

Document title	Multi-application tester for package & wafer-level reliability
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1 PURPOSE

For its research activities targeted at developing 10 nm and beyond fully-depleted SOI technologies, CEA-LETI is willing to purchase a new equipment to investigate the reliability of advanced Back-End of Line (BEOL) and interconnects for 3D integration.

This equipment aims at gathering testing requirements for numerous failure mechanisms (electromigration (EM), stress migration (SM), time-dependent dielectric breakdown (TDDB), Bias Temperature Instability (BTI), etc.). It will have a flexible modular architecture that will enable easy upgrading from a few packages or die to a high-capacity test system, and will be available for package or wafer level testing.

Documents to be provided by the Contractor during the tender process

- ✓ The Contractor must complete and deliver to CEA-LETI **Appendix A: Summary of the 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**.
NB: the datasheet information allows CEA-LETI to design the fluid PID* and the electrical PID*. 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 equipment Contractor. (* Piping and Instrumentation Diagram)
- ✓ 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**
- ✓ A forecast packing list

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 Contractor may submit 2 proposals:

- 1 for a new equipment
- 1 for a partially or totally refurbished equipment specifying which part(s)

The equipment shall be modular i.e. allows many tests (EM¹, SM², TDDB³,...) to run concurrently (in parallel) at many different temperatures. Furthermore, the equipment shall be able to test one to tens or hundreds of packages (package level reliability, PLR) in parallel.

The smallest proposal should contain a system which allows EM, SM tests for PLR for around 120 packages (1 test structure per package) in parallel.

Acceptance testing

The Contractor should propose a series of tests for acceptance testing in addition to those of CEA, listed hereafter:

- Ovens acceptance testing
 - Temperature accuracy – Calibration
Suitable means should be made to determine the temperature of packages in the test sockets when the oven is fully and/or representatively loaded. The ovens are to be set at temperatures 50, 150, 250 and 350 °C and the oven stabilization time to 30 min. After the stabilization time has been accumulated, the mean readings should be within ± 1.0 °C of set temperature.
 - Temperature stability
After calibration is complete, start an oven stability test with an oven soak time of 1 h and obtaining one data set point per minute for 24 h.
After the 24 hours, RTD (provided by the manufacturer) measurements should be analyzed so that each individual RTD does not deviate more than ± 0.5 °C.
- Unexpected power cut or equivalent (storm, voltage drop...)
During a dummy test, a power cut will be done. When the power supply will be turned on and a restart of the system asked (start button activated), no problem must appear. The degradation data must have been saved and a log file must have been generated.
- Emergency stop
During a dummy test, the emergency stop button of the equipment will be activated. The resetting of the emergency stop device itself must not allow the machine to restart. After the resetting of the emergency stop button, the restarting of the equipment, no problem must appear. The degradation data must have been saved and a log file must have been generated.

¹ EM stands for electromigration.

² SM stands for Stress Migration.

³ TDDB stands for Time Dependent Dielectric Breakdown.

