

## VOLUMETRIQ

### VOLUME MANUFACTURING OF PEMFC STACKS FOR TRANSPORTATION AND IN-LINE QUALITY ASSURANCE

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**Project Coordinator:** Deborah Jones – CNRS

## DELIVERABLE REPORT

<b>D2.5 – TEST AND VALIDATE SHORT STACK MEETING PERFORMANCE OF 2,5 A/cm<sup>2</sup>@ 0,6 V</b>		
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<b>DISSEMINATION LEVEL</b>		
<b>PU</b>	Public	X
<b>PP</b>	Restricted to other programme participants (including the Commission Services)	
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<b>CO</b>	Confidential, only for members of the consortium (including the Commission Services)	
<b>NATURE OF THE DELIVERABLE</b>		
<b>R</b>	Report	X
<b>P</b>	Prototype	
<b>D</b>	Demonstrator	X
<b>O</b>	Other	

<b>SUMMARY</b>	
<b>Keywords</b>	<i>Short-stack, NM12, Milestone 4 achievement</i>
<b>Abstract</b>	<i>This report presents and describes the test results of the 9-cell short stack with NM12 format. It demonstrates the achievement of Milestone 4 of the project which is meeting a performance of 2.5 A / cm<sup>2</sup> @ 0.6 V.</i>
<b>Publishable abstract for confidential deliverables</b>	<i>This report presents and describes the test results of the 9-cell short stack with NM12 format. It demonstrates the achievement of Milestone 4 of the project which is meeting a performance of 2.5 A / cm<sup>2</sup> @ 0.6 V.</i>

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# TEST AND VALIDATE SHORT STACK MEETING A PERFORMANCE OF 2.5 A /cm<sup>2</sup> @ 0.6V

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## 1. INTRODUCTION

ElringKlinger AG fulfils, with this report, the demonstration of the achievement of a current density of 2.5 A / cm<sup>2</sup> @ 0.6 V with a short stack and the hardware format NM12, developed in the framework of VOLUMETRIQ. The Catalyst Coated Membranes CCMs were provided by Johnson Matthey Fuel Cells. The Bipolar Plates (BPP) were developed in Work Package 5 of the project and the Gas Diffusion Layers (GDLs) were sourced externally by EK (see WP4 and WP6). All components fulfil the requirement of being compatible with high volume manufacturing standards. The required operating conditions of the stack testing have been previously defined in WP2 and can be found in deliverable reports D2.2 and D2.3.

## 2. DEMONSTRATION OF THE HARDWARE AND RESULTS

For the purpose of this deliverable, a 9-cell stack has been assembled and is shown in Figure 1.



Figure 1. NM12 short stack test hardware showing end plates, clamping fixture and media interface (covered with yellow cups).

In Figure 2, the conditions in which the polarisation curves were obtained are demonstrated. Figures 3 and Figure 4 are showing the polarisation curves obtained under the VMQ and EU reference conditions accordingly where the exact conditions have been followed as defined at the beginning of project.

Test	Anode Stoich	Cathode Stoich	% RHA	% RHC	Anode Inlet p (kPag)	Cathode Inlet p (kPag)	Cell Temperature (deg C)
Volumetriq conditions	1,4	1,8	30 (52°C)	50	150	150	80
EU reference conditions	1,3	1,5	50 (64°C)	30 (53°C)	150	130	80
EK's standard conditions (atmospheric)	1,5	1,8	45 (55 °C)	80 (66°C)	30	up to 20	73

Figure 2: Testing conditions defined in WP2.

