



# EQUIPMENT SPECIFICATIONS

LITEN/DEHT/DIR/CDC/2025/004

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**Version A**

Date of issue: 10/02/2025

## Cycling bench for batteries

**FREE DISTRIBUTION**

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Platform: batteries  
Investment Plan Ref.

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### Table of changes

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## 1. PURPOSE

This file provides all the basic information upon the request of the Service of Batteries Technologies (STB) in CEA to purchase:

### **48 channels battery-cycling equipment with 8 incubators (15°C to min 60°C)**

The test bench with incubators will be used for the electrical characterisation of secondary cells.

A detailed estimate price and terms and delivery limits of this equipment is required.

## 2. DEFINITION

In this document, the contractor is referred to as “the supplier”.

The instructing party is referred to as “CEA”.

## 3. GLOSSARY

LITEN:	Laboratoire d’Innovation pour les Technologies des Energies Nouvelles et les nanomatériaux - Laboratory of innovation for new energy technologies and nanomaterials
PMAD:	Prise en Main A Distance (Remote control access)
DOE:	Dossier des Ouvrages Exécutés (As built file)
STB :	Service des Technologies de Batteries – service of batteries technologies

## 4. APPLICABLE DOCUMENTS

The supplier shall comply with the documents and all procedures in force at CEA/GRENOBLE. Below is a non-exhaustive list:

EQ/CS23-10: Règles applicables aux entreprises extérieures (French version)

EQ/CS23-11: Applicable rules for outside companies (English version)

These documents shall be available for consultation upon request by the supplier.

## 5. CUSTOMER – SERVICE PROVIDER CONTACT

The technical contacts for the basic and additional services are:

For any technical information

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## 6. CONFIDENTIALITY

The supplier undertakes to keep confidential and shall refrain from disclosing to any third party, without written approval from CEA, the whole or part of information and/or knowledge belonging to CEA or any third party, that it may obtain or may have obtained during the service performed on behalf of CEA.

## 7. TECHNICAL SPECIFICATIONS

### 7.1 Expected specifications

#### 7.1.1 General specifications

The battery-cycling bench with incubators must include all the hardware and software interfaces, chassis, wiring, electrical and electronic hardware necessary for its use.

Equipment performance must be detailed. Supplier will provide data and references ensuring that specifications are met. CEA will not spend time to develop and debug new software or hardware configuration with the supplier.

#### **Battery cycling bench unit**

The purpose of the equipment is to test and cycle (charge/discharge) secondary cells.

**The bench will include at least 48 channels each capable of  $\pm 10$  A continuous current, with a minimum 0 to 5 Volts range.**

Current will be preferentially monitored and measured with a minimum of **4 ranges covering  $\pm 1$  mA /  $\pm 20$  mA /  $\pm 0,5$  A /  $\pm 10$  A** in order to obtain accurate measurements. The system must have a minimum accuracy of **0.1% of full-scale in each range**. The exact value **must** be given in the bid.

Data acquisition rate must be adjustable in the range of 1 to 1000s at minimum.

**Cables** (2 m length min) **and specific holders** for connecting 48 pouch cells (1x7x13cm size +two 0,5 to 1cm width tabs separated by 2cm) **must be included (with specifications) and quoted in the general quotation of bench.**

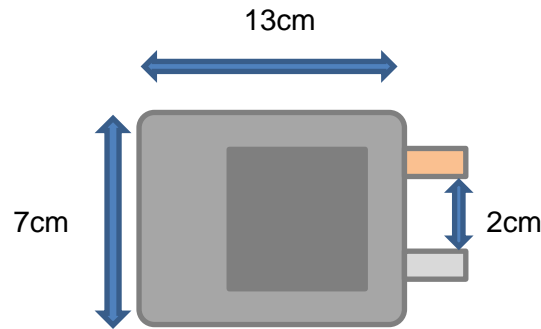


Figure 1:Pouch cell drawing

The 48-channel (minimum) bench must be equipped with at least **16 auxiliary voltage** measurement channels and **16 auxiliary temperature** measurement channels. **It must be possible to map each auxiliary channel to any of the 48 testing channels.**

Flexible Thermocouples sensors (T type) will be provided in order to be connected to the 16 additional auxiliary channels dedicated to temperature monitoring. Their specifications (temperature range, accuracy, working conditions) will be supplied with the delivery.

Auxiliary voltage cables will be provided in order to be connected to the 16 auxiliary channels dedicated to voltage monitoring.

