



NETWORK OF RESEARCH PILOT LINES
FOR LITHIUM BATTERY CELLS

D4.2

Validation of round-robin protocol

Deliverable Information

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Executive Summary

The present document is building up on the preliminary cell characteristics defined in deliverable 4.1 – Round-robin protocol. The characteristics and process parameters have been checked by the consortium regarding their feasibility to be produced in their respective pilot lines. The cell components and compositions have been defined precisely and suppliers were chosen accordingly. The key parameters for the testing protocol have been checked and have been, if needed, adjusted and frozen for the start of the round-robin test. Based on current trends and materials, NMC622/G cells will be tested as follows:

- Two formation cycles at C/20 including CV phase to C/40
- Capacity to be determined in the third discharge cycle at C/3
- Resistance determination via 1C pulse for 10 s at 3.6 V

The obtained data will be used for evaluation of the influence of the production processes on the cells' performance, which tolerances and defined compositions are stated in this living document.

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1 Introduction

1.1 LiPLANET in brief

The overall objective of the LiPLANET project is to create a European innovation and production ecosystem and reinforce the position of the European Union (EU) in the lithium battery cell manufacturing market. LiPLANET plans to build a more competitive lithium battery cell manufacturing ecosystem and increase the production of lithium battery cells towards industrial scale, by bringing together the most relevant European lithium battery cell pilot lines and the main stakeholders of the battery sector. The project LiPLANET lays the foundation for a network of battery cell pilot lines in Europe. This network allows to exploit synergies between pilot line operators, identify knowledge and equipment gaps, organize joint trainings as well as, favor collaboration with industry and academia, and facilitate the access to market.

For this purpose, different activities are followed throughout the project:

- mapping of the European lithium battery cell pilot lines and implementation of a network,
- creation of a standardized legal framework and a data exchange platform for the cooperation between industry, academia and pilot lines,
- round-robin test to compare qualification methods,
- development of a roadmap for joint strategies of the network towards industrial scale battery cell production in Europe.

1.2 Scope and objective of this deliverable

The objective of this deliverable is to define general materials, conditions and tolerances; being able to further standardize the production steps and determine their corresponding influence on the cell characteristics. The goal is that all network partners can conduct the round-robin test to validate and evaluate their results within the framework of LiPLANET.

The focus of the round-robin test is clearly set on widespread and thus non-competitive technologies or cell chemistries to cover as many pilot lines as possible and gain knowledge on the influence of the production processes on different cell properties.

Further on, through the planned detailed studies of the cell performance's, the creation of a benchmark and even further, standards within this network are facilitated via the round-robin parameter measurement.

2 Revised round-robin protocol

2.1 Materials & compositions

It was agreed within the network that the number of cathodes is a rather robust value compared to the cell capacity. Therefore, the round-robin protocol will be conducted by all partners with the total number of 10 cathodes, which results in, depending on the size of the production line, in different cell capacities. Anode and cathode materials as well as the electrode compositions and materials supplier are summarized in Table 1.

Table 1. Electrodes and other cell components, their compositions and supplier.

	MATERIAL	FORMULATION (WT%)	PRODUCT	SUPPLIER
CATHODE	Active material	95	NMC622	BASF
	Conducting agent	2.5 (1.5 + 1wt%)	C65 + SFG6L	Imerys
	Binder	2.5	PVDF (Solef5130)	Solvay
	Current collector	20 µm	Aluminium	Hydro
ANODE	Active material	95	Artificial graphite	Hitachi (Showa Denko)
	Conducting agent	1	Super C45	Imerys
	Binder	4 (1.5+2.5wt%)	CMC/SBR	DOW/ZEON
	Current collector	12 µm	Copper	Schlenk
ELECTROLYTE	EC:EMC 3:7 + 2wt% VC	~ 5 ml/Ah	EC:EMC 3:7 + 2wt% VC	Solvionic
	SEPARATOR	Separator	Trilayer PP/PE/PP	2325
			(possibly need for lamination)	

To assure the standardization during the test, crucial materials such as the active materials will be used from the same batch; meaning first ordered by the leading pilot line and then distributed among the partners accordingly.

2.2 Critical process parameters & tolerances

Depending on the pilot line size and stage of automatization and industrialization; the key parameters and their tolerances may vary within the network. The agreed values are displayed in Table 2.

Table 2. Production processes, parameters and tolerances.

PROCESS	PARAMETER	TOLERANCE
MIXING	Viscosity (Pa.s)	$\leq 5\%$
	Solid content (wt%)	$\leq 1\%$
COATING	Thickness after coating	$\leq 3 \mu\text{m}$
CALENDARING	Thickness after calendaring	$\leq 1 \mu\text{m}$
	Degree of densification	$\pm 5\%$
STACKING	Thickness	$\leq 0.1 \text{ mm}$
ELECTROLYTE FILLING	Weight before/after	$\pm 0.5 \text{ g}$
FORMATION	OCV after formation cycles	$\leq 2\%$
	Cell capacity	$\leq 2\%$
	Resistance	$\leq 8\%$

2.3 Test protocols

After the last step of the cell production, the electrolyte filling, the cells will have a 24 hours rest period before being charged and discharged at low currents (formation). Afterwards, the produced cells will be degassed (if necessary) and the corresponding capacities and inner resistances will be determined according to the following protocols:

- Two formation cycles at C/20 including CV phase to C/40
- Capacity to be determined in the third discharge cycle at C/3
- Resistance determination via 1C pulse for 10 s at 3.6 V

The results will be shared among the partners to check for standardization and evaluate the influence of the corresponding production processes.

3 Final statements

This document is a living document and therefore based on current technologies, knowledge and experience with the corresponding materials and components. With increasing data sets and participating partners, this document will be continuously validated and updated accordingly.

The present round-robin test is non-competitive and therefore open to all interested pilot lines for standardization of production and characterization methods.