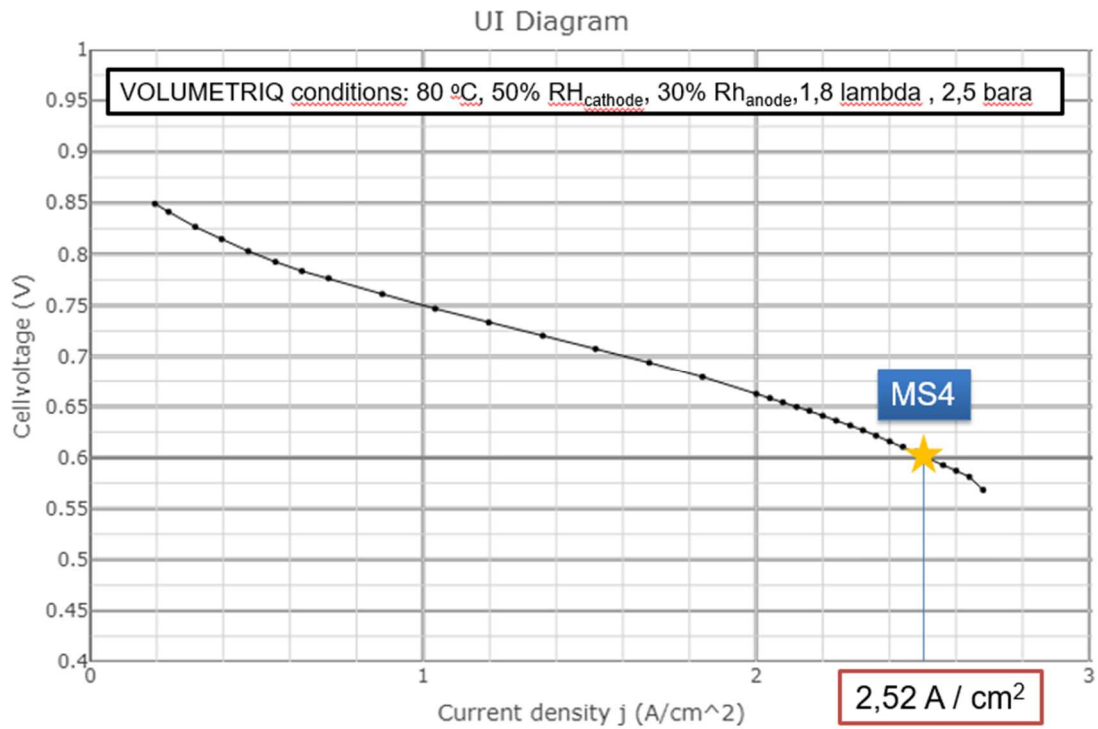


Figure 3: IV plot under the VOLUMETRIQ conditions, where the achievement of milestone 4 is shown.

Comments on the results / V-I polarisation plots

VOLUMETRIQ Conditions:

- Measurement starts at 0,2 A/cm<sup>2</sup> and goes up to 2,7 A/cm<sup>2</sup>
- At 2,52 A/cm<sup>2</sup> the voltage is still at 0,6 V which provides a power density of 1.5 W/cm<sup>2</sup>
- At higher current densities the voltage drops faster, which indicates a beginning of diffusion limitation.
- The project performance target is achieved under the required operating conditions.

