations mentioned below are the responsibility of the customer and must be completed before the Thermo Fisher Scientific FSE arrives on-site to build up the Enclosure.**

The Microscope is build in an Enclosure. Both the Enclosure and the Microscope must be permanently fixed to the ground.

The Customer is responsible for drilling all holes to anchor the system to the floor, before the system arrives on site.

Refer to Appendix 1: Drawings and Floorplans on page 69 for the floor plan with drilling positions.

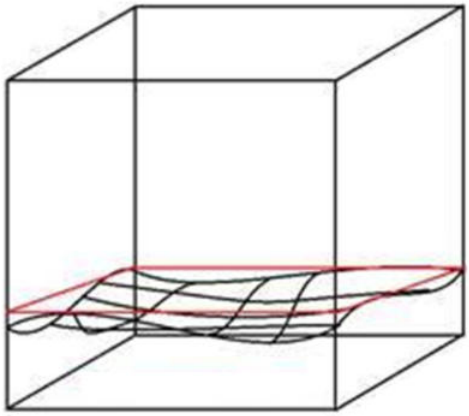
A drilling jig, drills and 20 chemical anchors are be supplied, see Items shipped to the Customer by Thermo Fisher Scientific on page 10 for more details.

When the S2 options is present, also the Cabinets and HT Tank can be fixed to the ground. For details see Seismic Restraining Kit on page 99

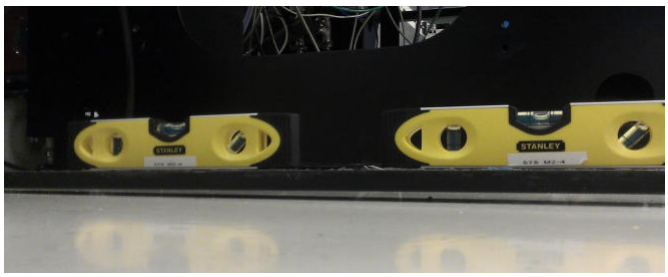
4.6.1 Floor flatness and unevenness

For stability of the Enclosure, the flatness and unevenness of the floor must be at spirit level (maximum deviation allowed is 3.0 mm/m).

Unevenness:



Flatness: adjustable stands on the Enclosure ensure frame levelness.



There is a rubber gasket mounted along the bottom of the frame. to make sure that the Enclosure is air-tight at this position. This implies that there can be no large excursions nor bumps in the floor roughness which cannot be "filled" by the gasket.

4.6.2 Enclosure Drilling Jig

A metal jig to align the hole pattern of the system enclosure and base brackets on the customer's floor should be used to drill the holes. The metal jig must be assembled and attached to the floor to prevent intermediate shifting.

The metal jig comes with the following items:

- jig
- anchors
- socket
- screws
- plug/screws for keeping the jig in place when drilling the big holes.

The drilling machine and chemical anchors are not part of the delivery.

The drilling jig hole pattern has three purposes:

- attachment of the system enclosure (outer set of holes)

- attachment of mechanical base brackets (4 x 2 holes)
- attachment of tooling at the backside of the system (1 hole at hinged part of jig).

Before drilling the holes, make sure that the distance between the front of the Enclosure and the wall is > 1598 mm (This space is necessary for maneuvering the Microscope into the Enclosure during install).

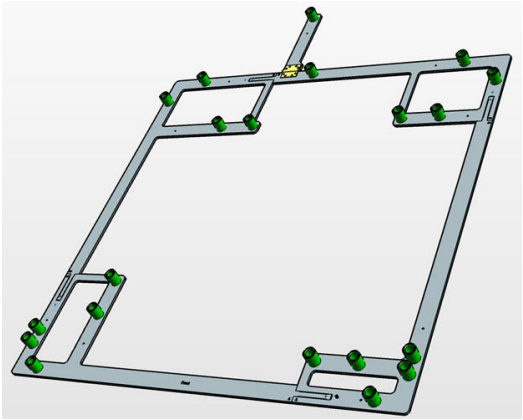
If for urgency reasons this kit needs to be on-site very early a reference number is given (1177897)

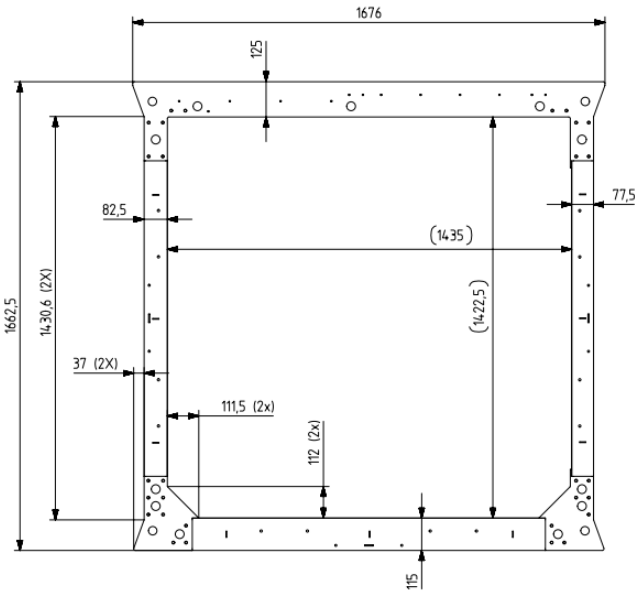
Note **Delivered to customer: items listed in Items shipped to the Customer by Thermo Fisher Scientific on page 10 .**

4.6.3 Using the drilling jig

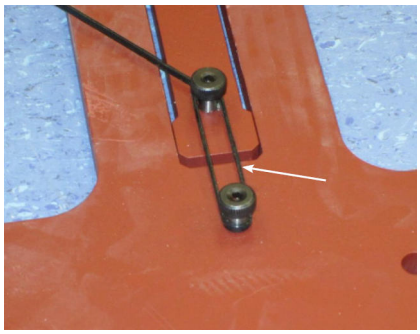
1. Assemble the drilling Jig, each part has letters matching the parts with the same letters.
2. Position the drilling Jig in the correct position in the room (Refer to Appendix 1: Drawings and Floorplans on page 69).

Note **When positioning the drilling Jig, consult the floorplan and be aware of the ceiling heights mentioned in the floorplan.**



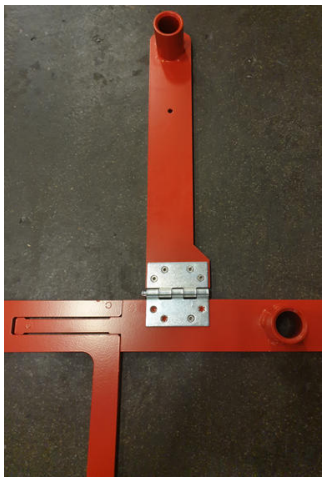


3. Clamp the drilling Jig parts together with tie wraps.



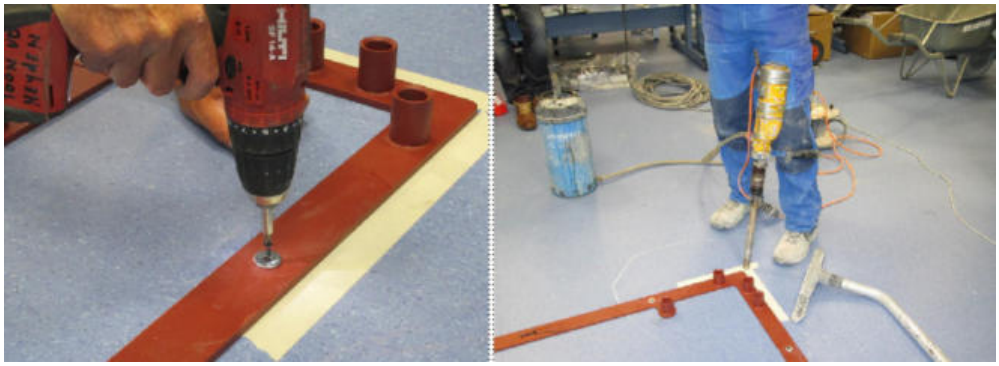
Note **With the introduction of unified enclosures for Spectra / Krios / Metrios also a new crane will be introduced at the backside of the microscope for mounting the lead parts on the filters & replacing FRU parts of the filter. The crane also needs to be bolted to the floor.**

4. Mount the strip E with a hinge on strip C

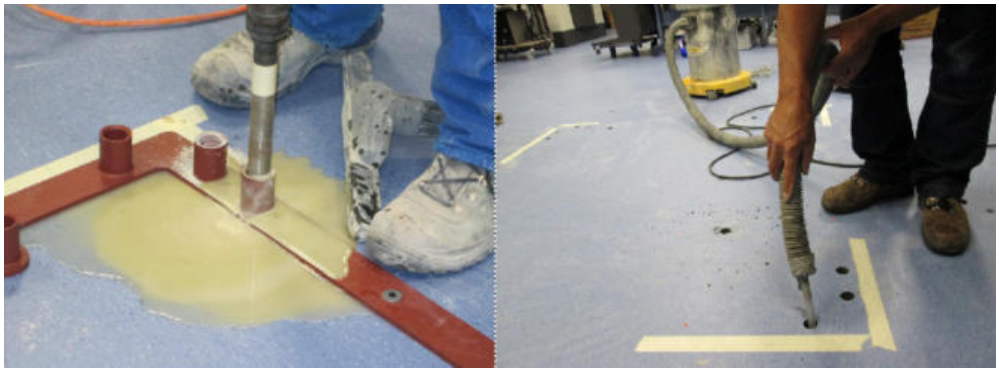


5. Drill the small holes (6 mm x 35 mm) for fixating the Drilling Jig to the floor.
6. Temporarily remove the Drilling Jig and insert the plastic plugs in the small holes.

7. Reposition the Drilling Jig and bolt the Drilling Jig to the floor with screws and washers.



8. Drill the holes for the Anchors via the Drilling Jig into the floor. The required dimensions of the holes are 28 x 180 mm.



9. Use the Roughening tool 28 in the holes to enable a better connection to the floor for the chemical anchors

10. Clean the holes.
11. Make sure the Anchors can be installed properly before inserting the epoxy glue.

4.6.4 Prepare and install Adhesive Anchors

Note **Only the Epoxy Adhesive delivered by Thermo Fisher Scientific can be applied, Epoxy Adhesives from other suppliers or other Epoxy Adhesives with a different product ID from Hilti may not be applied. See** **Items shipped to the Customer by Thermo Fisher Scientific on page 10 .**

If the Epoxy Adhesive Anchor is not delivered to the Site, contact your local Thermo Fisher Scientific representative.

Technical parameters of the Epoxy Adhesive Anchor:

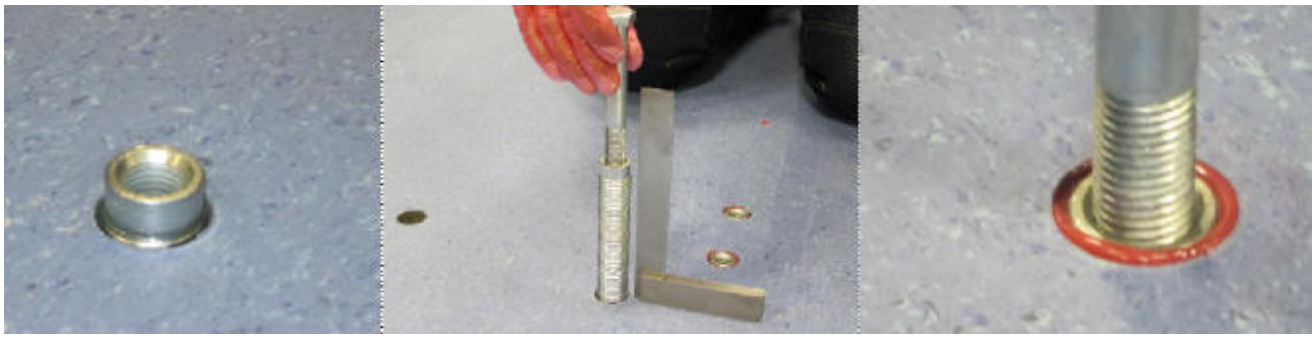
Parameter	Value
Manufacturer	Hilti
Product ID (Manufacturer)	2123403
Anchor Type	Chemical Fastener
Material Composition	Epoxy Resin
Basic Materials	Concrete (uncracked)
Temperature Range (for usage)	-40 °C - +70 °C
Storage Temparture Range	+5 - +25 °C
Thermo Fisher Scientific order code	1032987 / 4022 198 80912

1. Before placing the anchors in the drilled holes, the holes drilled with diamond drilling tools (diameter 28 mm) must be internally roughened to ensure proper mechanical/adhesive strength. Roughening tools are delivered in the pre install kit.
2. The anchor holes need to be free of electrical earth. Possible earth contact can occur when the anchor makes contact with the rebar or an additional earth grid in the concrete (rebar is the steel in reinforced concrete). This unwanted contact could cause an earth loop which will be difficult to trace once the enclosure is installed. Therefore we need to check the drilled holes for earth contact after they are made. The easiest way this can be checked is with the help of a multimeter: measure the inside of the hole with respect to the earth contact to which the microscope will be connected. After the anchors are inserted in the holes it is advised to measure with respect to earth again.
3. Prepare the two component mastic gun with a new cartridge.
4. Use an M16 bolt as a helping tool to insert (and retract) the anchor.
5. Insert enough mixture in the hole to get the anchor completely surrounded by glue. (approx. 2x full squeeze).
6. Insert the anchor in the following way:
   a. Flush to the floor or max. 5 mm below
   b. Perpendicular to the floor
   c. Centered in the hole

Note **To prevent alignment issues with the base anchoring during the installation, make sure to insert the anchor in the described way. If the adhesive anchors are not placed in the middle correctly, it may not be possible to align the base anchoring.**

7. Remove the superfluous mixture.
8. Allow the mixture to harden for at least 24 hours.

Note **Wait at least 24 hours before the anchor is ready to be used.**



5 General Requirements of a Site

To meet the ambient conditions required for the System site, a standard set-up is chosen. This set-up consists of an air handling unit and a HVAC system (Heating Ventilation and Air Conditioning). In this chapter the reference data are summarized.

The following points should be taken into account when choosing a site for the system:

- Avoid sites subjected to high levels of stray magnetic fields, e.g. locations near to large motors and transformers, electric railways and tram ways, etc.
  Always consider the presence of any high power or other EMI radiating equipment placed in the same facility as the System. These can have a negative effect on the System performance.
- Avoid sites subjected to heavy vibrations or high acoustic noise levels, e.g. locations near elevators, trains, shipping vehicles, busy roads, etc.
  - The best base for an electron microscope is a solid concrete block founded directly and intensively into the bare ground or sand of the site.
  - To minimize exposure to vibrations that travel through the structure of the building, the concrete block should be decoupled from the rest of the building.
  - For safe anchoring of the system to the floor, the type of concrete must be *concrete C20/C25* or better, with minimal thickness of 226 mm (8.90").

WARNING! **Insufficient quality of the concrete floor can result in unsafe anchoring of the equipment!**

Note **Minimum floor thickness is 226 mm**

Note **To avoid or reduce pressure waves we recommend to use sliding doors for all doors connected to the microscope room.**
Opening or closing regular doors creates pressure waves which can have a negative impact on the system performance.

Note **To avoid or reduce pressure waves we recommend to minimize the pressure difference between the microscope room and connecting rooms. When a significant pressure difference cannot be avoided we recommend to use an airlock between the rooms.**

5.1 Ambient Specifications

5.1.1 Temperature and Relative Humidity

It is mandatory to separate the Microscope Room from the Facility Room, for details see Room Dimensions on page 23 .

	Microscope Room	Facility Room
Maximum ambient temperature range for operation within specification.	18 °C to 23 °C	10 °C to 25 °C (LX3 Water)

	Microscope Room	Facility Room
		18 °C to 22 °C (LX3 Air)
Maximum permitted temperature change for operation within specifications	Within 0.8 °C p-p/ 24 h (Enclosure can handle any temperature variation time within this bandwidth)	To be determined.
Maximum ambient temperature range without damage to the microscope, storage temperature range	5 °C to 40 °C	5 °C to 40 °C
Relative humidity	< 80 %, Dew point below 18 °C	10 to 80 %

It is also advised to separate the Microscope Room from the Operator Room.

	Operator Room
Recommended ambient temperature (for operator)	20 °C
Relative humidity at 20 °C	30 % - 70 %

Note **The Room with microscope operator must follow local Occupational safety and health law and regulations.**

5.1.2 Heat dissipation

Nominal heat dissipation of the instrument depends on the setting and operating mode. The values in the tables below are the maximum values for the heat dissipation of various microscope units intended for the design of the air-conditioning and cooling water supply.

Heat transferred into the environment per area:

	Heat dissipated into air of Microscope Room	Heat dissipated into cooling water
Column, including TMP and electronics console **+ DHAPM** **+ BDFA**	500 W 6 W 12 W	2955 W N/A N/A
Optics Cabinet **+ Lorentz (Option)**	200 W 5 W	800 W 25 W

	Heat dissipated into air of Microscope Room	Heat dissipated into cooling water
+ OASA Boards	2x 5 W	NA
TEM Cabinet **+ SuperX/ DualX** **+ CAB/A** **+ 24port switch** **+ NGSTEM** **+ EMPAD PC (option)***	300 W 200 W 2x 40 W 18 W 116 W 300 W	N/A N/A N/A N/A N/A N/A
Power Cabinet **+ Lorentz (Option)**	700 W 60 W	N/A N/A
Accessories Cabinet (Option)	515 W	N/A
Corrector Cabinet (Option) **- 1/2 Correctors**	400/650 W	N/A
HT tank G2	350 W	N/A
PVP Column Turbo	321 W	N/A
PVP Base Turbo	500 W	N/A

The following options can be present:

	Heat dissipated into air of Microscope Room	Heat dissipated into cooling water
GIF **(Gatan Image Filter)**	39 W	79 W
Corrector (Option) - 1/2 Correctors	0 W	300 W/ 600 W
Camera (Falcon, Ceta) **(value is per camera)**	130 W	80 W

Lorentz Lens	10 W	50 W
EMPAD* ● DCU ● Detector	 ● 15 W ● 10 W	

* EMPAD is currently not an option for Metrios AX and Krios G4

	Heat dissipated into air of Microscope Room	**Heat dissipated into cooling water**
Gatan Cabinet (Option)	1053 W	N/A

Facility Room Heat Dissipation

The chiller must be placed outside the microscope room to prevent any interference with the system. Be sure to account for head loss due to hose length and chiller height when determining which model of chiller to use.

Item	**Heat dissipated into air of the Facility Room**
Haskris LX3 G2 W S2 (Water cooled)	The heat dissipated into the Facility Room is negligible
Haskris LX3 G2 Air (Air cooled)	6760 W
Data Server Cabinet ● Falcon / Ceta storage Server	Maximum cooling capacity 12000 W ● 1600 W

* Nominal heat dissipation of the instrument depends on the setting and operating mode. The values in the table below are the maximum values for the heat dissipation of various microscope units intended for the design of the air-conditioning and cooling water supply.

Only a water cooled chiller to be used in case the data server cabinet is placed in the facility room (recommended)

5.1.3 Ventilation and Room Cleanliness

For ventilation the following design is prescribed:

- For ventilation a de-centered system is advised with air inlets low in the corners of the room and a centered air exhaust in the ceiling.
- The air flow must be uniform, low and constant via air ducts.
- Extra cooling can be supplied by wall cooling systems.

The proposed site must be clean of dust. The advised dust class is ISO 8 (ISO 14644-1):

Class	Maximum particles/m³			FED STD 209E equivalent
	≥ 0,5 µm	≥ 1 µm	≥ 5 µm	
ISO 8 (advised)	3.520.000	830.000	29.300	Class 100.000

Determining whether a room meets ISO 8 classification is possible but difficult and expensive.

For this reason, if an evaluation of the site's cleanroom level is not feasible, ensure the room fulfills the following requirements:

- A directed air flow with use of filters.

5.2 Room lighting

Every effort must be made to entirely eliminate natural lighting from the Microscope room to achieve temperature stability and prevent biological growth inside the water cooling system. For maintenance and normal work inside the Microscope room, light levels according to local (Occupational safety and health) regulations must be available. A guideline for illumination required for mechanical work is 750 lux.

	Microscope Room	Service Room
Usage	300 - 500 lux, dimmable	N/A
Service	750 lux	750 lux

Due to heat dissipation it is advised to use dimmable LED.

Heat dissipation of the lighting has to be added to the heat dissipation table in section Heat dissipation on page 33 .

CAUTION! **Magnetic fields that are generated by lighting or dimmers can negatively influence the performance of the microscope.**

Verify that the proposed lighting complies with the EMI requirements for the Microscope Room.

Activities	Requirement
Normal operation	500 lux
Installation and maintenance	750 lux or higher, depending on local occupational health and safety regulations for mechanical / electrical work.

If the Microscope Control Room is adjacent to the Microscope Room then make sure that the installed lighting does not generate magnetic fields that can influence the performance of the microscope.

5.3 Magnetic fields (EMI)

Conversion: 100 nT = 1 mG (Gauss)

These specifications must be met at the following locations in the Microscope Room:

- At and near the location of the gun.
- At and near the location of the stage.
- If applicable, at and near the location of the Energy Filter (EF).

These specifications apply to:

- Slowly varying magnetic fields.
- Near DC fields, caused by for example elevators, trams and trains.
  Near DC EMI is included in the *asynchronous* specifications.
  For Near DC EMI measurement refer to asynchronous specifications.

5.3.1 Achievable HR-STEM image quality and distortion due to magnetic fields (EMI)

Max. Magnetic Field	Expected HR-STEM Resolution and Distortion
80nT p-p	Required resolution, but with a noticeable distortion.
50nT p-p	System resolution, but with a minor distortion.
30nT p-p	System resolution with best image quality.

5.3.2 Systems with Continuum Energy Filter

EMI specifications provided above do not cover the entire specification range for systems with a Continuum Energy Filter. The Continuum Energy Filter compensates for 50/60Hz Mains frequencies but is unable to compensate for higher harmonics such as 100/120Hz. The ability of the Energy Filter to obtain high resolution is limited by the presence of the higher harmonics (and all frequencies other than the mains frequency) resulting in the determination of additional specifications for the direction perpendicular (Left - Right) to the Continuum direction in the horizontal plane.

Continuu, Energy Filter Type	Front-Back MAINS	Front-Back Higher harmonics and other frequencies	Left-Right MAINS	Left-Right Higher harmonics and other frequencies	Vertical (Z)
CFEG + Continuum 1065/1077/1069	50 nT p-p	50 nT p-p	50 nT p-p	20 nT p-p	75 nT p-p

An additional procedure for measuring EMI fields near the Energy Filter will be performed during the Thermo Fisher Scientific site-survey.

5.4 Site Acoustics and Floor specifications

5.4.1 Thermo Fisher Scientific Site Evaluation tool (SE-tool™)

Acoustic noise and floor vibrations can excite resonances in the microscope. The resulting disturbance in high-resolution images is an integral sum of the contributions of the individual disturbing sources. Because these sources are typically interlinked, Thermo Fisher Scientific intentionally does not provide separate specifications for acoustics and floor vibrations.

