

RFD Crab Cavity – BCP Procedure

****NOTE:** This procedure is based on a generic BCP procedure at JLAB. In general, each cavity has its own procedure specified by a customer. The procedure cover sheet will be added to inform the document number, procedure author, approver, revision and so on. The approved procedure will be saved in the document repository of SRF institute of JLAB. **

- (1) BCP Cabinet is located at the clean room in the Test Lab. Any personnel performing the BCP procedure should follow the gowning protocol of clean room.
 - The cleanroom meets ISO Class 4 and International Standard 14644
 - Has 100% HEPA filter coverage with at-grade perforated floor return
- (2) Cavity mounted vertically in the BCP Cabinet:

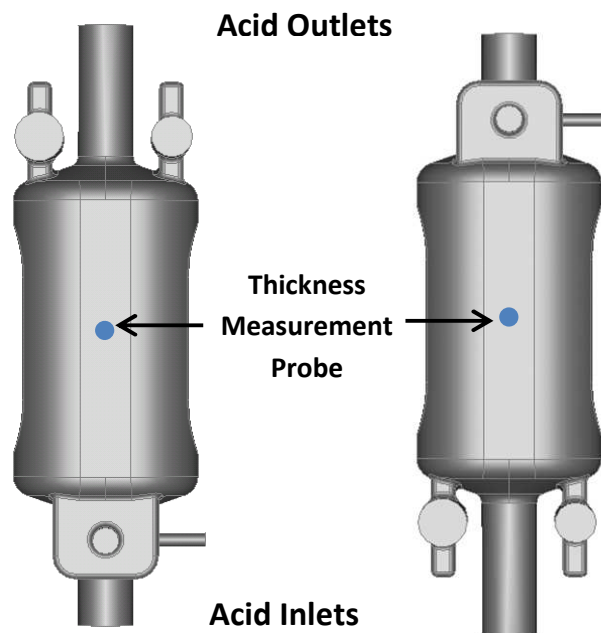


Fig. 1: BCP Cavity Orientation

- (3) Assemble BCP flanges (FPC flange, HHOM flange, beam tubes, VHOM flange and Pick Up flange) hardware as follows:
 - Install High-Density Polyethylene (HDPE) flange with Teflon Encapsulated Viton O-ring to FPC flange with stainless steel screws, washers, and silicon bronze nuts.

- Location of O-rings should be designed to prevent the acid contact with braze joints and flange surfaces.
- Beam tube flanges should be parallel to the floor during hardware installation to ensure proper O-ring centering.
- Use a crisscrossing pattern when tightening the bolts/nuts with socket wrench/stationary wrench combo.
- Tighten a little each time to avoid an uneven clamping effect on the flange surface. Do NOT over tighten, as this can lead to drastic bending in the flange itself OR stripping of the bolt head.

(4) Chemistry in the BCP tool

****NOTE:** The BCP tool shall be operated by qualified personnel only. **

- Install the stainless steel cage mount adapter into base of processing cabinet.
- Use Back-tech lift to place caged cavity into stand, making sure that the bottom beam line flange is in the lowermost position.
- Connect hose to each BCP flange and connect to manifold.

(5) Leak check

- Activate the “rinse cavity” feature on control panel; while the DI water is running inspect all the seal areas for any leaks. If leaks are present, tighten nuts/fixtures as needed.

(6) “In situ” thickness measurement setup

- Attach the probe near the high magnetic field region (Fig. 1) of the center cell of the cavity
- Route the probe cable through the vent hole so that the process doors can be closed
- Attach the probe cable to the handheld ultra-sonic gage controller. Turn on the controller and verify thickness reading
- Start Labview software on the chem tech CPU. Enter the appropriate values into the software and run the program
- Verify communication between Labview software and the ultrasonic gage controller
- Close process cabinet doors

(7) BCP tool control panel parameters

- Total removal of 150 μm in 4 iterations and flip the cavity after each iteration
- Follow BCP recipe:
 - Acid mixture of HF (49%) :HNO₃ (69.5%) : H₃PO₄ (85%) at 1:1:1 in volume
 - Sump temperature: 8 °C
 - Etch rate is monitored during the etching process

- The following variables needed to be adjusted within the sump screen:
 - Drain Delay: 85 seconds
 - Polish time: 15-20 minutes (Monitor total removal)
 - Polish Flow: 8 gpm
 - Process Flow: 6 gpm

(8) Start BCP processing

- Record amount of material to be removed in microns
- Record ultra-sonic thickness gage reading prior to BCP processing
- Start the BCP etch process and record start time
- Monitor the Labview software and/or thickness gage controller while BCP is flowing through cavity. The operator must stop the process when predetermined amount of material has been removed.
- Stop the BCP etch process and record actual BCP etch processing time in minutes
- Record ultra-sonic thickness gage reading after BCP processing

(9) Cavity Fill and Dump (F&D) procedure

- From the sump screen, press the “rinse cavity” button. Each rinse cavity series completed represent one F&D. Execute 10 complete F&Ds then unhook hoses allowing cavity to empty
- Remove all hoses from cavity
- Rinse external surfaces of cavity thoroughly with DI rinse gun

(10) Hot Ultra-Pure Water (HUPW) rinse at 81 °C nominal temp

- Loosen BCP flange hardware enough so that water will trickle out of the flanges during the HUPW rinse
- Connect HUPW line to cavity lower connection
- Connect resistivity meter hose to upper cavity connection
- Set the HUPW controller to 30 minutes and rinse cavity
- Ensure the HUPW flow does not overflow the process chamber sump
- Record HUPW resistivity after 20 minutes of rinsing
- When HUPW cycle is complete, turn on cabinet DI water spray for about five minutes to cool the cavity
- After cavity has cooled, disconnect hoses and chemistry hardware from cavity.

(11) Flip the cavity and repeat processes (2)-(10) for 3 more iterations.

(12) Record pertinent information in appropriate traveler and Chemistry Log Book: Polish Time & Flow, Process Time & Flow, Sump Temp & Level, Drain delay, Rinse Time, Fill & Dumps, and Overflow Resistivity (along with HPR variables when necessary).

- (13) Enter data into Acid Usage Excel File: Date, Cavity ID, Acid Etch rate ($\mu\text{m}/\text{m}$), Cavity Surface Area, Niobium Density (g/cm), Etch time (min), Acid volume (gal), Total Removal, Niobium volume in Acid (g/L), Total (g/L), and Microns (μm) removed.

References:



Fig. 2: Cavity mounting inside the BCP Cabinet.



Fig. 3: BCP Cabinet control panel.



Fig. 4: Thickness measurement probe.