# Channels	Current range				Voltage range (V)	auxiliary Voltage	auxiliary Temperature
	Low	Med1	Med2	High		x16	x16 T-type
<b>48</b>	$\pm 1\text{mA}$	$\pm 20\text{mA}$	$\pm 0,5\text{ A}$	$\pm 10\text{A}$	[0-5V]	[0-5V]	[-50 ;150°C]

### **Incubators**

**8 individual incubators controllable by the cycling bench must be supplied.**

Each incubator must be able to keep a setpoint temperature for at least one pouch cell between 15°C and a minimum of 60°C. **It must be possible** to control each incubator with the cycling bench individually in the same program as the electrical settings of the tested cell, in order to be able to dynamically change the temperature of the batteries during the electrical test.

Real time monitoring and recording of each incubator temperature must be possible in the test bench software together with electrical values. The minimum needed usable volume of each incubator is **7x10x15cm (1,1L)**. Maximum chamber volume of each incubator must be below 30L.

Each incubator must come with appropriate cables, feedthrough and **pouch cells holders for connecting at least one cell to the cycling bench.**

Each incubator must also be supplied with appropriate cables and **holders for cylindrical cells (at least 18650 to 21700 format)**.

### **7.1.2 Setting up of the charge and discharge schedule**

These parameters must be accessible via the test-scheduling interface:

- Parameters for the charge, discharge or relaxation steps: current, voltage, power, energy, time...
- Charge and discharge at fixed current and/or fixed C-Rate and/or fixed voltage and/or fixed power (with the possibility to apply them alternatively during the same charge or discharge step)
- Commutation parameters and step limits: charge time or discharge time or relaxation time, voltages, charge or discharge capacities (Ah), charge or discharge energies (Wh), charge or discharge currents, gradients...
- Parameters to control the supplied incubators : temperature setpoint for each program step
- At least 3 variables must be available to store capacities/energies of a specific step and reuse it as a step limit in a later steps.

### **7.1.3 Measurements exploitation**

Viewing results data for each channel: time (step, test...), current, voltage, cycles number, internal resistance, discharge/charge capacity ...

The results files will have to be processed through Microsoft EXCEL. Without additional numeric processing of the files, they must permit to draw the following curves:

- Evolution of discharge capacity (Ah) versus cycles number
- Evolution of charge or discharge capacity (Ah) versus cycles number
- Evolution of energy (Wh) versus cycles number
- Evolution of voltage or current or ... during one or several specific cycle(s)
- Capacity derivative vs. voltage  $dQ/dV$  vs.  $V$  or vs.  $Q$

It must be possible to overlay the different graphical data mentioned above, graphical data possibly corresponding to different cells too.

## 7.2 IT equipment

The computer shall be set up with a Windows 10 Entreprise (1607 version and later) Operating System and shall be compatible with the SYMANTEC Endpoint Protection 12.1 RU6 MP6 at least (12.1 RU6 MP9 preferred) antivirus.

The hardware shall enable networking and shall feature at least wired (Ethernet) network.

CEA's facilities management shall be called on to configure the PC to the CEA standard before its networking.

It must be possible to save the configuration and acquisition data in a repository of a network server. Therefore, the acquisition data shall be supplied as result files that can be transferred onto the network.

The system must have a remote supervisory system. This supervisory system shall feature a read only profile of the parameters. It shall not be possible to perform any action on the operation of the equipment.

Additional profiles will allow to make the following functions:

- User for the piloting of the equipment
- Maintenance technician for the configuration of the equipment
- Administrator (only for the system administrator staff)

Remote control access of the computer equipment from the Internet shall not be authorised for the maintenance or commissioning phases. Should, for technical reasons, remote control access from an Intranet be required, the supplier shall specify such requirement in its bid. It shall provide the list of all the remote actions that may occur on the equipment using the remote control access. CEA will then carry out an analysis to determine whether or not CEA grants an exception, without this being constituted as a commitment. In any case, the implementation of remote control access shall give rise to a reduction by the supplier which shall be specified in the bid. By default, the remote control access shall then be implemented via RDP (Remote Desktop Protocol) software.

In case parameters of the system can be modified, the supplier will have to indicate in the offer the elements of **analysis of security of this system of supervision allowing to demonstrate that the security of the equipment remains mastered by technical means independent from the system of supervision**. If these elements are not briefly known at the time of the offer, the supply of these elements will constitute a deliverable in the putting into service.