To assess how the noise and vibrations in the Microscope Room may affect the performance of the microscope, a trained Thermo Fisher Scientific engineer will use the Site Evaluation Tool (SE-tool™). The SE-tool represents decades of expertise on the dynamics of Thermo Scientific microscopes and their response modes. The SE-tool uses this built-in knowledge to predict how the frequency spectra that are recorded in the Microscope Room may affect the performance of the microcope.

5.4.2 Acoustic noise reduction

An Electron Microscope typically is sensitive for acoustics in the low frequency range (< 500 Hz).

To reduce acoustic noise in the Microscope Room:

- It is highly recommended to use sound damping materials and constructions. Keep in mind that the floor, ceiling and walls must not collect or emit dust and particles, and are easy to clean.
- The climate control and ventilation systems must be quiet, especially in the low frequency range.

5.4.3 Preventive and corrective counter-measures for vibrations in the Microscope Room floor

For floor vibrations above 10 Hz, Thermo Scientific microscopes have a built-in air cushion system that provides enough passive isolation above 10 Hz for virtually all sites.

For floor vibrations below 10 Hz, Thermo Fisher Scientific recommends the following:

Item	Recommendation
Construction guidelines for the Microscope Room floor	Solid concrete block under the microscope base or the entire Microscope Room: ● Founded directly on the bare ground or sand under the site. ● Isolated from the surrounding building structure to prevent the transfer of vibrations into the Microscope Room from equipment or walking persons elsewhere in the building.
Active vibration isolation	If a site assessment with the Site Evaluation Tool (SE Tool) concludes that the floor vibrations are near or above the limits that allow for system performance within specifications, then the following corrective options are available: ● The Thermo Scientific iVIS (Integrated Vibration Isolation System) option is available for selected systems. The SE-tool can predict if installation of the iVIS option is sufficient to eliminate excessive floor vibrations. ● Third party active vibration isolation system. The SE-tool can not predict the effectiveness of third party systems.

It is recommended to perform a Site Evaluation with the SE-tool before construction of the Microscope Room starts. If a new building is constructed, then an assessment of the building site can be performed. The assessment can be repeated as soon as the bare construction of the Microscope Room is completed.

6 Connection Specifications

The Customer is responsible for all the services used by the microscope system. Any deviation from the specification of these services may cause deterioration in Instrument specification.

6.1 Pre-Installation Items

See section Items shipped to the Customer by Thermo Fisher Scientific on page 10 for the list of required materials to prepare system connections to the facilities.

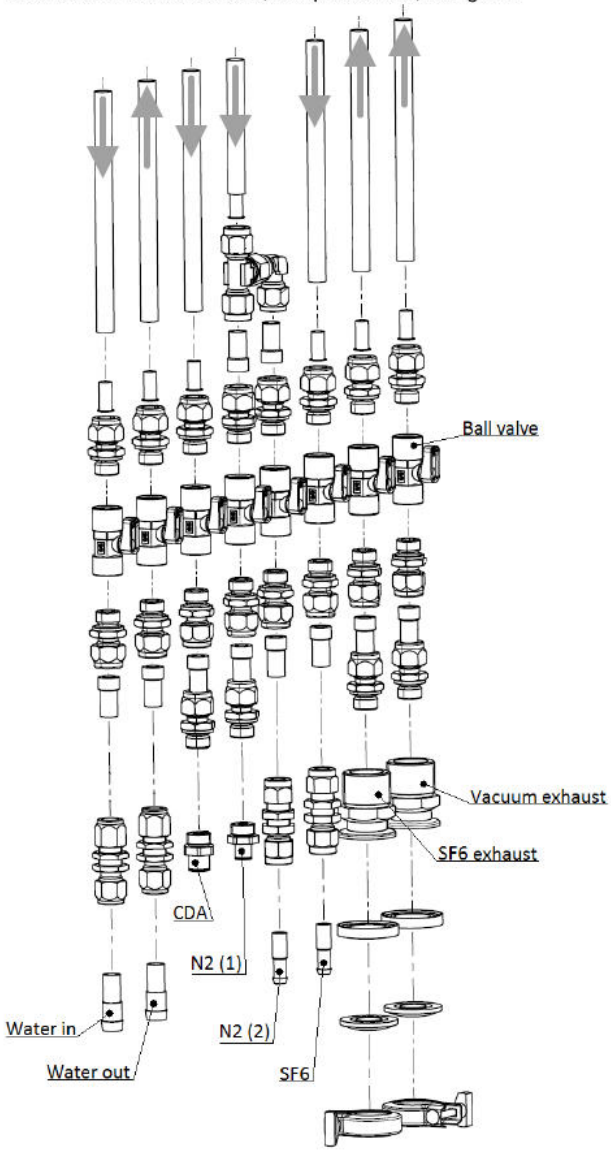
Note **These items must be installed before the start of the installation.**

6.2 Connection to Facilities

Note **If the system must be SEMI S2 compliant, then the Facility Connection Box must be installed.**

In case no Facility Connection Box will be installed, then Thermo Fisher Scientific recommends to install the facility connections in the same layout as the Facility Connection Box:

Connections to chilled water, compressed air, and gases



Connections to the microscope system

The connections towards the microscope must meet the following requirements:

Category	Requirement	Remarks
Connections	The following connections must be installed, preferably in the same left-to-right order as listed below: ● Cooling water IN (from the chiller to the microscope). Pressure: < 6 bar ● Cooling water OUT (from the microscope to the chiller). ● Compressed dry air (CDA). Pressure: < 8.5 bar ● N2 for regular system operation. Pressure: < 3 bar ● *Optional*: N2 for service purposes. Pressure: < 3 bar ● *Optional*: SF6 IN Pressure: < 10 bar ● *Optional*: SF6 exhaust (*check local laws and regulations*). ● Vacuum exhaust	SF6 is typically supplied and disposed in gas cilinders, not via a facility connection.
Location	The connections must be installed at the location that is specified by the floorplan for the Microscope Room.	
	Distance between neighboring connections (center-to-center): > 60 mm	
	Distance to the wall (center-to-wall): > 59 mm	
	Distance to the floor: 500 - 1500 mm	
Orientation	The connectors towards the microscope face downward.	
Identification	Each connection has a label that shows: ● An identification of the material that flows through it. ● An arrow that specifies the flow direction.	
Operation	Each connection can be opened and closed with a valve.	A ball valve is preferred to ensure instantenous closing.
Safety	The valves are easily accessible, so that they can be operated quickly in case of a malfunction or emergency.	If the valves are covered by a panel or door, then there must be *no* lock.

Note **Before installing an *SF6 exhaust* connection, check the local laws and regulations regarding the disposal of SF6 to the environment.**

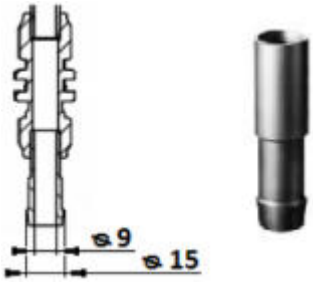
SF6 is a strong greenhouse gas. Even if local laws and regulations allow for the disposal of SF6 to the environment, Thermo Fisher Scientific strongly recommends to recycle SF6 to protect the environment.

To prevent damage or delay during installation and maintenance, it is strongly recommended to install couplings as specified in the table below.

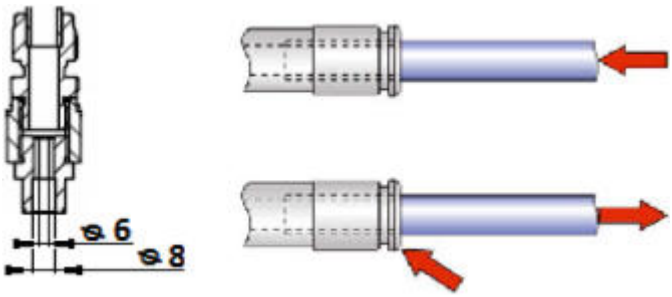
The hose dimensions are specified for reference only. Hoses for the connection with the microscope system will be supplied with the system.

Connection towards the microscope	**Remark**	**Recommended coupling type**	**Hose**		
			Outer diameter	**Inner diameter**	**Wall thickness**
Water IN	Chiller to microscope	Serto hose nozzle inner diameter: 9.2 mm outer diameter: 15.0 mm	21 mm	13 mm	4 mm
Water OUT	Microscope to chiller	Serto hose nozzle inner diameter: 9.2 mm outer diameter: 15.0 mm	21 mm	13 mm	4 mm
CDA		Press-in	8 mm	6 mm	1 mm
N2 (1)	Regular operation *Venting & flushing*	Press-in	6 mm	4 mm	1 mm
N2 (2) *Optional*	Service purposes	Serto hose nozzle inner diameter: 7.0 mm outer diameter: 9.5 mm	—	—	—
SF6 IN *Optional*		Serto hose nozzle inner diameter: 7.0 mm outer diameter: 9.5 mm	13 mm	8 mm	2.5 mm
SF6 exhaust *Optional*	Check local laws and regulations	NW25 coupling with a hose nozzle inner diameter: 10.0 mm outer diameter: 15.0 mm	23 mm	16 mm	3.5 mm
Vacuum exhaust		NW25 coupling with a hose nozzle inner diameter: 10.0 mm outer diameter: 15.0 mm	23 mm	16 mm	3.5 mm

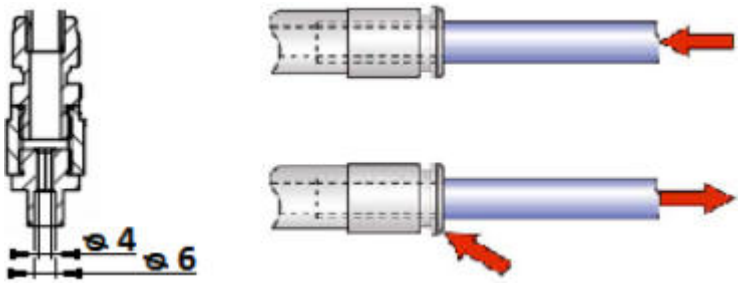
- *Water IN* and *Water OUT*: pillar / bared / hose nozzle connector



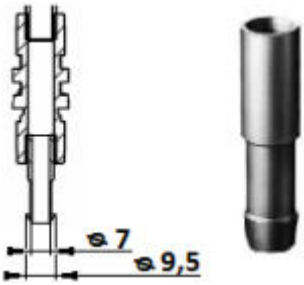
- *CDA*: press-in connector



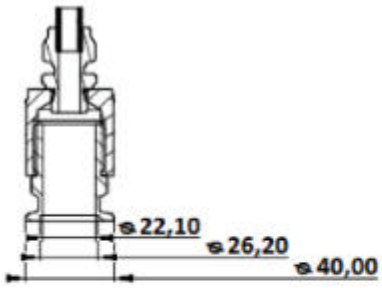
- *N2* (1): press-in connector

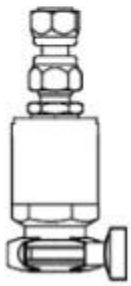


- *N2* (2): pillar / bared / hose nozzle connector for hoze with inner diameter: 8 mm.
- *SF6 IN*: pillar / bared / hose nozzle connector

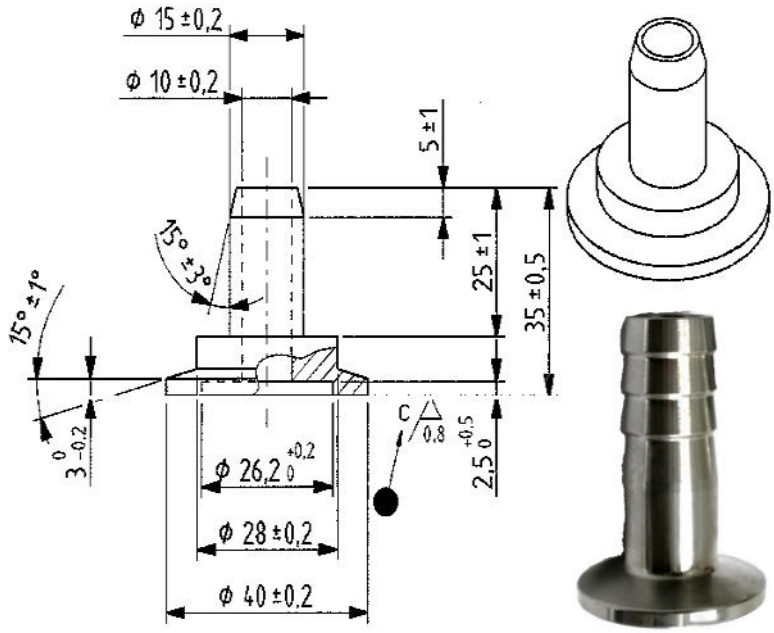


- *SF6 exhaust* and *Vacuum exhaust*:
  - NW25 coupling





- Hose nozzle



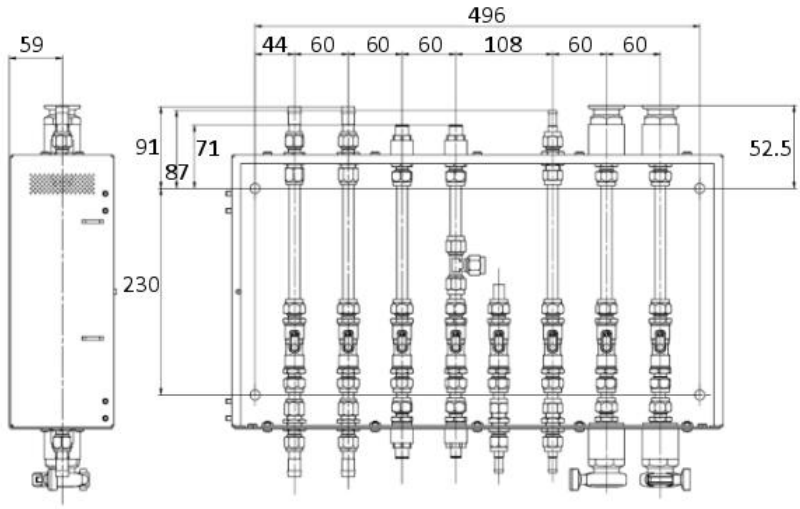
The hose (inner diameter 16 mm) is secured to the hose nozzle with a hose clamp.

The Facility Connection Box is a special unit with connectors to quickly connect the system to facilities on Customer's site. It also allows the Customer to prepare the facilities without the System being on site.

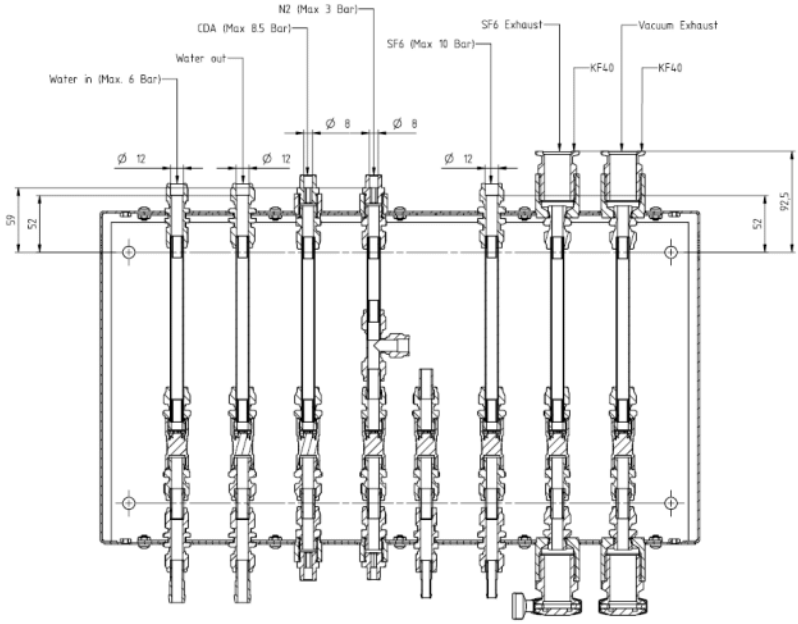
The site can be prepared before the Connection Box is delivered or unpacked. This is recommended to improve time needed for the installation of the system.

Preparations for installation

1. Prepare a space on the microscope room wall as indicated in the system floor-plan (Microscope Room Dimensions on page 23).
2. Drill 4 holes for mounting of the Connection Box on the wall according to the following picture:



3. Prepare the facilities to be connected to the Connection Box as indicated.

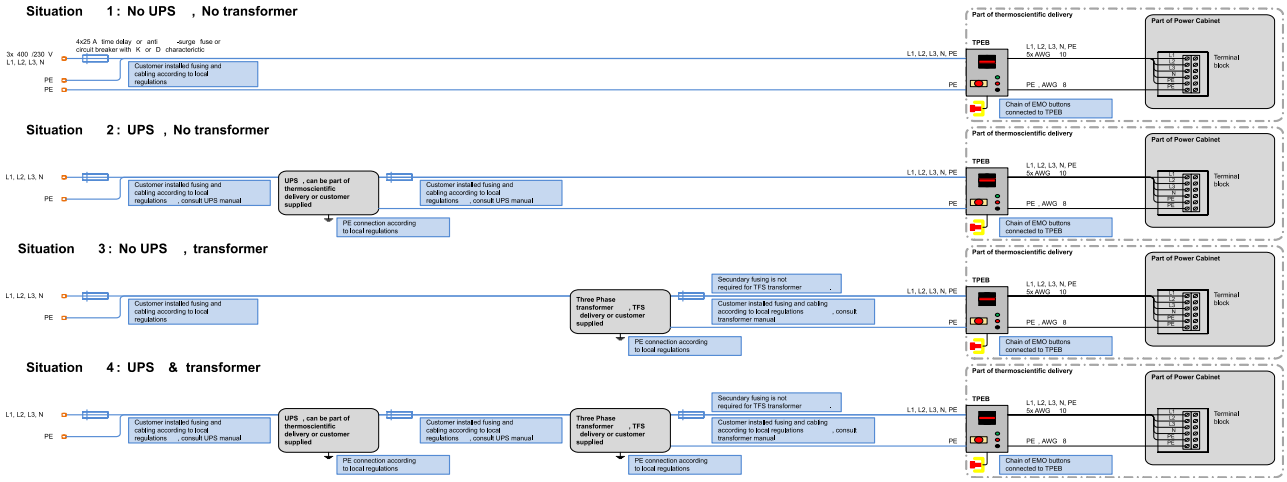


4. Install the Facility Connection Box according to the manual delivered with the Box.

6.3 Electrical Power Supply

The Facility connections for the system have several possible configurations depending on the presence of the Optional SEMI S2 Kit and/or the presence of a Mains Matching Transformer.

1. TPEB
2. UPS, No Mains Matching Transformator
3. No UPS with Mains Matching Transformator (chapter 6.3.1.3)
4. UPS with Mains Matching Transformator (chapter 6.3.1.4)



No SEMI S2 kit Ordered:

With or without ordering a Mains Matching transformer the EMO circuit should be connected via the TPEB (Three Phase EMO Box)

SEMI S2 Kit Ordered:

In order to meet SEMI S2 requirements, an S2 compliant chiller must be ordered.

The EMO circuit should be connected via the TPEB, and the EMO connection on the transformer (if ordered) is terminated.

Note **Currently the SEMI S2 kit is not an option for Krios G4 systems**

6.3.1 Mains Connections (incl. EMO) via TPEB

Standard the power from the customer will be connected to the TPEB.

The EMO circuit will always be connected to the TPEB, no matter what additional options have been ordered (UPS / Mains Matching Transformer).

CAUTION! **Electrical fusing, cabling and/or equipment must be installed by a qualified electrician.**
All electrical installations must comply with:
• Local installation standards, laws and regulations.
• The installation instructions for the fuses, cabling and/or equipment.

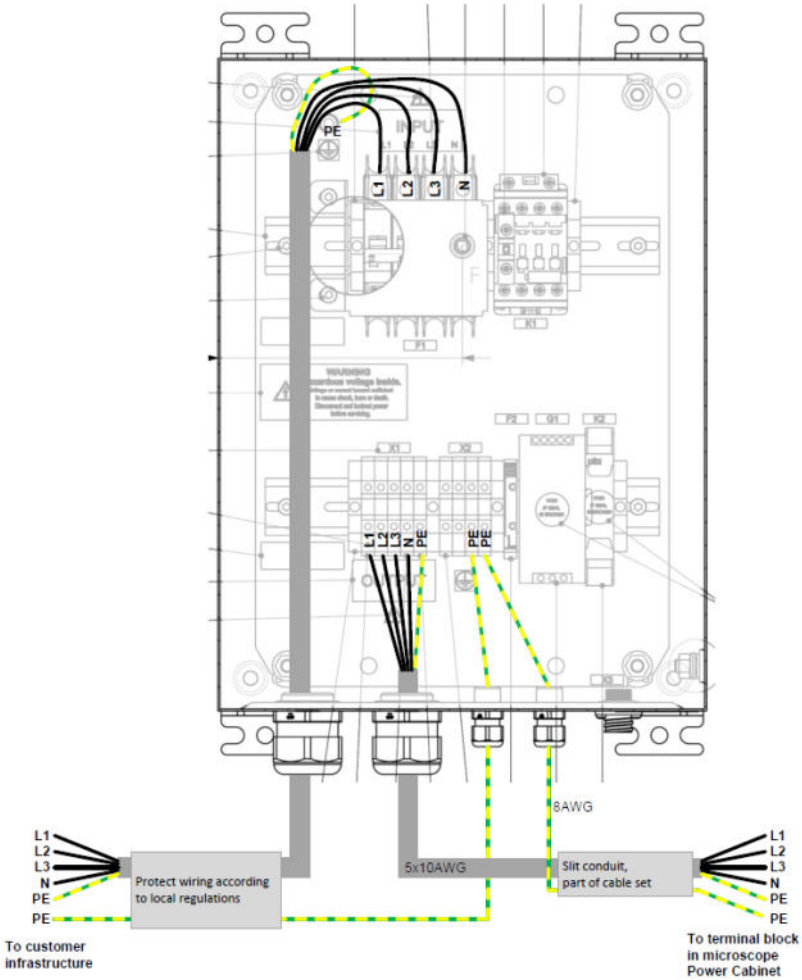
6.3.1.1 TPEB (Three Phase EMO Box)

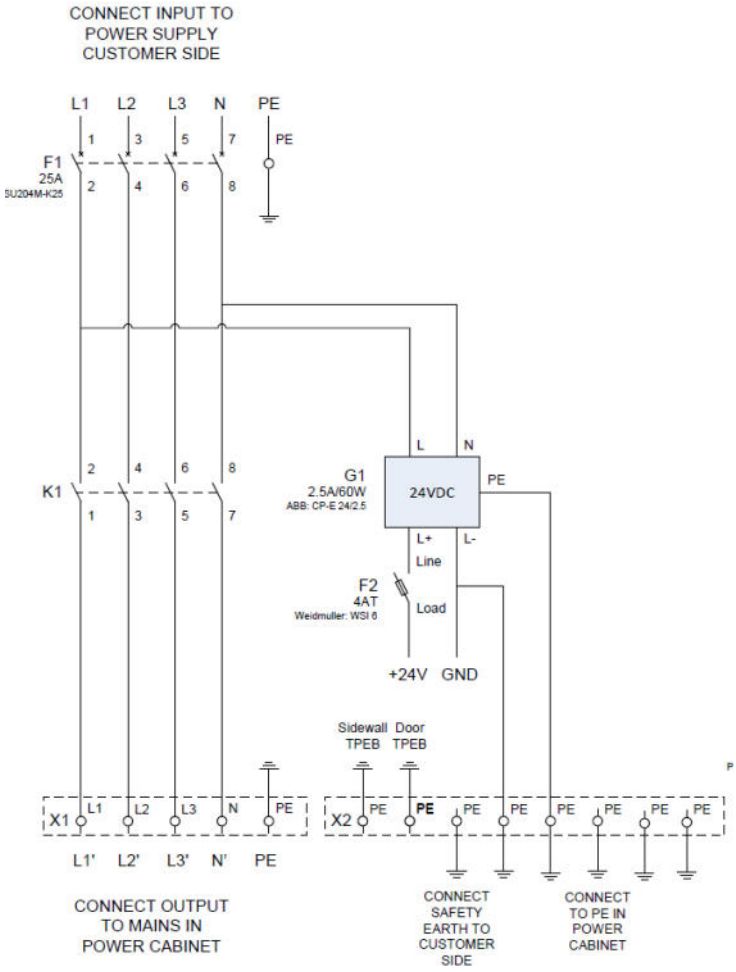
To connect the TPEB to the facilities of the customer is the responsibility of the customer.

