EQUIPMENT SPECIFICATIONS FORM

Document title	Measuring device for Resistance Area of Josephson Junction

Réf. Chrono	LETI/DPFT/SDEP/26.024

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1 PURPOSE

The tool must be able to measure the Resistance-Area product (RA) on blanket films of Josephson Junction (JJ) and has to be placed in a clean room environment.

The equipment must be able to handle 200mm silicon wafers, but also pieces of wafer (at least a size of 20x20mm).

N°	Parameters	Specifications
1	Surface Scanning: XY range Resolution Accuracy (on full range)	 150x150mm 100nm 5µm
2	Sample visualization Optical system Camera	Magnification to be able to easily place the probes on 30x30µm square Live view of the probes/sample
3	Range of RA measurable on JJ stack	$0.5\ \Omega.\mu m^2 \leq RA \leq 100\ k\Omega.\mu m^2$
4	Reproducibility RA measurement	Better than 1%

Documents to be provided by the Contractor during the tender process

- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix A: Summary of Contractor's comments** and put any comments in this section (the Contractor must not add any comments in the main text).
- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix H: Datasheet for Tool Installation.**
- ✓ The Contractor must deliver to CEA-LETI the system footprint and dimension of all systems or sub systems
- ✓ The Contractor must deliver to CEA-LETI pre installation manual
- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix I: Risk Identification Sheet**
- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix J: SECS/GEM Compliance**
- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix K: pedestal specification**

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2 PROCESS OR MEASUREMENT SPECIFICATIONS

The Contractor will have to demonstrate its capacity to reach the specifications to which he complies, by presenting results obtained on the proposed tool. The probes used for these tests (Process 1 to Process 3) will be provided by the equipment manufacturer.

Process 1 : cartography and probes life time.

The Josephson Junction (JJ) stack will be provided by Leti and will have RA between 20 and 500Ω.μm2.

The measurements will be taken on a stack with a Pt and Ru capping layer:

- Si/SiO2 – Al 100 nm / Al Ox / Al 25nm - Pt 7nm
- Si/SiO2 – Al 100 nm / Al Ox / Al 25nm - Ru 7nm

This process aims at testing the scan function of the machine for RA cartographies, evaluate the duration of each measurement, and the life time of the probes.
This test will be done on 200mm wafer, using a matrix of 10x10 equidistant measurements on 150x150mm area. The first 5 measured points will be measured a second time after completion of the matrix measurement to determine the reproducibility of the measurement or the drift induced by probe ageing.

Test n°	*Description of test*	*Specification*
Test 1	Probes approach speed	<1mn to have contact and be able to start a measurement
Test 2	Probes life time & cartography: Uniformity measurement on one 200mm wafer: Matrix of 10x10 equidistant points on 150x150mm surface. 5 selected points will be measured a second time after completion of the matrix measurement. The measured stack is a Junction with a RA around 100Ω.μm^2.	- > 100 measurements without replacing the probes. - RA difference for the 5 points that are measured twice less than +/-2%. - Provide mapping of RA for the measurement matrice.
Test 3	Reproducibility 5 measurements: one measurement comprising probe down, measurement, probes up, small displacement of the stage. Comparison of the 5 measurements near the same point.	Difference between the 5 measurements is less than +/- 1% for RA.

Process 2 : reproducibility of the measurement.

The aim of this process is to test the reproducibility of the measurement, with the same probe and between probes.

The JJ stack with a Pt or a Ru capping will be provided by Leti and will have RA between 20 and 500Ω.μm2.

Test n°	*Description of test*	*Specification*
Test 4	Reproducibility with the same probe. On the same wafer, 5 measurements with one probe, and 5 measurements with another probe. All the measurements have to be done beside.	Difference between the 5 measurements in each series is less than +/- 1% for RA.
Test 5	Reproducibility between probes. On the same wafer, 5 measurements with one probe, and 5 measurements with another probe. All the measurements have to be done beside.	Calculation of the mean RA in each series of measurements. Difference between the mean value is less than +/-0.5% for RA.

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Process 3 : RA measurement on JJ stack with no capping

The aim of this process is to confirm that we could establish good looking contact on wafers or sample (at least a size of 20x20mm) and measure RA on JJ stacks without capping:

- Si/SiO2 – Al 100 nm / Al Ox / Al 25nm

Test n°	*Description of test*	*Specification*
Test 6	Conduct 10 measurements to find optimal probe and pin combinations for the sample. The measured stack is a Junction with a RA around 100 Ω.µm2.	Difference between the measurements is less than +/- 1% for RA.

3 EQUIPMENT TECHNICAL SPECIFICATIONS

Equipment installed in a clean room must under no circumstances alter the features and characteristics of the zone.

3.1 Equipment description

The machine should be insulated from floor vibrations (antivibration platform).
The stage should handle wafers, and small samples (2x2cm2).
The machine must be able to measure RA on Josephson Junction stacks.
The machine must be able to give RA cartographies of a wafer at least on 150mmx150mm square.
The total measurement duration of each point must be below 1 minute (loading/unloading time not included).
The machine should be able to measure and extract RA, Rtop and Rbottom parameters for JJ devices with different tunnel barrier oxidation processes.

For chemical equipment

The workbench shall be fitted with an enclosure/hood in order to reduce exhaust demand while maintaining good working ergonomics (to be defined with the users); the windows shall be retractable.
The exhaust airflow rate shall be regulated according to the window opening and shall be self-adjusting with respect to the available exhaust negative pressure, i.e. it shall not be affected by upstream or downstream pressure variations. These control dampers shall be of the Phoenix, IRIAN, or equivalent type.

The minimum (windows closed) and maximum (windows fully open) airflow rates shall be defined by the supplier and communicated to the CEA via Appendix H.

For chemical sub-module, a simpler regulation system able to manage only 2 exhaust levels associated with door open/close positions, is acceptable. Such as a first level of exhaust suitable when doors are closed and another one able to maintain user safety when door are open.

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3.2 Hardware

3.2.1 Pumping system

The Contractor shall draft his recommendations for pumping according to the specifications indicated by the CEA-LETI and his own specifications.

3.2.2 Gas/chemical lines

The machine shall be equipped with the gas/chemical lines necessary for the processes and for the required performances. Each line shall be equipped with a filter compatible with the corresponding active gas/chemistry.
Each gas/chemical line shall be clearly identified and equipped with a manual shutdown valve up-line from the flowmeter (line isolation).
Each gas line (or chemical line) shall be equipped with a digital flowmeter, and the information of instant flow as well as total gas / chemical volume shall be reported to the facilities. Alternatively, the information of the valve status will be reported to the facilities in order to calculate the total gas or chemical consumption.

Each gas or chemical line shall be identifiable on the control monitor of the machine, the name of the line shall indicate the name of the gas/chemistry used.
The gas/chemistry panel and the lines internal to the machine shall be manufactured and assembled using welded pipe (orbital type welding) or pipes assembled by "VCR" type joint techniques. The stainless steel used for the piping, bellows, and other parts shall be electro-polished ANSI316L steel (0.25 µm Ra).

All connections provided will be internal to the equipment and under extraction. Power supplies from facilities must be able to enter the equipment with a double-walled connection (toxic, corrosive, and flammable gases) and have sufficient space to terminate the double wall inside the equipment before connection.

All chemical connections will also be internal to the equipment, with space for a double wall. Chemical connections must enter the equipment through a side panel, and the end of the double wall must be located in a containment tray segregated according to the nature of the chemical. Under no circumstances should any leakage (or flushing) from the chemical compartment flow into the double walls.

It must not be possible for mass-flow bypasses to be in open position if the equipment is in “gas demand” (gas input valve open), so as to prevent any excessive discharge flow incompatible with the extraction systems (example: dilution by a neutral gas for flammable gases).

3.2.3 Equipment consumption monitoring

All fluids that are controlled in flowrate through Mass Flow Controllers shall be monitored by equipment software and their consumptions shall be recorded. This shall include at least process gases, chemicals and de-ionized water. Fluid consumption data shall be accessible on equipment user interface for viewing and shall be readily exportable to cleanroom IT network through SECS/GEM protocol in dedicated SVIDs.

3.2.4 Idle mode management and interface with peripheral sub-equipments

The equipment shall be able to detect idle time and trigger relevant actions aimed at decreasing power and fluid consumptions (for instance: temperature decrease, purge flowrate decrease…). Idle time threshold to trigger these actions shall be settable through equipment user interface. Upon restart all equipment process parameters setpoints shall be automatically restored and process launch shall be inhibited until parameters have reached their setpoints.

The equipment shall embed an interface box to manage communication with peripheral sub-equipments (pumps, abatement systems…). Communication with sub-equipments shall rely either on dry contacts or on Ethernet connection. The interface module shall be able to collect information from sub-equipments (status, alarms, warnings) and trigger relevant actions on the equipment (process aborts, process inhibits…). Such actions shall be settable on equipment user interface. The interface module shall also be able to send standby commands to sub-equipments in

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order to decrease their power and fluid consumptions during idle times, which commands shall also be settable on equipment user interface (pump speed decrease, abatement burner shutdown…). Upon restart nominal sub-equipment operation shall be automatically restored and process launch shall be inhibited until nominal operation level of all sub-equipments is reached.

3.2.5 Flammable gas management

The flammable gases, particularly pure or mixed silane and hydrogen, will be diluted by pump ballast nitrogen at vacuum pump outlet, so that the concentration is < LIE (LEL) /2. Ballast flowrate shall be monitored by the equipment and flammable gas dispensing shall be inhibited if it is below dilution requirement. Required nitrogen flowrate will be calculated based on the maximum flowrate that can be delivered by the MFC.

3.2.6 Temperature control

Non applicable

Heat exchangers / Chillers

The Contractor shall price the heat exchangers and chillers as an optional item.
The Contractor shall draft his recommendations for heat exchangers and chillers according to the specifications indicated by the CEA-LETI and his own specifications.

3.2.7 Vibrations

The Contractor will provide the vibration emissivity specifications (amplitude and frequency) of the equipment and its sub-elements.
The Contractor will provide the vibration sensitivity specifications (amplitude and frequency) of the equipment and its sub-components.

3.2.8 Other

Non applicable

3.2.9 Light Tower

The Equipment will be able to accept the following light tower scenario

Color	Position	Status	Description
Red	top	flashing	
		On	Error has occurred on any of the equipment
		Off	
Yellow	2nd	flashing	
		On	Warning has occurred on any of the equipment
		Off	
Green	3rd	flashing	Equipment is in idle mode and connected to automation
		On	Equipement is in Idle mode
		Off	
Blue	bottom	flashing	Carrier removal request at output port
		On	Equipement is processing
		Off	

NOTE: For Rx equipment a 2nd light tower must be present (see chapter 5.10)

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3.3 Software

3.3.1 OT configuration

The supplier must provide us with a dedicated IT specialist contact.

Software Update and Upgrade
The Contractor shall systematically provide CEA-LETI with updates (bug corrections, etc.), upgrades, and the latest version of the software as soon as it becomes available and shall install them free of charge during the warranty period.
After the warranty has expired, the Contractor will keep CEA-LETI informed of any upgrades or new versions that improve functionality and provide pricing conditions if requested by CEA-LETI.

Notwithstanding the warranty expiration, the Contractor will perform the software modifications needed to fix any bugs and thus maintain the original functionality of the software at no cost to CEA-LETI. Modifications related to corrections (bugs, etc.) shall be supplied and installed free of charge.

Through-the-Wall Installation
If the equipment is installed in through-the-wall mode, user interface stations shall be available in both white and grey areas. The two control stations shall not be active at the same time.

3.3.1.1Full OT Description of the Equipment

In the context of connecting to the cleanroom information system, the equipment supplier must provide us with:

- Number of PCs and controllers in the network within the equipment
- System configuration of each pcs
  - Operating system
  - Processor(s)
  - RAM
  - Hard drives capacities
  - MAC address
  - Network diagram of the different PCs, with the connection to the cleanroom information system highlighted.
- Presence of remote PCs/stations with a list of ports and communication protocols between the station and the equipment
- Presence of servers or computing stations associated with the equipment:
  - Provide a list of ports and communication protocols between the station and the equipment
  - Installation recommendations
- Presence of internal storage type NAS.
- In general, the list of protocols and ports required on the industrial network

3.3.1.2Time Server (NTP)

To ensure proper timestamping and consistency of the different results and processes of the equipment, the supplier will provide the procedure to configure an NTP server.
To avoid any malfunctions, all PCs of the equipment must be synchronized with this server.

3.3.1.3Naming of Workstations and Other Requests

To ensure proper tracking of the equipment, is it allow to modify the name of the PC(s) connected to the network? CEA-LETI recommends the presence of the supplier on the day of network connection.

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3.3.1.4Remote access

Remote access can be set up.
This requires the ability to install a VNC server (UltraVNC) or SSH (for Linux) on the PC connected to the information system.
The supplier will have the ability to connect to the equipment via a web proxy and access the keyboard, mouse, and screen of the PC under the supervision of the equipment manager.
File transfers are prohibited via remote access.
For data transfer needs (log uploads, downloading updates, etc.), other solutions will be available but will be studied on a case-by-case basis depending on the sensitivity of the equipment data.
Remote access will be occasional and used solely to facilitate maintenance and qualification issues of the equipment but never for remote operation.