## 8. WORK ENVIRONMENT, PLACE OF INSTALLATION, SUPPLY LIMITS

### 8.1 Supply limits

The supply will include:

- The 48 channels battery cycling bench, with software, pouch cell holders and cables
- 8 independently software controllable incubators interfaced with the cycling bench, with software, cell holders and cables
- The packing and domestic transportation
- The setting up and the tests for startup and install,
- The dimensions and the weight of the bench and incubators, to be supplied in the offer.
- Range and accuracy for each parameter (current, voltage, time, temperature...)
- Listing of additional equipments necessary for the setting up and the startup of the bench as climate controlled room, power source,
- Corrective operations planned in case of component failure (like computer failure, power outage...)
- The supplier will have to plan a short formation for the future users at the end of the setting up and the startup of the device. Its duration will be detailed in the offer.
- documents in French as possible including :
  - a Setup manual and an User manual **(in French)**
  - the manufacturing plans
  - the electric schemes
  - the reports of safety certification

The offer will have to take into account all the supplies.

### 8.2 Environment, Facilities

The power source must be either AC 220V or AC 380V (50Hz) (Preferably 220V). The equipment will have to be protected (even isolated) in order to avoid any risk of electromagnetic interferences between the different channels.

The electrical cupboard must be equipped with an emergency stop switch (or button).

The supplier shall include in its bid the fluid requirements, electrical power supply and any other required interfaces.

The supplier shall include in its bid the fluid requirements, electrical power supply and any other required interfaces.

### 8.3 Delivery

Any item of equipment delivered shall bear the order number as well as the recipient's name. The supplier shall plan all measures for unloading and installing the equipment. Delivery shall be performed between 8 a.m. and 4:30 p.m. from Monday to Friday.

**The equipment shall be installed on the CEA-LITEN/DEHT/STB site in the D2a building. The width of door is 150 cm and 200 cm height.**

The equipment and peripherals shall be delivered in a clean condition and packaged in a proper manner.

Transport trays, pallets and packaging crates shall be suited to the weights and volumes of the items so as to ensure safe transport and to subsequently prevent any dispute related to defective packaging.

All transport trays, pallets and packaging crates shall be removed by the supplier as the processing of packaging waste is not managed by CEA.

### 8.4 Conditions for performing work on the CEA site

In cooperation with the supplier and its subcontractors (if any), CEA shall draw up the overall prevention plan for the equipment installation and commissioning services.

As equipment lending, including safety equipment, is prohibited by CEA, the supplier and its subcontractors (if any) shall provide the required safety equipment for preventing the specific risks caused by its work (PPE, CPE, etc.). It shall be responsible for replacement and repair of said equipment and, as applicable (without compensation from CEA), it shall train and acquaint its staff with the use thereof in keeping with regulations. Said equipment shall comply with the regulations in force and the supplier shall possess a certificate of conformity.

The supplier and its subcontractors (if any) shall provide collective safety equipment designed to prevent accidents stemming from the work (marking out of the work areas, marking out of the traffic areas; marking out of the handling areas, marking out and implementation of barriers around pits, height differences, etc.). It shall perform and ensure their removal insofar as the service no longer requires the presence of marking systems.

## 9. LEAD TIMES

The bench and incubators should be installed on site and received preferentially within a timeframe of 8 weeks (desired time) after the T0 approval date of the order by CEA and the supplier.

## 10. QUALITY

The supplier shall apply a quality management system that is of the same level as ISO 9001 for all its activities.

Any significant and/or repeated failures to comply with the specifications shall be notified to the supplier (anomaly email or improvement sheet) in order to perform corrective actions within

a stipulated timeframe. In the event of failures or should said corrective actions not be performed, penalty shall be applied to the service provider in reference to the contract.

CEA Grenoble reserves the rights to inspect the effective operation of the system at any time, via quality audits which may be performed at the service provider's premises and on the CEA Grenoble site.

Any measurements taken by the supplier for acceptance tests shall comply with the requirements of paragraph 7.6 of ISO 9001 (control of monitoring and measuring devices). Should the supplier subcontract these measurements, they shall be supplied with a certificate of conformity.

## **11. SAFETY AND CONFORMITY**

As set forth in CEA's general purchasing conditions, the supplier undertakes to consider safety as an absolute priority in the design, preparation and performance of the services subject of the Contract.

The supplier shall read and apply the "Rules applicable to outside companies working at the Grenoble centre" (refer to chapter 4, "Applicable documents").

The supplier and its subcontractors (if any), irrespective of their rank, shall apply the legal and regulatory provisions pertaining to safety and environmental protection.

The equipment shall comply with the regulations in force.

