

INSTRUCTION MANUAL

Product: Steel-lined PTFE Hydrothermal Digestion Vessel / Hydrothermal Synthesis Reactor (25 / 50 / 100 mL)

1. Product Description

The steel-lined PTFE hydrothermal digestion vessel is designed for laboratory research applications involving high-temperature and high-pressure chemical reactions.

Typical applications include:

- Sample digestion for ICP-MS, AAS, and AFS
- Trace element analysis and sample preparation
- Hydrothermal synthesis
- Organic synthesis
- Crystal growth
- Corrosion-resistant high-purity reactions

This equipment is intended for laboratory research use only. It is not intended for industrial production, continuous operation, or large-scale pressurized processing.

2. Technical Specifications

- Available volumes: **25 mL / 50 mL / 100 mL.**
- Recommended maximum operating temperature for routine work: **200 °C.**
- Conservative maximum allowable working pressure for standard steel-lined PTFE vessels: **3 MPa at 200 °C.**
- Recommended routine fill volume: **1/3 to 1/5** of the PTFE liner capacity.
- General fill limit for routine work: not more than **60%** of the PTFE liner capacity.
- Absolute upper fill limit: never exceed **80%** under any circumstances.

The limits stated above are unified operating limits for safe routine laboratory use. If a specific vessel model, nameplate, or manufacturer instruction states a lower limit, the lower limit shall apply.

3. Operating Limitations

The specified pressure and temperature limits apply only when:

- The fill volume does not exceed the approved operating limit
- The reaction system does not generate rapid or excessive gas
- The vessel is properly assembled and tightened according to instructions
- Heating is gradual and controlled in an oven
- The equipment is free of mechanical damage, deformation, cracking, or leakage
- The actual internal pressure depends on:
 - ◆ Reaction temperature
 - ◆ Solvent vapor pressure
 - ◆ Chemical gas generation
 - ◆ Reaction kinetics
 - ◆ Fill volume

Users must perform an appropriate risk assessment before conducting any high-pressure reaction. For gas-evolving, oxidizing, corrosive, or thermally unstable systems, a reduced charge and a more conservative fill volume shall be used.

4. Personal Protective Equipment and Pre-Use Inspection

- Minimum personal protective equipment: laboratory coat, chemical-resistant gloves, and safety goggles or face shield.

- For corrosive, volatile, mixed-acid, hydrofluoric acid, perchloric acid, hydrogen peroxide, or aqua regia systems, loading and opening shall be performed in a fume hood.
- Before each use, inspect the PTFE liner, PTFE lid, steel sleeve, pads, threads, clamp, and bolts as applicable.
- Do not use the vessel if the liner shows deformation, cracking, whitening, leakage traces, or poor lid fit.
- Do not use the vessel if the metal body shows corrosion, thread damage, distortion, or mechanical cracking.
- Confirm that all pads and sealing parts are present, clean, and correctly oriented before assembly.

5. Operating Instructions

5.1 Before Use

- The PTFE liner should be cleaned and, if required, acid-washed before initial use or after long storage.
- Rinse thoroughly with clean water or deionized water and dry as required by the procedure.

5.2 During Loading

- Add sample and solvent into the PTFE liner.
- Use the minimum practical charge for the intended reaction.
- Prefer a fill volume of 1/3 to 1/5. For routine work, do not exceed 60%. For gas-evolving systems, use a lower fill volume.
- Close the PTFE lid securely.

5.3 Assembly

- Place the liner into the stainless steel sleeve or vessel body.
- Install the lower and upper pads in the correct order and orientation for the model in use.

- Assemble the cap, clamp, or threaded closure and tighten manually. Excessive force is not required and shall not be used.

5.4 Heating

- The vessel shall be heated in an oven only. Open flame, hot plate, sand bath, oil bath, and direct furnace heating are prohibited unless explicitly approved for the exact model.
- Recommended staged heating for routine digestion work: heat to 100 °C and hold for 1 hour, then increase to the target temperature and hold according to the method.
- Typical working range for most routine reactions: 80 °C to 140 °C.
- Do not exceed 200 °C.

5.5 After Reaction

- Allow the vessel to cool naturally and completely to room temperature.
- Ensure that the internal pressure has returned to ambient pressure before opening.
- Open carefully with the body and face kept away from the opening direction.
- Clean and dry all components thoroughly after use.

6. Special Reaction System Controls

6.1 Gas-Evolving Reactions

Reactions that may release large amounts of gas require separate evaluation and a reduced fill volume and sample charge.

Examples include carbonate decomposition, sulfide reactions, strong oxidation of organics, metal-acid reactions, and systems with uncertain side reactions.

6.2 Strong Oxidizers and Mixed Acids

Perchloric acid, hydrogen peroxide, mixed acids, and other strong oxidizing systems shall only be used after specific hazard review and approval.

For highly reactive systems, use small-scale trials first.

6.3 Hydrofluoric Acid, Aqua Regia, and Other Corrosive Media

The PTFE liner has broad chemical resistance, but users remain responsible for confirming compatibility for the exact reaction system.

Metal parts shall be protected from corrosive residue, and all waste shall be collected according to the laboratory waste procedure.

7. Safety Warnings

- Never exceed the recommended temperature or fill volume.
- Do not use the vessel for highly gas-evolving reactions unless properly evaluated.
- Do not use the vessel if the liner or any pressure-bearing part shows deformation, cracking, corrosion, or leakage.
- Do not attempt to modify the vessel or substitute incompatible parts.
- Do not loosen bolts, clamps, or caps during heating or cooling.

Opening the vessel while hot or pressurized may result in serious injury, chemical exposure, or violent release of contents.

8. Cleaning, Storage, and Maintenance

- After each run, remove reaction residues promptly and clean the PTFE liner, PTFE lid, pads, and outer body with appropriate solvent and water.
- Acid washing may be used where required by the analytical method or contamination control procedure.

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- After cleaning, dry all components thoroughly.
 - Store matched components together by vessel number whenever possible to avoid mixing parts between assemblies.
 - Store in a clean, dry environment away from corrosive atmospheres and mechanical damage.
 - Any vessel that has experienced suspected over-temperature, over-pressure, severe corrosion, or abnormal deformation shall be removed from service pending inspection.

9. Abnormal Conditions and Emergency Response

- If leakage, smoke, unusual odor, or abnormal sound is observed during heating, stop heating immediately and isolate the area.
- Do not attempt to open, move, or dismantle the vessel while it is hot or may still be pressurized.
- Allow full cooling before further evaluation.
- If the vessel appears locked due to pressure or residue, do not force it open. Confirm cooling and zero pressure before any controlled opening attempt.
- In the event of burn injury or chemical exposure, follow the laboratory emergency response procedure immediately and seek medical attention as required.

10. Compliance and Liability

- This equipment is designed as laboratory research equipment.
- Unless explicitly stated in writing for the exact model, this product shall not be assumed to be certified under AS/NZS, ASME, PED, or other international pressure vessel codes.

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- Compliance with institutional safety regulations, local legal requirements, and internal approval procedures remains the responsibility of the end user.
 - The manufacturer or supplier shall not be liable for improper use, operation outside specified limits, over-pressurization, unauthorized modification, incorrect assembly, or failure to conduct proper hazard assessment.