Note **The TPEB has a SCCR of 10 kA.**

These are general directions for the customer as a reference:

- To connect the facilities to the TPEB, connect to Circuit Breaker F1. Advise is to use cable 5x AWG10 (6mm^2) (see diagram, Connect Input Power Supply)


PE
L1
L2
L3
N
L1
L2
L3
N
PE
PE
PE
8AWG
L1
L2
L3
N
PE
PE
Protect wiring according to local regulations
5x10AWG
Slit conduit, part of cable set
To customer infrastructure
To terminal block in microscope Power Cabinet



- Protective Earth from Customer side, connect to terminal X2 using 1x AWG10 (6mm^2) Gn/Ye with an eyetongue

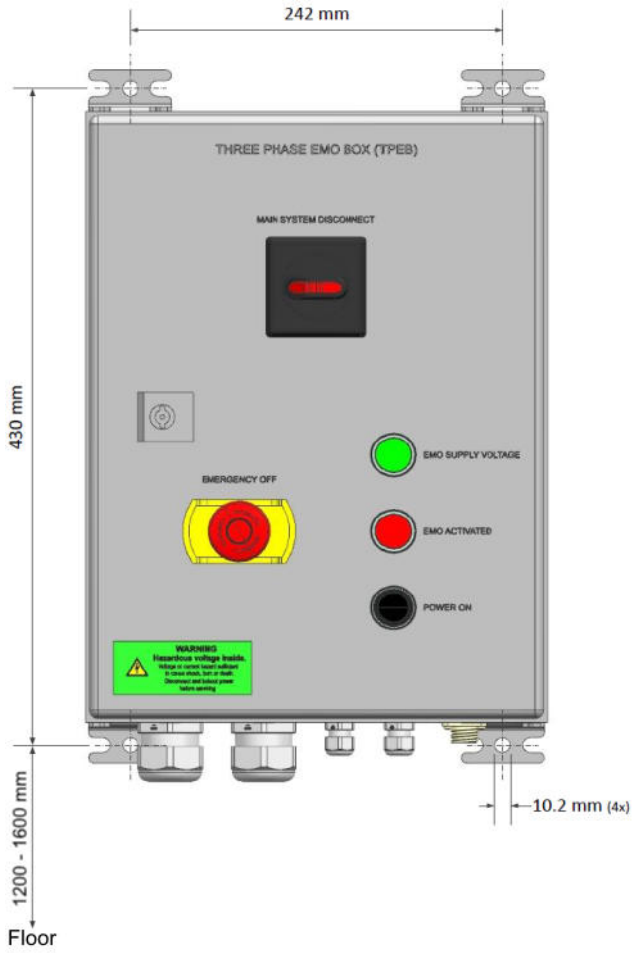
.

- All connections shall be made with cables and wires that are in compliance with applicable safety requirements and local legislation

The TPEB is a unit that is placed between the customers facilities and the system and should be mounted according to the floor layout.

Preparations for installation

1. Prepare a space in the microscope room wall as indicated in the system floor-plan (Microscope Room Dimensions on page 23).
2. Drill 4 holes for mounting of the TPEB on the wall according to the following picture, the distance between the floor and the lower side of the TPEB must be between 1.2 and 1.6 meters:



6.3.1.2 Mains Connections (incl EMO) via transformer (optional)

The EMO circuit of the microscope system is connected *only* to the Three Phase EMO Box (TPEB). When an EMO button is pushed, the power supply from the TPEB to the microscope system is cut off immediately.

Note **The Mains Matching Transformer is not connected to the EMO circuit of the microscope system. When an EMO button is pushed, the transformer is not deactivated.**

In case 400 V +/-10 % is not available a Mains Matching transformer shall be used.

This transformer can be either supplied by the Customer or by Thermo Fisher Scientific.

Input fusing	Consult manual of Mains Matching transformer for information about primary fusing.
Output fusing	Not needed for the system but might be required by local regulations.

WARNING! **Do *not* disconnect the protective earth terminal for the equipment.**

Do *not* interrupt the protective earth conductor inside or outside the equipment.

The protective earth connection must meet local safety requirements. Any interruption or disconnection of the protective conductor is likely to make the equipment dangerous.

Protective earth conductors and connections must be checked during the Pre-installation survey.

Note **Mains matching transformer should be located in the Facility room, not in the Microscope room.**

Note **The Mains Matching Transformer has a SCCR of 10 kA.**

Note **On delivery, all taps are set for a line input of 230 V.**

Note **Conductivity from the floors should not be any issue**

Contact your local mains supplier for installation recommendations such as max. permissible load and fusing.

CAUTION! **The Mains Matching Transformer must be installed at least 10 meters distance from the Microscope Column to minimize stray fields.**

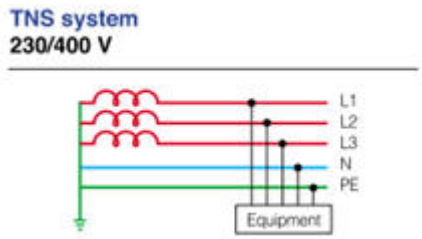
The Microscope is connected via the TPEB to a **Three Phase Transformer**.

Note **Be aware the system needs to be connected to a three phase supply. Depending on the configuration the load is distributed over the three phases therefore the load does not need to be the same in every phase.**

Connections between Transformer and TPEB	5-wire (6 mm^2 / 10 AWG conductors), 3 phase, 1 neutral and earth

Power consumed by the Microscope, including accessories and loaded	13 000 W

Mains frequency	50 or 60 Hz ± 1 %
Inrush current	< 200 A, 50 ms (The maximum level of the inrush current is strongly dependent on the impedance of the power grid)
Earth leakage current	< 50 mA,
Power factor	> 0.9

Earth resistance (check the local requirements)	Because of the relatively high earth leakage current a second permanent PE conductor is required, this shall be 10 mm^2 or AWG8. This conductor shall be routed close to the mains cable to minimize loop area.
Earth loops	Earth loops must be avoided: To avoid 50/60Hz currents through the microscope the complete microscope including all cabinets shall be floating from the building and all its infrastructure, the only connection to Protective Earth is via the mains input cable and the extra PE cable. Do not allow the console to touch external metal pipes or conduit. Water connections must be terminated with at least 15 cm of rubber hose, fitted after the main shut-off valve. A Residual-current device (RCD), Residual-current circuit breaker (RCCB) or a Ground Fault Circuit Interrupter (GFCI) is not needed for the system but local regulations may require otherwise. If required, select a medium sensitivity type (>100mA) to avoid nuisance tripping. When a RCD is used, then a TNS connection must be used, other ways of connection can cause issues. 

Power consumption of main accessories	Lorentz	100 W
	GIF system	1500 W
	Camera	500 W
	Corrector	400 W
	STEM	45 W

6.3.1.3 UPS (Uninterruptible Power Supply)

Note **When ordering a UPS make sure it can deliver 150 % of max. power for > 1 minute.**
The water chiller shall not be connected to the UPS of the Microscope. If this is required, an additional UPS need to be ordered for the water chiller.

A UPS can only be used for the complete system, for safety reasons it is not allowed to supply parts of the System from a UPS.
The UPS can be supplied by Thermo Fisher Scientific or the Customer, the installation should be done by a local electrical engineer.

6.3.1.3.1 System UPS Requirements

In case that a Customer supplied UPS is used, it has to comply to the following requirements:

Required Power	15 kVA
Output Voltage if the System is directly connected to the UPS	3 x 400/230 V ± 10 %
Backup time	To be decided by the customer
Input Fusing	Consult the UPS manual and local regulations
Output Fusing	Consult the UPS manual and local regulations. If the system is directly connected to the UPS, the current to the system must be limited to 25 A.

6.3.1.3.2 UPS for Water chiller

A Residual-current device (RCD), Residual-current circuit breaker (RCCB) or a Ground Fault Circuit Interrupter (GFCI) is not needed for the system but local regulations may require otherwise. If required, select a medium sensitivity type (>300mA time delay) to avoid nuisance tripping.

Water chiller UPS requirements for Haskris LX3

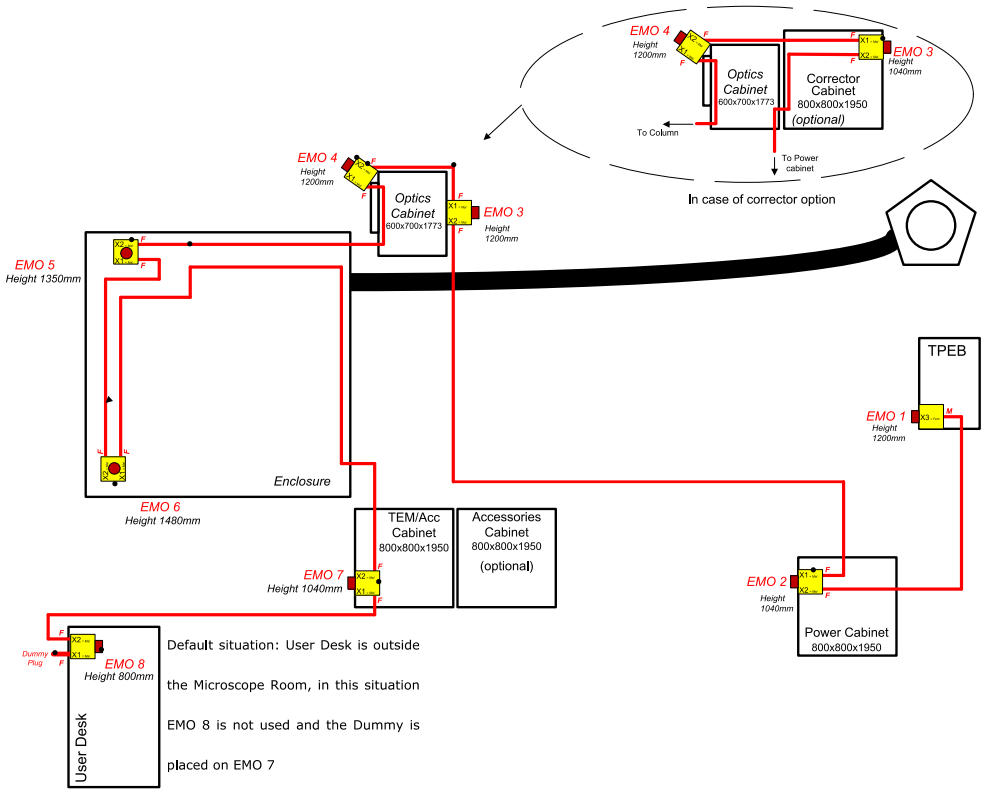
In case that a UPS is needed for the water chiller, it has to comply to the following requirements

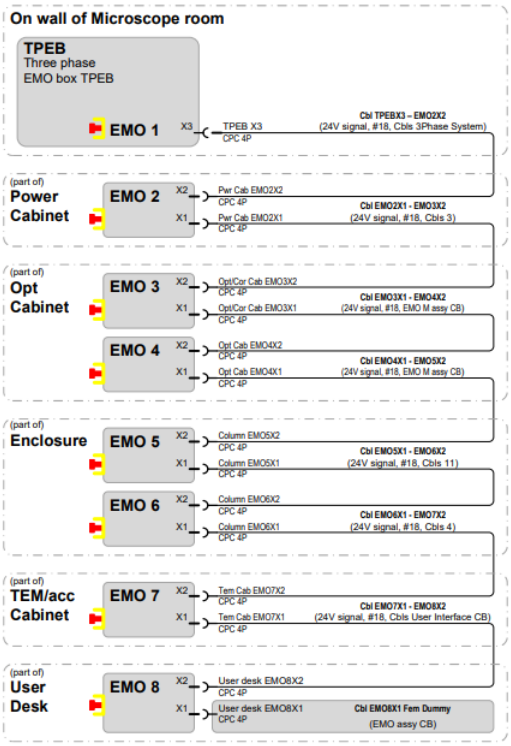
Required Power	5.2 kVA
Min. Circuit Ampacity (MCA)	21.5 A
Max. Overcurrent Protection (MOP)	30 A
Output Voltage	single phase, 230/110 VAC ± 10 %, 50/60 Hz
Backup time	To be decided by the customer
Input Fusing	Consult the UPS manual and local regulations
Output Fusing	Consult the UPS manual and local regulations

6.3.2 User Desk EMO

The EMO button on the user desk will only be connected to the EMO circuit when the desk is in the same room as the microscope, within a maximum distance of 15 meters.

If the user desk will be placed in a separate operator room, there will be no EMO button used on this desk.





Make sure to mount the EMO button at the left or right front edge of the User Desk.

6.3.3 Earthing

Double permanent protective earth (PE) connection

DANGER! **Do not connect the microscope system to any electrical power supply before the system is permanently connected to a protective earth (PE) conductor.**

DANGER! **Under no circumstances must the safety provisions of the electrical connection of the microscope system be negated by the use of an extension cord without protective conductor.**

If a part of the system that is open to touch becomes electrified due to faulty wiring or other circumstances, then the use of an extension cord without protective conductor (earth pin and wire) can result in a powerful electrical shock.

CAUTION! **The leakage current from mains to earth exceeds 3.5 mA.**

To comply with the European safety standards, a double permanently connected and separated safety earth must be fitted to the earth rail of the Spectra 200 Power Cabinet.

The mains cable must be connected with the Three Phase EMO Box (TPEB). In addition to the protective earth (PE) connection in the mains cable, the TPEB is provided with a separate, additional PE connection. This separate PE connection must remain permanently connected. The PE wires must comply to local regulations.

Earth loop prevention

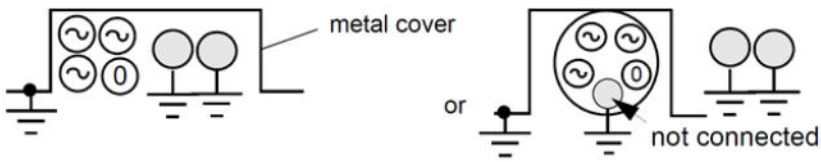
The maximum allowed leakage current in the earth wire of the mains power supply is 50 mA AC. In the grounding wires internal loop, a current can occur up to 5 A DC. This DC current is '*by design*' and has no negative impact on the performance of the system. These DC currents are specified with a maximum variation of 2 mA on the column of the microscope.

To prevent the occurrence of 50/60 Hz AC currents through the PE connections, the PE wire that is running with the mains cable and the extra PE wire must be connected to the same PE rail in the customer mains panel. To reduce the loop area, the extra PE wire must run as close as possible to the mains cable.

Use a *current clamp meter* to measure the AC and DC currents in the PE wires.These currents can not be measured properly with a digital multimeter, because the resistance of the grounding wire changes when a multimeter is connected in series.

Ducts, conduits and cable trucking systems

To protect the mains cable (L1-L2-L3-N-PE) and the additional PE cable from accidental disconnection or mechanical damage, they must be enclosed in suitable ducts such as a conduit or a cable trucking system. If a metal duct is used, then the duct itself must also be connected to protective earth (PE).



6.3.3.1 Earth-leak Current Breakers

To prevent an uncontrolled switching off of the microscope and guarantee the correct working of the microscope it should not be connected behind a Earth-leak current breaker.

A Residual-current device (RCD), Residual-current circuit breaker (RCCB) or a Ground Fault Circuit Interrupter (GFCI) is not needed for the system but local regulations may require otherwise. If required, select a medium sensitivity type (>100mA) to avoid nuisance tripping.

If the microscope will be damaged by an uncontrolled switching off due to an earth-leak current breaker the service contract will not cover the cost. Thermo Fisher Scientific is also not able to guarantee the correct working of the microscope after such a switch off.

6.3.4 Cable Duct

All cables that are routed over the floor should be protected by suitable covers.

See Safety Manual for details.

6.4 Cooling Water Supply

6.4.1 Cooling Water Specifications

Note **Thermo Fisher Scientific does not allow the use of a locally purchased water chiller. Only the water chillers approved by Thermo Fisher Scientific can be used.**

For the *Haskris LX3 G2 W S2* chiller, the facility water needs to meet these specifications:

Item	Requirement
Connections	1/2" FNPT Couplings
Temperature range	5 – 32 ºC
Recommended temperature	18 ºC
Flow rate (at 24 ºC)	1000 L/hr
Min-Max differential pressure	0.7 - 6.9 bar
Maximum inlet pressure	6.9 bar

Water flow for Options:

Gatan Image Filter (GIF)	15 l/h
Camera	15 l/h
1 Corrector	60 l/h
EMPAD	15 l/h

6.4.2 Supported Water Chiller

Thermo Fisher Scientific supports the following chillers for worldwide use (Haskris suitable for 50 and 60 Hz):

- Air cooled: Haskris LX3 G2 Air Enh, Commercial order Code: 1148372
- Water cooled: Haskris LX3 G2 W (S2 compliant) - Commercial order code: 1148375

Note **It is required to place both types (air cooled unit, water cooled unit) Chillers in a separate Facility room, not in Microscope Room. This is due to the acoustic noise and mechanical vibrations.**

Note **Air cooled unit: The facility room has to be ventilated according to the maximum heat load. See also Heat dissipation on page 33**

Note **It is strongly advised to have a water leak detector present in the Microscope Room.**

Note **To avoid electrical earth leak problems via the water piping, the water connections must be terminated with at least 15cm of rubber hose, fitted after the main shut-off valve.**

6.4.3 Water Chiller connections

Note **Some of the connection materials needed for connecting of the water Chiller may need to be purchased by the Customer, see section Materials and Tools on page 10 .**

Note **The Chiller supply must be separate from the system. It can't be connected to the microscope Mains Matching Transformer.**

General electrical connection requirements:

Input voltage	230 VAC ± 10 %, 50/60 Hz
Input current	Consult the Chiller manual
Fusing	Consult the Chiller manual and local regulations
Power	50 Hz: 220-240V-1Ø -5% +10% 60 Hz: 208-230V-1Ø -5% +5%
Minimum Circuit Ampacity	21.5 A, LX3 Air Cooled 19.8 A, LX3 Water Cooled
Maximum Overcurrent Protection	30 A

See the Water Chiller data sheets (Appendix 5: Optional Configurations on page 86) to determine power supply needed. If you are not sure which type of water chiller was ordered, please contact a local Thermo Fisher Scientific representative.

To connect a chiller to the System and water supply, the following hoses are needed:

2 hoses to connect the chiller to the microscope	1/2” hose, length depending on the facility arrangements
2 hoses to connect the chiller to facility water (applicable for water cooled chiller only)	1/2” hose, length depending on the facility arrangements

6.5 Gases

6.5.1 Compressed Air Supply for Pneumatics

A compressed air supply from a compressor unit or a cylinder must be connected to the instrument with the following specifications and dimensions:

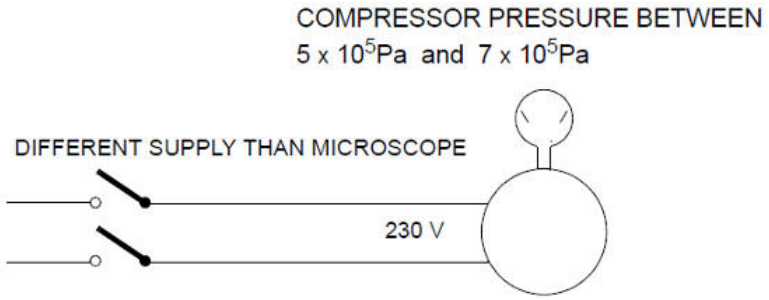
Min. air pressure	6.0 x 10^5 Pa (6 Bar)
Max. air pressure	7.0 x 10^5 Pa (7 Bar)
Pressure fluctuations	0.1 Bar per minute
Solid particles	Mass concentration: 5 - 10 mg/m^3
Water content	Dew point < -20°C
Oil content must not exceed:	5 mg/m^3
Push in connector	8.0 mm (outside diameter)

If a separate compressor is used, it must be placed outside the microscope area in order to prevent switching transients of the motor affecting the microscope electronics, the unit should be connected to a mains supply different from the microscope mains supply, see figure below.

CAUTION! **Do not use the same nitrogen cylinder(s) or wall outlet for both venting and pneumatic pressure.**

The requirements for nitrogen that is used to vent the system are much stricter than the requirements for pneumatic functions. Nitrogen for pneumatic functions could be not clean/dry enough for venting, which results in contamination of the system.

Nitrogen for venting and nitrogen for pneumatic functions must be supplied from separate cylinders or wall outlets.



6.5.2 Nitrogen (N2)

Nitrogen is used to vent the chamber and vacuum system and cool down the Cold Trap. For each use a different source of Nitrogen is specified.

6.5.2.1 Venting (N2)

Nitrogen is used to vent the chamber and vacuum system. A cylinder of dry compressed nitrogen, and a reduction valve set to a minimum pressure of 1 x 10^5 Pa (1 Bar over-pressure) must be present during installation and there-after.

The microscope will reduce the pressure to 50 mBar using a reduction valve as standard. The connection pillar of the gas inlet of the microscope has a diameter of 8 mm and the dust filter connection diameter is 6 mm. Use very clean contamination free parts, from bottle to microscope, to assemble the N_2 gas supply system.