3.3.2 Antivirus and Data Backup

CEA-LETI performs backup copies of all data stored on all computers and associated peripheral devices of the equipment.
This is achieved by performing both:

- A complete capture of all disks, with a tool like "Symantec Ghost" or Clonezilla
- An automatic data copy, capturing (on a periodic basis) updates to recipes and parameters of the equipment during operation

3.3.2.1Backup Procedures (Full Images) of Hard Drives

CEA-LETI uses Clonezilla to create full images of all PCs in the equipment.

If the supplier does not allow CEA-LETI to use Clonezilla,
the supplier must provide a procedure and all necessary equipment for backups and restorations of the different PCs.
They will train CEA-LETI maintenance staff in the correct application of this procedure.
A backup will be performed for the acceptance of the tool and equipment.

The frequency of these backups will be defined with the equipment manager and the supplier (monthly, annually, etc.).
If the software has a protection mechanism that could interfere with the replacement of the equipment disk, then the supplier must provide CEA-LETI with the method to reactivate the software. This is particularly mandatory if a new user license key is required by the software after a hard drive change.

3.3.2.2Backup of Recipes and Parameters

The supplier must provide a procedure to back up and restore the recipes and parameters of the equipment. This backup will be stored on the network.

3.3.2.3Antivirus

Mandatory for All Windows PCs of the Equipment Connected to the Information System.
CEA-LETI proposes four antivirus solutions:

- Symantec SEP
- TrendMicro Apex One
- TRELLIX:
    - Application control: sealing based on a whitelist without active scanning.
    - Endpoint security: antivirus with active scanning

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For antivirus solutions with active scanning:

- An exclusion list can be set up to avoid disrupting the business software. The list must be provided by the supplier.
- There is no complete scan of PCs during production.

3.3.3 Automation

Contractor shall provide the CEA-LETI with:
• The software and licenses required to operate the SECS / GEM interface
• The peripheral hardware required for the SECS / GEM interface (ex: network interface, etc.)
• Documentation (in English) associated with the SECS / GEM interface

The equipment shall implement the following mandatory standards:

- SEMI E5 (SECS-II)
- SEMI E30 (Generic Equipment Model)
- SEMI E37 (HSMS)
- SEMI E37.1 (HSMS-SS)
- SEMI E37.2 (HSMS-GS)
- SEMI E39 (Object Services)
- SEMI E40 (Process Job Management)
- SEMI E84 (Carrier Handoff Parallel IO Interface)
- SEMI E87 (Carrier Management)
- SEMI E90 (Substrate Tracking)
- SEMI E94 (Control Job Management)

The equipment shall implement the following optional standards:

- SEMI E41 (Exception Management)
- SEMI E42 (Recipe Management)
- SEMI E53 (Event Reporting)
- SEMI E54 (Sensor/Actuator Network)
- SEMI E58 (Availability, Reliability, Maintenability)
- SEMI E95 (Human Interface)
- SEMI E98 (Object Base Equipment Model)
- SEMI E99 (Carrier ID Reader/Writer)
- SEMI E109 (Reticle and Pod Management)
- SEMI E116 (Equipment Performance Tracking)
- SEMI E120 (Common Equipment Model)
- SEMI E125 (Equipment Self Description)
- SEMI E126 (Equipment Quality Information Parameters)
- SEMI E128 (XML Message Structure)
- SEMI E132 (Client Authentication and Authorization)
- SEMI E134 (Data Collection Management)
- SEMI E138 (XML Semiconductor Common Components)
- SEMI E139 (Recipe and Parameter Management)

The Contractor must complete and deliver to CEA-LETI **Appendix J** « SECS/GEM Compliance »

It should be noted that, during the equipment acceptance, a total of 5 working days will be needed for automation tests. During these 5 days, the support of a field support engineer will be required on site. A software automation engineer should also be available for remote support (mail, online conference, phone, etc…)

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3.4 Transfer and handling of wafers

This section deals with the relationship between machine, wafer carriers and wafers.

3.4.1 Wafers specifications

The equipment must be able to handle with 200mm silicon wafers, but also with pieces of wafer (at least a size of 20x20mm).

3.4.2 Load ports

The wafers will be loaded manually.

3.4.3 Handling and contact surfaces

Non applicable

3.4.4 References of wafer carriers used on equipment

Non applicable

3.4.5 Handling system reliability

Non applicable

3.5 Mini environment

This section is only relevant for equipments operating, at least partly, under atmospheric pressure.

Parameters	Specification
Overpressure of the mini-environment with respect to the clean room	> 1 Pa
Blowing speed at 10 cm under filters	Between 30 and 40 cm/s
Blowing speed at the level of the wafers	Between 20 and 40 cm/s
Integrity of filters	Visual check

3.5.1 Check of the physical characteristic of the air

In no event shall any necessary slight overpressure of the environmental chamber compared with the room affect to the confinement with odors nor cause a risk of spreading aerosols nor other vapors in the operator environment. During in situ tests, the Contractor shall be responsible for adjusting air speed of fan filter units (FFUs).

The service includes all equipment, auxiliary modules (air conditioning units (ACUs), fans, and filter housing) and systems necessary for maintaining temperature and humidity conditions and controlling particulate contamination (and molecular if necessary) in the equipment.

3.5.2 ESD (Electrostatic Discharge)

The equipment must be made of dissipative materials in particular, in so-called sensitive areas (< 25 cm from devices):

- Carrier loading/unloading plates,
- Plant unit transfer arm/shovel,
- Chuck/support plates.
- Casing.

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For surfaces located at less than 25 cm from the wafers, the electrostatic discharge must be less than 100 V/inch (circuit breakdown voltage).
If the machine is equipped with ionising bars:

Measurements of ionising bar efficiency at the level of the plates	• Time of the positive discharge from + 1000V to + 100V < 20s • Time of negative discharge from – 1000V to –100V < 20s
Contamination check on the tips of ionising bars	• Whitish deposit (to be cleaned)

3.5.3 Particle checks

This section refers to particle counts in air flowing through the mini-environment.

Particle check in static mode
The sampling probe of the particle counter is placed at the location representing passage of the plates.
The mini-environment will be checked at 7 sampling points with a sampling time of 1 minute per point.
The maximum number of particles allowed will be 35 particles per m^3 of size> 0.1µm (or 1 particle per ft^3)

Particle check in dynamic mode
The probe is placed close to the various moving elements.
Specific attention will be paid to parts which may present friction.
The mini-environment will be checked at one sampling point per site in motion with a sampling time of 1 minute per point.
The maximum number of particles allowed will be 3,500 particles per m^3 of size> 0.1µm (or 100 particle per ft^3)

3.6 Interface with the rest of the clean room and its organisation.

The equipment must be compatible with the environment for which it is intended.
It should not degrade the environmental conditions of the room according to the following constraints (see the environmental conditions in Annex B):

- The cleanliness class (It should respect the cleanliness class according to ISO 14-644-1)
- Temperature
- The relative humidity
- The VOC (Volatile organic compounds) content: VOC <50ppb
- The air contamination (Any parts likely to release particles or other contaminants should have an appropriate extraction)

The Contractor should respect ISO 3 to ISO 8 clean concept rules.
The provider must follow the rules of "clean concept" imposed in accordance with quality documents mentioned in this specification.
Regarding the personnel involved in clean rooms, the service provider provides the CEA-LETI with a proof of a registered training in "Clean environment concept in micro and nanotechnology" for both himself and his possible subcontractors.

3.7 Contamination

3.7.1 Particle contamination

Following particle contamination specifications shall be achieved by the equipment and equipment performances shall be verified as part of acceptance tests. Equipment shall also consistently achieve these performances over the course of the warranty, which will be verified through tests carried out by CEA-LETI on a regular basis.

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Test #	Test name	Method	Result to pass
C1	Frontside particle contamination: handling	Silicon monitors Handling (mechanical only) in and out of process chambers Pre and post-handling particle measurements with unpatterned wafer defect inspection system	< 100 particles @ 0.16-0.2µm minimum particle size 3 consecutive wafers within specification
C2	Frontside particle contamination: process	Silicon monitors Representative process to be agreed upon between CEA-LETI and Contractor Pre and post-process particle measurements with unpatterned wafer defect inspection system	< 100 particles @ 0.16-0.2µm minimum particle size 3 consecutive wafers within specification
C3	Backside surface condition	Silicon monitors Handling (mechanical only) in and out of process chambers Backside measurements with unpatterned wafer defect inspection system NB: for 200mm equipments, wafers will be handled upside down (polished side in contact with robots, chucks etc…)	No scratch signature on defect map 3 consecutive wafers within specification No result drift: total defect count for backside measurement of wafer ID #3 must not exceed total defect count for backside measurement of wafer ID #1 by more than 10%

3.7.2 Metallic contamination

The metal contamination specifications are those that the equipment must have when it enters the cleanroom.

This control is a handling test. It reports on the level of metal contamination at the end of installation, before the equipment acceptance tests are started and before any process tests.

The test wafers must be handled throughout all the equipment modules.

The process acceptance tests are mentioned in section 2 of the specifications document.

Test C4 : Use Monitor quality silicon substrates.

Loading/unloading (handling) in **all equipment modules.**

Test C5 : Use Monitor quality silicon substrates

Loading/unloading (handling) in **all equipment modules**

NB: For equipment handling wafers with a diameter of 200mm or less, the wafers will be handled upside down (polished side in contact with robots, chucks, etc.).

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Test #	Test name	Analysis method	Result to be achieved
C4	Metal contamination Front side	TXRF measurement localised analysis at different points	For all the elements measured (1): Average: < 1E11 at/cm² Localised peak: < 1E12 at/cm²
C5	Metal contamination Back side	TXRF measurement localised analysis at different points	For all the elements measured (1): Average: < 1E11 at/cm² Localised peak: < 1E12 at/cm²

(1) List of elements measured in TXRF : Na, Mg, Al K, Ca, Ti, Cr, Fe, V, Mn, Co, Ni, Cu, Zn, Ga, Ge, As, Sr, Y, Zr, Nb, Mo, Ru, Pd, Ag, Cd, In, Sn, Sb, Te, Ba, La, Hf, Ta, W, Ir, Pt, Au, Pb, Ce, Gd, Dy, Er, Yb, (this list of elements may be modified at the discretion of LETI)

(2) List of elements « CONTA 1 » : Al, As, B, Ca, Co, Cr, Cu, Fe, Ga, Ge, Hf, K, In, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Sb, Sn, Ta, Te, Ti, V, W, Y, Zn, Zr, (list of elements which may be modified at the discretion of LETI)

3.8 Specific interface with facilities

3.8.1 If CMP type equipment (Chemical Mechanical Polishing)

In the event of pressure disturbances on the EDI network, if the operation of the equipment during the process or in IDLE mode involves stopping the EDI flushes (tray, head, etc.) then the return to standby mode of operation (IDLE) must be automatic upon return of EDI network to specification.

3.8.2 If WET BENCH type equipment

If one or more baths of the equipment are supplied from the network (with a chemical distribution system) via a calibrated orifice, the equipment manufacturer must specify this at least, or even better propose alternative solution.

4 GENERAL BUILDING, FLUIDS, ELECTRICITY, ENVIRONMENT SPECIFICATIONS

4.1 Environment of the equipment

4.1.1 Building specifications

Features of the location of the equipment:

- Environment: cleanroom
- Cleanliness class according to **ISO 14-644-1**:
  - **52B:** **ISO 4-6** depending on the installation site in the building

- Environmental Conditions and tolerances (temperature and humidity)
  - **52B:** **21 +/- 2 ° C // 47 +/- 5% RH** except for the 2 following areas:
    TTH Zone: 20.5 +/- 2.5 ° C // 52 +/- 5% RH
    LITHO Area: 21 +/- 1 ° C // 47 +/- 5% RH

- Mounting: Password walls or openspace
- Location of devices: basement, gray fingers

The Contractor must ensure that the Equipment installed in a clean room will not have to disturb modify the characteristics of the zone.

In case a furnace needs to be installed in our facilities:

- The Contractor must provide the equivalent thermal power.

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- **Caution: no installation "furnace" under the mesh with petroleum jelly.**

4.1.2 Building fluids

In the case of fluids (liquids or gases), the Contractor must ensure the compatibility of its equipment with CEA supply sources.
Examples: chemical drums, gas cylinder sizes, etc.

See **Appendix B**: General fluids building 52B

4.1.3 Building power network specifications

CAUTION:
The equipment covered by these specifications must be connected to an electrical distribution mains with earthed neutral system (TN –S diagram).

If necessary, refer to CEI 60364 standard

Electrical features
Power supply voltages available on main:

- Single-phase: 1 phase + neutral + earth
  Phase/Neutral voltage: 230 V +/- 10 %

- Three-phase: 3 phases + neutral + earth
  Phase/Phase voltage = 400 V +/- 10 %;
  Phase/Neutral voltage = 230 V +/- 10 %

Main frequency: 50 Hz

4.1.4 Adaptation of the machine to the power network

CAUTION:
When the neutral lead is distributed in the machine, a cut-off device must be placed on the neutral lead, at the equipment item's general switch.

Neutral lead colour in machine:
Inside the equipment, the neutral lead shall be of light blue colour (EN 60204 standard) or clearly identified otherwise (colour ring, marker).

Protection lead colour in machine:
Inside the equipment, the protection lead (earth) shall be of green and yellow colour.

