



Abstract

During the last years encouraging results on improvements of acceleration gradients of TESLA TTF cavities are gained. In an industrial EP apparatus in use within the Collaboration of DESY and KEK in 2001 as well as treatments in the DESY electro-polishing facility acceleration gradients are pushed towards 40 MV/m by electro polishing. Beside the new surface preparation technique the subsequent handling- and preparation steps had to be adjusted to the needs of the electro-polished high gradient resonators. We report on the major differences in the treatment sequence of BCP and EP cavity handling. Changes on the infrastructure and tooling as well as processing sequences, adapted to the need of electro-polished resonators, will be described in detail.

### Procedures for Cavity Preparation

| Delivery              | installing and fabrication  | tank welding   | system component test                                  | module assembly  |
|-----------------------|---|--|--|--|
| acceptance inspection | aligning and cleaning<br>Titanium BCP inside<br>outside 20µm<br>insertion in room 2-1400°C annealing  | cleaning<br>aligning<br>ventilation of cavity with inert gas<br>electron beam welding of titanium rings        | adjustment of HOM resonator<br>cleaning-degreasing     | cleaning-degreasing<br>alignment of cavity n for module<br>ventilation of cavity |
|                       | insertion to room 2-1400°C<br>annealing<br>Titanium BCP inside 80 µm<br>outside 40µm                  | frequency control and adjustment<br>TIG welding of Nb for Ti connection<br>frequency control and field profile | 1st high pressure rise<br>assembly of flange tank test | assembly of connecting flange<br>assembly of cavity n+1                          |
|                       | raising of field profile<br>the flange pressure rise  | welding of helium vessel<br>break test of tank   | 2nd and 3rd high pressure rise                         | alignment of coupler port distance   |
|                       | assembly of flange tank test<br>2nd and 3rd high pressure rise<br>EP acceptance test for tank welding | insertion of pre-connector<br>break test of tank<br>assembly of tuner  | general track check<br>alignment and frequency control | assembly of power coupler<br>assembly of titanium vessel                         |
|                       |   | EP acceptance test for module assembly   | acceptance test for module assembly                    | assembly of power coupler<br>assembly of titanium vessel                         |



Cavity assembled to BCP stand

Established procedure for TTF cavities (BCP surface treatment)

### Sequences for electro polishing

**Assembly for Electro Polishing**  
Align sliding connectors  
Install frame to fixture  
Close circular sliding connector disc  
Install timing belt disk  
Connect current leads to stiffening rings  
Install cavity to EP apparatus  
Close EP frame  
Install bottom EP heads  
Insert electrode  
Leak check system



Alignment frame for sliding connector disc

timing belt disc; sliding connector disc; current leads to stiffening rings installed

Installation to EP apparatus completed

**Electro polishing process**  
Rinse cavity  
Fill cavity with UP water



EP Process control of current and acid outlet temperature

EP Process control of rinsing water inlet (LW2) and outlet (LW1)

**Remove Cavity from stand after EP**  
Remove electrode  
Cover top flange by blank off flange  
Disconnect tubes of bottom EP head  
Open EP frame  
Remove cavity from EP apparatus  
Remove timing belt disk  
Remove sliding connector disc  
Remove current leads to stiffening rings  
Hand over cavity to clean room



Remove electrode (open quick connect)

Remove electrode

Cover top flange by blank off flange

**Enter Clean room**  
Clean cavity exterior by car wash  
[detergent + DI water rinse]  
Clean cavity exterior with Ultrasonic  
[Cleaning at 50C for 20 Minutes]  
Rinse cavity exterior with UP water  
[R<= 14 MOhm cm]  
Exchange bottom EP head to rinsing flange  
Exchange EP blank off flanges to rinsing flange  
[HOM / Pick Up / Power coupler]  
Exchange intermediate blank off flange  
Install fine rinsing flange  
Rinse cavity interior  
[ 4 bar to R=18 MOhm cm]  
High Pressure rinsing of cavity interior  
[one path at 100 bar]



Disconnect tubes of bottom EP head

Remove timing belt disk; sliding connector disc and current leads to stiffening rings

Hand over cavity to clean room

The well established sequences for cavity with surface preparation by Buffered chemical polishing (BCP) processing and tank had to be adapted to the new infrastructure and needs of the EP processed surface.