The equipment shall be CE certified, feature a "CE marking" and shall be accompanied by a CE declaration of conformity (refer to chapter 0 "Documentation").

### **11.1 Risk analysis**

The Supplier shall provide a risk analysis for the equipment and include all the associated items of safety equipment, their actions and servo-controls.

Said analysis shall highlight the specific risks related to the equipment and provide substantiation for the associated protection measures.

The supplier shall transmit this analysis to CEA right from the design phase (refer to chapter 0 "Documentation").

### **11.2 Risks related to facilities and machines**

The equipment shall comply with the regulations in force, especially the "Machinery" Directive 2006/42/EC.

#### **11.2.1 Power supply disconnection and separation device**

A power supply disconnection and separation device shall be provided on the equipment, for each source of energy of the machine.

#### **11.2.2 Power supply lockout / tagout device**

A power supply lockout / tagout device with dissipation of the residual energy shall be provided on the equipment, for each source of energy of the machine.

#### **11.2.3 Emergency stop**



Emergency stop buttons shall feature protection against unintentional operation. See the example on the photo opposite.

#### 11.2.4 "Service" nitrogen or compressed air connection

Whenever the equipment uses compressed air or nitrogen to control valves, actuators and other systems, the machine shall be equipped with a general shut-off valve.

This valve may be secured in closed position by means of a padlock in order to allow lockout / tagout of the facility (maintenance).

One or more bleeding devices shall also be provided to allow the residual pneumatic energy stored within the machine to be dissipated after closing the general shut-off valve. This dissipation shall be carried out without any risk for the exposed personnel.

### 11.3 Risks related to electricity

#### 11.3.1 Generalities

The equipment shall comply with the regulations in force, in particular the following Directives:

- "Electrical Equipment" 2017/35/EU;
- "Electromagnetic compatibility" 2014/30/EU;
- "Restriction of the use of certain hazardous substances in electrical and electronic equipment" (2011/65/EU).

If the equipment is composed of electrical measurement, control and laboratory devices, it shall comply with standard NF EN 61010-1.

If the equipment forms an electrical test equipment facility, it shall comply with standard NF EN 50191.

#### 11.3.2 Presence of an uninterruptible power supply (UPS)

If the whole equipment must be supplied by an uninterruptible power supply (UPS), then this power supply shall be provided by CEA.

The supplier shall give all the required information for product definition (voltage, power, battery life).

The supplier shall provide connection terminals on the equipment to connect the uninterruptible power supply.

In the event that only a portion of the equipment is powered by an internal UPS integrated by the manufacturer, the following rules shall be observed:

- An all-pole isolating device shall be installed downstream of the UPS in order to enable maintenance operations.
- If voltage still remains after the master switch of the machine has been turned off, such presence shall be indicated close to the switch.
- All circuits that remain live after switch off shall be marked in orange colour in accordance with standard 60-204.

### 11.4 Risks related to fire

By default, the detectors integrated into the equipment shall not be connected to the fire safety system of the building and shall act only on the equipment concerned and its associated peripherals, if any.

If the supplier considers that it is necessary to connect its fire safety system to the fire safety system of the building, it shall previously contact CEA to verify the compatibility of the entire system.

## 11.5 Risks related to work at height

In the event that use, maintenance or installation operation of the equipment require access at height, the supplier shall give priority to the installation of collective protective equipment (e.g.: built-in work platform with handrail complying with the standards in force) or, failing that, provide personal protective equipment (e.g.: anchoring points or lifelines complying with the standards in force). In the latter case, the technical documents shall very clearly refer thereto, so that the associated regulatory checks can be implemented.

Where necessary, the associated personal protections may be required.  
These shall have been validated by CEA.

## 11.6 Risks related to noise

The equipment shall comply with the regulations in force, in particular the "Machinery" Directive 2006/42/EC.

## 11.7 Risks related to temperatures

The equipment shall comply with the regulations in force, in particular the "Machinery" Directive 2006/42/EC.

## 11.8 Signalling

The equipment shall comply with the regulations in force, in particular the "Machinery" Directive 2006/42/EC.

Residual risks shall be indicated on the machine by means of regulatory hazard pictograms (triangles with yellow background), accompanied by additional text when applicable. In this case, this text shall be written in French.

## 11.9 Regulatory inspections

CEA shall have the necessary regulatory inspections carried out by an authorised organisation of its choice, in order to verify that the supplied equipment complies with the regulations.