Power supply transformer (general machine)
Should a transformer be necessary :

- Contractor shall estimate this supply as an option, indicating all electrical features (power, primary and secondary voltages, etc.).
- A dry transformer (without liquid dielectric medium) is preferable;
  For transformers or other devices, containing a liquid dielectric medium:
  - Pyralene is prohibited;

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- Installation conditions in machine shall meet Decree of January 17, 1989 establishing prevention steps against fire hazard introduced by dispersion and ignition of flammable liquid dielectric media. In this case, mandatorily consult us.

- Characteristics of the transformer:
  - It shall be compliant with the “low voltage” directive **2014/35/EC** and affixed with the CE marking for this purpose,
  - case of a three-phase transformer:

    Secondary windings must be bridge connection so that there is a neutral point

    This provision applies even if the neutral is not used by the machine in order to enable protection against indirect contacts (ground connection if necessary)

- For "dry" transformers, the applicable construction standards are:
  - **NF EN 61558** standard, for powers of less than 25 KVA single-phase, or 40 KVA three-phase
  - **NF EN 60076** standard, for powers in excess of 25 KVA single-phase and 40 KVA three-phase

4.1.5 Uninterruptible power supply (UPS)

Should all the equipment be powered by an emergency power supply (UPS), this power supply shall be provided by CEA.
Contractor shall provide all the necessary information for defining the product (voltage, power, autonomy).
Contractor shall provide lock terminals on the equipment to connect the emergency power supply.

If only a section of the equipment is powered by an internal UPS incorporated by the manufacturer (IT section for example), the following rules shall be complied with:

- An omnipolar separation mechanism shall be installed downstream of the UPS in order to allow maintenance operations.
- The presence of voltage after shutoff of the machine master switch shall be signalled on same.
- The circuits still powered after cut-off must be identified in orange inside the equipment as per standard **NF EN 60204**.

4.2 Management of the environment

In reference to its “Sustainable Development” initiative, CEA-LETI is working on improving its environmental performance and would like understand what its service providers and Contractors ’contributions are to this regard.

Contractor shall therefore list in its offer all the initiatives that it has undertaken and / or is planning to undertake to make its business more sustainable from an environmental and social perspective. It will provide details about:

- its efforts regarding reduction in :
  - consumption of electrical and heat energy, and fluids ;
  - exhaust flows through careful design of covers and exhaust points ;
  - cooling water flow rates using an optimized calculation for heat exchangers.
- proposed fluid recycling.

The equipment must be designed so as to limit polluting emissions in the environment in particular by implementing clean technologies, segregation and treatment of effluents and waste depending on their characteristics, and reduction of the discharged quantities.

The Contractor will provide emissions evaluation:
- vapour/gaz emissions rate and liquid chemical wastes
- Actives wastes mass and volume of if possible, pollutants rate in rinsing wastes.

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4.2.1 Process Cooling Water

Contractor will provide design calculations for heat exchangers to be connected to the buildings process cooling water supply system (allow for delta T of at least 5°C). If necessary, it will also justify pressure relief valves on the valve console. In the event flexible pipes are used in the equipment or for links with auxiliary modules, connections using a single Swagelock rubber series PB from-end or the equivalent with a central tube in Buna N, braided-fiber reinforcement and covered with abrasion-resistant, nonflammable Buta N. End-pieces will be the push-on type and/or double-ring in 316 stainless steel adapted for the required pressure (Serflex or similar collars are prohibited). Color of flexible piping: blue for “inlet” into the equipment and red for “outlet”.

4.2.2 Exhaust and other internal equipment air systems

The Contractor will provide design reports or tests used to define air flow rate required to comply with current regulations. It will select the sections of adapted systems in order to limit resistance (air speed < 8m/s for exhaust and < 6m/s for supply). It will study optimal routing inside the equipment, particularly by limiting the number of specific head losses. If flexible piping is used, they shall be classified M1 for fire and be of the smooth interior type adapted to the fluid being carried.
Drawings will be provided before construction to indicate routing of air systems (exhaust and supply), design inside the equipment and it auxiliary modules.
In the case of extracting calories from power box cabinets or electrical bays located in the clean room, an extraction fan must be integrated into the cabinet or electrical bay: the “hot air flow” will be extracted from the cabinets or electrical bay and it will be redirected directly into the false floor of the clean room.

4.2.3 Segregation of liquid effluents

- Depending on their composition, liquid effluents shall be directed to dedicated drains.
- Fluorinated effluents whose concentration is more than or equal to 1% fluoride, as well as phosphorus effluents must be directed to the drain for fluorinated / Phosphorus effluents. Temperature shall not exceed 50°C
- Solvent effluents must be directed towards the solvents drain.

➢ If the process involves using heavy metals (copper, nickel, gold, cadmium, etc.), a specific collection drain as well as interfacing with the dedicated recovery system for these effluents shall be provided for by Contractor. The HSE cell shall validate the collection and treatment mode for these effluents.
To note: The means for transporting dangerous or unsanitary fluids and for the collection of effluents which are polluted or are likely to be so are sealed and resist the physical and chemical action of products which they are likely to contain.

➢ For process equipment generating liquid effluents containing H2SO4 or H2SO5 (Caro), the discharge of these effluents must be staggered over time to facilitate subsequent treatment. The discharge volume must be less than or equal to 20 liters. A dry contact indicating the opening of the H2SO4 or H2SO5 (Caro) drain valve will be provided as an option.

4.2.4 Case of DI return or recycling of ultrapure water

Contractor will provide DI flow evaluation (for mainframe and all sub-systems):
- process flow
- idle flow

Reclaim drains collecting non-polluted ultrapure waters used for maintaining the quality of equipment is available in building 4102 and BHT, in an initiative for rationalising and saving processed water.
Where possible, Contractor shall provide for a “DI return” outlet collecting all the water used to preserve the quality of the equipment, guaranteed without contact with the process chemicals (recirculation loop, recirculated bath, etc.). This ‘DI Return” outlet shall be equipped with an adjustable flow meter. The Contractor will provide data showing the minimum necessary water flow to keep the process / equipment quality.
In the case of wet bench or similar equipment using ultra-pure water, the quality of water is maintained through a programmable flush rather than permanent leak flow.
Moreover, in the case of rinsing containers or equivalent process, it will propose the possibility of recovering rinsing water excluding raw sewage for a collection in a “reclaim” drain and reuse of this water in the facilities water.

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4.2.5 Gaseous effluents

Depending on the process and the operation mode of the equipment, the installation of a gaseous effluents treatment system will be decided by CEA-LETI.

Contractor shall provide the information required for the needed analysis: gas quantities of the standard process recipe, sub-products of the reaction, etc.

The Contractor must be pro-active regarding the nature and conditions for setting up a reduction system which is compatible with its equipment.

CEA-LETI reserves the right to refuse the proposal of the abatement system recommended by Contractor.

4.2.6 Odours

The required steps must be taken in order to limit odours from effluent processing. The Contractor will carry out the studies and the design of its equipment for an effective capture at source of aerosols, chemical vapors and other gas effluents to ensure the personnel 'safety against the risk of inhalation and the protection of the process in the environment of the equipment. Before delivering the equipment, it will perform factory testing to demonstrate that the level of risk is acceptable and provide associated reports. In the event of failing extraction, he will do the necessary modifications until obtaining the requested results.

All the equipment will be equipped with covers adapted to the activity. These protections will have to allow reduction of the air flows to put in place for rationalizing energy and better efficiency without bringing ergonomic constraints which can endanger the operator.

The Contractor will integrate in the design of its equipment protections and other points of catchment considered necessary at the time as of maintenance operations.

5 SAFETY

5.1 EC conformity

A new European regulation (EU 2023/1230) will come into force on 20 January 2027, replacing the European Machinery Directive 2006/42/EC => Update in progress

The supplied equipment or service shall meet the regulations in force in France.
Said regulations include the European directives transposed into French Law.

European Directives:

Compliance with the European directives applicable to the equipment is mandatory.

In particular (if applicable) :

- "Machinery" directive **2006/42/EC**
  See **Appendix D**: Specifications for delivering work equipment (Compliance with European machinery directive **2006/42/EC**).
- "Electromagnetic compatibility EMC" directive **2014/30/EU**
- "Low voltage" directive **2014/35/EU**
- "ATEX" directive **2014/34/EU**
- "Pressure" directive **2014/68/EU**

The equipment shall be EC certified, a "CE marking" shall be affixed thereon and it shall be accompanied by an EC/EU declaration of conformity.

Construction standards

Compliance with harmonized European Standards (NF EN or NF EN ISO) will be favored, the application of these standards giving a presumption of conformity on the subjects concerned.

- **Risk analysis**

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The various risks (mechanical, electrical, thermal, gas, chemical, radiation) shall be clearly mentioned by Contractor in its proposal.
The risk analysis will be made according to the applicable reference standard: **NF EN ISO 12100** : "Safety of machinery - General principles of design - Risk assessment and risk reduction"

These risks shall be handled :

- in accordance with the instructions of the applicable directives:
- in accordance with the recommendations of Paragraphs 5.2 to 5.12

- **Design of safety related parts :**
  The safety functions will be designed in accordance with standard NF EN ISO 13849-1 **"Safety of machinery - Safety-related parts of control systems - Part 1: general principles of design"** for each type of hazard (mechanical / gas / thermal…)

- **Electrical equipment of machines**
  The electrical equipment of machines will be designed in accordance with standard **NF EN 60204**

Reminder of technical points in relation with the regulations:

Warning :
This paragraph is aimed at attracting the manufacturers' attention to a few specific technical points which may lead to non compliance if they're not completed.

- **Energy separation device**
  The equipment will be fitted with an isolation device on each energy source (electricity, pneumatic, nitrogen, etc.) that can be locked in the off position.

- **Electrical cabinets**
  Electrical cabinets will have an IP2X protection index and it will only be possible to open them with a tool or a key ; the inside of the cabinet will also have an IP2X protection rating so as to avoid any risk of direct contact during maintenance operations (components / wiring)

- **Guards design**
  - Protection panels:
    Protection panels (guards) will be strictly designed in compliance with Machinery Directive **2006/42/EC** (See appendix F: 1.3.8 to 1.4.3)
    Moreover, the following conditions shall be complied with for selecting guards:

    Fixed guards:
    The installation of fixed guards by manufacturer will be accepted if:
    - Frequent disassembly for maintenance is not necessary
    - Removal of guard is exclusively reserved to maintenance personnel by following a written instruction drawn up by manufacturer (lock out tag out of affected moving elements for example).

    Moving guards:

    Moving guards will be considered as all types of guards installed on hinges (doors) or not complying with the criteria of fixed guards.

  - The opening of the movable protectors will have to stop the risks present behind these protectors, by means of a safety system designed in accordance with the applicable European standards.

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- The opening detectors installed on movable guards will be safety components in accordance with **NF EN ISO14119**

- **Maintenance modes**
  If the machinery is equipped with “maintenance” or “service” mode in which the safety systems are neutralised, these modes will be strictly designed in compliance with Directive 2006/42/EC “Selection of control or operating modes”
  (See: appendix F point 1.2.5)

  Consequently:
  - The maintenance of the equipment should not require the direct neutralization of the detection components (interlock doors). If this neutralization is necessary it should be done via a maintenance mode accessible via a code or a key and simultaneously cause the reduction of risks (reduction of speeds, permanent control of the movements ...)
  - The maintained action required to validate the movements will be of the pedal type or "dead man" safety handle.
    In particular, this system will be present on the control modules ("teach pendant ") for teaching robots.

- **Fume cupboards**
  In case of fume cupboards, the applicable standards are:
  NF EN 14175-1, NF EN 14175-2, NF EN 14175-3, NF EN 14175-4, NF EN 14175-6, NF EN 14175-7.
  Factory and onsite “type tests” shall be subject to a conformance certificate or Contractor declaration. The Contractor shall anticipate all exhaust surveillance devices, associated servomechanisms and operator information devices on equipment operating state.

5.2 Risks connected with facilities

Power supply sectioning:
A power supply-sectioning device must be designed on the equipment for each energy source of the machine

Electrical supply cut-off device:
The accessories enabling the electrical supply of all or part of the machine to be immobilised shall be supplied with the equipment (locking circuit breakers in off position).

Compressed air connection or "service" nitrogen:
When the equipment uses compressed air or nitrogen for valve, actuator and other system control, the machine must be equipped with a general shut-off valve.
This valve must include a locking system, by means of a padlock, in order to make the facilities safe for maintenance.
One or more drain/purge systems must be available to dissipate the residual pneumatic energy stored in the machine after general valve shutting-off. Energy dissipation must be harmless to any exposed personnel or operators.

Presence of an uninterruptible power supply (UPS):
The instructions of Paragraph 4.1.5 shall be complied with.
The cut-off component at UPS output may be locked in “off” position.

5.3 Risks connected with fire

Automatic fire extinction system for equipment using solvents:
Equipment implementing solvents in open tray (pans, most often) must have an automatic CO2 extinction system.
This system will be connected to the operation of detectors (smoke, flame, temperature, etc.) installed above open trays, but also at equipment retention trays.
DESAUTEL (or equivalent) type automatic extinction systems certified and validated by qualified authorities shall be installed with approval of the facilities department. Dry contacts shall be supplied in the building in order to report each of the following elements of information:

- System disturbance
- Fire detection (1 detector giving alarm)
- Confirmed fire detection (2 detectors giving alarm, extinction triggered)

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Intrinsic equipment fire detection system:
When fire detectors are supplied with the equipment, they must be accompanied by the risk analysis leading to their installation, in such a way that the LETI is able to make decisions on the grounds for doubling said detection using existing systems in the building which are compatible with the fire systems in place. Detectors integrated into equipment shall not be connected with the fire system of the building and shall only have an action on the equipment in question and its related peripheral devices, if required.

