University of Plymouth
New Engineering and Design Facility (NEDF)

Requirements Specification
Composites Engineering Laboratory

WP3-1: Aeroform Autoclave Refurbishment

Purpose of this document

- To specify the resources for WP1 of the Composites Engineering Laboratory

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1. Background

The University of Plymouth is looking to reinforce its reputation as an innovative centre of excellence for engineering research, teaching and learning. The new Engineering and Design facility (NEDF) being constructed on the western edge of the main Plymouth campus will provide a new home for the specialist laboratories and teaching facilities of the School of Engineering, Computing and Mathematics and the School of Art, Design and Architecture.

NEDF integrates a fully refurbished Babbage Building with a new-build, wrap-around area to create more than 10,400m² of research laboratories and teaching spaces. New, state-of-the-art resources are planned that will enable engineering teaching and research to underpin the fourth industrial revolution and complement existing equipment. The new building and its physical resources will inspire the development of new inter-disciplinary activities in teaching, learning and research, and nurture the innovative graduate engineers demanded by future society.

2. Composites Engineering Laboratory

The Composites Engineering Laboratory for NEDF has two roles:

1. To provide engineering students with a hands-on experience of composite materials and structures, composites manufacturing, and composites characterisation using industry standard equipment and testing methods.
2. To provide a facility for development of novel composite materials and small-scale components for research and commercial applications.

This document sets out our requirements for refurbishment of existing equipment that will support these two roles.

3. Requirements for Refurbishment of Existing Equipment

WP1: Aeroform Autoclave Refurbishment

Our existing Aeroform Autoclave (Figure 1) which was first commissioned in 1989.

Figure 1: Plymouth Aeroform Autoclave

The cylindrical working volume is 670 mm diameter by 1600 mm long with a maximum temperature of 400ºC (673K) and maximum pressure of 1380 kPa (14 bar/atmospheres). When operating with an air environment, pressure is provided by an Ingersoll Rand 3 cylinder 2 stage compressor. The autoclave could also be configured for pressurisation from liquid nitrogen cylinders. Ten 3kW electrical heating elements are positioned in an annular channel adjacent to the insulated vessel wall with the air circulation driven by a 3.5 kW fan (~34 kW system overall). The control system currently runs on PID and manually operated valves.

Table 1: Operational Characteristics of Plymouth Aeroform Autoclave

Cylindrical Volume	≈ 0.56 m^3
Cylindrical Diameter	0.67 m
Cylindrical Length	1.60 m
Maximum working temperature	400°C
Maximum working pressure	14 bar
Electrical Heating	10 x 3 kW
Air Circulation Fan	3.5 kW

Our intentions are to move the Aeroform Autoclave to the new Composites Engineering Laboratory in NEDF. This provides an opportunity to refurbish the autoclave, modernise its primary services, and update its control system. We would also like to explore the feasibility to extend its capability to support some innovative composites manufacturing techniques.

We invite tenders to supplier the following bundles of work as described below:

Lot 1	**Site Visit**	
Qty	**Ref**	**Description**
1	**CL16a**	A suitably qualified engineer to visit the University of Plymouth and inspect the Aeroform Autoclave in-situ, and assess the condition of the pressure vessel and its associated services. Discuss with end-users the scope of works and performance specification of the refurbished autoclave. Agree a time plan for completion of all tasks. Issue a fixed price tender for refurbishment of the autoclave.

Lot 2	**Removal from Site**	
Qty	**Ref**	**Description**
1	**CL16b**	Uplift and removal of Aeroform Autoclave from existing location at the University of Plymouth and transport to an appropriate place for refurbishment works to be completed (or undertake work on campus)?.

Lot 3	Autoclave Refurbishment	
Qty	**Ref**	**Description**
1	**CL16c**	Strip down autoclave and remove all components agreed to be replaced. Clean and make good working condition of the pressure vessel. Make good all service connections and electrical wiring. Enable the autoclave to be operated under pressure using liquid nitrogen supplied from remotely stored bottles. Fit a PC-based control system with software safety checks suitable for operation by students and staff. The control system should use remotely operated valves and safety inter-locks with feedback to the control unit. Certify safe working limits of the autoclave.

Lot 4	Autoclave Installation	
Qty	**Ref**	**Description**
1	**CL16d**	Transport refurbished autoclave to University of Plymouth and position in the new Composites Engineering Laboratory in the NEDF building. Install and connect to local services, commission and calibrate in situ in June / August 2023

Lot 5	On-site Training	
Qty	**Ref**	**Description**
1	**CL16e**	Provide on-site training to staff and research students on how to operate and maintain the refurbished autoclave.

Lot 6	"Cool-Clave" Optional Upgrade	
Qty	**Ref**	**Description**
1	**CL16f**	The "Cool-clave" project requires power feeds inside the pressure vessel for electrical heating of mould tools. The pressure vessel has unused penetrations that are currently blanked off that could provide a route for the additional electrical connections required. Specification to be agreed following dialogue between end users and supplier

4. General Requirements

4.1 Supplier should be an established original equipment manufacturer of industrial quality autoclaves with the management of the design and manufacture of original equipment conforming to ISO9001 and evidence that their products are used by UK based aerospace and automotive manufacturers.

4.2 Supplier should have an established UK service and support facility and evidence their ability to support the University of Plymouth campus in an effective manner.

4.3 The autoclave should be powered from a 50 Hz 240 V ac single phase and 50 Hz 415V ac three phase electricity source and conform to the Supply of Machinery (Safety) Regulations 2008: Great Britain.

4.4 Demonstrate that the autoclave was suitable for use by appropriately trained University staff and students in a way that fulfils the Provision and Use of Work Equipment Regulations 1998 (PUWER 98)

4.5 Suppliers need to be sympathetic to the role of the University as a technology-led research, teaching and learning environment and demonstrate how the capabilities of the autoclave are future-proofed to remain as state-of-the art.

4.6 The supplier should identify and specify any building infrastructure and services requirements and ensure conformance to relevant building regulations, e.g. Part B (Fire) Part P (Electrical Safety) Part F (Ventilation).

4.7 The supplier should outline the specifications of any external computer hardware and software required to operate the autoclave where required.

4.8 The supplier must provide a list of consumables and costs associated with ongoing operation of the autoclave.

4.9 All essential software applications will be licenced for 3 years in the first instance.

4.10 Supplier should use an experienced and suitably qualified team to deliver to site, offload to the new Composites Engineering Laboratory in NEDF building, position, commission and calibrate in situ in June / August 2023.

4.11 The supplier will provide a minimum 3 year warranty for all components.

4.12 The supplier will provide an on-site maintenance and support plan with ongoing costs.

4.13 The supplier will provide on-site training to University of Plymouth staff.

4.14 The supplier will define any specific environmental control measures, e.g. temperature control, humidity control, air purification, required during operation

5. Budget Costs

A total budget of circa **£60k excluding VAT** has been allocated for the packages of work specified in Section 3. Please provide budget costs for supply of the individual lots and recommend any additional features or accessories that may be useful to include in the overall package.

6. Terms and Conditions of Supply

The University of Plymouth Standard T&Cs of supply can be found here: https://www.plymouth.ac.uk/about-us/university-structure/service-areas/procurement/terms-and-conditions

7. Procurement

The procurement process will be managed by the University of Plymouth procurement team.

Prospective suppliers may propose more than one solution to enable a fuller assessment of the options available. As the sole supplier (post-tendering), please outline the collaborative / sponsorship arrangements with the University that you are willing to support to ensure the functionality and capability of the autoclave are future-proofed, remain at the state-of-the art, and relevant to the changing needs of high valued added engineering industries.