Note **An N_2 cylinder with reduction valve is not delivered with the microscope and it is a customer's responsibility to purchase it locally.**

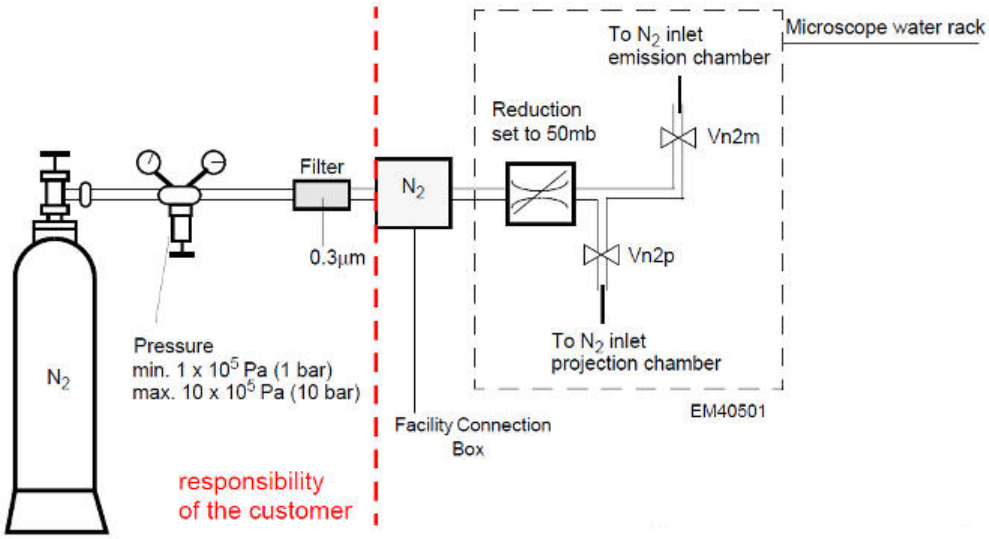
The supplied N_2 has to comply to the following specifications:

Pressure	1 x 10^5 Pa (1 Bar over-pressure)
Water content	less than 10 ppm
Connection specification	The connection pillar of the gas inlet of the microscope has a outside diameter of 8 mm
Dust Filter	Dust filter with a filter grade AA (0.3 µm) must be installed in the N_2 line (order number 5322 480 20066) The dust filter connection diameter is 6 mm

Note **The filter is not delivered with the microscope and it has to be purchased by the customer, for details see Items to be purchased by the Customer on page 12 .**

CAUTION! **Do not use facility N_2 supply to vent or flush the microscope.**

Facility N_2 gas can contain too much water and/or other contaminants. This can result in contamination of the microscope and the specimen.



Venting Nitrogen connection

6.5.2.2 Liquid Nitrogen (LN2)

LN_2 is needed for cooling of a Coldtrap. The Coldtrap acts as a cryopump and, if applicable, cools down the detector SDDs.

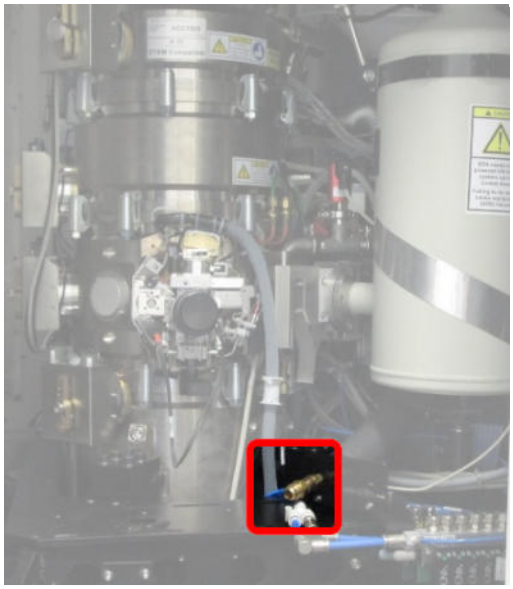
The Coldtrap is attached to the Dewar vessel containing 7.4 l of liquid N_2. Liquid nitrogen consumption is between 1.5 and 2 liters/day. Refilling schedule is once in every 4 days.

A filling system requires a main supply tank with an overpressure of max. 0.7 bar (~ 10 psi). Exceeding this value means the filling system will not function within spec.

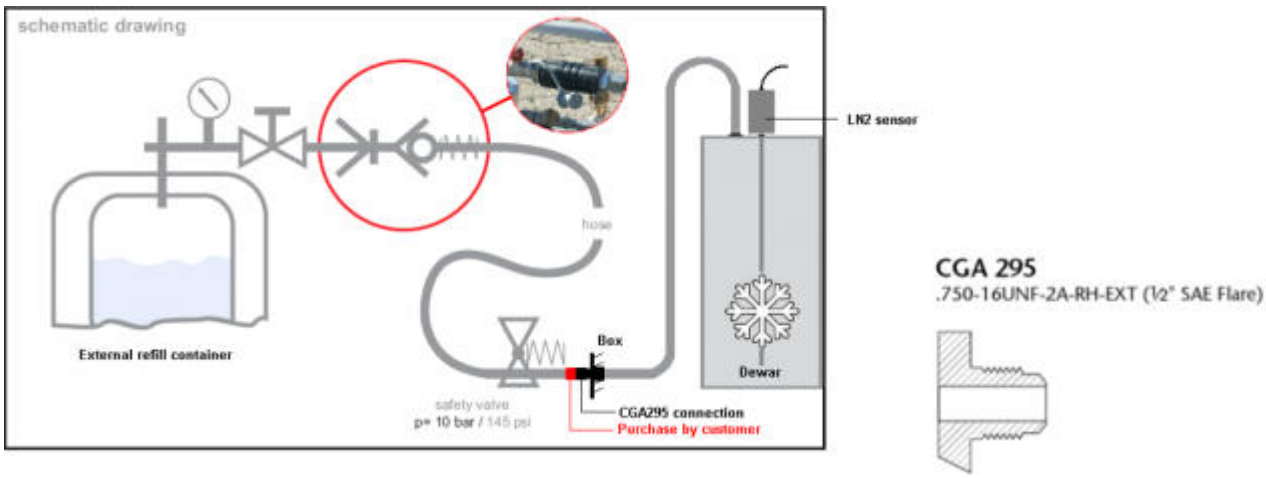
Thermo Fisher Scientific delivers a Filling connection behind the door on the right side of the enclosure. When using this setup it is not needed to use a ladder or remove the LN_2 sensor during filling.

Note **Customer is responsible for arranging additional parts.**

This setup requires that the external refill container has SST 1/2 SAE couplings to connect to the filling system.



A schematic overview on how to connect the external refill container



6.5.3 Sulfur Hexafluoride (SF6)

SF_6 gas is used as insulation gas in the HT Tank and the Accelerator Emission chamber of Spectra 200. This gas is commonly used in both light and heavy industrial environments. It is non-toxic at temperatures less than 250 °C.

The HT Tank and Accelerator Emission chamber of Spectra 200 are both sealed vessels and there will normally be no leakage of gas from these items. Nevertheless, international regulations require that certain environment and safety procedures regarding SF_6 gas must be known and implemented by the person responsible for the installation. In addition, any local regulations concerning SF_6 gas must also be followed. More information about the SF_6 properties and procedures can be found in the chapter Safety and Environmental Requirements on page 7 .

On installation of Spectra 200 there must be at least **2 gas cylinders** present with SF_6 gas, each containing a min. 15 kg of gas. One cylinder is required for filling the HT Tank and Accelerator Module and the other one is needed as a spare, back-up cylinder. The cylinder in use must be provided with a suitable reduction valve [$>6x10^5$ Pa (6 Bar)].

Note **The Customer is responsible for obtaining the requested quality and amount of SF_6 prior to the beginning of the Installation, Items to be purchased by the Customer on page 12 .**

Note **This note only applies to countries of the European Union (EU): Next to two full cylinders of SF_6 also one empty cylinder for recycling SF_6 must be always on site. The cylinder must be equipped with a valve (DIN 477-part1: Type A,1" No.8)**

Supplied SF_6 gas must meet the following specifications:

	SF_6	(IEC)
SF6 min. contents	weight %	99.9
Air	weight %	max 0.05
CF4	weight %	max 0.05
Water	weight ppm	max 15
Acidity calculated as HF	weight ppm	max 0.3
Hydrolyzable Fluoride calculated as HF	weight ppm	max 1
Mineral oil	weight ppm	max 10

Weight of SF_6 gas during transportation is:

	SF_6 Weight (kg)
Accelerator 200 kV	0.2
Accelerator 300 kV	0.25
HT Tank 200 kV	1.37
HT Tank 300 kV	1.8

Total amount of SF_6 gas in finished Spectra 200 is:

	SF_6 Weight (kg)
Accelerator 200 kV	1.1
Accelerator 300 kV	1.2
Accelerator 300 kV Mono	1.3

	SF_6 Weight (kg)
HT Tank 200 kV	6.8
HT Tank 300 kV	8.8
HT Tank 300 kV Mono	9.1

Note **For CFEG, same values as for Accelerator 300 kV and HT Tank 300 kV apply.**

WARNING! **SF6 bottles must be stored in a well-ventilated area or cabinet that is not in the Microscope Room. Do not keep SF6 bottles in a lockable cabinet!**

The best storage location for SF6 bottles is a gas cabinet with a fire resistance of at least 60 minutes.

Also always refer to local laws and safety regulations.

SF_6 is a potent greenhouse gas. In line with its mission, Thermo Fisher Scientific promotes the recycling of SF_6. Please ask your Thermo Fisher Scientific representative on how we can minimize the environmental impact of SF_6.

6.5.3.1 SF6 Recovery Kit Pump Outlet

WARNING! **For information and instructions how to safely and properly handle SF6 gas, refer to Safety and Environmental Requirements on page 7 .**

If a service action requires that SF6 gas is removed from the Accelerator or the HT Tank, then the Pre-Vacuum Pump (PVP) of the microscope is used to pump away a certain volume of SF6 gas. This SF6 gas cannot be re-used and must be discarded in accordance with local Environmental Health and Safety regulations.

For countries where it is mandatory to recycle SF6, an *SF6 Recycling Kit* is available as service tooling.

With this SF6 Recycle Kit, the PVP can be used to pump the removed SF6 into an empty SF6 recycle bottle. To do so, the PVP is connected to the SF6 Recycle Kit via a reducer.

- Pump hose pillar outside dimension: KF25
- Service tool is needed

6.5.3.1.1 Provision to pump large amounts of SF6

SF_6 gas is heavier than air and will sink to floor levels. There should be an extraction ventilator channel opening as low as possible above the floor but always < 5 cm.

DANGER! **The SF6 extraction ventilator channel must be completely separated from the central ventilation system.**

Under no circumstances must it be possible that the extracted SF6 flows into any other area or room.

Note **Depending on local laws and regulations,**
the SF_6 extraction channel must not open directly into the outside air.

6.5.3.1.2 Provision to pump small amounts of SF6

SF_6 recycling kit:

6.5.4 Oxygen Detection

Note **The customer is responsible for the purchase, installation and maintenance of an oxygen detection and warning system.**

To decrease the risk of hypoxia, Thermo Fisher Scientific *strongly* recommends the installation of an oxygen detection system in the Microscope Room.

Hypoxia is the insufficiency of oxygen supply to the brain, organs and/or other tissues in the body. Hypoxia can occur when the oxygen concentration in a room decreases, for example due to the release or inflow of other gases, such as CO2 or N2. The symptoms of hypoxia depend on the oxygen concentration and the duration of the oxygen deprivation. These symptoms include, but are not limited to:

- Decreased heart rate,
  or an increased heart rate that is not explained by physical activity.
- Increased breathing rate and/or a sense of breathlessness.
- Headache.
- Confusion and/or drowsiness.
- Impaired judgment.
- Decreased vision and/or hearing.
- Blue-ish discoloration of the lips and/or skin.
- Numbness or tingling sensation in fingers and toes.
- Loss of coordination.
- Loss of the ability to stand up, walk or even crawl.

Note **Hypoxia can lead to asphyxiation (loss of consciousness or death by oxygen deprivation).**

Item	Requirement
Sensor location	● Close to the column, but outside the enclosure. If an LN2 tank is present in the room: near the LN2 tank. ● Distance from the floor: 1.5 – 2 meter.
Alarms	● Warning alarm at < 19% O_2: flashing light(s). ● Main alarm at < 18% O_2: loud siren, beep, or other sound.
Alarm location	The warning alarm and the main alarm: ● Must be installed inside the Microscope Room. ● Must be clearly visible and audible outside the Microscope Room, next to the room entry.
Maintenance	● Functionality checks and maintenance actions must be performed according to the schedule and specifications of the manufacturer. ● Maintenance must be performed by trained personnel. ● The oxygen sensor(s) and the alarms must be replaced at the end of their specified lifetime. **Do not postpone replacement until the sensor or alarm is defective!**

7 Information and Communication Technology

7.1 Telephone Line in the Microscope Room

For fast and easy access to regional and global technical support, it is highly recommended to install a **telephone line** with **direct international dialing access** in the Microscope Room.

7.2 Broadband LAN Connection in the Microscope Room

In the Microscope Room, a **broadband LAN connection with internet access** must be available to enable Remote Operation, Remote Diagnostics and Remote Support.

Upload speed:

- Minimum: 20 Mps
- Recommended: 100 Mps or faster

7.3 Requirements for a Network PC or Support PC for network security and remote services

From a cyber security perspective, the Microscope PC is *not* safe. The Microscope PC does not have a virus scanner or other malware protection software, and the firewall and Windows Update functions are intentionally disabled. Therefore, the Microscope PC must never have a direct (unprotected) connection to the internet.

To assure safe network access to the Microscope PC, a Network PC or Support PC must be installed between the Microscope PC and the LAN connection. All security software and configuration settings on the Network PC or Support PC are managed by the customer.

On the Network PC or Support PC, the Thermo Scientific Port Forwarder software facilitates safe data traffic to and from the Microscope PC for (among others) the following functionalities:

- Remote Operation with TARO and VNC software.
- Remote Support with RAPID software.
- Email services to send (among others) data packets for Remote Diagnostics.

Thermo Fisher Scientific offers a *Network PC* that meets the hardware requirements for the above functionalities, and for which installation, configuration and troubleshooting documentation is available. This is an off-the-shelf Small Form Factor desktop PC with a mouse, keyboard and monitor (total weight < 10 kg).

It is also possible for the customer to purchase a computer from a different supplier with the following specifications:

Item	Requirement
Processor	Intel Core i5 or better
RAM	4 GB or more
Network connectivity	At least two 1 GB LAN adapters with RJ45 ports
Operating System	Windows 10

7.4 RAPID and Health Monitor connection requirements

The standard system configuration includes RAPID software and Health Monitor services. RAPID and Health Monitor are complementary service tools that enable fast and accurate support, resulting in optimal system performance and system availability.

Note **More information about RAPID and Health Monitor is available from your account manager or your field service manager. They can provide you with all features and IT whitepapers for both RAPID and Health Monitor.**

- RAPID (Remote Access Program for Interactive Diagnostics) is a service tool that enables secure remote access and operation of the microscope by Thermo Fisher Scientific personnel.
- Health Monitor continuously collects and stores key system parameters (no user data) in a database on the microscope. This data is synchronized daily to a central database at Thermo Fisher Scientific. If support is needed, Thermo Fisher Scientific support personnel use this data for quick, accurate problem analysis, thereby minimizing downtime and inefficiencies. The Health Monitor system sends e-mail messages with data packets to the central database.

For successful implementation and use of RAPID and Health Monitor, the customer must provide the following e-mail facilities:

- A dedicated **e-mail account in the customer domain** from which the Health Monitor data packages are sent.

  If the customer has multiple microscopes, it is strongly recommended to assign a unique e-mail account to each individual microscope.

An **SMTP** or **Microsoft Exchange** mail server that can be reached from the broadband LAN connection in the Microscope Room, and for which no specific authentication is required.

- The customer site must have a broadband internet connection, The minimum upload speed is 1Mbps. But 5 Mbps upload speed is recommended for the full capabilities of remote diagnostics.
- Port 1194, inside the corporate firewall, must be outbound for TCP and/or UDP to at least one of these RAPID servers. See the table.

Note **For optimal performance, open port 1194 to all RAPID servers.**

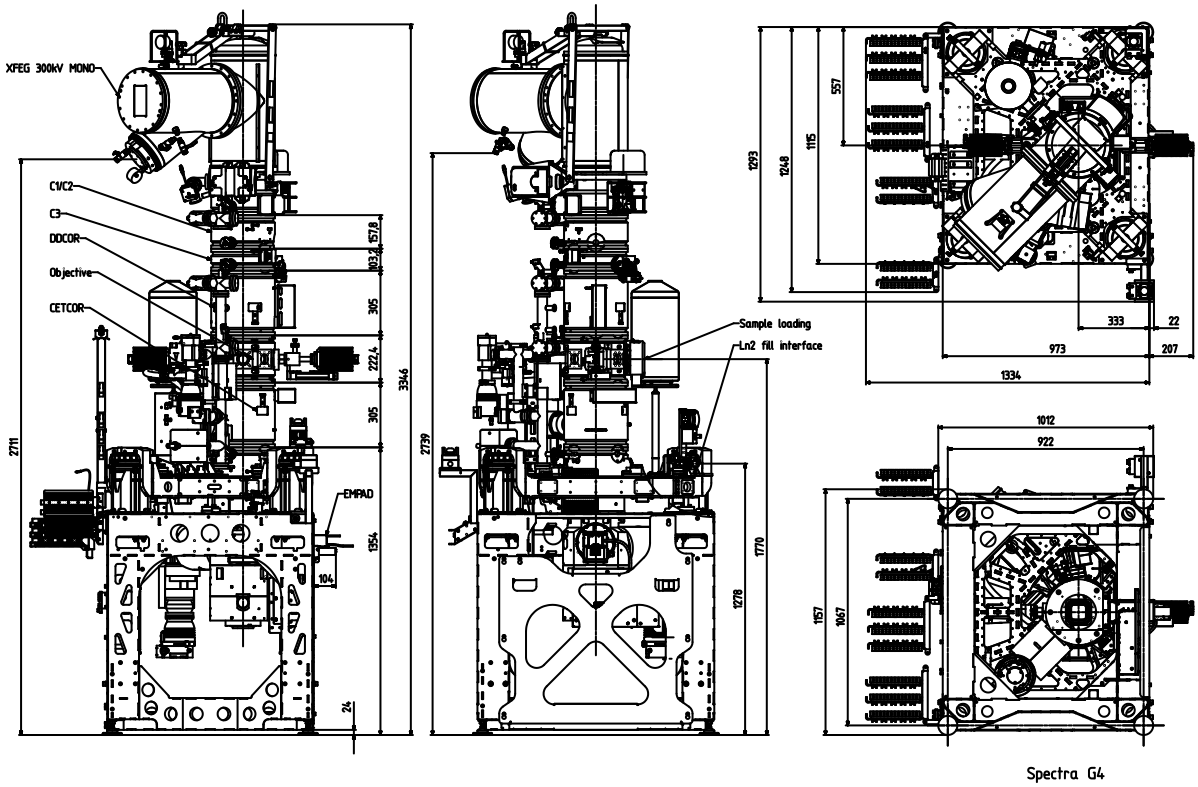
Location	DNS names	IP addresses
Europe	vpn-euw1.rapid.thermofisher.com rapidvpn-nl.fei.com	34.246.232.17 99.81.142.99 54.74.173.167
Japan	vpn-apne1.rapid.thermofisher.com rapidvpn-jp.fei.com	54.249.130.46 35.77.166.137
USA West	vpn-usw1.rapid.thermofisher.com rapidvpn-us.fei.com	52.8.48.139 54.176.72.242
USA East	vpn-use1.rapid.thermofisher.com rapidvpn-us.fei.com	54.147.20.143 18.233.124.124 44.194.77.165
China	rapidvpn.thermofisher.cn	180.167.227.251

Note **For customers in China, only use the RAPID VPN server in China.**

8 Appendix 1: Drawings and Floorplans

Note **All dimensions in this section are in mm.**

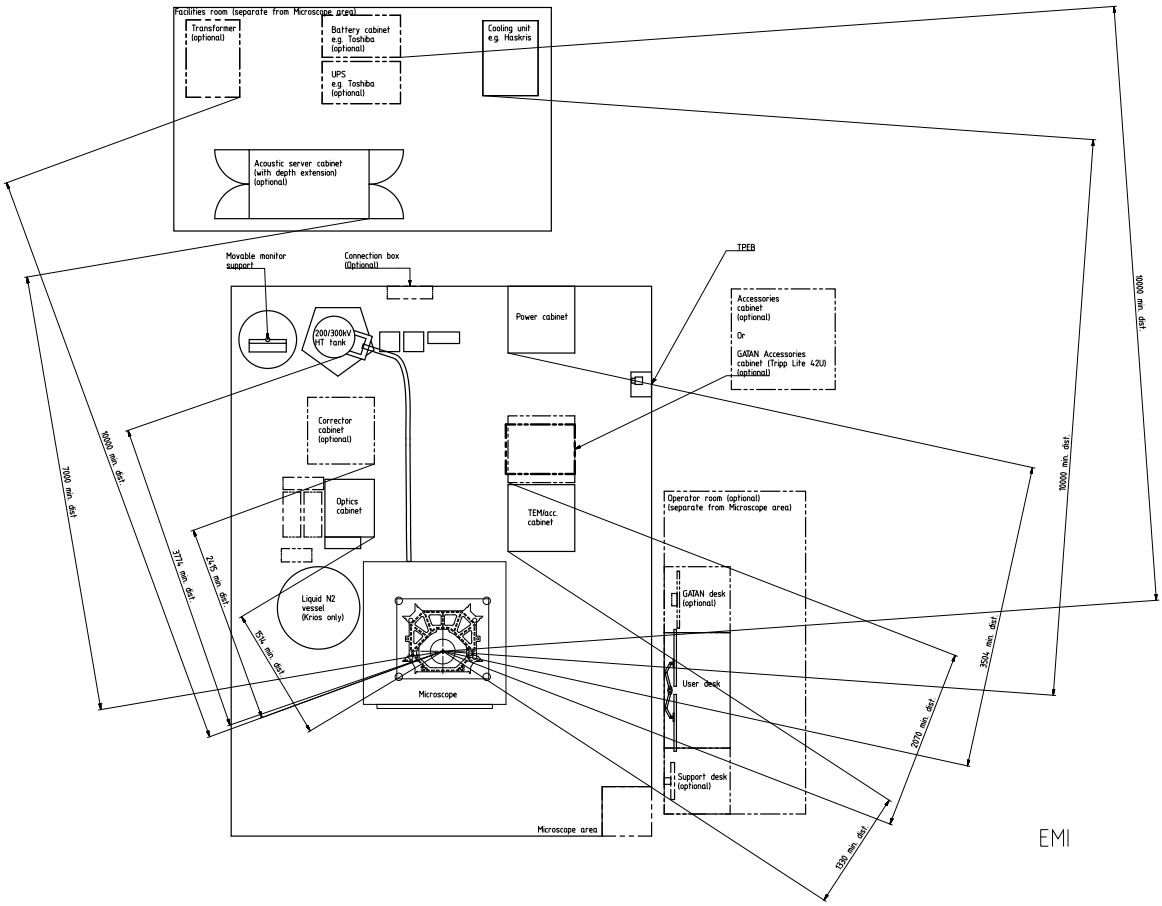
Microscope view, height of modules:



Note **The System is always shipped with the Accelerator module removed. The transport height also depends on the System configuration.**

EMI Distances:

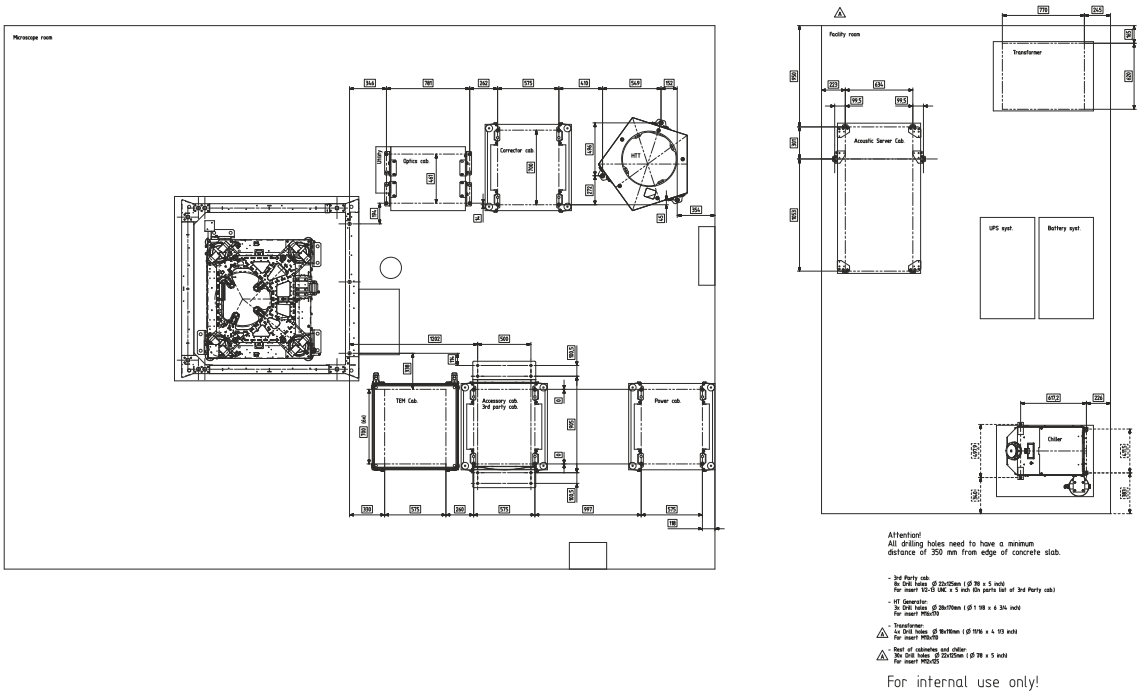
EMI distances: pdf version: 1155895-110-06



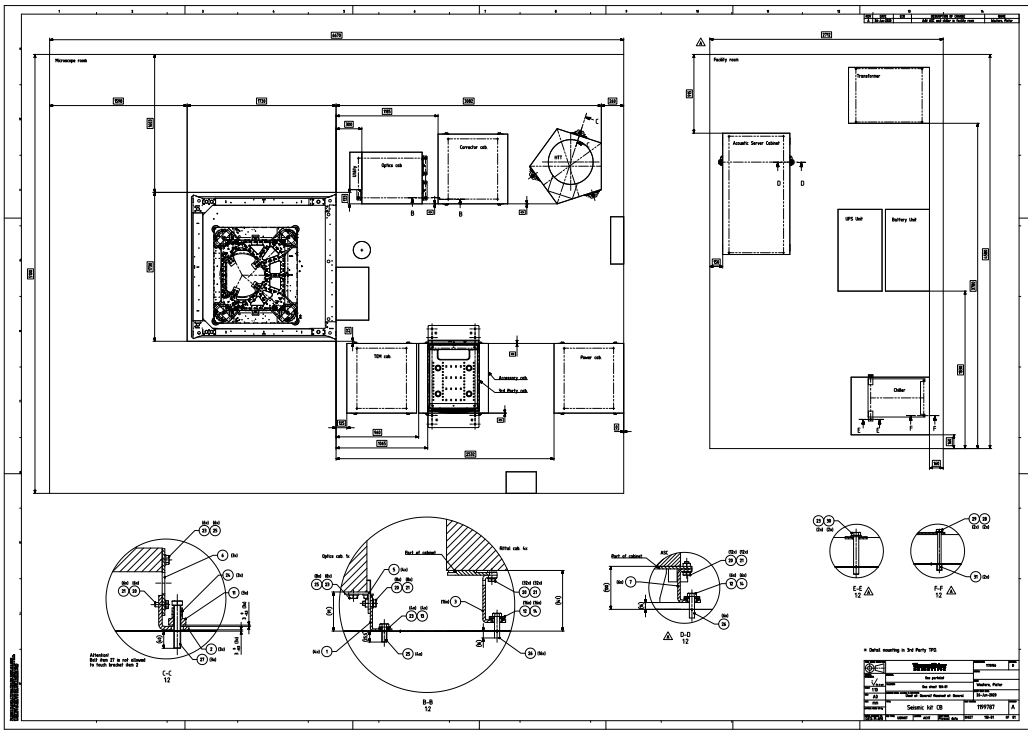
Required minimum distance:

Item	Required minimum distance from column to the equipment in the facility room
Chiller	10 m (maximum pressure loss 0.33 bar)
Transformer	10 m
Acoustic Server Cabinet	3.5 m
UPS	10 m

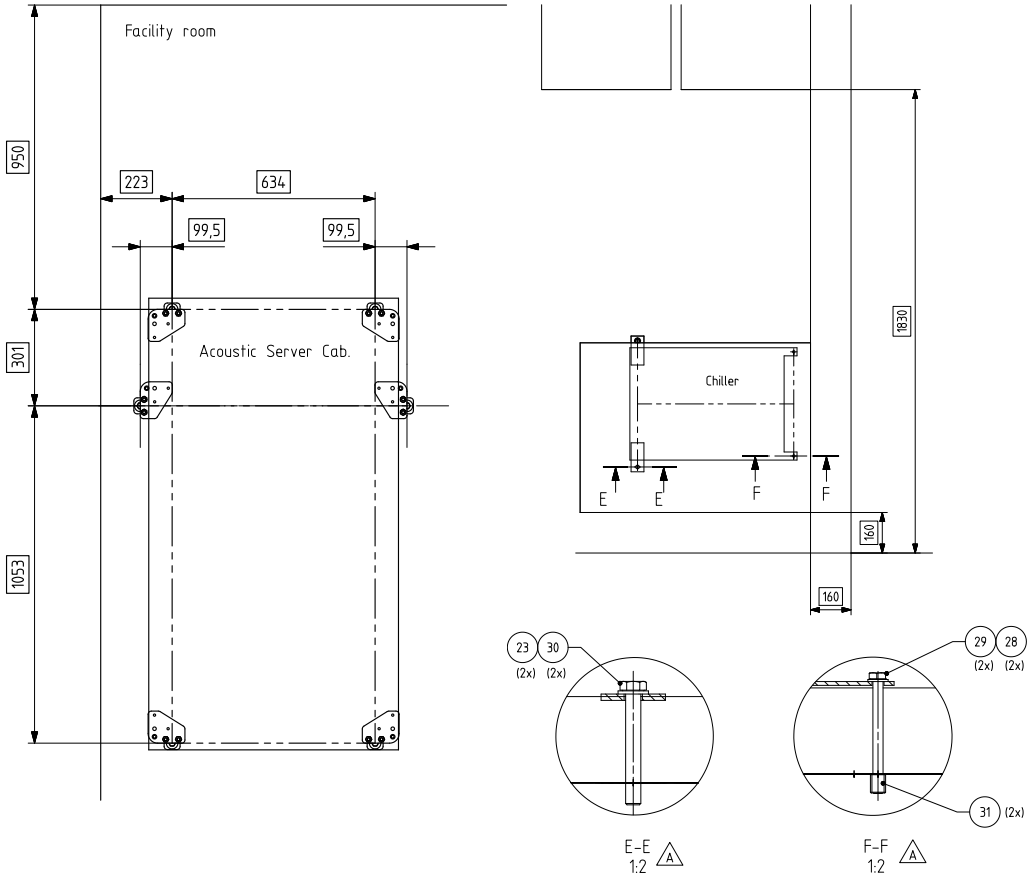
System anchoring



Anchoring of the Cabinets (if applicable due to Seismic Option):



Details for anchoring of the Acoustic Server Cabinet (not used in Material Science) and the Chiller

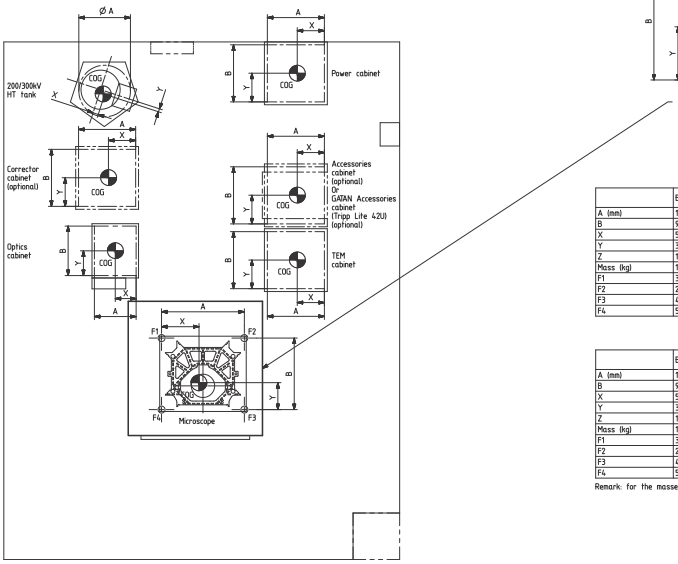


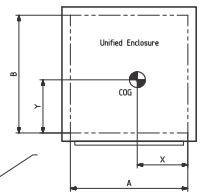
For Gatan Filters: Attaching the Stabilizer Plates is described in:
307597

Center of Gravity

pdf version: 1155895-110-07

	200kV HT Tank	300kV HT Tank	Power cabinet	TEM cabinet	Optics cabinet	Corrector cabinet	Accessories cabinet	GATAN Trip Lite cabinet (Standard with IS option)	2.97 Unified Enclosure	3.3 Unified Enclosure	3.7 Unified Enclosure
A (mm)	Ø 665	Ø 665	735	735	538	735	735	717	1513	1513	1513
B	-	-	735	735	638	735	735	395	1517	1517	1517
X	70	70	350	350	269	350	350	350	652	652	652
Y	40	40	369	369	319	369	369	200	685	685	685
Z	800	1037	974	1048	1000	1030	1130	587	1853	2031	2241
Mass (kg)	375	415	243	256	250	275	250	172	1495	1519	1656
kg/leg	75	83	61	64	63	69	63	43	128	139	151





	Basic, with filter	Image corrected, with filter	Probe corrected, with filter	Double corrected, with filter
A (mm)	1067	1067	1067	1067
B	922	922	922	922
X	500	500	500	500
Y	380	380	380	380
Z	1385	1396	1442	1447
Mass (kg)	1660	1815	1815	1970
F1	329	360	360	390
F2	285	311	311	338
F3	483	528	528	573
F4	564	617	617	669

	Basic, no filter	Image corrected, no filter	Probe corrected, no filter	Double corrected, no filter
A (mm)	1067	1067	1067	1067
B	922	922	922	922
X	500	500	500	500
Y	380	380	380	380
Z	1456	1460	1509	1508
Mass (kg)	1570	1725	1725	1880
F1	311	342	342	372
F2	270	296	296	323
F3	457	502	502	547
F4	533	586	586	638

Remark: for the masses the autoloader is included for all systems (these configs are virtual)

Center of gravity

Note **Required space between frame and enclosure is on both nearest sides 3 cm for optimum range of hoist.**

Note **As noted, the weight of the Autoloader (50 kg) is included in above table, also for non-Autoloader systems)**

Connections and Cable Ducts

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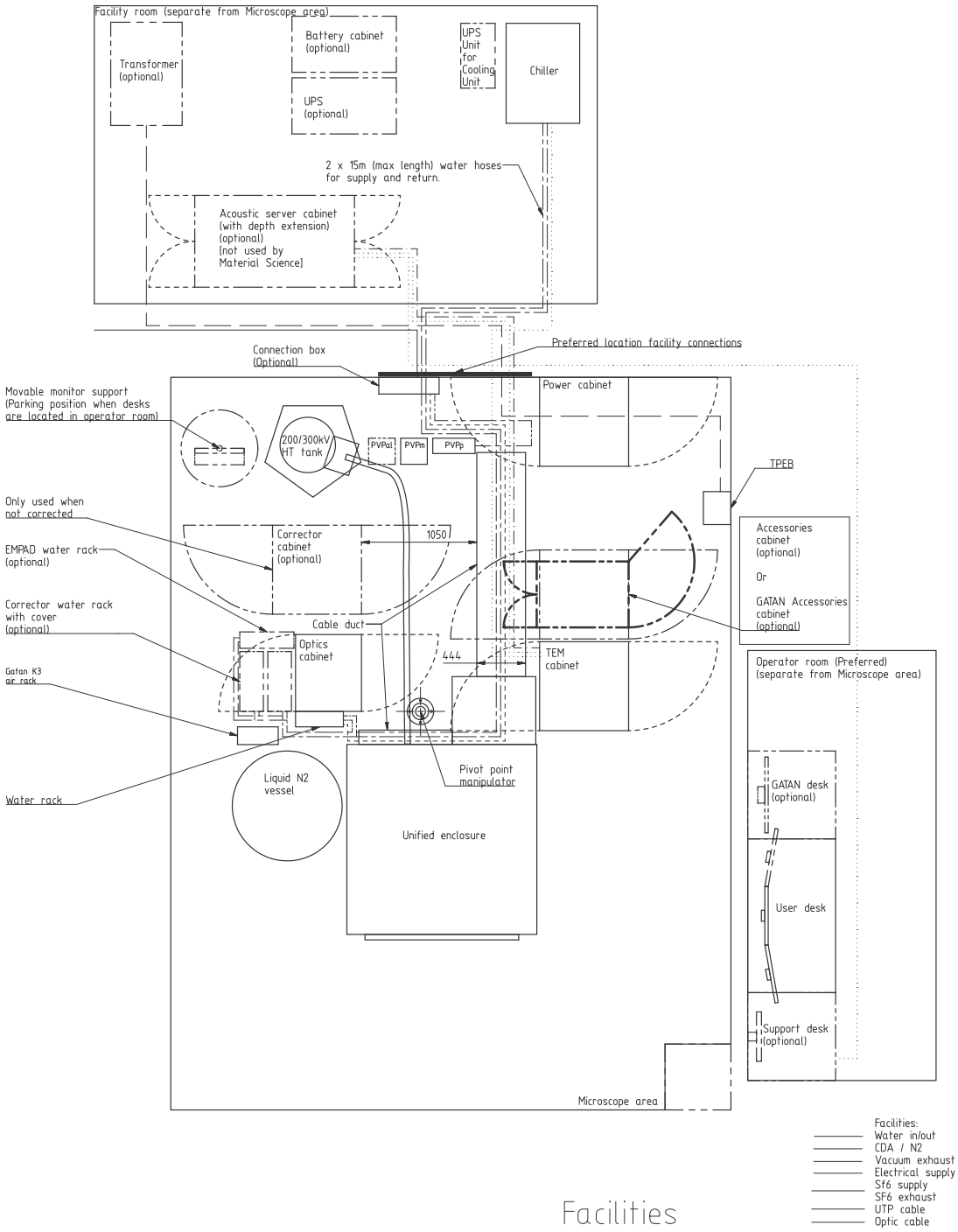

Note **To fulfill all requirements of NFPA79 the cable between the TPEB and the Power Cabinet should not be longer than 7m**

Side Views

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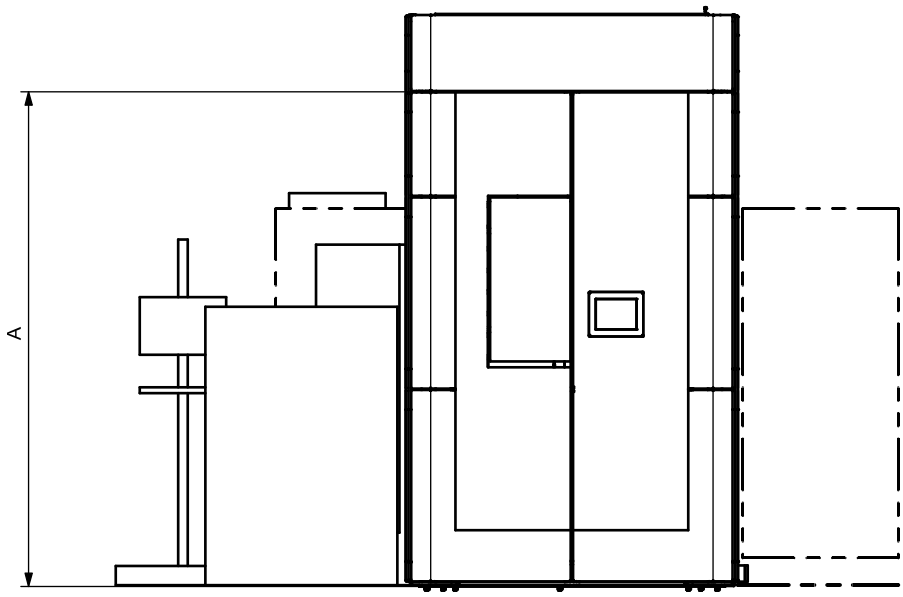


2.97 Acoustic enclosure

Front and back door height (mm)	A	2600
Left and right door height (mm)	B	2980

3.3 Acoustic enclosure

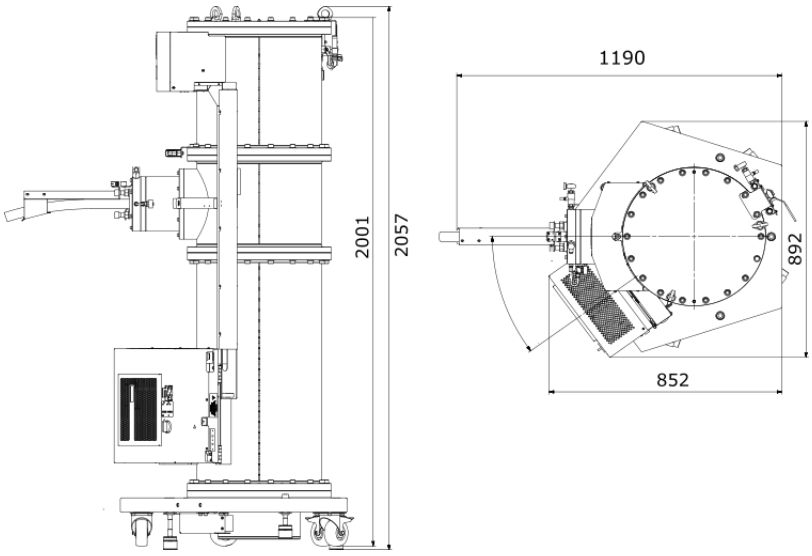
Front and back door height (mm)	A	2922
Left and right door height (mm)	B	3305

3.7 Acoustic enclosure

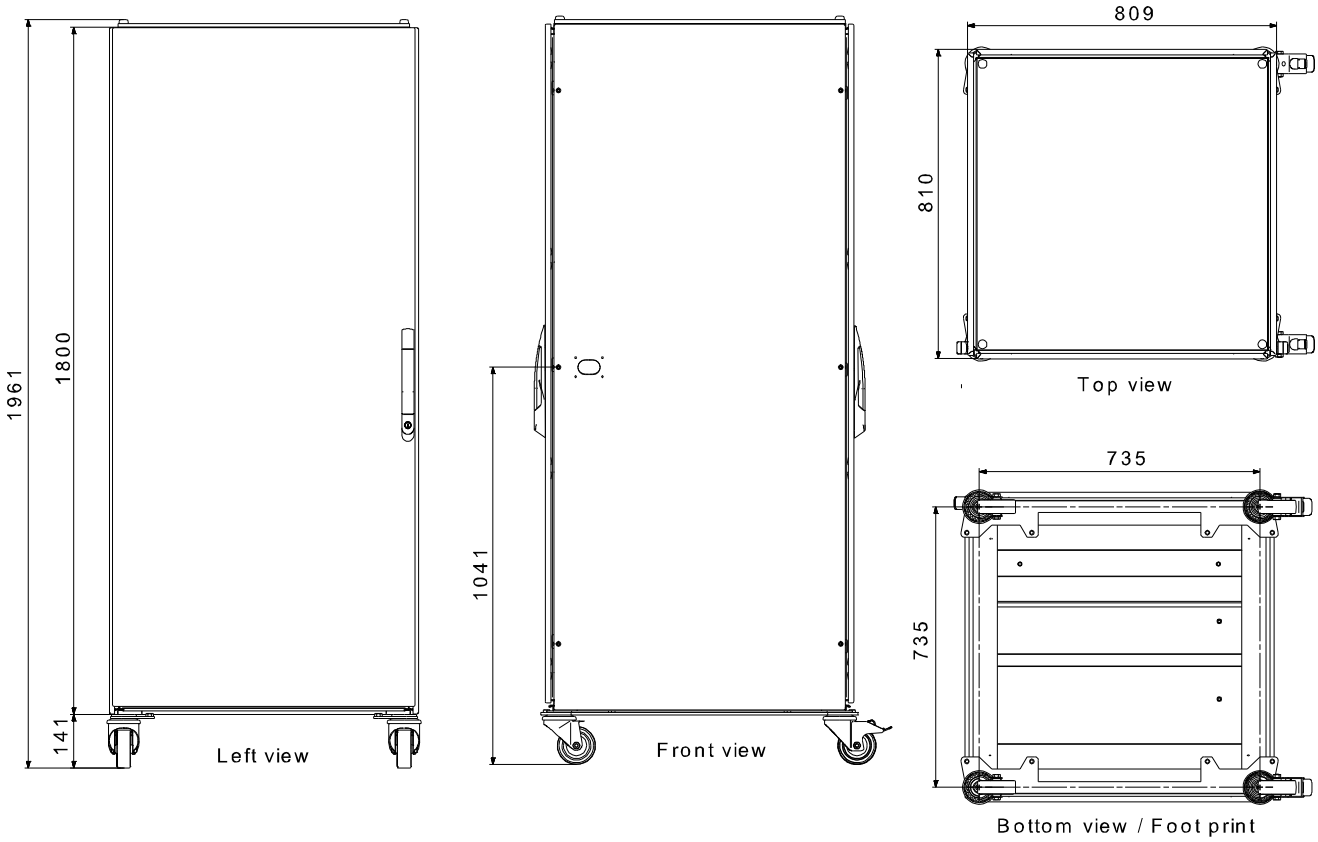
Front and back door height (mm)	A	3322
Left and right door height (mm)	B	3705