The Contractor will specify and provide the necessary documentation relating to:

- Periodic calibration of sensors: frequency, operating mode, calibration gas used, parts to change in preventive and corrective maintenance, and any information necessary to maintain the detectors in good working order.
- Connections required on the equipment, in case of:
  - Detection alarms for different thresholds
  - Malfunctions

A list of these interlocks with the corresponding wiring diagrams will be provided.

5.4 Risks connected with chemical products

- When chemical products (solid, gaseous or liquid) are supplied by the Contractor within the framework of installing equipment, testing or any other operation, it must comply with **EC regulation 1907/2006**. It must also supply the full list of products as well as safety information sheets in French for each product. These documents must comply with European directive CLP.

The CEA-LETI shall be particularly vigilant with regard to compliance with content, pictograms and classification used, as well as the provision of a version drafted in French.

- Product classified as noxious, toxic, extremely toxic, corrosive, etc. (e.g., fluorhydric acid with a concentration greater than 7%, gas, etc.) supplied by an outside source to the equipment shall be distributed with double-walled pipe up to the equipment intake. Pipes connecting dangerous chemical fluids between the equipment and auxiliary modules will also be double-walled.

- If there is a risk in a chemical containment of the equipment during a maintenance operation, a safety device in the system shall be able to cut power supply of devices that may present a risk to personnel.

  All equipment containing liquid chemicals must be organised in such a way as to create a retention system aiming at preventing the accidental spread of said products outside the equipment without voluntary action. All elements of the installation in the equipment that could be a source of leaks (fittings, valves, filters, etc ...) will be placed on the retention and under extraction.

- These retention systems shall be fitted with leak detectors reporting the information to the equipment control console. Alarm enabling of a detector shall interrupt automatic supply to the machine and the chemical fluid circulation.

  The detectors shall be tested before activating the equipment.

- The exhaust level shall be permanently controlled by one or several extraction controllers. In case of exaust failure, a visual and sound alarm must be present on the working station and sub equipements (this is drived by the extraction controller).
  The sensors controllers will give an indication of current negative pressure/flow level and shall also ensure equipment safety servo mechanisms in the event of an alarm. It must be possible to recalibrate the sensors on site to correct drifts over time. A calibration certificate shall be provided upon installation.

  For each type of control sensor used on the exhaust a spare sensor will be delivered with the equipment to be kept as a spare part.

- NB: for automated equipment, this “extraction” alarm may be linked with the other types of alarms on the equipment control consoles.

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All equipment modules and devices (reactor, chemical vat, stove, coater, gas or chemical storage cabinet including the lower cabinets of the benches, canisters, etc.) and, more generally, any compartment where a leak may occur including those housing connections, valves, pumps, etc., that present a risk to operators shall be included in the exhaust system.

- In order to ensure efficient exhaust, the mobile front should have no rim.
  Ideally, the bench should have 2 exhaust strips: a first one on the worktop level and a second one located on the top of the bench, in order to promote the exhaust of chemical vapours.
  If the bench includes bulky elements (ultrasonic tank, oven, etc.), these elements must be embedded in the worktop and not on the top of it in order to prevent any perturbation of exhaust and aerolics performance.

- Chemical product trays of pans must be equipped with an adjustable time delay automatic drainage system in such a way that solutions may be automatically directed towards drains in the event of a prolonged shut-down of extraction.

- For the requirements of certain processes, chemical products will need to be heated. At the end of operation, these baths may only be evacuated to designated drains if the temperature of the bath does not reach 60°C. For higher temperatures and for drainage in the “solvent” drain, a study must be conducted in order to determine the best solution: PVDF material, dilution module, thermal exchanger, etc.

  If the solution selected by the Contractor consists in installing a buffer tank to enable these effluents to cool, it must be located under retention and be equipped with an adjustable time delay drainage system as stated previously.

- For equipment with processed chambers, the Contractor must provide the list of expected by-products in the event the chamber is opened, in order to facilitate maintenance operations.

- For equipment with gas detectors, The Contractor will specify and provide the necessary documentation relating to:
  - ✓ Periodic calibration of sensors: frequency, operating mode, calibration gas used, parts to change in preventive and corrective maintenance, and any information necessary to maintain the detectors in good working order.
  - ✓ Connections required on the equipment, in case of:
    - Detection alarms for different thresholds
    - Malfunctions

  A list of these interlocks with the corresponding wiring diagrams will be provided.

- For solid compounds used as insulating materials in furnaces, the Contractor will provide all relevant information on the nature and dangerousness of these materials: Material Safety Data Sheet (MSDS) should be provided. If one of these materials contains Refractory Ceramic Fibres (RCF), the Contractor must provide costed alternatives: substituents and less dangerous materials than RCF.

5.5 Risks connected with handling

For the parts of equipment requiring handling: pumping units, chamber lids, covers, etc., notably during maintenance or installation operations, lifting means must be foreseen and described in the equipment safety notice.

Systems integrated into the equipment will be favoured over mobile systems.
In the case of a mobile system, it must be marked "**CE**", be the subject of an EC declaration of conformity and an instruction manual in French.

5.6 Risks connected with automatic loading of Foups onto LoadPorts

As part of the project to automate the loading of FOUPs onto load port using automatic loaders (MHF), the equipment will be fitted with immaterial safety bars in the load port area or any other material to address the risk of personnel being crushed by the equipment. The implementation of this safety measure complies with the European Machinery Directive 2006/42/EC.

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5.7 Risks connected with pressurised equipment

For equipment subject to “Pressure” directive **2014/68/EU,** Contractor shall:

- Provide a complete file of the equipment in order to enable the commissioning inspection operations
- Update the roll where all the interventions will be recorded (inspections, requalification, and maintenance).

Contractor shall submit the periodicity of visit and controlled equipment requalification.

5.8 Risks connected with work at height

Should equipment use, maintenance or installation operations require elevated access, the Contractor shall provide protected access with guard rails in compliance with European standards **EN 14122-3**, if not, anchoring points compliant with European standards **EN 795**. In the latter case, technical documentation must make a very clear reference to it, in such a way as to implement related regulatory checks.
Where required, related personal protective equipment may be requested. They must be validated by the HSE Cell.

5.9 Risks connected with laser radiation

The design, implementation and labelling of lasers must be compliant with the last version of the standard **NF EN 60825-1**. It means that the characteristics of all the laser sources will provided (see please check appendix I to fill radiation information).

Risk warning labels must be in French and English without abbreviations.

Lasers must have EC marking. By affixing this marking, the manufacturer indicates that a product complies with the requirements set out in EU product rules. It allows the product to be freely marketed anywhere in the EU, regardless of where it was manufactured. Machinery manufacturers must comply with technical design rules and, in particular comply with the principle of integrating safety from the design stage onwards carry out a risk assessment and reduction process compile a technical construction file affix the CE marking and draw up an EC declaration of conformity. The final machine, where applicable, must comply with the new EU Regulation 2023/1230 on the safety of machinery and equipment, which replaces the Machinery Directive 2006/42/EC (Machinery Directive) from 20 January 2027.

If a laser risk exists, laser beams must be automatically shut-off, when the enclosures, in which the laser beams are confined, are opened (for example: vacuum chamber opening, mobile protectors opening, etc.).

If alignment, information, or signaling lasers are incorporated into the equipment, they must be class 2 (or class 1) and, if possible, have the minimum power required to perform the function for which they were incorporated.

Installation operation: Supplier has to provide surrounding protections if needed, to install the laser equipment (clean room compatible) to be separated from the remaining part of the clean room, which is not concerned by the installation and the commissioning. Laser safety qualified worker of the equipment company will take charge of the installation and commissioning of the equipment.

Maintenance operation:

- Maintenance operations, adjustments and repairs of optical system will be performed only by trained person. CEA workers are not trained to this type of job.
- Maintenance operations, adjustments and repairs, which do not involve optical systems, can be performed by CEA maintenance team but all radiation sources need to be automatically turned off during the maintenance.
- If maintenance is required, this must be known at the time of purchase of the equipment. It is necessary to determine how and by whom it will be carried out, as well as the laser protective measures required for maintenance personnel and workers operating in the vicinity of the safety perimeter.
- If this maintenance is to be carried out internally, training must be scheduled on site by the equipment vendor or a subcontractor on the machine delivered to our site.

Numbers of windows has to be reduced at minimum and if not, all of them has to be certified NF EN 12254 (Screens for laser working places) or/and NF EN 60825-4 (Safety of laser products - Part 4 : laser

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guards) in agreement with the worse accident scenario, which will be described by the company which sold the equipment. If windows are certified according NF EN 12254, their AB scale number will be provided in agreement with the worse accident scenario. If special protection certified according to NF EN 60825-4, the protection level will be described according this standard. Cameras are acceptable solutions **and are preferable solutions than windows.**

A very simple diagram showing the path of the different laser beams inside the equipment, where the location of the smallest beam diameters are indicated, will be provided.

If several laser sources or incoherent sources coexist, it is essential to know which sources emit simultaneously (coherent or/and incoherent).

Please check appendix I to fill radiation information.

5.10 Risks related to sources of ionizing radiation (radioactive sources / electric generators of ionizing radiation, etc.)

If the equipment contains radioactive sources, or if it embeds an Electric Ionizing Radiation Generator, a description must absolutely be provided: type of source / characteristics / radiation / activity / kV / mA / ....

Please note: In this area, certain design obligations result solely from French regulations, including the decisions of the Nuclear Safety Authority (ASN)

The design of the device on the risk of ionizing radiation must meet an obligation of results, the specifications of which are given below.

Equipment design:

DECISION 2017-DC-591

The equipment must comply with DECISION 2017-DC-591 of the Nuclear Safety Authority "setting the minimum technical design rules to which the premises where electrical devices emitting X-rays are used must comply"

Full text available (in French) on request.

Warning: also applies to electrical devices emitting unwanted X-rays (for example: ion implanters, electron beam welding equipment, etc.)

In application of this decision:

- **Access restrictions**
  When access is possible (door / hatch) :
  - Door open = X-ray emission not possible
  - Opening of the door = shutdown of X-ray production

- **Emergency stops**
  An emergency stop button will be present near the control device and will cause:
  - A shutdown of X-ray production upon triggering
  - Holding of the stop order until it is rearmed

- **Risk light signalling:**
  - A light sign will be installed on each access
    - Power-on signalling
    - Radiation emission signalling
  - If several devices are installed: identification of the one in operation

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- In application of this criterion, a specific light tower will be installed outside the equipment at each access (doors);
  - orange color will indicate power on;
  - red color will indicate emission

- **Shutter**
  - The X-ray emission signalling will operate in connection with the position of the shutter and will flag the shutter open position.
  - In addition, a light signal will be present at the shutter level

Construction and test rules

FRENCH STANDARD NFC 74-100

Any equipment equipped with one or more X-ray generators must comply with the French standard **NFC 74-100** " RADIOLOGY EQUIPMENT X-Ray Apparatus Construction and tests REQUIREMENTS "

The application of this standard is mandatory in France.

Certification assessment will be planned by the manufacturer on his site before delivery

If necessary please contact us to obtain the address of an accredited organization able to do this assessment.

The certificate of conformity regarding NFC 74-100 will be provided at delivery.

Radiation flux :

The manufacturer will certify that the emission measured at any point 10 cm from the equipment is less than 1µ Sv / hour (1 micro Sievert per hour)

5.11 Risks connected with noise

In reference to machinery directive **2006/42**:
“Machinery must be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of means of reducing noise in particular at source.
The level of noise emission may be assessed with reference to comparative emission data for similar machinery.”

The noise level measurements will be performed and mentioned in the instruction manual in compliance 2006/42
The noise level generated by the equipment in its installation environment should be less than 70 dB (A).
If noise level is likely to exceed 70 dB (A), the Contractor will suggest quoted technical solutions of reduction: silent hardware, soundproof materials, soundproof covers on noise sources...

5.12 Risks connected with temperature

Hot surfaces: the temperatures of directly accessible hot surfaces must comply with standard requirements **NF EN ISO 13732-1**

Cold surfaces: The temperatures of cold surfaces directly accessible shall comply with the requirements of standard **NF EN ISO 13732-3** of 2008

WARNING: In the case of heating systems embedded in the machine

- The manufacturer must foresee the consequences of a malfunction of the control unit by installing a completely independent overheating safety device (sensor / regulator ...). This safety system will shut down the power and will require manual reset for restart (after fault clearing). The reliability of the cut-off system will be defined according to **EN 13849-1**
- The manufacturer must be able to define the consequences of a sudden and simultaneous complete interruption of the machine's "facilities": water / electricity / extraction hot air / nitrogen service ... when the system is at nominal temperature.

The equipment will have to support this scenario without generating a fire risk internal to the machine, nor any other risk (explosion ...)

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In this scenario, if the temperature of the external enclosure of the equipment exceeds that of the equipment in normal mode, the Contractor will give the estimated temperature values and will consider them in the installation instructions (safety distances from the walls and other equipment).