3 EQUIPMENT TECHNICAL SPECIFICATIONS

3.1 Equipment description

Technical requirements

	Parameter	Specification
3.1.1	Uninterruptible Power Supply (UPS) or equivalent system	Removes all potentially harmful variations from the AC power line and in the event of a total AC power failure, the equipment will continue to run for a sufficient duration before gently stopping the experiment, without any loss of data. Once the AC power is restored, the experiment can be restarted from the control unit at the exact point where it stopped.
3.1.2	<u>Packages</u>	
3.1.2.1	Type	DIL/CDIP
3.1.2.2	Number of pins	Up to 2×14 pins
3.1.2.3	Min. width	0.3 inches
3.1.2.4	Max. width	0.6 inches
3.1.3	<u>Socket</u>	
3.1.3.1	Type	ZIF or equivalent
3.1.3.2	Assignment	Unlimited
3.1.4	<u>DUT board material</u>	Ceramic
3.1.5	Method for TCR determination	According to JEDEC JESD33 or JEP154
3.1.6	<u>Structures per package</u>	
3.1.6.1	Devices under test (DUT) per package	min. 1
3.1.6.2	Extrusion monitor per DUT	min. 1
3.1.6.3	DUT temperature monitor (for TCR extraction according to JEDEC JEP154)	min. 1
3.1.7	<u>Total test capacity</u>	Min.: 120 packages
3.1.8	<u>Oven</u>	
3.1.8.1	Temperature range	Room temp. to +350 °C
	Set-point	
3.1.8.2	Resolution	1 °C
3.1.8.3	Accuracy	±1 °C
	Measure	
3.1.8.4	Resolution	0.1 °C
3.1.8.5	Accuracy	±0.5 °C
3.1.9	<u>Specifications for an electromigration module</u>	
	Capabilities	
3.1.9.1	Failure mechanism	Electromigration, stress migration
3.1.9.2	Stress type	Min.: DC (ref.) Pulsed DC
3.1.9.3	Measurement method	4-wire Kelvin testing + Wheatstone bridge for low resistance devices
	Max stress current range	
3.1.9.4	For advanced BEOL	Few µA to ~5 mA
3.1.9.5	For 3D integration	Few mA to ~50 mA
	DUT measurement range	
3.1.9.6	For advanced BEOL	>> 500 Ω
3.1.9.7	For 3D integration	>> 50 mΩ
3.1.9.8	Sampling rate	Real time

3.1.10	Software	
3.1.10.1	Ability to perform a continuity test before starting the aging test	
3.1.10.2	Ability to change the aging test time in real-time	
3.1.10.3	Ability to reverse the direction of the electric current flow in real-time (for electromigration)	
3.1.10.4	Ability to restart an aging test without performing the TCR phase	
	End of test criterion	
3.1.10.5	Manual (stop button)	
3.1.10.6	Stress time reached	
3.1.10.7	Absolute increase of a given parameter (resistance for example)	
3.1.10.8	Relative increase of a given parameter (resistance for example)	
	Data and statistical analyses	
3.1.10.9	Failure criterion	Absolute or relative
3.1.10.10	Time To Failure (TTF) adjusted after a change of the failure criterion	
3.1.10.11	Statistical distributions	Normal, lognormal, Weibull
3.1.10.12	Parameter estimation	Rank regression, MLE
3.1.10.13	Suspended or right censored data	
3.1.10.14	Confidence bounds	
3.1.10.15	Black's parameters extraction	
3.1.10.16	Data access and plot possibilities	
3.1.10.17	Current (set-point + supplied)	
3.1.10.18	Voltage (measured)	
3.1.10.19	Time (sampling)	
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3.1.10.22	DUT temperature estimated by its TCR	
3.1.10.23	DUT temperature estimated by the DUT temperature monitor	
3.1.10.24	Ramp resistances vs. temperature (TCR extraction)	
3.1.10.25	Absolute degradation over time	
3.1.10.26	Relative degradation over time	
3.1.10.27	TTF vs. parameter (time for example) → lifetime distribution	
3.1.11	Dimensions: width / depth / height	Max. 120 cm / 100 cm / 240 cm

3.2 Hardware

3.2.1 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 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.

3.2.2 Temperature control

See paragraph 3.1, section 3.8 – Oven and subsections.

3.3 Software

3.3.1 IT configuration

The Contractor shall describe the configuration and possibilities of the equipment management IT system (PC, OS safeguard device, etc.)

Restoration of the system:

Contractor agrees to provide CEA-LETI with:

- the procedure enabling complete backup of the embedded hard drives
- the hardware required for correct application thereof

It will train the CEA-LETI maintenance staff in proper application of this procedure

A backup will be performed for tool acceptance.

Licenses

Contractor agrees to deliver the equipment with all the operating licenses enabling it to be used by CEA-LETI.

Software update and upgrade

Contractor shall systematically provide the CEA-LETI with update (bug correction, etc.), upgrade 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 upgrade or new version that improves the functionality and provide the price conditions if the CEA-LETI request them.

Notwithstanding the warranty expiration, the Contractor will perform the software modifications needed to fix any bugs and therefore maintain the original functionality of the software at no cost to the CEA-LETI. The modifications connected with a correction (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.

3.3.2 Antivirus and data back-up

Antivirus:

- **Only required for computers running with Windows type of Operating System, and directly connected to CEA-LETI network.**

NOT APPLICABLE

- **Required for all computers connected to CEA-LETI network, whatever the Operating System is**

NOT APPLICABLE

Data back-up:

CEA-LETI performs back-up copy of all data stored on all computers and associated peripheral devices of the equipment.

