Funded by the European Union

The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research

Clean Hydrogen
Project BRAVA
No. 101101409

T3.3 - Deliverable D3.2 – Report
AM HEX requirements and KPIs

Deliverable Details

Deliverable No.	D3.2
Related WP	WP3.3
Deliverable Title	AM HEX requirements and KPIs
Deliverable Date	31/03/2023
Deliverable Type	REPORT
Dissemination level	Sensitive – member only (SEN)
Author(s) and contributors	Morpheus - Javier Viñuales Morpheus - Ahmed Hussein MADIT - Javier Díaz Airbus - Lucía Bayona Airbus - Esteban Martino
Checked by	WP Leader: Lucía Bayona Expert reviewer: Esteban Martino - Desi Bacheva
Final approval	Airbus Coordinator name - David Jullien

Change History

Version	Date	Changes	Done by	Approved by
V1	27.03.2023	First Version	Lucía Bayona	David Jullien

List of Acronyms and Abbreviations

Abbr.	Description	Abbr.	Description
2-PC	Two-phase cooling	MTBF	Mean Time Between Failure
A/C	Aircraft	MTC	Motorised turbo-compressor(s)
AM	Additive Manufacturing	NM	Nautical mile
BoP	Balance of Plant	OCV	Open circuit voltage
BPP	Bipolar plate	OEM	Original Equipment Manufacturer
CCM	Catalytic coated membrane	PAX	Passengers
CA	Consortium agreement	PFSA	Perfluorosulfonic acid
CFD	Computational fluid dynamics	PGS	Power Generation System
CL	Catalyst layer(s)	POD	PGS Unit
DCE	Dissemination, Communication and Exploitation	PPS	Propulsion Power System
DMU	Digital mock-up	PEM	proton exchange membranes
EASA	European Union Aviation Safety Agency	PEMFC	Proton Exchange Membrane Fuel Cell
EOL	End of Life	PM	Particulate matter
FC	Fuel Cell	RAC	Ram Air Channel(s)
FL250	Flight level 250 (= 25,000 ft)	RH	Relative humidity
GHG	Greenhouse gas	SAF	Synthetic aviation fuel
GT	Gas turbine	SLM	Selective Laser Melting
HEX	Heat Exchanger(s)	SoA	State of the Art
IP	Intellectual property	SRIA	Strategic Research and Innovation Agenda
IPN	Interpenetrating polymer networks	TMS	Thermal Management System
IPR	Intellectual property rights	TEFO	Total Engine Flame Out
ISA-35	International Standard Atmosphere	TO	Take-Off
KPI	Key Performance Indicator	ToC	Top of Climb
KSO	Key Strategic Orientations	TOGA	Take-Off and Go-Around
L2	Liquified hydrogen	TRL	Technology Readiness Level
MEA	Membrane Electrode Assembly	VOC	Volatile organic compounds
MCU	Motor control unit	XCT	X-ray Computed Tomography
		ZEROe	Airbus initiative towards zero emission aircraft

Executive Public Summary

BRAVA will develop breakthrough technologies for the key subsystems of a dedicated Power Generation System (PGS) for aviation with a performance target in the range of 2 MW.

Advances in the Thermal Management System (TMS) and a compact HEX design through Additive Manufacturing (AM) technology will act as a building block among other main ones to boost the efficiency of the PGS.

In particular, heat exchangers (HEX) from the TMS within this high performing PGS need to dissipate up to 1 MW of heat while being compact, lightweight and corrosion resistant, considering the environmental conditions to which they are subjected. Another major challenge is the integration between the HEX core, the manifolds and the rest of the surrounding liquid-air interfaces, given the fact that conventional heat exchangers have a cubical shape.

Therefore, AM technology brings design flexibility and integration as the main advantages. The aim is to develop a disruptive and complex shape HEX that can fit in the available volume within the engine fairing. By making the fairing more compact and streamlined, the drag of the overall A/C is reduced, contributing to the reduction of fuel consumption.

This Deliverable 3.2 Report as part of the *T3.3. AM Heat Exchangers and KPIs* outlines the technical requirements and technical activity description to be conducted within BRAVA focusing on the deliverables, KPIs and identified risks and mitigation strategies.

5. Acknowledgments

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

#	Partner short name	Partner Full Name
1	A-D	AIRBUS OPERATIONS GMBH
2	A-E	AIRBUS OPERATIONS SL
3	AER	AEROSTACK GMBH
4	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
4.1	UM	UNIVERSITÉ DE MONTPELLIER
5	HER	HERAEUS DEUTSCHLAND GMBH & CO KG
6	LTS	LIEBHERR AEROSPACE TOULOUSE SAS
7	MAD	MADIT METAL S.L.
8	MOR	MORPHEUS DESIGNS S.L.
9	NLR	STICHTING KONINKLIJK NEDERLANDS LUCHT – EN RUIMTEVAARTCENTRUM
10	SOL	SOLVAY SPECIALTY POLYMERS ITALY SPA
10.1	RHOP	RHODIA OPERATIONS
10.2	RHLA	RHODIA LABORATOIRE DU FUTUR
11	TUB	TECHNISCHE UNIVERSITÄT BERLIN

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101101409. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Clean Hydrogen Joint Undertaking. Neither the European Union nor the granting authority can be held responsible for them.