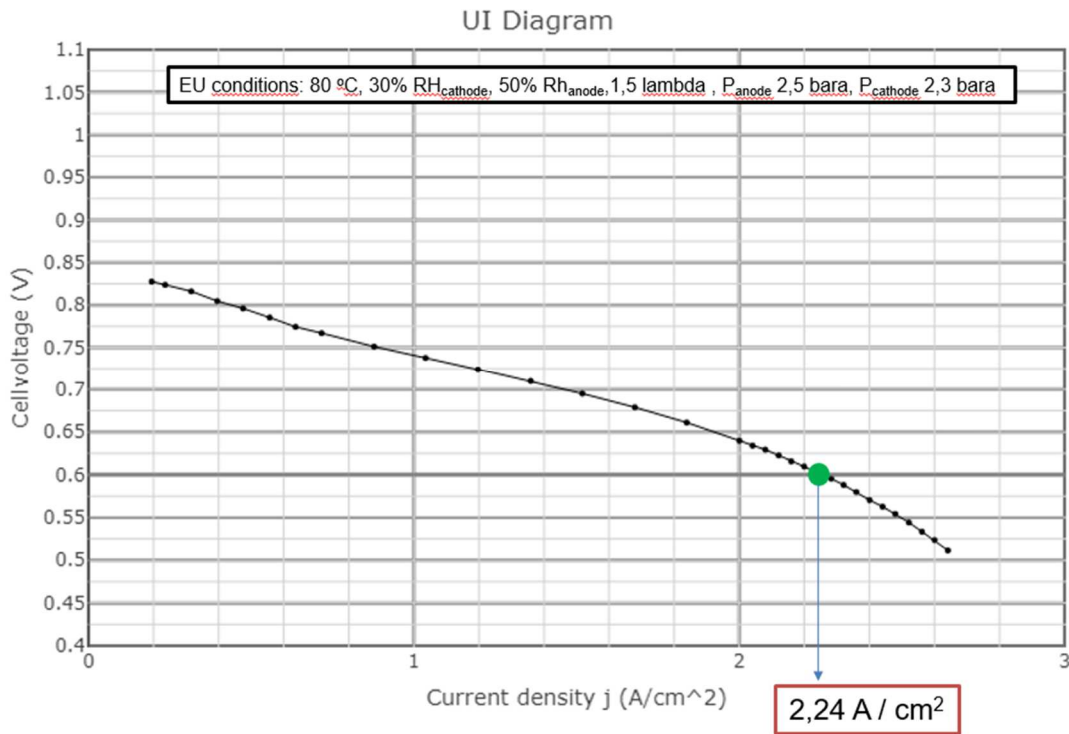


Figure 4. I-V plot under EU reference conditions.

EU reference conditions:

- Under the EU reference conditions with slightly lower gas stoichiometry, the current density at a voltage of 0,6 V was 2,24 A/cm<sup>2</sup>.
- The voltage slope at higher current indicates a more pronounced diffusion limitation under this conditions

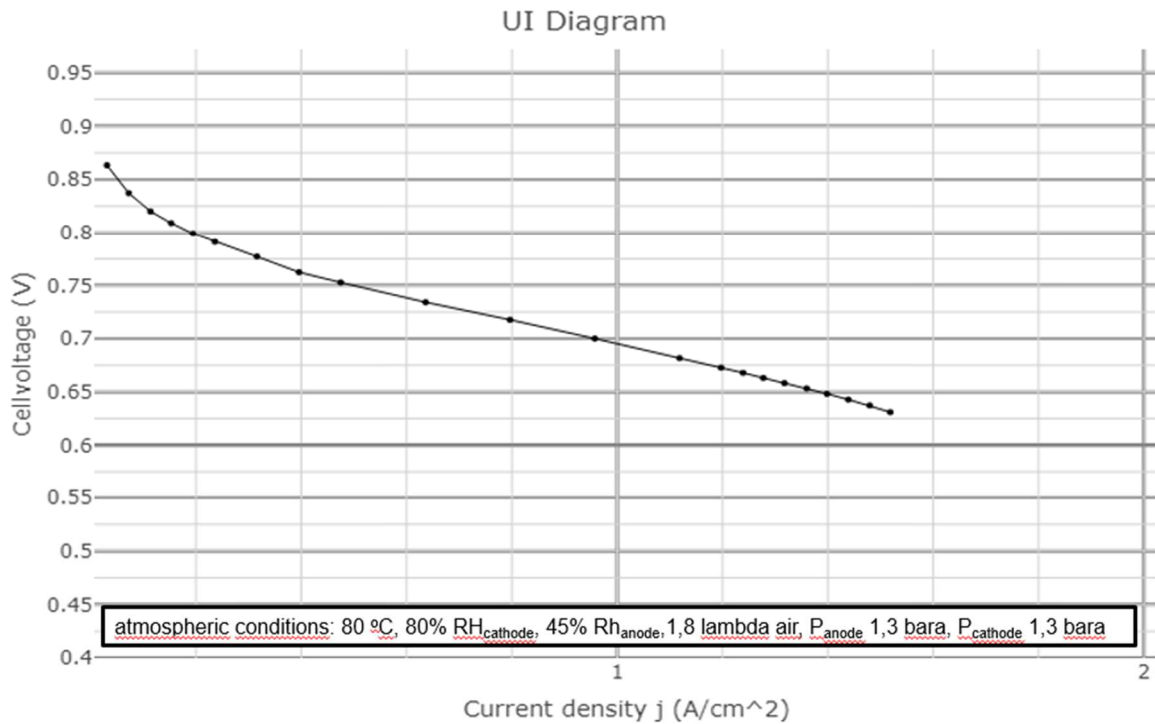


Figure 5: IV plot under EK reference conditions.

In Figure 5 the EK-defined reference polarisation line is shown with a cathode inlet pressure of 1.3 bara.

- As expected, under lower operating pressure conditions, the power density is lower than in a pressurised environment. The trade-off is the lower compression power needed for the fuel cell system.

### 3. CONCLUSIONS AND FUTURE WORK

As demonstrated by the results in this report the performance target of D2.5 and MS4 has been achieved. The continuation of this deliverable is the demonstration of the NM12 full-size stack that meets the performance target of 90 kW.