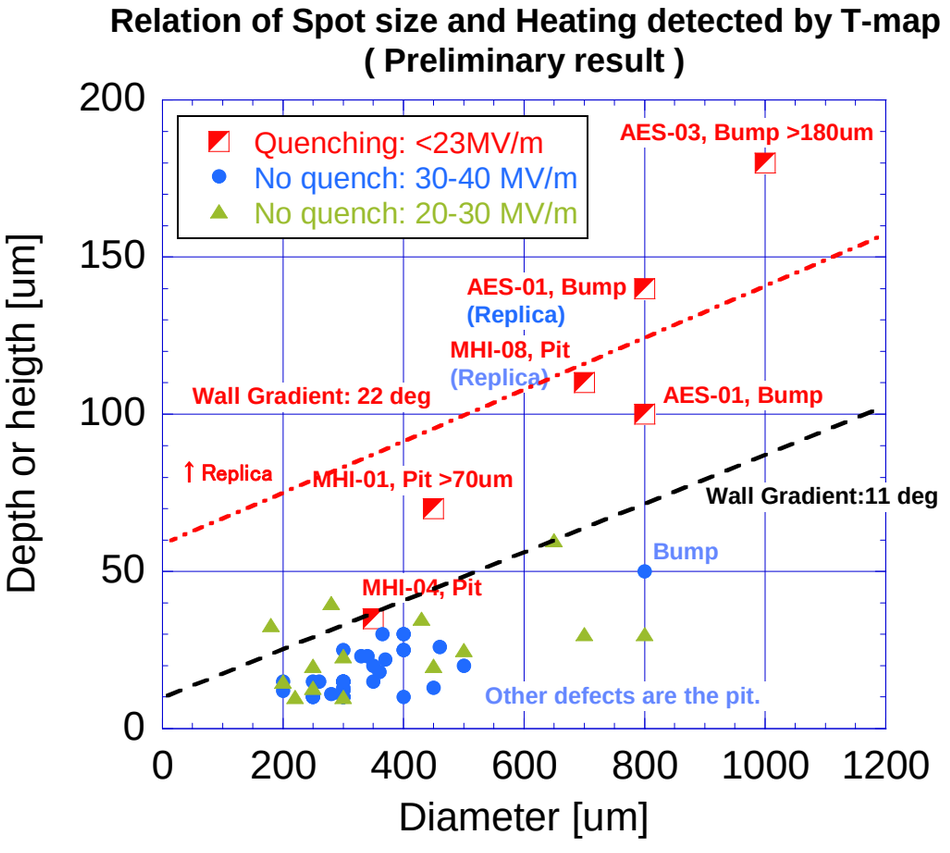
Replica and Local grinding

Repair for JLAB LG#1, AES-01, RI-026

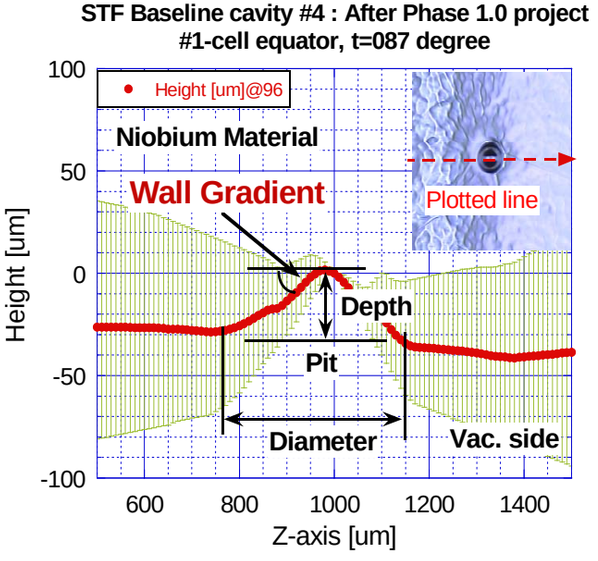
K. Watanabe (KEK)

Introduction



Found defects: 60 defects （13 cavities, 103 cells）

(Quenched defect: 6 defects, Poor EBW)