System Modules

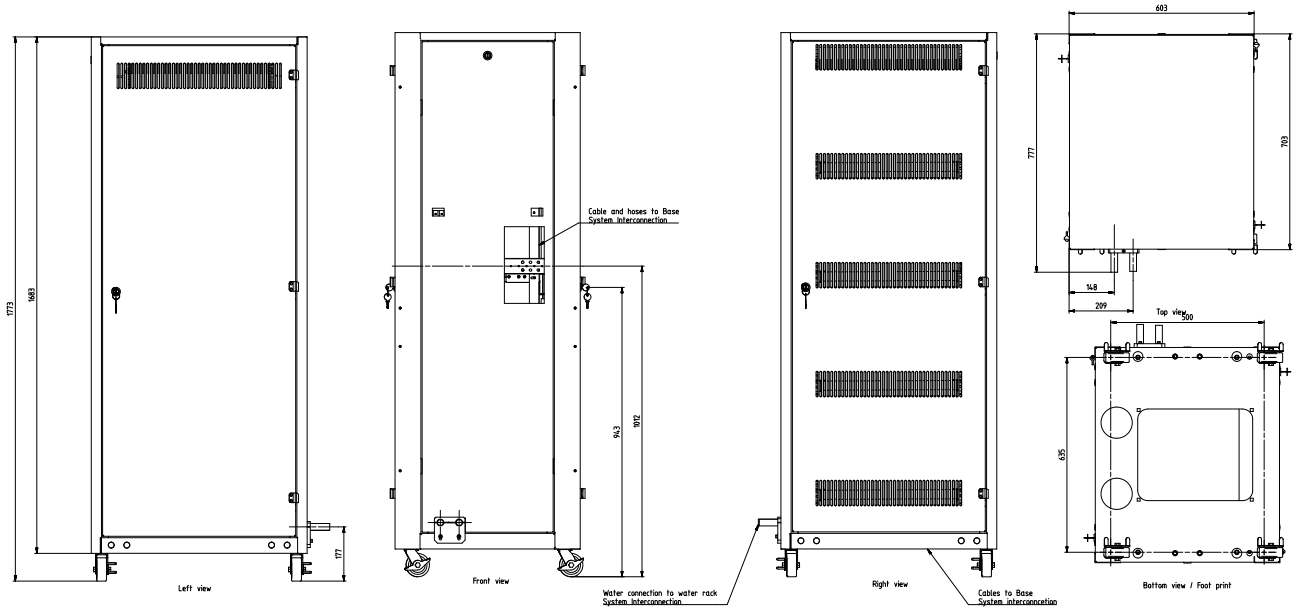
HT Tank:



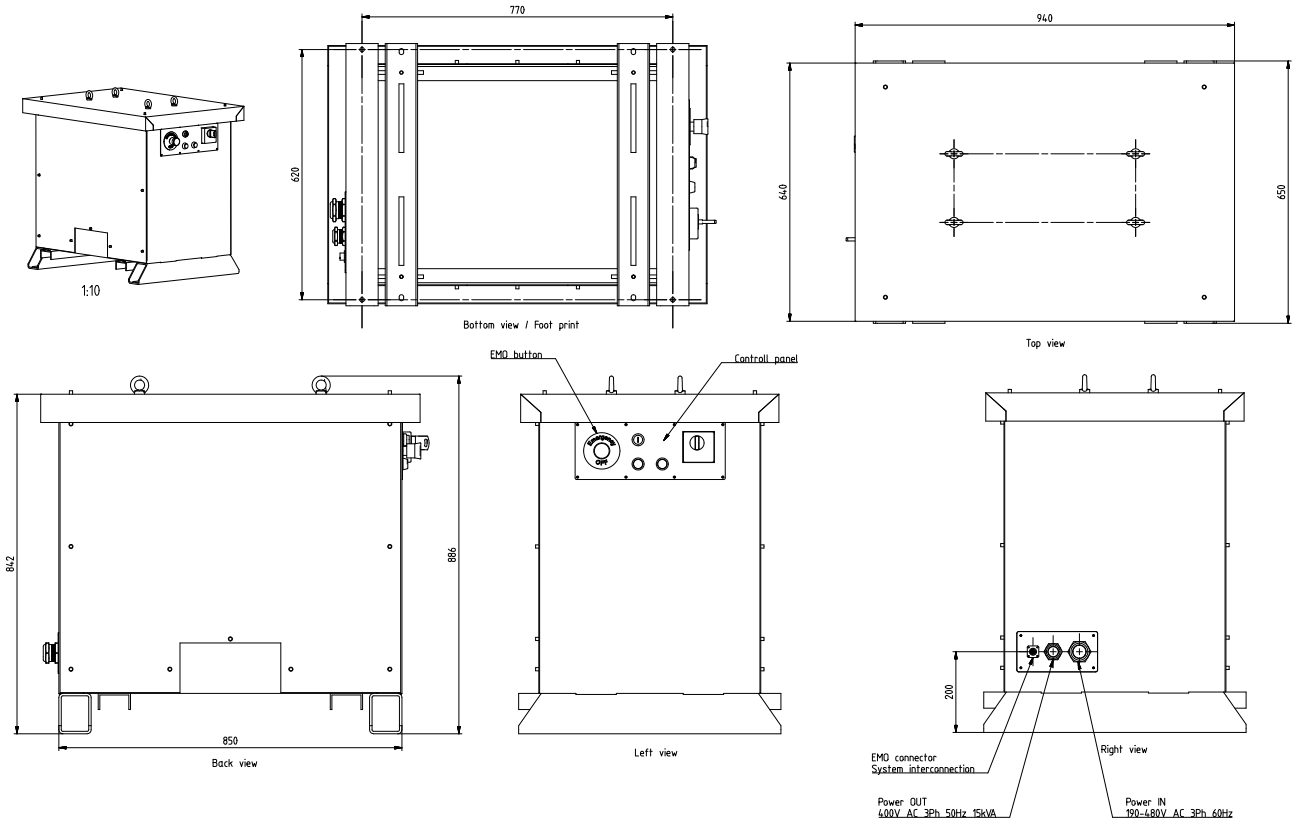
Rittal Cabinets (TEM, Power, Accessories, Corrector Cabinet):



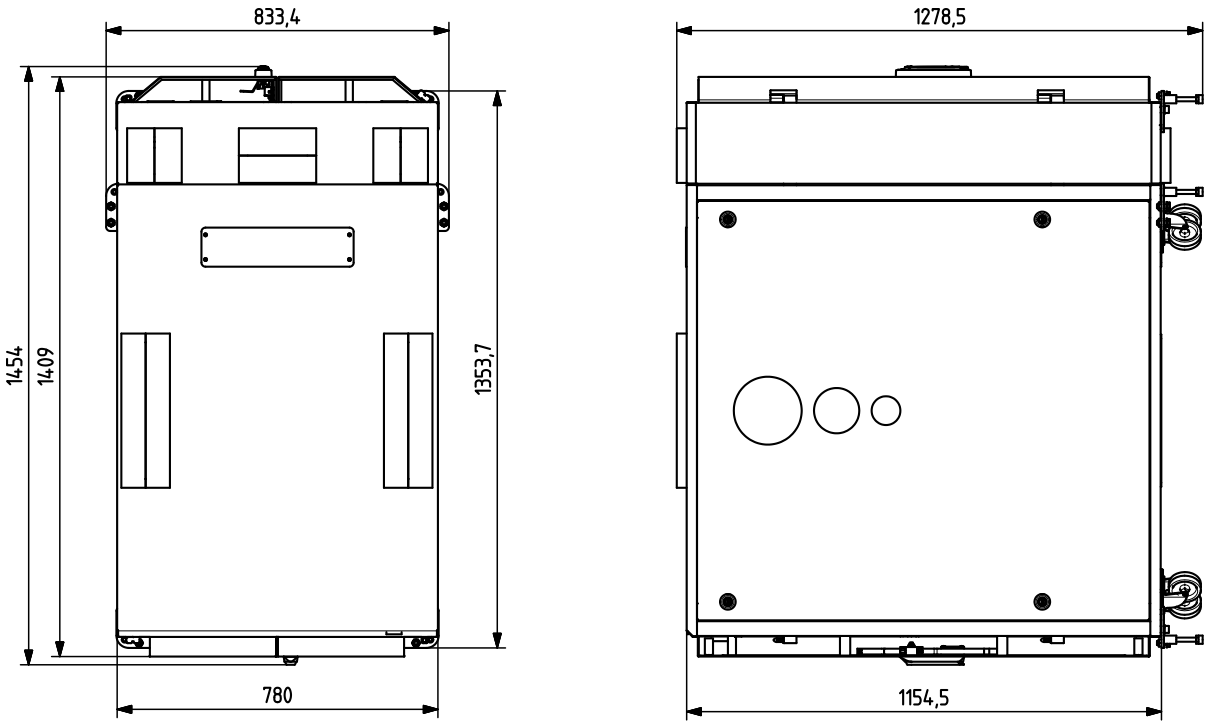
Optics Cabinet:



3 Phase Transformer



Acoustic Server Cabinet (1187425)



9 Appendix 2: Pre-Installation Checklists

9.1 Pre-Installation Site Survey

Before the system installation starts, a trained Thermo Fisher Scientific Field Service Engineer will perform a pre-installation survey. This is a series of checks and measurements to verify that the rooms in which the system will be installed meet the requirements and specifications for successful installation and use.

The pre-installation survey consists of:

Survey	Summary	Tools
Site Survey	Verification that the rooms and environmental conditions meet the installation and use requirements.	Dactron kit (4035 273 20971)
Unloading Area Survey	Images and measurements to verify that all items can be safely delivered and unloaded.	Camera
Monitoring Survey	Magnetic fields.	Spicer Monitoring Kit
Additional measurements	Verification that the room and environment do not inhibit successful installation and use of the system	

For the checklist that is used to verify that the site, rooms and environmental conditions meet the pre-installation requirements, see: Pre-Installation Checklist on page 80 .

The Site Survey leads to a *Pass* or *Fail* result.

Note **If changes have been made to the site, room or environment *after* a Site Survey has been performed, then an additional Site Survey must be performed.**

If the site does not meet the requirements and specification in the pre-installation survey, then:

- The customer is responsible to correct the failed aspects.
- The customer must sign a Performance Waiver.
  See: Appendix 3: Performance Waiver on page 84 .

Additional site preparation packages can be ordered as a separate SPSS support service.

The customer may be required to engage their local IT support personnel with regards to the connection of the server(s) to the customer network infrastructure.

To help the Thermo Fisher Scientific logistic departments to prepare for the transport and unloading of the all shipped goods at the customer's site, the Thermo Fisher Scientific engineer who performs the Site Survey will request to:

- Take pictures of the access road to the unloading area.
- Take pictures of the unloading area where the truck will be parked.
- Measure the height and take pictures of the loading dock.

All pictures of the abovementioned areas will be shared with the local Thermo Fisher Scientific SSOC.

Note **The Thermo Fisher Scientific engineer will only take and share pictures after receiving the explicit permission from the customer to do so.**

9.2 Pre-Installation Checklist

Item	Answer
Customer	
Customer User, Title, Name	
Address	
City	
Country	
Date	
Product Type	Spectra 200
RE / Consultant Checked by	
Serial number (if known)	
Quote number (if known)	
Thermo Fisher Scientific Organisation	
Corrector Present? How many? (TEM only)	
Planned Installation Start Date	
Local Customer IT Support	
Network Connectivity	
Any Special IT Requirements	
Restricted Site (Yes/No)*	

Note ***Restricted Site: Computers and/or USB sticks are not allowed, and USB ports are blocked. If this is a site where the USB service dongle cannot be brought inside, notify the service manager and/or the account manager that the NSR "service feature control for restricted sites" has to be ordered." Also create a digital forms ticket and escalate to GTS-C in order to get a temporary service dongle activation.**

Title	Value	OK	NOK	Remarks
Unloading Area Survey	Pictures and measure height for system and boxes			
Transport Route System Crate	Dimensions: 1700x1310x2560 Weight: Basic: 1695 kg 1 corrector: 1850 kg 2 correctors: 1928 kg Filter: + 90 kg			
Transport Route Enclosure Crate	Dimensions: Frame: 2900x2050x1450 Panels: 2300x850x1950 Height Depending Parts: 2700x950x1950			
Transport Route without Corrector	1563x1323x1942 LxBxH			
Transport Route with 1 Corrector	1563x1140x2260 LxBxH (only Probe Corrector)			
Transport Route with 2 Correctors	N/A			
Transport Route Ramp	< 5 degrees			
Elevator Capabilities	Measure dimensions and check weight if needed.			
Microscope Room Dimensions and Safety Distances	6670x5100			
Microscope Room Height	3040 (enclosure 2970) 3370 (enclosure 3300) 3770 (enclosure 3700)			
Facility Room	12.5m²			
Operator Room	10m²			

Title	Value	OK	NOK	Remarks
Floor Flatness and Enclosure Anchoring	3.0 mm/m			
Floor Thickness	≥ 226mm			
Room Temperature	18° to 23° Microscope room 13° to 25° Facility room			
Room Temperature Stability	Microscope room: 0.8 °C p-p/24 hr			
Relative Humidity	< 80 %			
Heat Dissipated without Options - Cooling Water	3780 W Corrector Cabinet 400/650 W			
Heat Dissipated without Options - Microscope Room	4015 W + Gatan Cabinet: 1053 W + EMPAD 330 W			
Heat Dissipated without Options - Enclosure	N/A			
Heat Dissipated - Facility Room Depending on Configuration	Air chiller: 6760 W DMP/Athena: 3200 W			
Air Speed	Low Airflow			
Magnetic Field Specification without MONO	80 nT peak to peak all directions			
Mechanical Vibrations without corrector with STEM vertical-L/R-F/B	N/A. See Pre-Installation Manual, Chapter 5.4 Site Acoustics and Floor Specifications			
Acoustic Specification	N/A. See Pre-Installation Manual, Chapter 5.4 Site Acoustics and Floor Specifications			
Electrical Connection	See Pre-Installation Manual, chapter 'Electrical Power Supply'			

Title	Value	OK	NOK	Remarks
Water Supply	Flow: Min 4 Bar, Max 6 Bar Stability: 0.1 Bar Input: 18° C ± 0.5°			
Compressed Air Supply	Flow: Min 5 Bar, Max 7 Bar Stability: 0.1 Bar Particles: 5-10 mg/m^3			
Nitrogen Supply gas liquid	pressure: 1 bar over-pressure water content < 10ppm			
Argon				
SF6 Supply	2x 15 kg full 1 empty reduction valve 6 Bar			
ICT: telephone line	direct international dialing line			
ICT: network connection (RAPID e.g.), server connections	Depending on Configuration see Chapter 7.1 for Athena /DMP see Chapter 7.2 for Rapid and Health Monitor			
Pre-installation items, needed before or during installation	Hilti epoxy (ordered by the SSOC) see chapter 3.1 of the Pre-Installation Manual			
Installation items: needed for installation, supplied by Thermo Fisher Scientific or Customer	For all the Tools & Materials and connections needed prior the installation, check and read Chapter 3 of the Pre Installation Manual.			
Site Survey	Site Survey of Monitoring report Checklist and Pre Installation Manual for the CustomerMonitoring report			
Epoxy Adhesive for Enclosure	2			

10 Appendix 3: Performance Waiver

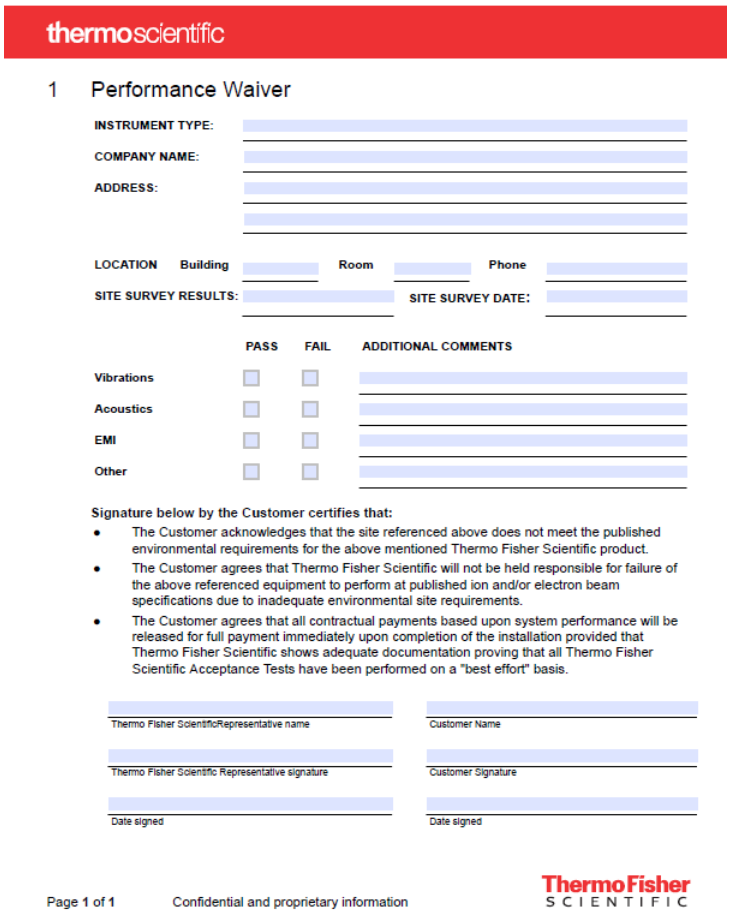
When the site is not according to the specifications, the customer can sign a Performance Waiver. This means that the customer certifies that:

- The Customer acknowledges that the site referenced above does not meet the published environmental requirements for the above mentioned Thermo Fisher Scientific product.
- The Customer agrees that Thermo Fisher Scientific will not be held responsible for failure of the above referenced equipment to perform at published ion and/or electron beam specifications due to inadequate environmental site requirements.
- The Customer agrees that all contractual payments based upon system performance will be released for full payment immediately upon completion of the installation provided that Thermo Fisher Scientific shows adequate documentation proving that all Thermo Fisher Scientific Acceptance Tests have been performed on a "best effort" basis.

The Thermo Fisher Scientific representative conducting the survey will notify the Thermo Fisher Scientific site account manager so that this performance waiver can be prepared as part of the sales order.

To use the Performance Waiver, open 309991 , fill in the appropriate fields and print it.

Example image:



thermoscientific

1 Performance Waiver

INSTRUMENT TYPE:

COMPANY NAME:

ADDRESS:

LOCATION Building Room Phone

SITE SURVEY RESULTS: SITE SURVEY DATE:

	PASS	FAIL	ADDITIONAL COMMENTS
Vibrations	☐	☐	
Acoustics	☐	☐	
EMI	☐	☐	
Other	☐	☐	

Signature below by the Customer certifies that:

- The Customer acknowledges that the site referenced above does not meet the published environmental requirements for the above mentioned Thermo Fisher Scientific product.
- The Customer agrees that Thermo Fisher Scientific will not be held responsible for failure of the above referenced equipment to perform at published ion and/or electron beam specifications due to inadequate environmental site requirements.
- The Customer agrees that all contractual payments based upon system performance will be released for full payment immediately upon completion of the installation provided that Thermo Fisher Scientific shows adequate documentation proving that all Thermo Fisher Scientific Acceptance Tests have been performed on a "best effort" basis.

Thermo Fisher ScientificRepresentative name | Customer Name

Thermo Fisher Scientific Representative signature | Customer Signature

Date signed | Date signed

Page 1 of 1 Confidential and proprietary information ThermoFisher SCIENTIFIC

INSTRUMENT TYPE: _____

COMPANY NAME: _____

ADDRESS: _____

_____

LOCATION **Building** _____ **Room** _____ **Phone** _____

SITE SURVEY RESULTS: _____ **SITE SURVEY DATE :** _____

	PASS	FAIL	ADDITIONAL COMMENTS
Vibrations	☐	☐	
Acoustics	☐	☐	
EMI	☐	☐	
Other	☐	☐	

Signature below by the Customer certifies that:

- The Customer acknowledges that the site referenced above does not meet the published environmental requirements for the above mentioned Thermo Fisher Scientific product.
- The Customer agrees that Thermo Fisher Scientific will not be held responsible for failure of the above referenced equipment to perform at published ion and/or electron beam specifications due to inadequate environmental site requirements.
- The Customer agrees that all contractual payments based upon system performance will be released for full payment immediately upon completion of the installation provided that Thermo Fisher Scientific shows adequate documentation proving that all Thermo Fisher Scientific Acceptance Tests have been performed on a "best effort" basis.

Thermo Fisher ScientificRepresentative name	Customer Name
Thermo Fisher Scientific Representative signature	Customer Signature
Date signed	Date signed

11 Appendix 5: Optional Configurations

11.1 Ceta Speed Enhancement (Ceta-2) (incl. Ceta Camera)

The Ceta Speed Enhancement (Ceta-2) option adds the following items to a regular Ceta camera configuration:

- CMTS in the same cabinet in the Microscope Room that contains the CSU.
- Storage Server or Offloading PC in a Server Room.
- Network connections between the Microscope Room and the Server Room.

11.1.1 Storage Server

11.1.1.1 Location and Accommodation of the Storage Server

Install the Storage Server in a Server Room, or in an *Acoustic Server Cabinet* (1187425) in the Facility Room.

The Storage Server generates 36 dBA of acoustic noise during normal operation, with peaks up to 90 dBA.

- When installed in the Microscope Room, the noise level may affect the performance of the microscope.
- When installed in the Microscope Control Room, the accumulated noise exposure exceeds acceptable levels for a healthy and comfortable work environment.

11.1.1.2 Deliverables by Thermo Fisher Scientific for the Storage Server

Thermo Fisher Scientific supplies an HP Apollo 4200 Storage Server to store high resolution images from the CMTS.

Dimension	Value
Product	Storage Server
Height	87.5 mm (3.44 in)
Depth	812 mm (32 in)
Width	448 mm (17.63 in)
Weight	• Storage Server including 12 hard drives (as delivered by Thermo Fisher Scientific): approx 32 kg (70.50 lbs). Requires two people to be present for installation due to weight. • Storage Server including 24 hard drives (maximum possible weight): approx 40.60 kg (89.50 lbs). Requires three people to be present for installation due to weight.
Information	Specification sheet for the HPE Apollo 4200 server on the manufacturer's website:

Dimension	Value
	Gen9: HPE Apollo 4200 Gen9 Server - Quick Specs Gen10: HPE Apollo 4200 Gen10 Server - Quick Specs
Ambient	Heat generation will be max. 900 W at 200Vac.
Electrical	Power supply and heat: ● Two (primary and backup) 1400 Watt power supplies (200 - 240Vac). This is to ensure that the server remains running in case one of the power supplies fails. The server will function with just one supply, but this will result in increased temperature. **North-America and Japan regions:** **explicitly request 800W power supplies (110-220 Vac)**. ● Dutch power cord. If not compatible with local wall sockets, arrange a local power cord. ● Maximum 900 W at 200 Vac.
Noise	Normal operation: 36 dBA average Peak noise up to 90 dBA
Network	● 1 Gbit RJ45 ethernet port for connection to the Microscope PC ● 10 Gbit optical optical for connection to the CMTS, ● 1 Gbit RJ45 ethernet port and 10 Gbit optical port for connection to the customer network.