- The DESY EP apparatus is located outside of the clean room and not clean room compatible (sliding current leads; motors; safety regulations)
- Due to the fact that actually there is no post processing treatment for EP cavities, dressed with helium tank, available new handling procedures have to be developed for tank welding.

|                          | BCP (TTF) | BCP/EP (DESY/KEK) | EP (DESY) |
|--------------------------|-----------|-------------------|-----------|
| Installation to frame    | X         | X                 | X         |
| Ultrasonic cleaning      | X         | X                 | X         |
| Installation of Tubes    | X         | X                 | X         |
| Removal of X µm (by)     | 80 (BCP)  | 80 (BCP)          | 180 (EP)  |
| remove from apparatus    | X         | X                 | X         |
| Outside chemistry µm     | 40 (BCP)  | 40 (BCP)          | 20 (BCP)  |
| 800 C annealing          | 3 h       | 3 h               | 3 h       |
| 1400 C post purification | 3,5 h     | 0 h and 3,5h      | NO        |
| Titanium removal µm      | 80 (BCP)  | 0-80µm (BCP)      | NO        |
| tuning                   | X         | X                 | X         |

| USE                | enter clean room after EP |
|--------------------|---------------------------|
| Car wash cleaning  | Detergent/ 5 min/ 80bar   |
| Car wash rinsing   | DI water/ 10 min/ 80 bar  |
| Ultrasonic         | T= 50 C / 20 Minutes      |
| UP water rinse     | R >= 12 MOhm/cm           |
| Exchange of        | EP heat short side        |
| Exchange of        | EP flanges (HOM; Pick Up) |
| Low pressure Rinse | 4 bar R>= 18 MOhm cm      |

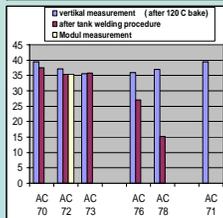
|                               | BCP (TTF)  | BCP/EP (DESY/KEK) | EP (DESY)  |
|-------------------------------|------------|-------------------|------------|
| Ultrasonic cleaning           | X          | X                 | X          |
| Installation of tubes         | X          | X                 | X          |
| Removal of µm                 | 20 (BCP)   | 100 (EP)          | 45 (EP)    |
| Cleaning for clean-room (USE) | No         | No                | Yes        |
| Exchange of flanges           | X          | X                 | X          |
| Low pressure rinsing          | 18 Mohm cm | 18 Mohm cm        | 18 Mohm cm |
| High pressure rinsing         | 1 time     | 1 time            | 1 time     |
| Drying in class 10            | X          | X                 | X          |
| Assembly of components        | X          | X                 | X          |
| High pressure rinsing         | 2 time     | 6 times           | 6 times    |
| Assembly of antenna           | X          | X                 | X          |

### C SEQUENCES FOR TANK WELDING

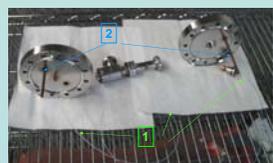
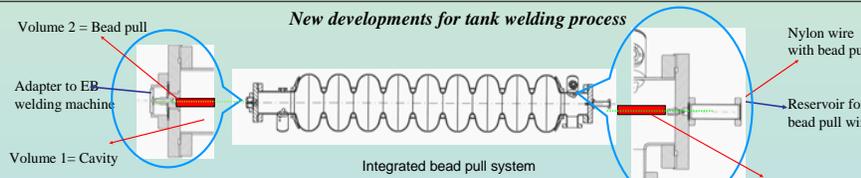
- Remove variable antenna
- Exchange power coupler port to High Q antenna
- Exchange Pick up probe
- High pressure rise
- Leak check and venting with Argon
- EB welding of tank interconnection
- Control of mode spectrum
- Cleaning for clean room
- Removal of Pick Up
- Removal of high Q antenna
- HP rinse
- Installation of bead pull
- Install mode spec. antenna
- Tuning
- Cleaning for clean room
- Removal mode spec antenna
- Installation of antennas
- HP rinse
- Leak check and venting with Argon
- Tank tube welding
- Cleaning for clean room
- Check field profile. Install / remove bead pull
- Installation of pick Up and HOM probes
- 6 times High pressure rinsing

### C NEW SEQUENCE WITH INTEGRATED BEAD PULL (UNDER TEST)

- Remove variable antenna
- High pressure rinsing
- Install integrated bead pull
- Pump and purge volumes
- EB welding of tank interconnection control field profile
- Tuning
- Tank tube welding control field profile
- Cleaning for clean room
- Remove integrated bead pull
- Installation of pick Up and HOM probes
- 6 times High pressure rinsing



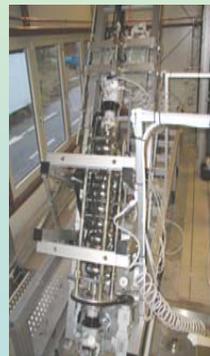
Change in cavity performance due to tank welding procedure



Cavity flanges with integrated bead pull [1] and antenna [2] (Cavity vacuum side)



Cavity flanges with pump units [1] and bead pull reservoir [2] (Cavity normal air side)



Cavity assembled to EP stand