5.13 Signaling

Signalling: risks shall be indicated on the machine using danger pictograms such as described in European regulations, accompanied as the case may be by an additional text;

In this case, the text must be labelled in French.

5.14 Intervention conditions on the CEA-LETI site

In collaboration with the Contractor and its possible sub-contractors, the CEA-LETI shall draft an overall prevention plan for installation, start-up and possibly development (JDP) services on equipment.

As loaning material is prohibited at the CEA, the Contractor and any subcontractors must provide safety materials needed to prevent specific risks generated by its intervention: PPE, CPE, breathing apparatuses, etc. It shall be responsible for replacement and repairs and, if required (without compensation on the part of CEA), it shall promote awareness and train its staff for use of equipment as per regulations. This material shall comply with regulations in force and shall be accompanied by a certificate of conformity.

The Contractor and its possible sub-contractors must provide all collective safety equipment used to prevent accidents due to works (marking work areas, marking traffic areas, marking handling and flyby areas, marking and installation of barriers around pits, level differences, etc.). It shall carry out and ensure removal of them as soon as the service no longer requires the presence of marking.

6 SUSTAINABLE DEVELOPMENT

6.1 Corporate Social Responsibility (CSR)

With an amount representing nearly 2.7 billion euros, CEA purchases are an integral part of societal and environmental issues.
The CEA monitors the quality and diversity of relations with its suppliers. It conducts a responsible purchasing policy based on three priority commitments:

- Create and maintain confidence-inspiring relations with its suppliers,
- Take into account the responsible dimension of its purchases,
- Contribute to the development of Small and Medium Enterprises (SMEs) and innovation.

Since 2004, it has been a signatory of the “responsible supplier relationship” charter and adheres to the SME Pact, a national support scheme for innovative SMEs.

The CEA's commitment to developing responsible purchasing cannot be made without taking this dimension into account by its suppliers.
The CEA is therefore counting on your proposals within the framework of this consultation to optimize the environmental impact of your services and develop the integration of people who are excluded from employment and the protected sector.

6.2 Sustainable development and development of the local economic fabric

As part of the “Sustainable Development” approach, CEA Grenoble is striving to improve its environmental performance and requires the cooperation of its suppliers in this respect.



In its proposal, the service provider shall present its corporate strategy as regards sustainable development and its specific improvement proposals concerning the work that covered by these Specifications.

Furthermore, as part of its “Plan Déplacement Entreprise” (“Corporate travel plan”), CEA Grenoble undertakes to reduce its environmental footprint.
The service provider shall cooperate with CEA Grenoble and undertakes to use zero emission vehicles as much as possible to meet the requirements mentioned in these Specifications.

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Furthermore, LETI MINATEC is a pedestrian area, with regulated vehicular access.
Vehicles identified by the company's name may access the pedestrian area subject to CEA Grenoble's approval. All other vehicles shall be parked in the dedicated car park.

The recovery or disposal of waste created during the performance of the services is the responsibility of the supplier during the duration of the contract.
The supplier shall ensure that any operations, collection, transport, storage, sorting and disposal of waste created by the services subject to the contract are carried out to the sites likely to receive them, in accordance with the regulations in force.

6.3 Energy performance

As part of its ISO50001 "energy management" initiative, CEA Grenoble is working to improve its energy performance, and would like to be supported in this by its suppliers.



In its offer, the service provider presents its proposals for improvement specific to the services detailed in the present specifications.

CEA Leti asks the service provider to propose all equipment and solutions enabling to optimize and reduce as much as possible the energy consumption of the entire project, and to propose in its offer the energy saving certificates related to the project. »

7 EQUIPMENT DELIVERY CONDITIONS

The equipment and all the peripherals will be delivered clean and packaged in a serious and appropriate way.
The transport platforms, pallets and packaging cases must be adapted to the weight and volumes of the elements in order to ensure safe a transport and avoid any dispute connected with improper packaging.

The following cleanliness requirements shall be fulfilled for the specific case of equipment intended to be installed in the clean rooms:

- very careful cleaning of all the subassemblies before shipment in order to remove any trace of shavings, hydrocarbons, grease or any other potential contaminant.
- packaging of the parts intended to be installed in the clean room under double film in order to perform progressive unwrapping while allowing a minimum amount of particles to contaminate the clean room. Peripherals intended to be installed in the basement may be packaged in single skin.
- likewise, all packages containing cable works, spare parts, various accessories required for assembling the equipment must be compatible with the clean rooms; wood, cardboard or traditional paper-type materials are prohibited; Contractor shall provide plastic-based non-contaminating wafer carriers (rigid or corrugated plastic cases for example).
- Filters of the environmental chambers and **FFUs shall not be delivered mounted on the equipment at delivery** to avoid any risk of particulate contamination and deterioration during handling and installation. Mounting remains the responsibility of the Contractor.

8 CONDITIONS FOR INSTALLING EQUIPMENT

Contractor shall enclose with its technical proposal the pre-installation document defined in **Appendix E**, then an installation file at the time of the installation.

It shall include all the installation conditions in particular the elements required in Paragraph 2: "instruction manual /installation" of Appendix E: Specifications pertaining to documents and manual to be provided with the equipment.

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9 TRAINING & LEARNING

The Contractor undertakes to provide at no additional cost training covering the use of the equipment (operation and process development), and safety. Trainings for maintenance (hardware and software) will have to be proposed and quoted as an option. These trainings will be provided by a trainer of the Contractor and will end with a training certificate given to the trained personnel and the maintenance manager.

- **Training for use of the equipment**

After commissioning of the equipment, user training shall be provided on site for 4 people. This training shall cover use of the equipment in production mode and in engineering mode.

- **Safety training**

Contractor shall provide a complete safety training of the staff which will be appointed to operate the equipment.

In particular, this training must include:

- ✓ Training on the use conditions and contraindications of use,
- ✓ Information on the prevention devices implemented and residual risks,
- ✓ Training on the specific precautions and procedures to be complied with during adjustment and maintenance interventions,
- ✓ Training on the periodic functional check operations of the safety systems.

- **Level 1 maintenance training to be quoted as an option**

First level maintenance training will be provided for 3 people at CEA-LETI or on the Contractor's premises for maintenance and/or process staff upon acceptance.
The Contractor will provide a list and description of first level maintenance operations to be carried out on the equipment.

- **Advanced maintenance training to be quoted as an option**

The Contractor shall provide "advanced maintenance" training during the warranty period which will be carried out at the Contractor's training center. (Training for 2 people).

10 DOCUMENTATION

See **Appendix E**: "Specifications relating to the documents and manuals to be supplied jointly with the equipment".

A new European regulation (EU 2023/1230) will come into force on 20 January 2027, replacing the European Machinery Directive 2006/42/EC.

Manufacturers must ensure that machines or related products are accompanied by the instruction manual and information specified in Annex III of the regulation. It is now expressly stated that instructions may be provided in digital format, which appears to be the default medium.

The Regulation specifies the obligations that the manufacturer must comply with when the instructions for use are provided in digital format:

- **access to the instructions:** the manufacturer shall indicate on the machine or related product or, where this is not possible, on its packaging or in an accompanying document, how to access the digital instructions for use;
- **possibility of printing and downloading the instructions**: the manufacturer must present the instructions in a format that allows the user to print and download them and save them on an electronic device so that they can be accessed at any time, in particular in the event of a breakdown of the machine or related product;
- **Duration of accessibility of the instructions:** the manufacturer must make the instructions accessible online throughout the expected lifetime of the machine or related product and for at least 10 years after it has been placed on the market.

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Finally, it is specified that, at the user's request at the time of purchase, the manufacturer must provide the paper instructions free of charge within one month.

Important: The CEA-LETI requires that the safety section of the instruction manual be in French.

11 WARRANTY

11.1 Warranty conditions

Warranty shall start at the date of equipment acceptance for a duration of one year. An additional year of warranty (1-year extension) shall be quoted as an option
Warranty shall include corrective and preventive maintenance operations, with at least one preventive maintenance per process chamber and per year.

All costs related to maintenance operations during warranty period shall be borne by the Contractor: labour, spare parts, consumables, travels, shipments etc…

11.2 Support during warranty

During the warranty period, the Contractor agrees to provide on-site support within a maximum timeframe of 8 business hours after receiving an e-mail or a call from CEA-LETI.
Support shall be available for on-site intervention from 8am-6pm on weekdays.

11.3 Equipment performance indicators

A) The definition of the down-time calculation used by the CEA-LETI is set out in Appendix C.
Up-time (%) = 100 – Down-time (%)

B) During the warranty period:
Uptime > 96%
MTBF[1] > 1200h
MTTR[2] < 4h.

C) Penalties during the warranty period
The up-time (see **Appendix C** "up-time definition") shall be assessed on a three-monthly basis.
Should one of the 2 parameters (Uptime or MTBF), recorded during the warranty period, not comply with specifications: the warranty period shall be automatically extended by a period of 3 MONTHS.
During this extension, the Contractor shall perform all the corrective actions necessary to meet the specifications.
If, at the end of this warranty extension period, the specifications are still not met: the warranty shall be further extended by periods of 3 MONTHS until the specifications are met.

12 MAINTENANCE

12.1 Spare parts

12.1.1 List of spare parts:

In its bid, the Contractor shall include:

[1] Mean Time Between Failure
[2] Mean Time To Repair

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- A comprehensive list of spare parts;
- A comprehensive list of consumables needed to operate the equipment, with the functions, reference and price for each component.

These lists may be used as a basis for drawing up an agreement for the supply of spare parts and consumables.
The Contractor shall specify the standard delivery timeframe as well as the timeframe for an emergency situation.

12.1.2 Process-kit :

The equipment must be delivered with an additional process-kit per chamber to allow continuity of service after maintenance.

12.1.3 Storage area

The Contractor must specify in appendix A the floor space necessary for the storage of specific maintenance materials supplied with the equipment, including spare parts, tools, handling means etc:

1- Floor space required during installation phase
2- Floor space required during normal use of the equipment

12.2 Maintenance contract

At the end of the warranty period, the CEA-LETI shall have the possibility of subscribing a maintenance contract.
The Contractor shall commit to be able to perform preventive and corrective maintenance for each piece of Equipment after the warranty period has expired and for a minimum period of 10 years.

In the commercial proposal, the Contractor shall calculate the price of maintenance services, taking the following requirement levels into account:

- Full service including preventative maintenance, unlimited corrective maintenance, and all required spare parts. The Contractor should also commit to a defined up-time of the tool during this period. Unless otherwise stated, the performance of the tool during the Full Service contract will be that defined in the current « EQUIPMENT SPECIFICATIONS FORM ».
- Preventive maintenance plus corrective maintenance on request (hourly rates) complying with intervention and repair deadlines.

Further to the adjustment of CEA's needs with respect to maintenance, the maintenance contract may be implemented after the warranty period has expired further to negotiations.

12.3 Cost of ownership (COO)

Contractor shall provide the cost of ownership of system, including:

- Facilities consumption (gases, water -flows and required cooling capacity-, electricity, thermal load)
- Idle condition (includes consumables costs)
- Wafer move based (additional cost when tool is in production mode)
- Scheduled maintenance program and associated parts costs.

13 CHECKS & TESTS

The tests and checks of conformity for equipment subject of these specifications are broken down into six groups:

- ✓ At the factory
- ✓ Delivery
- ✓ Installation and commissioning
- ✓ Qualification
- ✓ Acceptance
- ✓ End of warranty

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13.1 Checks and tests at the factory (Factory acceptance tests)

Factory acceptance test shall be performed at the Contractor's site based on agreed test/check list defined beforehand and submitted by CEA-LETI. The Contractor will carry out the control in factory using its own wafers and carriers according to the references provided by the CEA.

A "Factory acceptance" report shall be drafted by CEA-LETI and signed by both parties to accept the Equipment shipment. Contractor shall not be authorised to ship the equipment without signature of factory acceptance and solving restrictions before shipment.

13.2 Check upon delivery & at unpacking

Contractor shall submit the packing procedure for CEA-LETI acceptance. It shall at least specify breakdown of the packages, space requirement and associated instrumentation (example: accelerometer indicator).
The Contractor will ensure proper following of this procedure. If the delivery occurs in the presence of the Contractor (or his representative), the Contractor will check the integrity of the various packages, analyse the associated instrumentation and draft a "delivery" report (using their own documentation). Otherwise, the delivery countersigned by CEA-LETI shall be considered as the delivery report.

The packages destination must be indicated on boxes: basement or clean room.

The Contractor shall ensure that the equipment is correctly unpacked.