Thermo Fisher Scientific supplies 2 x 10m OM3 10 Gbit fiber cables to:

- connect the TEM cabinet to the microscope room 10 Gbit wall socket and;
- connect the server room 10 Gbit wall socket to the Storage Server.

Note **The connection between the microscope room and the server room must be arranged by the customer, using OM3 or OM4 (50/125) fiber cable.**

Thermo Fisher Scientific supplies 2 x 10m 1 Gbit CAT6A cables to:

- connect the TEM cabinet to the microscope room 1 Gbit wall socket and;
- connect the server room 1 Gbit wall socket to the Storage Server.

Note **The connection between the microscope room and the server room must be arranged by the customer, using appropriate Cat6A equivalent or better network cabling.**

11.1.1.3 Deliverables by the Customer

Network connectivity

See Network Environment.

Storage Server accommodation

The customer must supply sufficient 19 inch rack space to accommodate the Storage Server.
This can be either:

- In a Server Room: reserve 3 U of 19 inch rack space.

- In the Facility Room: order an *Acoustic Server Cabinet* (1187425).

Storage Server dimensions and weight:

Dimension	Value
Height	87.5 mm (3.44 in) The Storage Server requires 3U of 19 inch rack space: ● Storage Server hardware: 2U. ● Free space: 0.5U above and below for ventilation.
Depth	812 mm (32 in)
Width	448 mm (17.63 in)
Weight	● With 12 hard drives (standard configuration): approx 32 kg (70.50 lb). ● With 24 hard drives (maximum capacity): approx. 40.6 kg (89.5 lb).

11.1.2 Offloading PC

11.1.2.1 Offloading PC Accommodation

There are no specific accommodation requirements for the Offloading PC. It can be placed in the microscope room, next to the TEM cabinet.

11.1.2.2 Offloading PC supplied by Thermo Fisher Scientific

Dimension	Value
Product	Offloading PC (4x SSD, 4 TB, RAID0)
Height	362 mm (14.23 in)
Depth	425 mm (16.70 in)
Width	184 mm (7.23 in)
Weight	18 kg (39.6 lbs)

The Offloading PC is preconfigured by Thermo Fisher Scientific. Integration in the customer network is a cooperation between the customer and Thermo Fisher Scientific.

11.1.2.3 Offloading PC supplied by Customer

The offloading functionality can also be realized with a PC or server that the the customer purchased elsewhere.

Note **Offload speeds are not guaranteed on non-Thermo Fisher Scientific supplied hardware.**

Note **Hardware that is not supplied by Thermo Fisher Scientific is not supported by Thermo Fisher Scientific service.**

11.1.2.3.1 Offloading PC Hardware Requirements

The system that will function as the Offloading PC must comply with the following hardware requirements:

Item	Requirements
Operating System	Windows7, Windows 10 or Windows Server 2012
CPU	Intel Xeon E5 or faster
Memory	16 GByte or more

Storage	A disk RAID set with:
	● 10 Gbit/s write speed or faster, e.g.:
	  ● 4 SSD's in RAID0
	  ● 8 SSD's in RAID1
	● At least 4 TByte disk space dedicated for camera data
	● Volume mapped to drive D:\

Network to microscope	To CMTS: ● 10 Gbit optical SFP+ transceiver port ● Based on Intel third-generation 10 GbE controller (82599 chipset) or later To Microscope PC: ● 1 Gbit Ethernet with standard RJ45 connector Network card configuration settings are specified below.
Network to customer network	● 10 Gbit optical SFP+ transceiver port ● 1 Gbit ethernet

11.1.2.3.2 Settings for the 1 Gbit Ethernet Connection to the Microscope PC

Network configuration settings for the 1 Gbit ethernet connection to the Microscope PC:

Parameter	Value
Name	TEM
Physical port	1st
IPv4 address	192.168.10.3
Subnet	255.255.255.0

11.1.2.3.3 Settings for the 10 Gbit Optical Fiber Connection to the CMTS

Network configuration settings for the 10 Gbit optical connection to the CMTS:

Network Connection Property	**Value**		
Name *Depends on the camera configuration*	Single camera		CAPP or use the camera-specific network connection name as specified below.
	Multi-camera	Falcon 3EC	CMTS-F3
		Ceta-2	CMTS-C2
		Falcon 4 (BM)	CMTS-F4-BM
		Falcon 4 (EF)	CMTS-F4-EF
		Falcon 4i (BM)	CMTS-F4i-BM
		Falcon 4i (EF)	CMTS-F4i-EF
IPv4 address	CMTS-F3		`192.168.30.1`
	CMTS-C2		`192.168.31.1`
	CMTS-F4-BM or CMTS-F4i-BM		`192.168.32.1`
	CMTS-F4-EF or CMTS-F4i-EF		`192.168.33.1`
Subnet mask	`255.255.255.0`		

Note **Depending on the Operating System, the network card and the network card driver, some of the parameters in the table below may not be available, or may have a different name.**

Advanced Property	**Value**
Adaptive Inter-Frame Spacing	Enabled
ECN capability	Disabled
Interrupt Moderation	Disabled
Interrupt Moderation Rate	Adaptive
Jumbo packet	9014 bytes

Advanced Property	Value
Max. number RSS queues	16 queues
Receive buffer **RX buffer**	• For Falcon 4i on a DMP 2.0 Server (HPE DL385 Gen10+): 35000 • For all other cameras and servers: 4096

Additionally, the *Firewall* for this network connection must be *fully disabled*.

11.1.2.3.4 User Accounts on the Offloading PC

The following user accounts must be configured as specified:

Name	Password	Type	Remarks
DAR	Diagnostics-001	User	
FEIApplications	Feiapps-001	User	
Supervisor	*Same as on the Microscope PC*	Administrator	
customerservice	*Same as on the Microscope PC*	Administrator	
Administrator	—	—	**This account must be disabled**

The *customerservice* account must be an administrator account in order to install software.

The password to this account must be set by the Thermo Fisher Scientific engineer, and cannot be changed once it is set.

11.1.2.3.5 Shared Folders on the Offloading PC

The following folders must be created and shared:

Path	Share name	Access
`C:\ProgramData\FEI`	ProgramDataFei	• DAR [r] • Customerservice [r/w]
`C:\Program Files\fei`	ProgramFilesFei	• DAR [r] • Customerservice [r/w]
`D:\OffloadData`	OffloadData	• FeiApplications [r/w] • Customerservice [r/w]

11.1.2.3.6 Firewall and Virus Scanner Recommendations for the Offloading PC

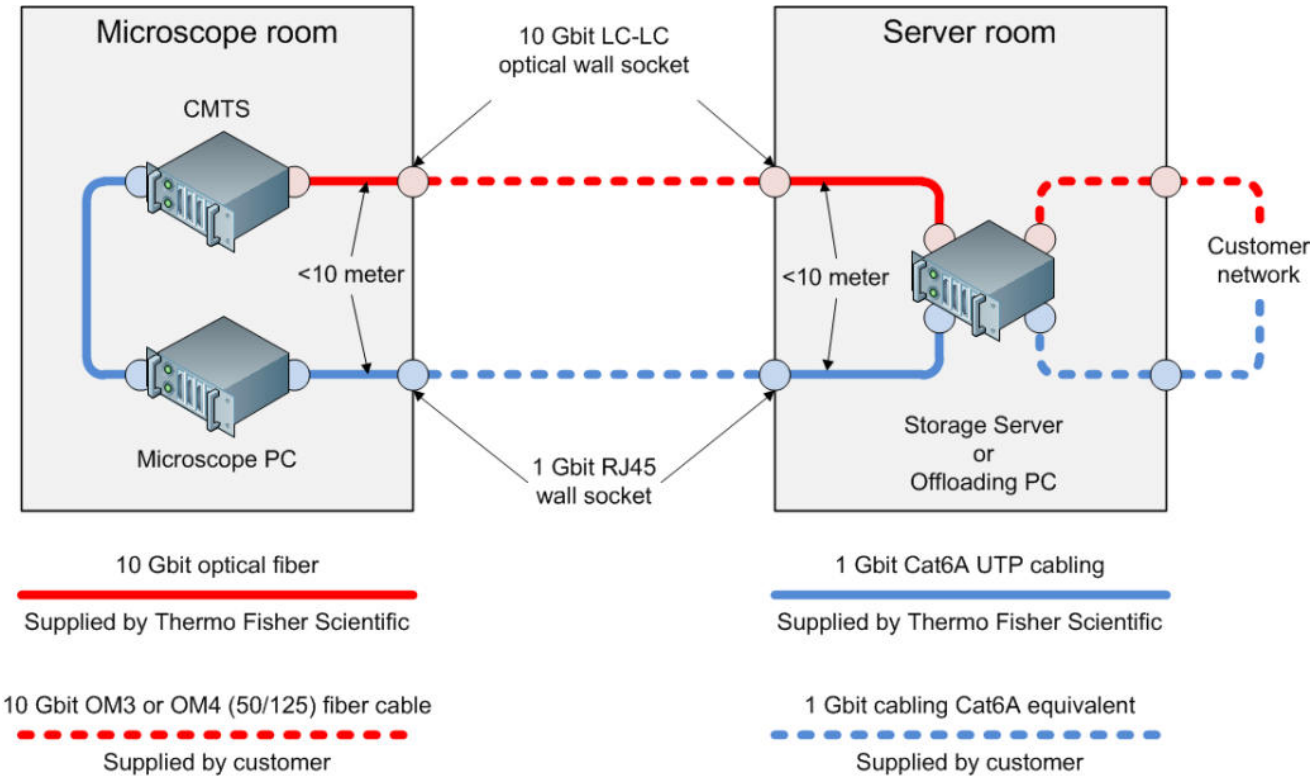
To minimize interference with camera data offloading performance, the following network security settings are recommended:

Parameter	Value
Domain firewall	Off
Public network firewall	Off
Private network firewall	Off
Virus scanner	Off (or at least off during data acquisition)

The network security settings are the responsibility of the customer IT department. The settings above are recommendations, they cannot be enforced by Thermo Fisher Scientific.

11.1.3 Network environment

11.1.3.1 Physical Network Connections for the Storage Server or Offloading PC



Note **The 10 Gbit connection between the microscope room and the server room must be arranged by the customer, using OM3 or OM4 (50/125) fiber cable.**

Note **The 1 Gbit connection between the microscope room and the server room must be arranged by the customer, using appropriate network cabling.**
(Cat6A equivalent or better)

In the microscope room:

- Two 10 Gbit connections must be available within 10 meters of the TEM cabinet or the third party accessories cabinet. Of these, one will be used for the connection between the CMTS and the Storage Server or Offloading PC.
- Two 1 Gbit connections must be available within 10 meters of the TEM cabinet or the third party accessories cabinet. Of these, one will be used for the connection between the Microscope PC and the Storage Server or Offloading PC.

In the server room:

- Two 10 Gbit connections must be available within 10 meters of the TEM cabinet or the third party accessories cabinet. Of these, one will be used for the connection between the CMTS and the Storage Server or Offloading PC.
- Two 1 Gbit connections must be available within 10 meters of the TEM cabinet or the third party accessories cabinet. Of these, one will be used for the connection between the Microscope PC and the Storage Server or Offloading PC.

  The Offloading PC is a desktop PC. It is not strictly necessary to install it in the server room.

Between the microscope room and the server room:

- For the 10 Gbit connection OM3 or OM4 (50/125) fiber cable must be used to connect the wall sockets in the microscope room and the server room.

  A representative image of 10G fiber optic LC-LC wall mounted feed through socket is shown below.

- For the 1 Gbit connection, Cat6A equivalent or better cable must be used to connect the wall sockets in the microscope room and the server room.
- The 10 Gbit and 1 Gbit link between the microscope room and the server room must be fully operational.

Note **It is recommended to use the lines between the microscope room and the server room exclusively for offloading camera data. Data traffic from other services and devices may interfere with camera data offloading speed and therefore camera performance.**

When the Storage Server or Offloading PC is not placed in a separate server room:

- The 10 Gbit optical link can be connected directly from the CMTS to the Storage Server or Offloading PC.
- The 1 Gbit ethernet link can be connected directly from the Microscope PC to the Storage Server or Offloading PC.

11.1.3.2 Network Security for the Storage Server or Offloading PC

On the Storage Server or Offloading PC:

- All firewalls are all disabled.
- No Anti Virus and/or Anti Malware software is present.

It is the responsibility of the customer IT department to protect the Storage Server or Offloading PC against unauthorized access and other cyber threats.

11.1.3.3 Connection of the Storage Server or Offloading PC to the CMTS via 10 Gbit Optical Link

For the network connection between the CMTS and the Storage Server / Offloading PC the following applies:

- The optical module in the CMTS is specified for 10 Gbit optical fiber with a maximum uninterrupted cable length of 100 meters.
- The maximum uninterrupted cable length at which performance has been verified by Thermo Fisher Scientific engineers is 50 meters.
- When the Storage Server is connected to the CMTS via couplings or (wall) sockets, the attenuation may introduce optical losses. This may reduce the maximum length at which reliable high speed offloading performance can be achieved.

A 10 Gbit high speed optical link and equivalent writing speed ensures all 4k x 4k images acquired at 40fps can be stored for post data analysis, for the continuous duration of:

- 48 hours on a Storage Server with 65 TB of disk space dedicated to camera data.
  (12 HDD's of 6 TB each, minus 1 HDD which is used for redundancy).
- 4 hours on an Offloading PC with 4 TB of disk space, of which 3.4 TB is dedicated to camera data.

When an experiment runs longer than the storage capacity allows it is necessary to move data to a location elsewhere in the customer network in order to maintain sufficient free disk space for incoming camera data. It is recommended to prepare such a relay mechanism.

11.1.3.4 Connection of the Storage Server or Offloading PC to the Microscope PC via 1 Gbit Ethernet Link

On the Microscope PC, the Quad Port Network Card in the Microscope PC must have at least one free port to facilitate a 1 Gb ethernet connection to the Storage Server or Offloading PC.

If there are no more free ports available, please pre-order a *Network card 2x Gigabit* (FRU 1151808). This network card can be installed next to the Quad Port Network Card in the Microscope PC.

Note **Do not connect to the Storage Server or Offloading PC via the network switches in the TEM cabinet.**

11.2 Gatan Image Filter (GIF)

11.2.1 Gatan Image Filter installation coordination

Note **Actions described in this chapter are performed by Thermo Fisher Scientific personnel.**

Gatan Image Filters (GIFs) are shipped from Thermo Fisher Scientific factory fully tested and aligned. On site, the FSE installs the lead shielding and the camera house to make sure the system is X-Ray safe.The Gatan engineer comes on-site and performs the installation of the cameras, fine tunes the system, confirms the specifications and provides a training of the customer.

Communication with supplier to arrange installation support

To arrange a proper timing of the installation date with our supplier the local Field Service manager is responsible for submitting a request at the regional Gatan office.

For more details see Gatan web site: http://www.gatan.com/contact.It contains a list of offices listed by country and the regional contacts with phone numbers.

In case of any problems:

Send an email to service@gatan.com.

Or call: +1 888 778 7933 or +1 925 463 0200. If no one answers, leave a message.

If this is not successful, escalate to InstallCoordinatorTEM@thermofisher.com.

Accepting filter

A hand-over of the system takes place 2 times during the filter installation:

1. Before a Gatan engineer starts installation (FSE to Gatan).
2. When installation is finished (Gatan to FSE).

Note **Beware that between the hand-overs the FSE does not need to be on site. the FSE only needs to be available in case of escalations.**

11.2.2 Continuum 1069 with K3 Camera

When the Continuum with K3 option is ordered, additional requirements must be taken into account during the site preparation.

Note **See the proper Gatan documents, for example the GIF Continuum Facility Specifications, available via Gatan and the FSE (Service-CD and FluidTopics).**

Due to the generated acoustic noise, the K3 Server PC should not be placed near the microscope, but it is recommended to accommodate the Storage Server in a separate server room.

- When installed in the same room as the microscope, the noise level may affect the performance of the microscope.
- When installed in the same room as the microscope user, the accumulated noise exposure exceeds acceptable levels for a healthy and comfortable work environment

Item	Values
Weight: GIF + K3	190.5 kg
Heat Dissipation GIF + K3 Power Supply	3200 W
Heat Dissipation K3 Camera into Cooling Water	180 Wj
Heat Dissipation K3 Camera Power Supply into air	155 W
K3 Camera Cooling Water flow rate	25 l/h

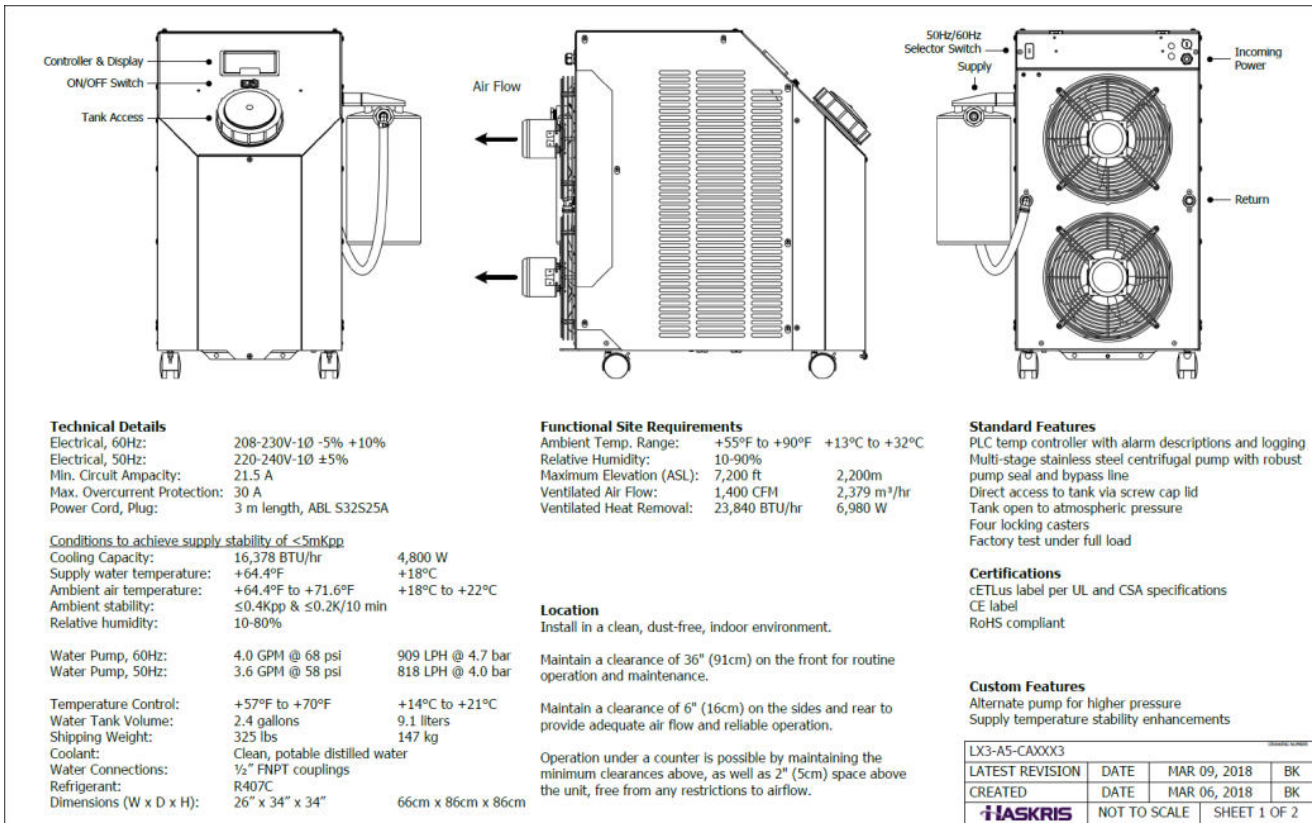
The earthing or the Continuum power must be the same as for the TEM power.

The Continuum power supplies must be plugged into the Gatan supplied power strip, and this **must** be grounded **only** to the TEM earthing.

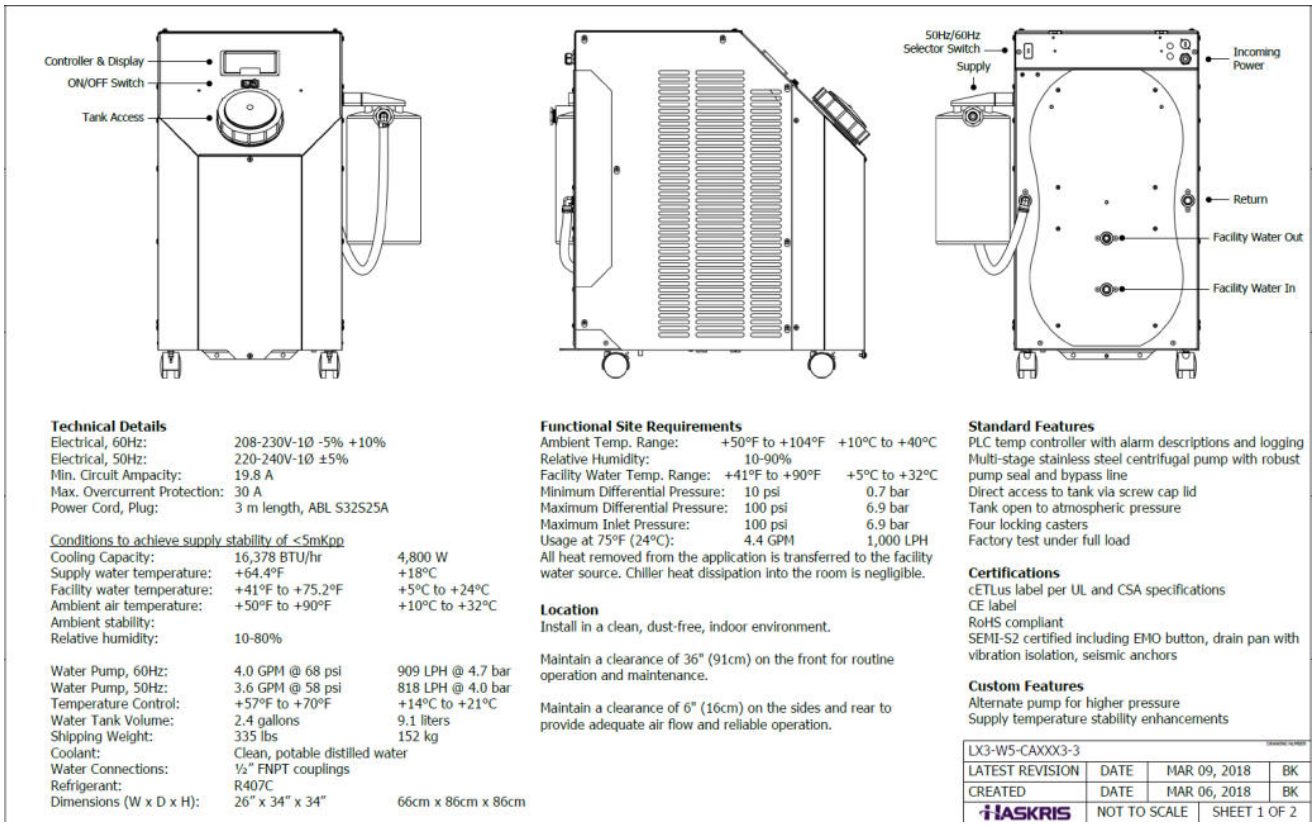
Two extra water in and two extra water out connections are needed for the cooling of the filter with K3 camera. The standard Microscope water connections should be expanded.