This is achieved doing both:

- a snapshot of all storage disks, with a tool like "Symantec Ghost"
- an automatic data copy, capturing (on a periodic basis) data updates during equipment operation

In case the equipment complies with such methodology, the Contractor must specify in his technical proposal the process to generate files dedicated to the periodic back-up.

If the equipment is not compatible with this methodology, the Contractor must specify in his technical proposal the way to create back-up material, in order to enable a complete computer reboot on a clean/brand-new disk. Any extra material (such as server or software) that would be required to perform these back-up (except basic file copy with standard protocols such as CIFS/SMB, FTP, CP/SFTP,NFS) must be provided by the Contractor. This is especially the case if a tool/software different from Symantec Ghost is recommended.

If the software has a protection mechanism that could interfere with an equipment disk replacement, then the Contractor must provide to CEA-LETI the way to reactivate the software. In Particular, this is mandatory if a new User License Key is required by the software after a hard drive change.

4 GENERAL BUILDING, FLUIDS, ELECTRICITY, ENVIRONMENT SPECIFICATIONS

4.1 Environment of the equipment

4.1.1 Building specifications

The equipment will be installed out of a clean room in building 51 in a laboratory equipped with many ovens and climate chambers.

The equipment will work 24/7/365 but doesn't require a daily presence.

Features of the location of the equipment:

- Environment: [laboratory](#)
- Cleanliness class according to ISO 14-644-1: [ISO 4 to 7](#)
- Environmental conditions and tolerances (temperature and humidity): [23 ± 5 °C](#)
- Mounting: [open space](#)
- Location of devices: [open space](#)

In case a furnace needs to be installed in our facilities, the Contractor must provide the equivalent thermal power.

4.1.2 Building fluids

See **Appendix B**: General fluids building [51](#)

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:
 - Pyralène is prohibited;
 - 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.

5 SAFETY

5.1 EC conformity

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**
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.
 - 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)

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 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...

5.5 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 ...)

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).

5.6 Signalling

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.

5.7 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.

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

The 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.

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.

- **Training for use of the equipment**

After commissioning of the equipment, user training shall be provided on site for 1 to 2 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.

10 DOCUMENTATION

See **Appendix E**: "Specifications relating to the documents and manuals to be supplied jointly with the equipment". Each manual must be available in two paper versions and, possibly on CD-ROM or electronic format (PDF). From a statutory standpoint, the delivery of a document or publication in CD-ROM format only (no hardcopy version) is construed as non-conformity.

11 WARRANTY

11.1 Warranty conditions

Warranty shall start at the date of equipment acceptance for a duration of one year.
Warranty shall include corrective and preventive maintenance operations, with at least one preventive maintenance 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 1 week 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 (%) = $100 - \text{Down-time (\%)}$
- B) During the warranty period:
Uptime $> 92 \%$
MTBF⁴ $> 4000 \text{ h}$
MTTR⁵ $< 168 \text{ h}$
- 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:

- 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.

⁴ Mean Time Between Failure

⁵ Mean Time To Recover

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 optional 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)

The 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

13.1 Check upon delivery & at unpacking

The 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.

13.2 Installation & commissioning

After uncrating completion, the equipment will be moved to its final location in the cleanroom by CEA-LETI or its subcontractor. The Contractor shall then take care of equipment final assembly and interconnections. The Contractor shall use its own tools to perform equipment assembly, including handling and lifting tools that may be necessary.

The Contractor shall 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.

Prior to powering up the equipment, CEA-LETI has programmed a compliance check of the applicable safety regulations (EC instructions), this check shall be performed by an independent approved body. The Contractor must be present and provide the required documents for the assessment of the equipment.

After powering on the equipment, the Contractor will perform the startup and adjust hardware settings (robotics etc.). The Contractor will carry out checks on facilities which includes checking the various safety controls. The Contractor shall prepare and provide a “hardware report” commissioning which summarizes the progress of this 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)

At this stage, the CEA-LETI will arrange for a safety compliance inspection by the applicable regulatory compliance body (EC requirements). This check is performed by an independent accredited body. The Contractor will be present during this inspection and will make all necessary documents available for the assessment of the equipment. Anomalies and malfunctions will be promptly corrected by the Contractor no additional costs. 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.