The Supplier shall remedy any non-conformity in the shortest time possible without being able to claim any compensation. Depending on the severity of the detected anomalies, CEA may decide to suspend the commissioning operations until the problems have been solved (refer to Article 30 of chapter 11 of the General Purchasing Conditions).

### **11.9.1 Inspection of the work equipment**

The equipment supplied shall comply with the regulations in force in France.

These regulations include European texts.

The various standards applicable to the machine shall be complied with.

The general rules specified by the "Machinery" Directive 2006/42/EC on the use of work equipment and protection measures shall be complied with.

Refer to chapter 14. CEA shall have an inspection of the work equipment carried out on the place of installation. The report issued further to this inspection shall be free of any non-conformity. In the event of a non-conformity, a second inspection shall be carried out after the equipment is installed on the site.

### 11.9.2 *Regulatory electrical inspection*

Once the equipment is installed on the site and prior to commissioning, CEA shall have a regulatory electrical inspection carried out by an inspection body of its choosing.

## 12. EQUIPMENT DOCUMENTATION

The supplier undertakes to provide:

- The user's manual written in French; if this is not possible, only the "safety" section of the manual shall be written in French.
- The servicing and maintenance manual.
- The work equipment inspection.
- The regulatory electrical inspection.
- The CE declaration.
- The equipment safety analysis (refer to § **Erreur ! Source du renvoi introuvable.** ) and in particular the supervisory system, the safety instructions and risk identification.
- The drawings.
- The as-built file (DOE).
- Any other document required by the applicable regulations.

## 13. ACCEPTANCE CONDITIONS

Acceptance is given after complete delivery of the equipment and at the end of the installation and commissioning operations, and after satisfactory tests.

Criteria for granting acceptance:

- Supply of the documents stipulated in the "Documentation" paragraph 12.
- scheduling and control of the benches,
- data acquisition and exploitation.
- On site test bench calibration by the supplier.
- 

[CAUTION: Whenever an acceptance criterion requires a measurement, the equipment used to perform the measurement must be ECME.

If CEA supplies the measuring instrument, ensure that an ECME is available and that it has the appropriate measurement accuracy.

If the supplier provides the measuring instrument, specify:]

Measuring, testing and monitoring equipment (ECME) (as defined in standard ISO 9001 § 7.6) shall be used to check the achievement of the acceptance criteria. The supplier shall provide calibration or check certificates of the measuring equipment used.

## 14. TRAINING

The supplier undertakes to provide the following training:

### 14.1 Training on the use of the equipment

The supplier undertakes to conduct training on the use of the equipment for 3 or 4 people. The supplier shall specify the duration of the required training courses in its bid.

This training shall include the formation on the equipment utilization and the formation for processing the data results files.

## 14.2 Training on first level maintenance

The supplier undertakes to conduct training on first level maintenance for 2 people. The supplier shall specify the duration of the required training in its bid.

This training shall include the formation on regular maintenance operations to be held by CEA to ensure good service life of the equipment.

## 15. WARRANTY

Notwithstanding the legal warranty, the equipment shall be guaranteed 1 year(s) as from acceptance against any material, manufacturing, installation and operating defect, in compliance with the technical requirements of the specifications.

Said warranty shall cover the parts (excluding consumables), workmanship, transportation and travel.

Throughout the warranty period, the supplier undertakes to carry out repair work at the latest within two weeks following receipt of a fax or an email from CEA requesting a service call. These services shall be carried out every day from Monday to Friday, from 8 a.m. to 5 p.m.

In the event of equipment unavailability, the warranty period shall be extended by a period of time equal to the equipment downtime.

## 16. MAINTENANCE

At the end of the warranty, CEA shall be given the possibility to purchase a maintenance contract.

The supplier shall include in its price base, a cost estimate, of the maintenance services by taking into account the following levels of requirement:

- Full service (commitments on the availability time of the equipment including the preventive maintenance services, unlimited corrective maintenance and supply of spare parts). By default, the performance expected in the Full Service contract is that stipulated herein;
- Preventive maintenance (parts and manpower) + corrective maintenance on demand (hourly rate) including compliance with service and repair lead times.

Following adjustment of CEA's maintenance requirements, the maintenance contract may be put in place after the warranty period, further to negotiations.

## 17. ELEMENTS TO BE PROVIDED IN THE BID

- ☐ Fluid requirements, power supply and other required interfaces
- ☐ Maintenance costs
- ☐ The description of required utilities

- ❑ The duration and description of the planned training
- ❑ As applicable, a copy of these specifications with the Supplier's comments
- ❑ Safety analysis of the equipment (refer to § 11) and in particular the supervisory system