11.3 Haskris LX3 Details

Haskris LX3 Air Cooled chiller:



Haskris LX3 Water Cooled chiller:



11.4 Vibration Isolation Systems

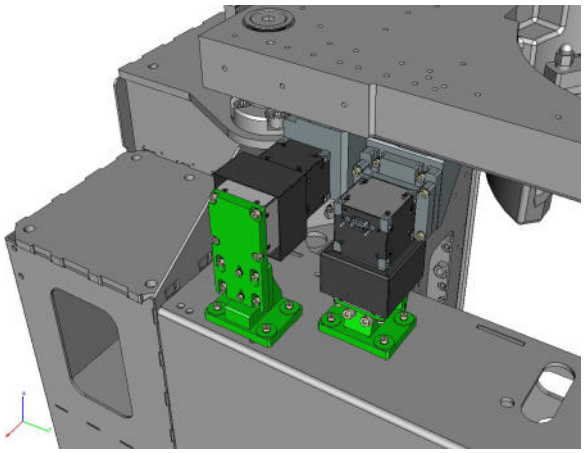
In case that the Microscope Site does not comply to the Vibration specifications (<Vibrations, Acoustics & Pressure waves>), different options available to ensure undisturbed System performance.

Note **For detailed information about each solution and the optimal choice for a specific situation please contact your local Thermo Fisher Scientific representative.**

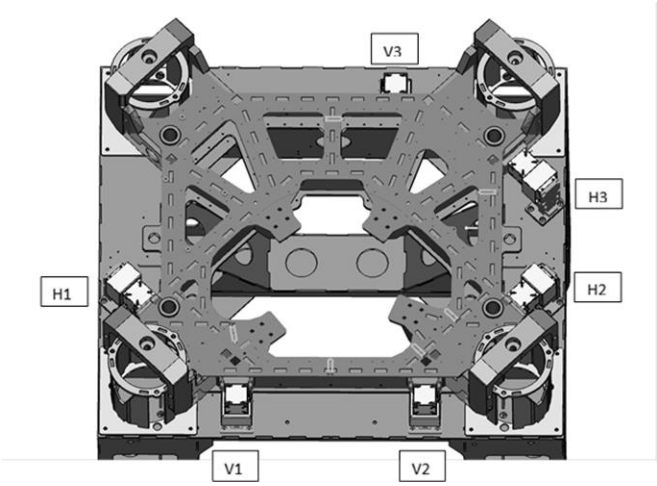
11.4.1 Integrated Vibration Isolation System (iVIS)

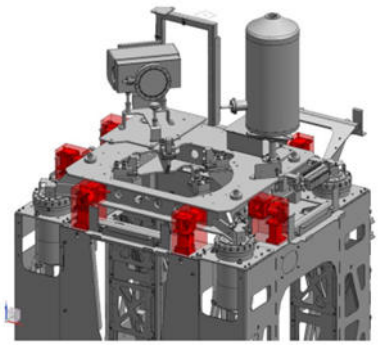
iVIS is a fully integrated system that reduces the sensitivity of Thermo Scientific TEM Microscopes to floor vibrations in the 1-5 Hz range, by active damping of resonance modes that are caused by these floor vibrations. The vast majority of customer sites will meet the floor vibration specifications when iVIS is present on the system.

iVIS is developed to actively dampen the resonance modes of the column on the air isolators. It is installed on the Microscope base in the Thermo Fisher Scientific factory. iVis does not require additional any pre-installation actions.



Example of two iVIS modules on a Common Base.





The maximum size of the gap between the floating table and the fixed world should be:

- width: 10 mm
- height: 1 mm
  (this is the maximum height difference between floating table and the fixed world)

11.4.2 Active Vibration Isolation solutions

Multiple solutions from different vendors are available for Active Vibration Isolation, for example anti-vibration platforms. The typical vibration cancelation solutions are designed to reduce vibrations over a broad frequency range.

Note **Any deviation from the specified floor flatness will result in inefficient floor vibration cancelation.**

If an Active Vibration Isolation solution is used, then additional pre-installation actions can be required. This depends on the selected solution, and must be specified in the documentation that is delivered by the vendor or manufacturer.

Note **If you have not received documentation for the Active Vibration Isolation solution, please contact your local Thermo Fisher Scientific representative.**

11.5 SEMI S2 Kit + Seismic Restraining Kit

11.5.1 S2 Compliance Kit

The S2 compliance kit is an optional part of Spectra 200 systems.
It contains the Seismic Kit containing the Floor anchors for Cabinets and chiller, consisting of:

- 1199787 Seismic Kit CB
- 1199866 Pre-install CB Seismic

Note **The S2 Labeling is standard implemented on all systems before shipment at the factory.**

Note **The kit does not contain the facilities Connection Box. The FSE must order this connection box as a FRU (1151147) when the S2 kit is ordered.**

To comply to the SEMI S2 certification, these items are required to be present on the order (configuration):

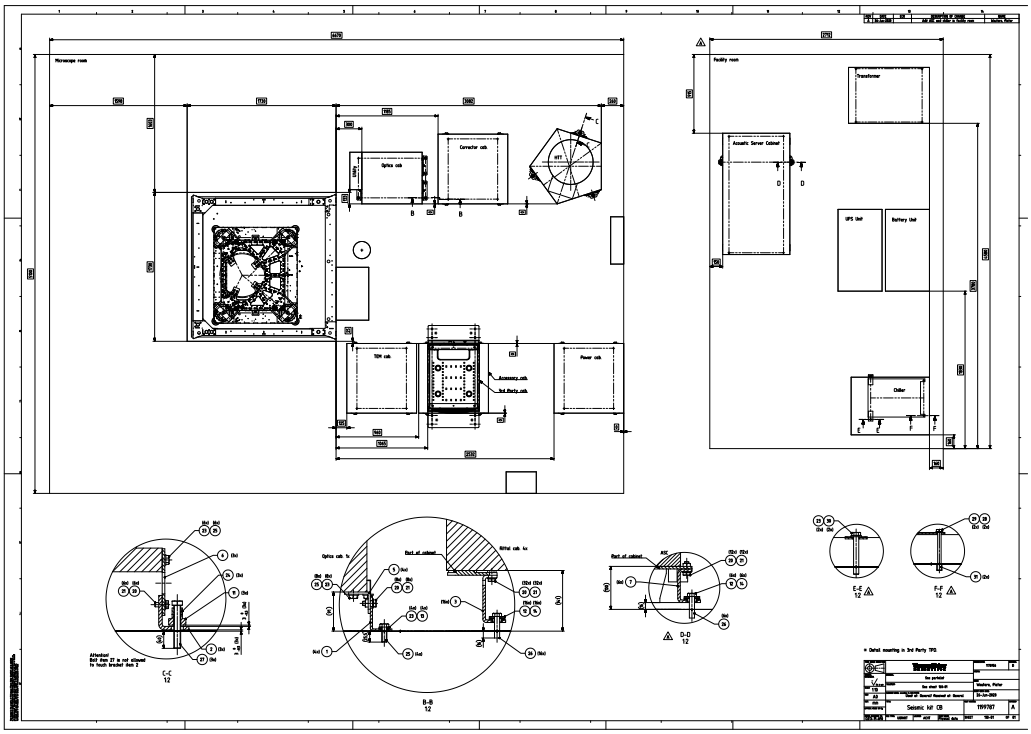
- Haskris LX3 G2 W S2 Enh. chiller (commercial order code 1148375)

11.5.2 Seismic Restraining Kit

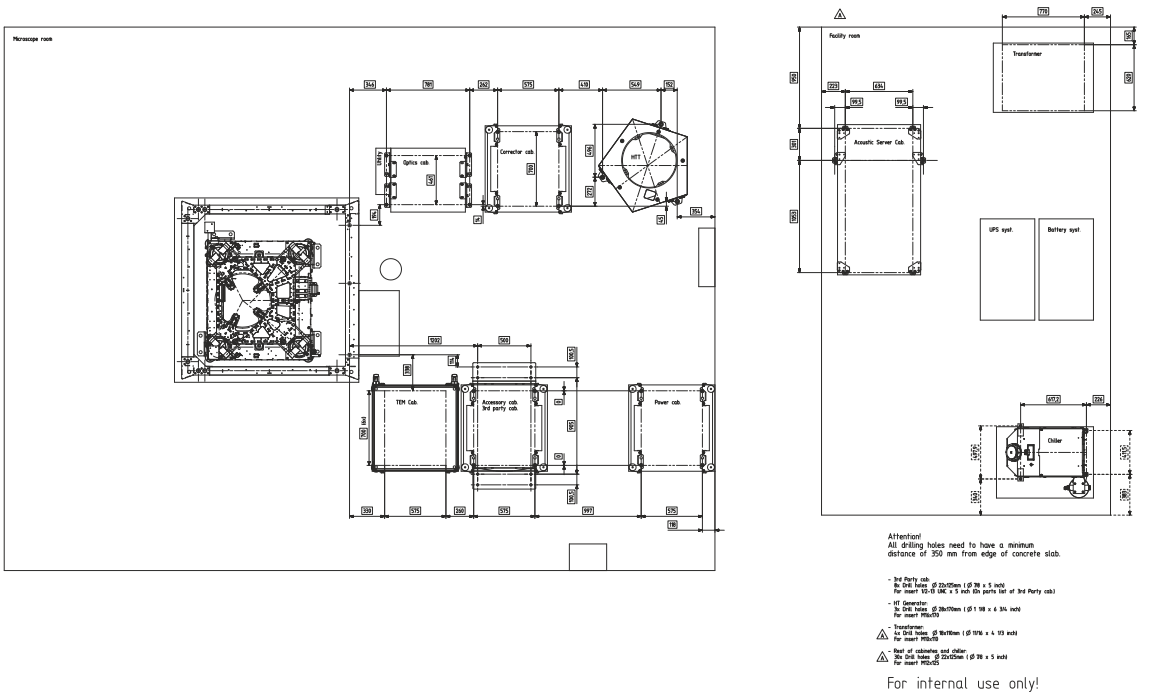
Note **All drilling and preparation mentioned below is the responsibility of the customer and must be completed before the Thermo Fisher Scientific FSE arrives on-site to install the System. It is advised to outsource drilling activities to a specialized company.**

The Seismic Kit requires that 22 and 28mm holes are drilled into the Microscope Room floor before installation and positioning of the Cabinets and chiller. 22mm holes are required for the Cabinets and HT Tank.

Please refer to the picture for the holes that need to be drilled for the Seismic Restraint Kit. For the chiller, it is required to drill 4 holes for the M12 bolts.



Note



See chapter Materials and Tools on page 10 for the list of items that are delivered with the System and which have to be purchased separately.

For details about System anchoring see chapter System Anchoring on page 26

Note **In case when the Seismic Restraining Kit is ordered, an additional Epoxy glue is needed. Make sure that full amount of Epoxy has been delivered as listed in Items shipped to the Customer by Thermo Fisher Scientific on page 10 . If the delivered Epoxy amount doesn't fit the description, contact your local Thermo Fisher Scientific representative.**

12 Appendix 6: Conversion Tables

Length	Energy
1 mm = 0.0393 in 1 cm = 0.3937 in 1 m = 3.2808 ft 1 m = 1.0936 yd 1 in = 0.0254 m 1in = 25.4 mm 1 in = 2.54 cm 1 ft = 0.3048 m 1 yd = 0.9144 m	1 Joule = 1 J = 1 Wsec = 0.2388 cal 1 kilo-Joule = 1 kJ = 1000 J = 0.9478 BTU 1 cal = 1 frigory = 4.1868 J 1 kcal = 4.1868 kJ 1 BTU = 1.055 kJ

Torque	Force
1 newton meter = 1 Nm = 0.102 kgfm 1 Nm = 0.7375 lbft 1 lbft = 1.356 Nm 1 kgfm = 9.8 Nm	1 newton = 1 N = 0.2248 lbf 1 dyne = 0.01 N 1 kgf = 9.806 N 1 lbf = 4.448 N

Mass	Temperature
1 g = 0.0353 oz 1 kg = 2.205 lb 1 oz = 28.35 g 1 lb = 0.4536 kg	0 °C = 32 °F °C = 5/9 x (°F - 32) °F = 9/5 x (°C) + 32

Volume	Power
1 cm^3 = 0.061 in^3	1 watt = 1 W
= 1 ml	= 1 J/sec
1 m^3 = 1.308 $yard^3$	= 0.2388 cal/sec
1 liter = 0.035 ft^3	1 kilowatt = 1 kW
1 liter = 1.761 UK pints	= 1 000 W
1 liter = 0.22 UK gallon	= 860 kcal/h
1 liter = 2.113 US pints	= 1.36 pk
1 liter = 1.057 US quarts	= 1.34 hp
1 liter = 0.2642 US gallon	1 cal/sec = 4.186 W
1in^3 = 16.387 cm^3	1 kcal/h = 1.163 W
1 $yard^3$ = 0.7646 m^3	1000 frig/h = 1.163 W
1 ft^3 = 28.32 liter	1 Brit ton of refr. = 3.89 kW
= 1 UK fl/oz	1 US ton of refr. = 200 BTU/min
= 28.41 cm^3	= 3.51 kW
1 UK pint = 0.57 liter	1 kWh = 3600000 J
1 UK gallon = 4.5461 liter	= 3.6 MJ
1 US pint = 0.4732 liter	1 pk = 0.735 kW
1 US quart = 0.9463 liter	1 hp = 0.7457 kW
1 US fl/oz = 29.57 cm^3	
1 US gallon = 3.785 liter	

Leak rate units	Flow
1 Torr l/s = 1.333 mBarl/sec	1 liter/min = 5.886 x 10^{-4} ft^3/sec
= 1.316 atm cm^3/sec	1 liter/min = 4.403 x 10^{-3} US gall/sec
= 10^3 lusec	1 liter/min = 3.667 x 10^{-3} UK gall/sec
= 2.795 x 10^{-3} atm.ft^3/min	1 ft^3/min = 0.472 liter/sec
= 2.083 x 10^5 gram/year (Freon 12)	1 US gall/min = 0.0631 liter/sec
= 5.7 x 10^{-3} kg/h (air)	1 UK gall/min = 0.076 liter/sec

Pressure	**Vacuum Pressure units**
1 Bar = 1000 mBar = 10^5 Pa = 1.02 kgf/cm^2 = 0.988 atm = 14.5 lb/in^2 1 mBar = 0.1 kPa 1 kPa = 1 kN/m^2 = 10 mBar 1 Pascal = 1 Pa = 1 N/m^2 = 0.01 mBar 1 lbf/in^2 = 0.07 kg/cm^2 = 0.068 atm = 6.894 kPa = 68.94 mBar = 0.069 Bar 1 kgf/cm2 = 1 atm = 98.066 kPa = 0.9806 Bar 1 atm = 101.325 kPa = 1.0132 Bar 1 mm Hg = 1 Torr = 0.1333 kPa = 1.333 mBar 1 mm H2O = 9.804 Pa = 98.066 mBar	1 atm = 760 Torr 1000 mBar = 750 Torr = 105 Pa 1 Pa = 0.01 mBar = 1.10^{-5} Bar = 7.5 x 10^{-3} Torr = 9.87 x 10^{-6} atm = 1.45 x 10^{-4} lbf/in^2 = 1.02 x 10^{-5} kgf/cm^2 = 2.953 x 10^{-4} in Hg = 7.5 x 10^{-4} mm Hg = 4.015 x 10^{-3} in H_2O = 0.102 mm H_2O = 7.5 micron = 99.99+ % vacuum = 1 N/m^2 1 atm = 1.013 x 10^5 Pa = 101 325 kPa 1 Torr = 1.333 x 10^2 Pa = 1 mm Hg 1 mm Hg = 1.333 x 10^2 Pa 1 micron = 1 µm Hg
	Magnetic field strength
	1Tesla = 10 000 Gauss 100 nT = 1 mG

Frequency	**Magnetic induction**
1 Hertz = 1 Hz = 1 cycle/sec = 60 cycles/min (cpm) 1000 cpm = 1.000/60 Hz = 16.67 Hz	B =μ x H = 1 Tesla = 10^4 Gauss μ =μ0 x μr μr = 1 in vacuum and air μ0 = 4π x 10^{-7} V sec/A.m Oersted = 10^3/4 π A/m = 79.6 A/m

Light	**Pumping speed units**
Color temperatures K Candlelight = 1 930 Tungsten lamp, home use = 2 800 Quartz halogen lamp = 3 200 Fluo. lamp, warm white = 3 500 Fluo. lamp, white = 4 500 Fluo. lamp, daylight = 6 500 Clear sky = 10 000 Luminance Lux Clear, mid-day sky = 100 000 Cloudy, mid-day sky = 32 000 Office, under fluo. light = 500 Candle light, distance of 20 cm = 10	1 l/s = 60 l/min = 2.12 ft^3/min = 3.6 m^3/h 1 ft^3/min = 0.472 l/s = 28.32 l/min = 1.7 m^3/h 1 m^3/h = 0.278 l/s = 16.67 l/min = 0.589 ft^3/min

13 Revision History

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Revision Table

Revision	Date	ECO number	Description of Changes
A	04-OCT-2019		Initial Release
B	25-OCT-2019		Updated content
C	04-NOV-2019	SDR21590	Updated Microscope Room Layout
D	15-NOV-2019	SDR21605 and other	Updated sections: ● about using the drilling jig ● Chiller properties ● internal transport height ● FEG Crate dimensions
E	22-NOV-2019		Updated weight distribution table
F	29-NOV-2019		Updated Pre-Installation Checklist
G	06-DEC-2019	SDR22076 SDR21287	Updated weight of the crate, and system crated. Updated Machine Classification S2. Updated Magnetic Fields Specification with X-CFEG
H	10-JAN-2020	SDR22502 SDR22473 SDR22174	Corrected number of holes and the dimensions for systems anchoring. Revised 9.1 Pre-Install Survey

Revision	Date	ECO number	Description of Changes
I	24-JAN-2020	SDR22628 SDR22631 SDR22629 SDR22632	Removed note in 4.6.2 about the drilling jig pre-ordering. Removed anchoring items from Pre-Installation kit Updated values for temperature range facility water Updated readability of table in 4.2.1.
J	31-MAR-2020	SDR24450 SDR24376	Added Airflow Guideline (5.1.3) Added 3.4 Items that can be pre-ordered Added link to pdf version of drawings
K	17-JUL-2020	SDR24943 SDR25723 SDR25842 SDR25860 SDR26086 SDR26066 SDR25999 SDR25850 SDR25829 SDR25218	Minimum pressure compressed air from 5 to 6 Bar Floor flatness requirement updated from 3 to 0.5 mm/m Added Sealing ring to be ordered with the SRVs Updated distance to wall in 4.6. Added Continuum 1069+K3 info in Optional Configurations Removed incorrect references to chapters in Electrical Connection. Removed (incorrect) references to X-FEG values Updated Transport Route Drawing Added drawing with Enclosure/Enclosure door height. Updated Anchoring Drawings
L	02-Oct-2020	SDR26721 SDR26571 SDR26743 SDR26742 SDR26740 SDR26767 SDR26632 SDR27256 SDR26632	Added order codes for FSE tooling Added EMI specifications for systems with Energy Filter Added comment in 4.2 that weights are without Accelerator Added floor layout for drilling jig Added EMO connections image in 6.3.2 Update due to Seismic for Chiller Added Acoustic Server Cabinet information Point load changed from N/cm^2 to kg/cm^2 Added additional Acoustic Server info on connections
M	09-Oct-2020	SDR26632	Additional updates for Acoustic Server Cabinet
N	16-Nov-2020	SDR23995 SDR23996 SDR27572 SDR27594 SDR27595 SDR27943 SDR27942	Sanitized the ICT requirements Sanitized the Optional Configurations > Ceta-2 chapter Added SCCR rating for Acoustic Server Cabinet Remove the X Tech Soundproof Box Added cooling option for Acoustic Server Cabinet Added crate dimensions Acoustic Server Cabinet Added image of schematics of mains connection of the Acoustic Server Cabinet.

Revision	Date	ECO number	Description of Changes
O	06-Apr-2021	SDR29174 SDR27280 SDR29334 SDR29463 SDR29547 SDR29670 SDR29774	Added maximum length cable TPEB-Power Cabinet Added the Connection Box details Added factory code for Epoxy Added 'near DC EMI' comment at Magnetic Fields Updated text for Air Ventilation Corrected the information about delivery properties Toolbox crate(s). Several minor changes due to review for next generation.
P	12-May-2021	SDR31058 SDR29994	Updated order numbers for S2 Seismic kits Floor flatness specification back to 3 mm/m
Q	07-Jul-2021	SDR30514 SDR30614 SDR28577 SDR30702 SDR30528	Added SF6 Detector in 'Tools provided by FSE' Updated Pre-Install Checklist-Transport Route Added comment on Facility Room size Revised and appended the connection specifications for water, air and gasses in the Microscope Room. Added note about use of sliding doors
R	26-Jul-2021	SDR31251	Max temp for Facility room to 25°C (was 32)
S	04-Oct-2021	SDR31281 SDR31312 SDR29837 SDR31930	Added installation guideline for UPS Removed double items from "to be purchased by customer" list. Removed/updated references to the Acoustic Server Cabinet, which is not delivered for Spectra Added minimum floor thickness
T	30-Dec-2021	SDR32559 SDR32914 SDR32974 SDR29674 SDR29426	Updated references in Room Layout drawing Added note about second earth wire Updated Machine Classification due to Brexit Added link to printable Performance Waiver Updated numbers for SF6 capacity
U	14-Jan-2022	SDR33757	Added the need for a TNS connection when using RCD.
V	15-Apr-2022	SDR32083 SDR34080 & SDR34592 SDR32976 SDR34187 SDR33671 SDR34737	Added note about Continuum K3 facilities specifications document Added Restricted Sites note in Pre-Install Checklist Corrected Floor thickness in Pre-Installation Checklist New Detector SF6 added. (1284273) Added image of floor unevenness. Changed RAPID port from 5900 to 1194.
W	22-Apr-2022	SDR35678	Change RAPID VPN parms, reuse AIT153962

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