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 above has been successfully completed.

The CEA-LETI also employs a firm that tests exhaust efficiency and air flow (FFUs) and takes ESD measurements.

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 solvent 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.

13.3 Qualification

The Contractor shall submit the qualification procedure to CEA-LETI for acceptance. It shall check all the functional specifications described in Paragraph 2.

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).

13.4 Acceptance

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

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
- ✓ EC conformity approval given by the body accredited by CEA.
- ✓ 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 the 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.

13.5 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.

14 INSTALLATION PREPARATION SCHEDULE

The schedule below includes the key stages of the contract. For some the date is stipulated by CEA-LETI relatively with respect to the contract starting date (T0) or the delivery date (TL), for others, the contractual date will be specified in the Manufacturer's offer.

Note: for equipment delivered in several stages, a schedule per subassembly shall be drawn up (one subassembly per delivery).

1	Starting date The start date of the contract ("T0") is date of the acknowledgment of receiving the contract if the latter does not exceed 10 days after the date of signature of the contract by CEA. In the case of an acknowledgment received after this period the "T0" is arbitrarily set at the date of dispatch of the contract by CEA-LETI (the date of the covering letter) plus 10 days.	T0
2	Preparation file of equipment installation (made up at least from the "installation" chapter of the instruction manual defined in Appendix E)	T0 + 0.5 months
3	Kick-off meeting at the latest 1 month calendar after notification of the order to the service provider	T0 + 1 months
4	PID (Piping and Instrumentation Diagram) approval by the Contractor. Hook Up and Fit Up will start after the official validation of PID by the Contractor	T0 + 1.5 months
5	Appendix H with definitive information relating to the required sub-equipment (to be provided by the contractor)	At the latest T0 + 2 months
6	Preparation file for equipment installation for approval; composed at least of: ✓ "Handling", "assembly", "commissioning and adjustments" chapters of the instruction manual defined in Appendix E. ✓ Transport specifications ✓ "Factory acceptance" and "Qualification" procedures	TL - 2 months
8	Project maintenance manual in electronic format (composition of a file as per Appendix E)	TL - 0.5 months
9	Detailed programming of delivery (date, time, carriers, civil status of the workers on-site, etc). Note: drafting of a prevention plan as per French regulation with a CEA-LETI engineer must be taken into account in the delivery schedule. The complete or simplified prevention plan (depending on the number of companies and the number of hours) must integrate commissioning of the equipment	TL - 0.5 months
10	Delivery	TL
11	Installation and assembly of the equipment and connection to the various networks Note: given that at this stage the equipment is still the property of the Contractor (under CEA-LETI responsibility) the presence of one of its representative is mandatory during the handling and connection operations.	
12	Commissioning. this phase will be finalised with acceptance by CEA-LETI of the equipment filed formalised on a report with safety inspection of the installation.	
13	Qualification of the equipment	
14	Final equipment file (in electronic format and in two hard copies of which at least one in clean room compatible paper composed as per Appendix E)	15 days before acceptance

Document title: Multi-application tester for package & wafer-level reliability

N° Chrono: DRT-LETI-DCOS-SCCS-LCEF-24-07-001604

15	Acceptance of the equipment (this stage notifies transfer of ownership of equipment to CEA, the warranty period starts at this date)	
16	End of warranty (this stage notifies end of the equipment warranty and start of any maintenance contracts)	At the end of the warranty period and after lifting of reservation

15 APPENDICES

APPENDIX A: Summary of the Contractor's comments

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

[APPENDIX A Equipment specification.dotx](#)

