Use of Hydrothermal Autoclave Vessels at UNSW

Introduction

In March 2021 a Hydrothermal Autoclave Vessel exploded in an oven. The circumstances of this incident resulted in UNSW ceasing the use of all hydrothermal autoclave vessels. This document provides guidance on the actions required to recommence use of the hydrothermal autoclave vessels.

Process to review and recommence use of Hydrothermal Autoclave Vessels

Some of the key findings from the incident investigation revealed the following improvement areas:

1. Only vessels compliant with the relevant AS/NZS standards or legislation or certified as safe to operate, considering design, pressure and temperature, by a UNSW authorised assessor or supplier can be put into use at UNSW.
2. All vessels must be stored in a locked cupboard.
3. The condition of vessels prior to use must be inspected by the user and the use logged to monitor any potential wear or erosion to the stability of the vessel as per the manufacturer's recommendations.
4. The nature of the task involving a vessel must be assessed, this includes that the task assessment is comprehensive and appropriate via current RMF and SWP that includes the calculation of pressure developed during the experiment application of appropriate engineering controls, and the appropriate authorising of the supervisor or manager sign-off prior to undertaking the task.
5. Confirmation of the users' competency (through training or assessment) and the provision of appropriate supervision based on the users' competency.
6. Verification that all engineering controls and PPE are in place prior to commencing the task.

To support UNSW in acting on these improvements and enable hydrothermal autoclave vessels to be re-introduced to service the following actions are required in the interim.

A. Preparatory Actions

Acknowledging that UNSW currently has a range of Hydrothermal Autoclave Vessels, the following preparatory actions must be conducted for each vessel. These include:

1. Asset Register of all vessels (refer Appendix A).
2. Review of the guidance for vessels and associated equipment to determine if the vessel can be re-introduced for use. Note the following:
    a. Parr hydrothermal vessels less than three years old with documentation can be made available for use.
    b. Non-Parr vessels and Parr vessels more than three years old certified by a UNSW authorised assessor as being safe to operate considering design, pressure and temperature can be made available for use.
    c. All other vessels which do not meet the requirements of (a) and (b) above must be taken out of service.

d. Inspection of all vessels to be re-introduced to determine any flaws or faults, such as shape distortion, corrosion, chemical pitting *etc.* (guidance is provided in Appendix B).

e. Ensure that all vessels are stored in a locked cupboard to control access and use is logged.

f. Confirmation that SWP and RMF's align with the detailed nature of the master SWP and RMF provided in Appendix C.

g. Confirmation that all equipment and PPE is available for use in the labs where the activity will be conducted.

h. Training content is appropriate.

Where the vessel and guidance materials meet the requirements outlined above, the Head of School (or his/her delegate) must sign off and endorse the introduction of the vessel for use.

B. Pre-Start Checklist

Once the above actions are complete and the outcomes align with the guidance to proceed, the following actions are required as the procedural first steps for any activities/tasks requiring hydrothermal autoclave vessels.

a. To re-introduce the vessel the supervisor or qualified delegate must be present to confirm:
    i. The competence and supervision of the user is aligned to the experiment
    ii. The pre-start checklist in Appendix D is completed.
    iii. The set-up of the equipment is aligned to the SWP.
    iv. The controls listed in the RMF / SWP are adopted.
    v. The user has PPE as specified by the RMF.

b. At the completion of the experiment, the user must:
    i. Return to vessel to the storage cupboard.
    ii. Log the use of the vessel in the logbook.
    iii. Inspect the condition of both autoclaves and PTEF cups and log the findings. Only those autoclaves that pass all areas of assessment can be used.

Where a vessel has been re-introduced previously to this use, the following pre-start activity is required.

a. Complete the pre-start checklist.

b. Return to vessel to the storage cupboard.

c. Log the use of the vessel in the logbook.

d. Inspect the condition of the device to enable it to be available for future use.

Appendix A: Asset Register: Refer to the Excel spreadsheet

High-pressure Reactive Vessels Register

Name of School:	

Equipment ID number	Location	Vessel Title	Vessel volume	Custodian	Manufacturer	Date purchased	Compliance with AS/NZS Standards or certification	SafeWork Procedure name and/or code	Is training provided on vessel use?	Are user training records kept?	Do you have a maintenance program/ records?	What heating device is used with this vessel?

Appendix B: Inspection Guide

The following items are required to be inspected and recorded after each use to ensure the vessel can be kept in operation.

Where the vessel is has been cycled 100 times or is 2yrs of age (whichever is the lesser), it must be sent for assessment by a UNSW authorised assessor.

Equipment ID number	Location	Vessel Title	Vessel volume	Custodian	Manufacturer	Date purchased

Date of Use …….. **Person using device: ……..** **Title of Experiment: …….**

Observation		Inspection detail	If 'YES' – ACTION REQUIRED	Rectification Date	Condition Status Pass / Fail
Bottom plate deformity	YES NO N/A		Replace the plate if deformity exists		
Discolouration of the inside of the metal body	YES NO N/A		Re-polish the metal body to remove any metallic corrosion product		
Corrosion disc and or blow-off disc corrosion and or signs of wear	YES NO N/A		Replace discs		
Cups and assembly parts are specific to vessel – no interchange	YES NO N/A		Ensure cups and assembly parts remain for the sole use of the vessel		
Corrosion/deformity of the cups and covers	YES NO N/A		Replace cups and corresponding cover		

Unusual damage or wearing of the liner OR liner exceeds number of safe uses	**YES** **NO** **N/A**		Replace the liner		

Condition Status	**AVAILABLE FOR USE** - all inspection items pass **NOT FOR USE**– out of use until repaired /replaced.

Appendix C: Master SWP and RMF

Refer to the two word documents

Appendix D: Pre-Start Checklist

This checklist is to be used prior to the commencement of the activity.

SAFETY FIRST

- ❑ Are you trained in this procedure?
- ❑ Have you confirmed the calculation of temperature/pressure to be used?
- ❑ Is the calculated temperature within vessel limits/chemical reaction limits as indicated by the manufacturer's recommendation?
- ❑ Is there a dedicated heating device engineered not to exceed reaction vessel limits as indicated by the manufacturer?
- ❑ Have you set the appropriate temperature on the heating device (it must not exceed 250 ^{0}C)?
- ❑ Following inspection of the outside and inside of the vessel and the liner, is it free from damage/deformity, discolouration inside the vessel, using cups and assembly parts specific to this vessel?
- ❑ Is the reaction liner within usage limits listed by the manufacturer (i.e. how many uses is recommended)?
- ❑ Is a fume cupboard / extraction fan available, if the procedure requires it?
- ❑ Are you wearing or intend to wear:
  - ❑ Safety glasses
  - ❑ Face Shield when loading /unloading the vessel in the heating device,
  - ❑ Lab coat,
  - ❑ Closed-toe shoes,
  - ❑ Heat protective gloves
- ❑ If the heating device is not isolated or oriented to limit exposure, have you a physical safety guard or shield available to place in front of the heating device?
- ❑ Is there an appropriate first aid kit and spill kit available in the lab for this procedure?

Signed by: …… Date: ……

Supervisor signature: …… Date: ……