14 – Installation

The following chapters describes the main steps for installation preparation

14.1 Preparation

Contractor should be available at all time to assist CEA LETI in the preparation of the system installation

Part 1: No later than 1 week after PO notification
Contractor must provide:

- **Appendix H v0:** This deliverable must contain at least the following information
  - List of equipment and sub-equipment supplied by contractor or to be supplied by CEA letisub contractor
  - List of sub-equipment to be supplied by CEA
    - Type of equipment
    - Requirements to be reached to comply with the main equipment (capacity of the equipment, delivered flow, temperatures to be reached, communication protocols, etc.)
- System footprint - Dimension of all systems or sub systems
- Pre installation Manual

Part 2: No later than 2 months after PO notification:

Contractor must validate:

- Appendix I with the CEA LETI safety officer which must be compliant with CEA risk management policy (Appendix I, Fire suppression analysis, laser radiation safety, extra safety detections common validation)

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- All the information of the Appendix H must be completed and approved by contractor to allow PIDs creation and Hook-up preparation

Contractor must consolidate the need of sub assembly which might be supplied by CEA LETI

Part3: 6 months before system shipment
Contractor must assist CEA LETI:

- with chassis conception, appendix K must be approved by contractor
  - Formal dimension with feet location, mass per foot, and cut off validation
  - Gravity centers locations
  - Vibration specifications
  - Seismic brackets requirements
- with PIDs (fluids & electric) conception

  PIDs must be reviewed and discussed for validation by CEA 4 months before delivery
- commissioning planning

Part4: 1month before system shipement
Contractor must provide to CEA LETI the ffinal packing list to be provided 1month before the shipment

14.2 Installation

Basic Rules:
During the installation and as soon as possible, the Contractor will remove all waste and parts from the installation which are no longer required

All along the installation, Contractor must follow CEA LETI teams safety policy and must not open or start any fluid or source of energy without specific approval.

The following chapter describe the main steps for the installation & commissioning

14.2.0 System delivery & move in to final location:

After system delivery, system will be uncrated and moved in to its final location in the cleanroom by CEA-LETI or its subcontractor. Contractor must be present during this phase at the same time in cleanroom and in unloading dock

14.2.1 Tiers 0 - System mechanical assembly, system start Up

Basic Rules:
The Contractor shall use its own tools to perform equipment assembly, including handling and lifting tools that may be necessary.

During this phase, the Contractor will perform the equipment assembly, levelling.

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Interconnections will be managed according to contract specification specified in the Appendix H

No energy will be present during this phase.

At the end of the Tier0:

- The machine and sub system will be energized.
- The Contractor must be present to acknowledge the power supply is meeting its specification

14.2.2 Tiers 1 - Final Hook Up and system start Up after power up

Basic Rules:

The Contractor must:

- Attend all the operations to install and connect the equipment to the facilities (fluids, extractions, etc.) and shall make sure that the latter are compliant with the Contractor's specifications. The contractor has the responsibility of the final connection from facilities to its equipment's
- Contractor must follow CEA safety policy and must not open or start any fluid or source of energy without specific approval.
- Make sure that the connections are compliant with the Contractor's specifications.
- For all the fluid connections (including effluents) or gas inter equipment or modules provided by the Contractor, the latter will carry out the marking and direction of these networks in accordance with European standard NF X 08-100 including pictograms SGH informing of the danger by printed solvant resistant laminated polyester adhesive stickers.
  The valves will be equipped with color labels engraved out of PVC 8/10e fixed by adapted collars indicating their function.
- At the end of the installation, the Contractor will remove all waste and parts from the installation which are no longer required.

At the beginning of this phase, the system will be able to be powered Up.
The connection to Gas, Fluid, air extraction and Drain will be performed during this phase

The final gas connection to the system will be supervised by the contractor

The contractor will then:

- Perform the required hardware adjustment and calibration (robotics etc.) according to its system specification.
- Carry out checks on facilities which includes checking the various safety controls.
- Provide an "hardware report" commissioning which summarizes the progress of the above step and the result of the various controls. This report will confirm that the connection by the Contractor and standard safety tests are completed. The main safety elements concerned are: emergency stops, the extraction detection, leakage or gas detection, door contacts ... (Operation and connections)

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Note:
The fluid connections to the equipment (process or chemical gases) will be made by CEA-LETI after receiving the "hardware report" described above from the Contractor and after the safety compliance inspection (described bellow) has been successfully completed.

At the end of the Tiers 1:

CEA-LETI will perform a safety compliance inspection (EC requirements).

The Contractor must be present during this inspection and will make all necessary documents available for the assessment of the equipment.

Depending on the anomalies, CEA-LETI may decide to suspend the commissioning operations pending remediation of the problems. Non-conformities noted correspond to non-compliance with the regulatory points.
Any non-compliance must be resolved before the acceptance report can be signed.

All Anomalies and malfunctions will be promptly corrected by the Contractor no additional costs.

14.2.3 Tiers 2 - Contractor Equipment qualification & Contamination/ Handling test

This qualification procedure shall be performed in the presence of CEA-LETI authorised representatives.

The summary of these tests shall be countersigned by CEA-LETI (qualification summary report).

During this step,

- The contractor will make the handling test according to specification
- CEA LETI will test exhaust efficiency and air flow (FFUs)
- CEA LETI will perform a system contamination test and the mini environment
- The contractor will make its own system qualification according to system specification. A summary report might be provided and countersigned by CEA Leti at the end of the contractor test

In the case it is not under specification, the contractor will take the proper actions to get the systems under CEA LETI specification.

At the end of the Tiers 2:
The equipment is meeting the contractor specification test and the equipment is available for the CEA LETI process qualification.
The Contractor will remove all waste and parts from the installation which are no longer required.

14.2.4 Tiers 3 - CEA Process Qualification

During this phase, CEA-LETI ensures that the expected specifications for each process are met.
If these specifications are not met, even after the equipment supplier's intervention, it may result in the CEA-LETI refusing to accept the equipment or recording reservations in the CEA Equipment Acceptance Report.

Note: the contractor must be present during the test of the equipment

14.3 Acceptance

This acceptance recognises conformity of the equipment and transfer of ownership. The equipment warranty period shall start once the acceptance has been confirmed.

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Acceptance shall be pronounced after:

- ✓ **Full delivery of the equipment**
- ✓ **The end of the installation and commissioning operations**
- ✓ **The qualification checks and tests successfully passed**
- ✓ **Authorisation from the installation manager at the home site**
- ✓ **Delivery of the documentation (see make up in APPENDIX E: Specifications pertaining to documents and manuals to be supplied with the equipment)**

A reception document without qualifications (*) will be signed between CEA-LETI and Contractor.
(*) A concession may possibly be granted for a reserve forming the subject of a detailed action plan for restoring compliance to the specifications subject of this document. If so, acceptance will be pronounced “with reservations”

Note: Only the report in CEA-LETI format, shall prevail to assert the associated payments with this stage and launch the warranty period.

14.4 End of warranty

The completion of the guarantee is pronounced at the end of the guarantee period under the following conditions:

- ✓ **Total removal of all qualifications noted during the acceptance**
- ✓ **No abnormalities detected**
- ✓ **Compliance of the equipment with the specifications during this period.**

In case of any abnormality, the Contractor will perform any work required to ensure the compliance of the equipment. If the functioning of the equipment is not satisfactory, the warranty period is automatically extended by a period described in the contract.

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15 APPENDICES

APPENDIX A: Summary of Contractor's comments

Use the following template and ask the Contractor to fill it:

APPENDIX A

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APPENDIX B: or general fluids to building 52B

Appendix B: GENERAL FLUIDS IN BUILDING 52B Clean Room

General fluid distribution	Building 52B characteristics	Specific observations
Cooling Water (recommanded dimensionning velocity in the tube including in the exchanges : 1, 5m/s)	Material: PVC – Stainless steel 316 Outgoing pressure: 6 bars Return pressure: ~ 0 bar Outgoing temperature : 19°C Conductivity: 200 microS/cm pH: 7	Closed loop recycled water circuits→wastes water consumption prohibited Processing products : pH control corrosion inhibition, bioacide
De Ionized Water (recommanded dimensionning velocity 1,5m/s)	Material: PVDF-HP Pressure: 5 +/-0.5 bar Temperature: 20°C +/-1°C Resistivity: 15 Mohm.cm pH: 7 Particles < 50 /l @ 0.2 microns	EDI recycling of machines out let dealt with on a case by case basics depending on the risk analysis (chemical or particles pollution)
City Water	Material: PVC Pressure: 6 bar Temperature : 12°C to 16°C Conductivity: 450 microS/cm pH: 7.7 Calcium: 70 mg/l	
Process Vacuum	Material: PVC-U Relative pressure: ~ -880 mbar	
Nitrogen gas "service" (recommanded dimensionning velocity 20 m/s)	Material: stainless steel 316L Ra 0.8 Relative pressure: 7 +/-0.5 bar O2 < 1000 ppb H2O < 1000 ppb	Service nitrogen replace compressed air for all pneumatic uses : it is also used for vacuum pump ballasting.
Nitrogen gas "process" (recommanded dimensionning velocity 20 m/s)	Material: stainless steel 316L Ra 0,4 Relative pressure: 7 ± 0.5 bars O_2 < 10 ppb CO + CO_2 + C_nH_m < 100 ppb H_2O < 10 ppb H_2 < 10 ppb	The nitrogen "process" is used for all which concerns the processes: purges, sweepings(scannings) of sieve(airlock,sieves,airlocks), …
Compressed Dry Air	Material: stainless steel 304L Relative pressure: 7 +/-0.3 bar H2O < 2 ppm Temperature: 20°C +/-5°C Particles 0.2 microns< 2 /cubic ft	
General fluid distribution	**Building 52B characteristics**	**Specific observations**
Network argon (recommanded dimensioning velocity 20 m/s)	Material: stainless steel 316L Ra 0,4 Relative pressure : 6 bars 0_2 < 100 ppb N_2< 100 ppb H_20 < 100 ppb H_2< 100 ppb $C0_2$ < 50 ppb C_n H_m < 100 ppb	
Oxygen network	Material: : stainless steel 316L Ra 0,4 Relative pressure : 8 bars	

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	H_2 0< 50 ppb	
	N_2< 100 ppb	
	$C0_2$ < 100 ppb	
	CH_4< 100 ppb	
Helium network	Material: stainless steel 316L Ra 0,2	
	Relative pressure : 5,5 bars	
	0_2 < 10 ppb	
	N_2< 100 ppb	
	H_20 < 20 ppb	
	$C0_3$ $C0_2$ < 50 ppb	
	H_2 < 100 ppb	
	THC< 50 ppb	
Hydrogen network	Material : stainless steel 316L Ra 0,2	
	Relative pressure : 4,5 bars	
	0_2 < 100 ppb	
	N_2< 200 ppb	
	H_20 < 20 ppb	
	$C0_3$ $C0_2$ < 50 ppb	
	THC< 50 ppb	
Waste collection	**Building 52B characteristics**	**Specific observations**
Acid-base drain	Material : PP	Reprocessed locally in a neutralizing plant - imperative limitation of discharge temperature at tool outlet --> less than 60°C
Fluorinated drain	Material : PP	Collected in a tank for reprocessing off site - imperative limitation of discharge temperature at tool outlet --> less than 60°C - limitation of dilution to reduce the volumes to be reprocessed --> no water venturi system but rather gravity draining.
Solvent drain	Material : stainless steel	Collected in a tank for reprocessing off site - limitation of dilution to reduce the volumes to be reprocessed --> no water venturi system but rather gravity draining or air venturi system.
Waste water drain	Material : PVC	

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Ventilation / extractions	Building 52B characteristics	Specific observations
Therm recovery network	Material: Jacob-type flanged RS stainless steel jacket. Available negative pressure: from -200 to -300Pa equipment inlet depending on location	Aeraulic network dimensioning in equipment for air velocity ≤ 8m/s stainless steel flexible jacket accepted for limited use (<1ml). Aluminium prohibited
Acid-base recovery network	Material: M1PVC Available negative pressure: from -200 to -300Pa equipment inlet depending on location	Aeraulic network dimensioning in equipment for air velocity ≤ 8m/s M1 flexible jacket with smooth inside accepted for limited use (<1ml)
Solvent recovery network	Material: Jacob type flanged RS stainless steel jacket. Available negative pressure: from -200 to -300Pa equipment inlet depending on location	Aeraulic network dimensioning in equipment for air velocity ≤ 8m/s stainless steel flexible jacket accepted for limited use (<1ml). Aluminium prohibited
Vacuum pump recovery networks	Material: rolled and welded stainless steel jacket Negative pressure: from -800 to -1000Pa depending on location	Removable networks with Pneurop-type quick-disconnect clamp for cleaning
Laminar flow for blowing in equipment	Fan Filter Unit to be provided for by Contractor	Installation must comply with EN ISO 14644 standard with easily removable filters.
Treated air Building 52B	Temperature: 21°C ± 2 for the entire building except in the Litho area: 21°C ± 1 Humidity: 47% ± 5 for all building modules	Operating limits: Outside weather conditions: Winter -12°C, RH = 90% summer: +32°C, RH = 40%

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APPENDIX C: Definition of Availability

1. Planned time

The total planned time corresponds to the total hours of use for a reference period: 5 shifts - 7 days (168h/week).

2. Up-time definition

The basic formula for calculating the up-time is:

- Up-time (%) = 100 - Equipment down-time (%)

3. Down-time definition

The equipment down-time is the time during which the machine cannot be used for production according to the process specifications.
The equipment down-time is divided into:

- Scheduled down-time
- Unscheduled down-time

A) SCHEDULED DOWN-TIME

The scheduled down-time is the equipment shut-down time scheduled by the maintenance and production for preventive maintenance, for operations involving cleaning, modification, improvement, changing location, etc...

B) UNSCHEDULED DOWN-TIME

The unscheduled down-time is an unscheduled period during which the machine can not be used for production. Down-time must result from a failure proper to the equipment and not result from external elements (fluids, building, etc...).
This time does not take the user's imperfections into account :

- malfunctioning after incorrect use of the equipment (non-compliance with operating procedures),
- malfunctions resulting from the user's installations or structural or social problems.