APPENDIX B: general fluids to building 51

General fluid distribution	Building 51 characteristics	Specific observations
Cooling Water (Recommended dimensioning velocity : 1.5 m/s)	Material: black steel	
	Pressure: 6 bar +/-1	
	Temperature: 16-20°C	
	Conductivity: <400 microS/cm	
	Ph: 7 +/-1	
De Ionized Water	Material: PP	PUS Exclusivity No DI water recycling at machine outlet
	Pressure: 4 bar	
	Temperature: 20°C	
	Resistivity: >15 Mohm.cm	
	TOC<20 ppb	
City Water	Material: PVC	Management by STL/EXP
	Pressure: 6 bar	
	Conductivity: 375 microS/cm	
	pH: 7	
	Calcium: 70mg/l	
Process vacuum	Material: PVC-U	Management by CEA→ PUS Vacuum pump at Building 51C with network in laboratory Building 51C&D
	Relative pressure: P<0.2 bar abs	
Nitrogen gas "Service"	Material: stainless steel 316L Ra 0,8	PUS Exclusivity. Available level 4
	Relative pressure: 7 ± 0,5 bars	
	O ₂ < 1 ppm	
	H ₂ O < 1 ppm	
Nitrogen gas « Process »	Material: stainless steel 316L Ra 0,4	PUS Exclusivity. Available level 4
	Relative pressure: 7 +/-0,5 bar	
	At the delivery point: BHT	
	O ₂ < 10 PPB	
	H ₂ O < 10ppm	
Compressed Dry Air	Material: stainless steel	PUS Exclusivity. General waste drain on Building 51 level 4. Relays are accessible in the laboratories.
	Relative pressure: 7 +/-0,3 bar	
	At the delivery point : BHT	
	H ₂ O < 2ppm	
	Dew point: -72°C	
Network Oxygen 5.0	Material: stainless steel 316L Ra 0,8	
	Relative pressure: 7 bar +/- 0,5	
	N ₂ < 5 PPM	
	H ₂ O < 3 PPM	
	HC < 0.2 PPM	
Network Argon 6.0	Material: stainless steel 316L Ra 0,8	
	Relative pressure: 7 bar +/- 0,5	
	O ₂ < 0.5 PPM	
	H ₂ O < 0.5 PPM	
	CO + CO ₂ < 0.1 PPM	

General fluid distribution	Building 51 characteristics	Specific observations
Network Helium 6.0	Material: stainless steel 316L Ra 0,8	
	Relative pressure: 7 bar +/- 0,5	
	O ₂ < 0.5 PPM	
	H ₂ O < 0.5 PPM	
	CO + CO ₂ < 0.2 PPM	
Waste collection	Building 51 characteristics	Specific observations
Acid-base drain	Material: PP Collect point located at the ground floor of building 51 A & 51C and then transferred towards DFT	PUS Exclusivity. Reprocessed locally in a neutralizing plant - imperative limitation of discharge temperature at tool outlet → less than 60°C Dilution limitation so as to reduce volume to be reprocessed → no water venturi system but rather gravity draining. Gravity flow forward DFT from building 51A level 4.
Fluorinated drain	Material: PP Collect point located at the ground floor of building 51C (laboratory) and transferred towards DFT with a general waste drain. General waste drain : from level 4 of building 51A towards DFT, crossing the technical areas of building 51B & C.	PUS Exclusivity. 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. Gravity flow forward DFT from building 51A level 4.
Solvent drain	none	No available building 51A
Waste water drain	Material: PVC	Management by STL/EXP
Ventilation / extractions	Building 51 characteristics	Specific observations
General extraction	Material: PVC Available negative pressure: from -200 to -600Pa equipment inlet depending on location	Management by PUS. 51B: level 0/1/2 51C: level 0/1
Vacuum pump recovery networks	Material: 304 L stainless steel Negative pressure: from -800 to -1000Pa depending on location	Management by PUS. 51B: level 0/1/2 51C: level 0
Treated air on 51B	laboratories	Working limits : external climatic conditions: Winter: -12°C, HR: 90% Summer: 32°C, HR: 40%
	18°C<t<23°C	
	Hi%: 50+/- 10	
	offices	
	Winter: 19°C	
Treated air on 51C	Summer: 6°C less than external temperature	Working limits : external climatic conditions: Winter: -12°C, HR: 90% Summer: 32°C, HR: 40%
	laboratories	
	21°C<t+/- 1	
	Hi%: 47°+/- 5	
	offices	
Treated air on 51C	Winter: 21°C +/- 2	

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

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.

$MTBF = \text{Up-time (in hours)} / \text{number of interrupts}$.

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.