4. Measuring up-time

Due to the up-time definition given above, measuring the up-time simply involves measuring the down-time.

5. Measuring down-time

A) START

Down-time starts from stoppage of production due to stopping of the machine, either deliberate or not, and from the agreement between the production and maintenance teams that production can no longer be performed with the specifications.
This moment is recorded on a document or in a file and is immediately notified to the Contractor (in case of failure) by telephone with confirmation by MAIL within 24h.

B) DURATION

Down-time covers:
- The initial period during which the operator performs troubleshooting to locate the cause of error, plus the waiting time of a maintenance person after a call to the Contractor's departments (in the case of a failure).
- The duration of the maintenance operation (repair / improvement / modification).
- The repair time resulting from waiting for spare parts.
- The time, after repair, to burn-in and check the equipment.
- The maintenance and process qualification time.

These different times must be noted and recorded accurately.

C) END

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The end of equipment down-time takes place after the process has been qualified again. At this moment the machine is again in compliance with the specifications and can be used for production in agreement with the maintenance and process teams.

The different down-time states and times are consultable and can be supplied to the equipment Contractor on request from him.

MTBF definition

The MTBF is the mean up-time value in hours between two failure (the interrupt can be scheduled or unscheduled down-time). This mean value is calculated over 13 weeks and is the number of hours of up-time divided by the number of interrupts.
MTBF= Up-time (in hours) / number of interrupts.

MTTR definition

Mean time to recover: mean time to put the machine back into a state of compliance, this state takes account of scheduled and unscheduled down-time and is averaged over 13 weeks.
MTTR= number of hours of down-time / number of interrupts

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APPENDIX D: Specification for delivery of equipment subject to the European "machinery" Directive 2006/42/CE

Purpose: The aim of this document is to recall the application conditions of this directive as well as certain important technical points

1/ Reminder of the applicable regulation

The "machinery" directive is a European text transposed into the French law.

2/ Definition of a machine

A machine is "an assembly fitted with or intended to be fitted with a drive system other than directly applied human or animal effort consisting of linked parts or components, at least one of which move and which are joined together for a specific application…"

Consequently:
Any equipment complying with the definition will be designed and built in application with the "machinery" directive 2006/42

A machine is considered as "placed on the market for the first time", "new" or "in the new condition" if it has not been used in a member state of the European Economic Community (EEC).

Consequently:
A second-hand machine from a non-EC country will be considered as new upon its entry into the EC.
The applicable regulation will be that in force at its date of entry.

3/ Reference standards

The presumption of conformity with regulatory requirements is provided by compliance with the provisions described in the harmonised standards mentioned above and circulated by AFNOR Tour de l'Europe 92049 Paris Cedex 7, France:

- specific standards to machinery
- general safety standards,
- standards pertaining to electrical equipment of machinery NF EN 60-204

Note: Compliance with standard 61010-1 does not give a presumption of compliance to the machinery directive

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4/ Documents to be provided with the equipment subject to directive 2006/42

- **EC declaration of conformity**

2006/42 annex II:

"EC DECLARATION OF CONFORMITY OF THE MACHINERY

The declaration and translation thereof must be drawn up under the same conditions as the instructions

[See Annexe I, Section 1.7.4.1, points a) and b)] and must be typewritten or else handwritten in capitals.

This declaration relates exclusively to the machinery in the state in which it was placed on the market and excludes components which are added and/or operations carried out subsequently by the final user.

The EC declaration of conformity must contain the following particulars:

1) business name and full address of the manufacturer and, where appropriate, its authorised representative;

2) the name and address of the person authorised to compile the technical file, who must be established in the community;

3) description and identification of the machinery, including generic denomination, function, model, type, serial number and commercial name;

4) a sentence expressly declaring that the machinery fulfilled all the relevant provisions of this directive and where appropriate a similar sentence declaring the conformity with other directives and/or relevant provisions with which the machinery complies. These references must be those of the text published in the official journal of the European Union;

5) where appropriate, the name, address and identification number of the notified body which carried out the EC type-examination referred to in Annexe IX and the number of the EC type-examination certificate;

6) where appropriate, the name, address and identification number of the notified body which approved the full quality assurance system referred to in Annexe X;

7) where appropriate, a reference to the harmonised standard used as referred to in Article 7, Paragraph 2;

8) where appropriate, the reference to other technical standards and specifications used;

9) the place and date of the declaration;

10) identification and signature of the person empowered to draw up the declaration on behalf of the manufacturer or his authorised representative."

- **An instruction manual**

An instruction manual shall be drawn up in compliance with Paragraph 1.7.4 of Directive 2006/42; see our Appendix **E**

5/ Marking on the equipment (2006/42 – 1.7.3)

"I. – Each machinery must be marked visibly, legibly and indelibly with the following minimum particulars:
a) The business and full address of the manufacturer;
b) Designation of the machinery;
c) The CE marking;
d) The designation of series or type;
e) The serial number if any;
f) The year of construction, that is, the year in which the manufacturing process is completed. It is prohibited to predate or postdate the machinery when affixing the CE marking.
Furthermore, machinery designed and constructed for use in a potentially explosive atmosphere must be marked accordingly.

II. – Machinery must bear full information relevant to its type and essential for safe use. Such information is subject to the requirement set out in Section 1.7.1.

III. – Where a machine part must be handled during use with lifting equipment, it must be indicated legibly, indelibly and unambiguously."

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APPENDIX E: Specification relating to documents and manuals to be provided with the equipment

A new European regulation (EU 2023/1230) will come into force on 20 January 2027, replacing the European Machinery Directive 2006/42/EC. => Update in progress

1. Purpose

This appendix is intended to define the documentation to be delivered by the Contractor with the equipment (content, language, delivery schedule).
The documentation to be delivered by the equipment must meet current regulations.
The CEA-LETI / LETI specifications include the statutory requirements.
These obligations depend on whether the equipment is subject to the machine directive 2006/42 / EC.

2. Supply of an equipment item subject to machinery directive 2006/42/EC (e.g. 98/37/EC)

2.1. Regulatory obligations

2.1.1. Instruction manuals

The regulations describe all the elements relating to the instructions that must be supplied with the equipment (content, language etc.).
This information is included in Annex I to Directive 2006/42 transposed into French law (Annex I of Book II of the Labour Code)

Content

The instruction manual will be drafted in compliance with Paragraph 1.7.4. of this appendix and where applicable Paragraphs 3.6.3 (moving machines) and 4.4 (lifting systems).

2006/42 - 1.7.4 .2: Content of the instruction manual:
“Each instruction manual must contain, where applicable at least the following information:

a) The business name and full addresses of the manufacturer;

b) The designation of the machinery as marked on the machinery itself except for the serial number in compliance with Paragraph 1.7.3;

c) The EC declaration of conformity or a document setting out the contents of the EC declaration of conformity, showing the particulars of the machinery, not necessarily including the serial number and the signature;

d) General description of the machinery;

e) The drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;

f) A description of the workstation(s) likely to be occupied by operator;

g) A description of the intended use of the machinery;

h) Warnings concerning ways in which machinery must not be used that experience has shown might occur;

i) Assembly, installation and connection instructions, including drawings, diagrams and the means of attachment and the designation of the chassis or installation on which the machinery is to be mounted;

j) The instructions relating to installation and assembly for reducing noise or vibration;

k) The instructions for putting into service and use of the machinery and, if necessary instructions for the training of operator;

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l) The information about the residual risks that remain despite the inherent safe design measures, safe-guarding and complementary protective measures adopted;

m) Instructions on the protective measures to be taken by the users, including, where appropriate, the personal protective equipment to be provided;

n) The essential characteristics of tools which may be fitted to the machinery;

o) The conditions in which the machinery meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdown;

p) Instructions with a view to ensuring that transport, handling and storage operations can be made safely, giving the mass of the machinery and of its various parts where these are regularly to be transported separately;

q) The operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;

r) The description of the adjustment and maintenance operations that should be carried out by the user and the preventive maintenance measures that should be observed;

s) Instructions designed to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations;

t) The specifications of the spare parts to be used, when these affect the health and safety of operators;

u) The following information on airborne noise emissions:

- the A – weighted emission sound pressure level at workstations, where this exceeds 70 dB (A); if this level is less than or equal to 70 dB (A), this fact must be indicated;
- the peak C - weighted instantaneous sound pressure value at workstations where this exceeds 63 Pa (130 dB in relation to 20 µPa);
- the A – weighted sound power level emitted by the machinery, where the A – weighted emission sound pressure level at workstations exceeds 80 dB (A).”

Language

“All machinery must be accompanied by instructions in French.

The instructions manual accompanying the machinery must be either an original instruction manual or a translation of the original manual in which case, the translation must be accompanied by the original instruction manual.” **(Transposition of 2006/42 1.7.4)**

“The instruction manual is drafted in French and may be in one or more official Community languages. The word original instruction manual must appear on the language version(s) verified by the manufacturer. Where no original instruction manual exists in French, a translation into this language must be provided by the manufacturer or by the person brining the machinery into France. This translation must bear the words translation of the original instruction manual.” **(Transposition of 2006/42 1.7.4.1)**

Consequently, the following will be provided:

- The instruction manual in its original version drafted in one of the EC languages, in any case
- The instruction manual translated in French (if the original version was drafted in another language than French) in the case where this obligation is incumbent upon the Contractor.

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2.1.2. Maintenance manual

"By way of exception, the maintenance instructions intended for use by specialised personnel mandated by the manufacturer may be supplied in only one community language which the specialised personnel understand." **(2006/42- 1.7.4)**

2.2. Specific specifications at CEA/LETI

Contractor shall mandatorily provide:

- The instruction manual as described in 2.1.1 and specified in 2.2.1.
- The maintenance manual as described in 2.2.2.
- A file of all elements that were tested and validated during startup and adjustments made in connection with facilities for each fluid. This file will also include factory tests and calculation sheet for parts of the facility used for their selection during design (heat exchangers, flow rates, sections of pipes that are inside equipment).

- These instructions should be delivered with the equipment except the installation section of the instructions which should be received by CEA-LETI / LETI, together with the Contractor's offer.

2.2.1. Instruction manual

The instruction manual shall correspond to the machine delivered and contain in particular the following chapters:

- Handling
- Assembly – Disassembly
- Installation
- Commissioning
- Adjustment
- Use
- Maintenance (1st level)

Handling

This chapter shall deal with the conditions for handling the equipment: lifting or bearing points, miscellaneous precautions to be taken during handling. It shall give indispensable information such as the weight in kilograms. It shall highlight the counter-indications such as for example shocks, tilting etc...
If the equipment is comprised of different parts, the same information shall be given for handling each part.

Assembly - Disassembly

This chapter shall specify if applicable the order of the operations, the precautions to be taken, and the tooling required.

Installation

This part shall contain all the specifications necessary for installation and connection of the machine on the CEA-LETI premises. A copy of this part shall be sent to the CEA/LETI/Department concerned, before the equipment is delivered. This chapter shall contain in particular the following information :

- For the equipment and its sub-assemblies: dimensions in mm, weight (in kg), dimensional drawing mentioning the connection points to the different networks.
- Environment required: dust content, hygrometry, vibrations, sensitivity to vibrations and electromagnetic radiation, extractions to be provided etc…
- Nature of the floor: resistance required with respect to the weight of the machine, flatness.
- Electricity: Voltage, Power, features of the power supply transformer if applicable.
- Pneumatics (compressed air): pressure, quality.
- Fluids: Type, pressure, flowrate, temperature, characteristics.
- Gas: Type, pressure, quality.
- Counter-indications for installation, nuisances introduced by the equipment.

All these parameters shall be accompanied by a tolerance.

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Commissioning
Even if commissioning is performed by the Contractor, this chapter shall set out the procedure to be followed for commissioning of the equipment (prior checks, start-up procedure etc.).

Adjustments
A procedure shall be provided to perform tuning/adjustments within the scope of normal everyday use of the machine.

Use
This chapter shall contain:

- The conditions of use scheduled by the manufacturer.
- The definition of the workstation(s) occupied by the operator(s).
- A presentation of the equipment enabling identification of the different parts (photos, diagrams) explaining the function of each part, particularly of the control and safety means.
- A description of the running sequence of the operations performed by the equipment. All the processes available on the equipment shall be described along with the nature and influence of each "process" parameter.
- An operating mode describing the details of the operations to be performed to process a sample, a batch (for example). It shall contain the learning instructions.

CAUTION
In the case of an automatic machine, the operation mode shall not be limited tonecessarily succinct description of loading/unloading of a sample or a batch (for example) but shall enable the parameters of the standard functions to be adjusted and the alarm messages to be understood.

In the case where man/machine dialogue takes place via keyboard + monitor or touch-sensitive screen, the following information provided by the manual shall enable :

- the general software architecture (maintenance part / engineering part / operator part for example) to be understood,
- navigation between the different parts,
- the parameters of a task performed by the machine and influencing the "process" (for example: speed, time, pressure, power etc.) to be adjusted, these operations falling within the scope of normal use of the machine in a research environment,
- the results or "process" running monitoring tables to be accessed,
- the alarm messages to be understood and interpreted.

To achieve this result, the manual shall reproduce the main tables displayed on the monitor. Each table shall be accompanied by comments on the actions to be performed, on the nature of the information given.

Maintenance
The object of this chapter is to enable troubleshooting to be performed and certain problems of low complexity to be resolved. It involves 1st level maintenance.