$MTTR = \text{number of hours of down-time} / \text{number of interrupts}$

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

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.”

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

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;

- 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 bringing 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.

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.

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 to necessarily 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),

- 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.

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

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.

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.

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:

	<i>Loadport</i>	<i>Objective</i>
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

APPENDIX H: Datasheet for tool installation

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

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 are then 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.

DPFT

Equipement Model :

List of Equipments & sub-equipments						
Name	Location (Fab or sub-fab)	Type (Chiller, pump,...)	Model	Dimensions (L x w x h) in mm	Weight (Kg)	Supplied by
Chiller 1	Sub-Fab	Heat Exchanger	NESLAB HK-150	500 x 600 x 900	400	Contractor
Pump 1	Sub-Fab	Pump	iHx 600	300 x 900 x 800	200	CEA-LETI
Mainframe	Fab	Mainframe	xxx	2500 x 1300 x 2600	2500	Contractor

EXAMPLE

Facilities requirements			Connection		Consumption (e)			Pressure (bar) at the connection on the tool		Temp (° C)		Purity	Supplied by	Comments (ex: max length...) (f)		
Fluid (a)	From	To	Description (b)	ID (c.)	Size (d)	Type	Min	Max	Average	Min	Max				Min	Max
N2S	Facilities	Mainframe CH A	N2 Purge	G1	1/4"	VCRM	15	50	25	2.5	5	N/A	N/A	N/A	CEA-LETI	EXAMPLE
Glycol	Chiller 1	Mainframe CH A	Chilled Water	F1	3/8"	swg	10	20	12	2	3	15	18	N/A	Contractor	installed by CEA-LETI ... EXAMPLE
BCG	Facilities	Mainframe CH A	BCG proces	J2	1/4"	VCRM	1	2	1.2	1	1.3	N/A	N/A	N50	CEA-LETI	Purity : N50

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.

APPENDIX I: Risk Identification Sheet

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

[Annexe I Fiche Identification Risques.xlsx](#)

cea leti		DPFT					
APPENDIX I : Risk Identification Sheet							
EQUIPEMENT REFERENCE & NAME :							
REFERENCE OF SAFETY DOCUMENTS PROVIDED							
EC Compliance certificate		<input type="checkbox"/>		Safety information and requirements in French		<input type="checkbox"/>	
RISK IDENTIFICATION							
Chemical risk : <input type="checkbox"/>							
Product name	Physical state (solid, liquid, gas)	DANGEROUSNESS				Usage concentration	Usage temperature
		Flammable	Combustive	Irritant / Harmful	Sensitizer / Toxic / CMR		
Explosion risk : <input type="checkbox"/>							
Under-pressure elements (bulb, pressure tank, ...):				Pressure :		Volume :	
Thermal risk : <input type="checkbox"/>							
Heating elements :				Temperature :			
Electrical risk : <input type="checkbox"/>							
Maximum voltage :				AC :		DC:	
Risk from ionising radiations : <input type="checkbox"/>							
Sealed radioactive material <input type="checkbox"/>		Presence of X-rays <input type="checkbox"/>		Open source radioactive material <input type="checkbox"/>			
Risk from non-ionising radiations : <input type="checkbox"/>							
UV <input type="checkbox"/>		Infrared <input type="checkbox"/>		High frequency <input type="checkbox"/>		Electromagnetic <input type="checkbox"/>	
Microwaves <input type="checkbox"/>		Permanent magnet <input type="checkbox"/>		Laser <input type="checkbox"/> Category (1-2-3-4) :			
Risk from handling during maintenance: <input type="checkbox"/>							
Manual handling <input type="checkbox"/>		Mechanical handling <input type="checkbox"/>		Handling device :			
Other risks :							
Equipment internal detections :							
Fire detection <input type="checkbox"/>				Leak detection <input type="checkbox"/>			
Gas detection <input type="checkbox"/>				Extraction control <input type="checkbox"/>			
Comments :							

Document title: Multi-application tester for package & wafer-level reliability

N° Chrono: *DRT-LETI-DCOS-SCCS-LCEF-24-07-001604*

APPENDIX J: SECS/GEM Compliance

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

[Annexe J SECS/GEM Compliance Statement](#)