CAUTION
All the chapters of this manual shall be drafted integrating the safety warnings so that the operations described can be carried out without any risks.
This appendix is fully applicable even if supply of the equipment is accompanied by personnel training.
The potential users of this manual are technicians or engineers in charge of tuning the "processes". This shall be taken into account in the choice of the information supplied.

The equipment shall only be accepted after a detailed examination of the documents provided.

2.2.2. Maintenance manual

It shall contain :

- a presentation of the machine enabling the component parts to be located (photos),

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- the interconnection diagrams between the different sub-assemblies,
- the electrical power diagrams, control diagrams, and interconnection diagrams between the different parts, the printed circuit board diagrams,
- the diagrams of the pneumatic and hydraulic circuits,
- the mechanical construction drawings (exploded views),
- the spare parts list,
- the specific documentation of apparatuses integrated in the machine such as automatic controllers, regulators, RF and micro-wave generators.
- the programs and programming tools associated to automatic controllers,
- the list of periodic checks to be performed,
- the list of preventive maintenance operations to be performed with the list of consumables associated with the operation,
- a troubleshooting guide,
- the access modes to the software maintenance parts, if applicable, and the back-up procedures.

3. Supply of equipment not subject to the machinery directive: Specifications of CEA/LETI

The special specifications of CEA/LETI [(§ 2.2)] of this document apply.

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APPENDIX F: Selection of protection against risks connected with moving parts Characteristics required for guards and protective devices

A new European regulation (EU 2023/1230) will come into force on 20 January 2027, replacing the European Machinery Directive 2006/42/EC. => Update in progress

Abstract of machinery directive 2006/42

1.2.5. Selection of control or operating modes
The control or operating mode selected must override all other control or operating modes, with the exception of the emergency stop.
If machinery has been designed and constructed to allow its use in several control or operating modes requiring different protective measures and/or work procedures, it must be fitted with a mode selector which can be locked in each position. Each position of the selector must be clearly identifiable and must correspond to a single operating or control mode.
The selector may be replaced by another selection method which restricts the use of certain functions of the machinery to certain categories of operator.
If, for certain operations, the machinery must be able to operate with a guard displaced or removed and/or a protective device disabled, the control or operating mode selector must simultaneously:
— disable all other control or operating modes,
— permit operation of hazardous functions only by control devices requiring sustained action,
— permit the operation of hazardous functions only in reduced risk conditions while preventing hazards from linked sequences,
— prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.
If these four conditions cannot be fulfilled simultaneously, the control or operating mode selector must activate other protective measures designed and constructed to ensure a safe intervention zone.
In addition, the operator must be able to control operation of the parts he is working on from the adjustment point.

****

1.3.8. Choice of protection against risks arising from moving parts
Guards or protective devices designed to protect against risks arising from moving parts must be selected on the basis of the type of risk. The following guidelines must be used to help to make the choice.

1.3.8.1. Moving transmission parts
Guards designed to protect persons against the hazards generated by moving transmission parts must be:
- either fixed guards as referred to in section 1.4.2.1, or
- interlocking movable guards as referred to in section 1.4.2.2.
Interlocking movable guards should be used where frequent access is envisaged.

1.3.8.2. Moving parts involved in the process.
Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process must be:
- either fixed guards as refer to in Section 1.4.2.1, or
- interlocking movable guards as refer to in Section 1.4.2.2, or;
- protective devices as refer to in Section 1.4.3, or
- a combination of the above.

However, when certain moving parts directly involved in the process cannot be made completely inaccessible during operation owing to operations requiring operator intervention, such parts must be fitted with:
- fixed guards or interlocking movable guards preventing access to those sections of the parts that are not used in the work;
and
- adjustable guards as referred to in Section 1.4.2.3 restricting access to those sections of the moving parts where access is necessary.

1.3.9. Risks of uncontrolled movements.
When a part of the machinery has been stopped, any drift away from the stopping position, for whatever reason other than action on the control devices, must be prevented or must be such that it does not present a hazard.

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1.4. Required characteristics of guards and protective devices.

1.4.1. General requirements.

Guards and protective devices must:
- be of robust construction;
- be securely held in place;
- not give rise to any additional hazard;
- not be easy to bypass or render non-operational;
- be located at an adequate distance from the danger zone;
- cause minimum obstruction to the view of the production process;
- enable essential work to be carried out on the installation and/or replacement of tools and for maintenance purposes by restricting access exclusively to the area where the work has to be done, if possible without the guard having to be removed or the protective device having to be disabled.

In addition, guards must, where possible protect against the ejection or falling of materials or objects and against emission generated by the machinery.

1.4.2 Special requirement for guards

1.4.2.1. Fixed guards.

Fixed guards must be fixed by systems that can be opened or removed only with tools.
Their firing systems must remain attached to the guards or to the machinery when the guards are removed.
Where possible, guards must be incapable of remaining in place without their attachment.

1.4.2.2. Interlocking movable guards.

1 Interlocking movable guards must be designed and constructed:
- to remain attached where possible to the machinery when opened;
- they can be adjusted only by means of an intentional action.

2 Interlocking movable guards must associated with an interlocking device that:

- prevents the start of hazardous machinery functions until they are closed,
And
- gives a stop command whenever they are no longer closed.

3 Where it is possible for an operator to reach the danger zone before the risk due to the hazardous machinery function has ceased, movable guards must be associated with a guard locking device in addition to an interlocking device that:
- prevents the start of hazardous machinery functions until the guard is closed and locked,
And
- keeps the guard closed and locked until the risk of injury from the hazardous machinery functions has ceased.

4 Interlocking movable guards must be designed in such a way that the absence or failure of one of their components prevent starting or stops the hazardous machinery functions.

1.4.2.3. Adjustable guards restricting access.

Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work must be:
- adjustable manually or automatically, depending on the type of work involved;
- readily adjustable without the use of tools.

1.4.3. Special requirements for protective devices.

Protective devices must be designed and incorporated into the control system in such a way that:

- moving parts cannot start up while they are within the operator's reach;
- persons cannot reach moving parts while the parts are moving,
And
- the absence or failure of one of their components prevents starting or stops the moving parts.

Protective devices must be adjustable only by means of an intentional action.

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APPENDIX G: Transfer and handling of wafers

1 – Applicable SEMI standards

Equipment must be compliant with following SEMI Standards:

	SEMI Standard
G1.1	SEMI E15.1 — Specification for 300 mm Tool Load Port
G1.2	SEMI E47.1 — Provisional Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers
G1.3	SEMI E57 — Mechanical Specification for Kinematic Couplings Used to Align and Support 300 mm Wafer Carriers
G1.4	SEMI E62 — Provisional Specification for 300 mm Front-Opening Interface Mechanical Standard (FIMS)
G1.5	SEMI E63 — Mechanical Specification for 300 mm Box Opener/Loader to Tool Standard (BOLTS-M) Interface
G1.6	SEMI E64 — Specification for 300 mm Cart to SEMI E15.1 Docking Interface Port
G1.7	SEMI E72 — Specification and Guide for 300 mm Equipment Footprint, Height, and Weight
G1.8	SEMI E103 — Provisional Mechanical Specification for a 300 mm Single-Wafer Box System that Emulates a FOUP
G1.9	SEMI E110 - Guideline for Indicator Placement Zone and Switch Placement Volume of Load Port Operation Interface for 300 mm Load Ports
G1.10	SEMI E111 - Provisional Mechanical Specification for a 150 mm Reticle SMIF Pod (RSP150) Used to Transport and Store a 6 Inch Reticle. (if applicable)

Other applicable standards

- Classification of air cleanliness: standard ISO 14644-1
- Metrology and test methods: standard ISO 14644-3
- Protection of electronic devices against electrostatic discharges: IEC 61340-5-1
- Mini-environment : IEST- RP-CC028.1
- Control of mini-environments: QM 07.08.011
- Check of mini-environments: QII 07.08.004
- Particle inspection of the air: QM 07.08.001
- Metrological inspections: QM 07.08.004

2. Handling Device

Loadport:

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	Loadport	***Objective***
G2.1	Loadport Kinematic coupling pins ground resistivity value	< 100 kohm
G2.2	Maximum wafer insertion temperature in FOUP	< 100 °C
G2.3	Maximum FOUP environment continuous temperature	80°C
G2.4	Inserted wafers in FOUPs are dry	No droplet
G2.5	Maximum static charge during wafers FOUPs insertion	< 100V cm
G2.6	Maximum delay between docking request and end docking movement	< 10s
G2.8	A “load” push button (one position stable) is placed at the right front side of FOUP load as figure 1	Y

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APPENDIX H: Datasheet for tool installation

Use the following template and ask the Contractor to fill it:

APPENDIX H

DPFT

ANNEXE H : Datasheet for tool installation

1) The datasheet informations allows CEA-LETI to design the fluid PID and the electrical PID.
2) These PIDs will be sent for verification and approval to the Contractor.
3) Hook Up and Fit Up will start after the official validation of PIDs by the Contractor.
4) All connexions and interconnexions sections must be clearly identified as Contractor or CEA responsability ("provided by" and "installed by"). Including final connectors (fluids & electricals).
5) **In any cases Contractor is in charge of terminals equipement connections control.**

Equipement Model :	0

Fluid requirements						Connector info "from"			Connector info "to"		
Fluid (a)	Type Fluid (i)	Type (j)	From	To	Description (b)	ID (c)	Size (d)	Type of connection	ID (c)	Size (d)	Type of connection

The datasheet information allows CEA-LETI to design the fluid PID and the electrical PID (PID = Piping and Instrumentation Diagram).
These PIDs are then sent for verification and approval to the equipment Contractor.
Hook Up and Fit Up will start after the official validation of PIDs by the Contractor.

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APPENDIX I: Risk Identification Sheet

Use the following template and ask the Contractor to fill it:

APPENDIX I

cea leti — DPFT

APPENDIX I : Risk Identification Sheet

EQUIPEMENT REFERENCE & NAME :

REFERENCE OF SAFETY DOCUMENTS PROVIDED

EC Compliance certificate	☐	**Safety information and requirements in French**	☐

RISK IDENTIFICATION

Chemical risk : ☐

Product name ($CAS or $EINECS)	Physical state (solid, liquid, gas)	DANGEROUSNESS				Usage concentration	Usage temperature	Exact location (main frame or $module)	Max total quantity (stored inside
		Flammable	Combustive	Irritant / Harmful	Sensitizer / Toxic / CMR				

Explosion risk : ☐

Under-pressure elements (bulb, pressure tank, ...) :	Pressure :	Volume :

Thermal risk : ☐

Heating elements :	Temperature :

Electrical risk : ☐

Maximum voltage :	AC :	DC:

Risk from ionising radiations : ☐

Sealed radioactive material ☐	Presence of X-rays ☐	Open source radioactive material ☐

Risk from non-ionising radiations : ☐

UV ☐	Infrared ☐	High frequency ☐	Electromagnetic ☐
Microwaves ☐	Permanent magnet ☐	Laser ☐ Category (1-2-3-4) :	

Risk from handling during maintenance: ☐

Manual handling ☐	Mechanical handling ☐	Handling device :

laser radiation: ☐

This applies to all lasers inside the equipment.

Laser brand and laser model	Laser class According the last version of NF EN 60825-1	Continuous or pulsed laser	Output wavelengths (nm) (or range of wavelength)	Full laser divergence (mrad)	Do the output wavelength(s) originate from other wavelengths? if the answer is yes, specify all these wavelengths

For continous lasers (CW laser)

Optical power (W)	Beam diameter at the laser output (µm)	Smallest beam diameter inside the equipment (µm)	Additional information: beam spatial profile?

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APPENDIX J: SECS/GEM Compliance

Use the following template and ask the Contractor to fill it:

APPENDIX J

Direction de la recherche technologique (Technological Research Department)

DPFT

APPENDIX J: SECS/GEM COMPLIANCE STATEMENT

Ref.: Equipment specifications

1. CUSTOMER ANSWER ON SEMI COMPLIANCE FOR MANDATORY STANDARDS

SUPPORT *ANSWER YES OR NO*	SEMI STANDARD	REVISION	DESCRIPTION
	E5		SECS-II Message Content (SECS-II)
	E30		Generic Equipment Model (GEM)
	E37		HSMS Transfer Protocol (HSMS)
	E37.1		HSMS Single-Session (HSMS-SS)
	E37.2		HSMS General Session (HSMS-GS)
	E39		Object Services Standard (OSS)
	E39.1		
	E40		Processing Management (PM)
	E40.1		
	E84		Carrier Handoff Parallel I/O Interface (EPIO)
	E87		Carrier Management Specification (CMS) In-line with track
	E87.1		
	E90		Substrate Tracking Specification (STS)
	E90.1		
	E94		Control Job Management Specification (CJM) In-line with track

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APPENDIX K: Pedestal specification

Use the following template and ask the Contractor to fill it:

APPENDIX K

DPFT

APPENDIX K : Template and Footprint		
EQUIPEMENT REFERENCE & NAME :		
Tool caracteristics		
Dimensions (mm)		
Weight (Kg)		
Footprint/drawings file name Has to be provided at T0 including subeq		
Chassis specifications		
Template file name (.DWG) Has to be provided at T1-6 months (with weight repartition and all cutt-off locations)		
Seismic brackets installation requested	Yes ☐	No ☐
Vibrations specifications		
Specific request		
Comments :		

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