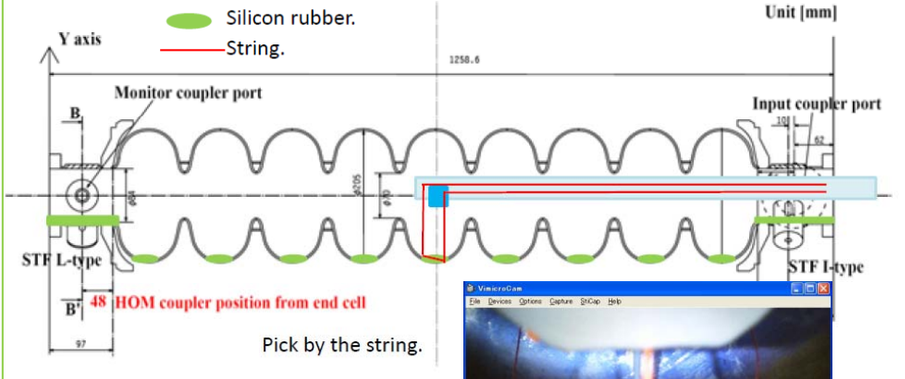
Maximum measureable wall gradient by the Kyoto camera system at Equator is ±22 degree. If the shape of defect is changing steeply, then the 2D-analysis for geometrical defect can not make by the Kyoto camera system.
To take a information for this defect, we need to use the replica method.

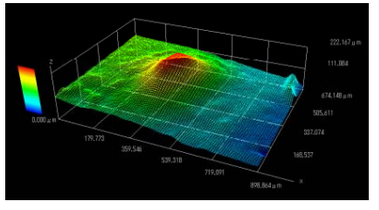
Replica (1)

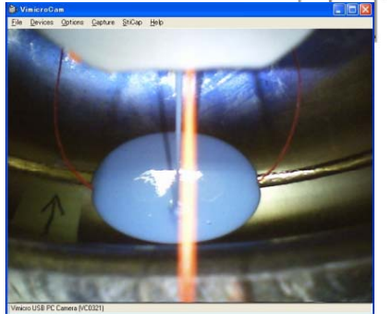
If the shape of geometrical defect can not measure by the Kyoto camera system.

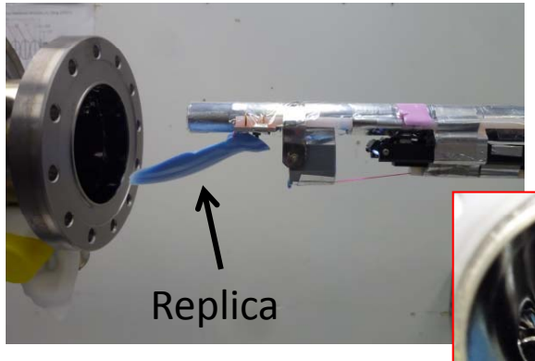
The replica method is useful to take a information of the shape of the defect.
We can take a replica by a special tool and humans hand.

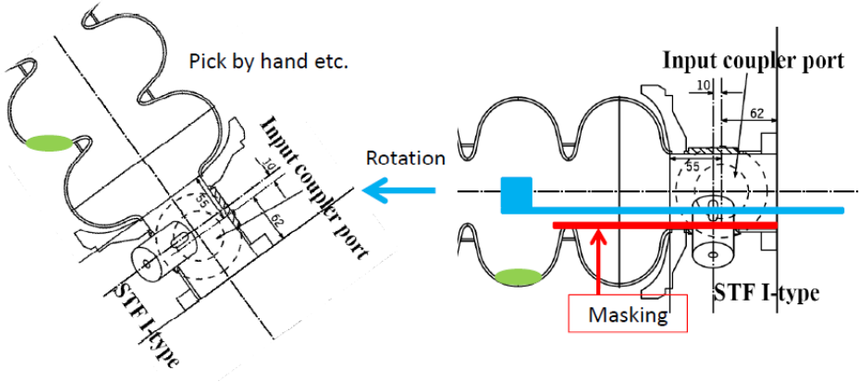
- All cell equators: Size 80 mm x 50 mm
- Beam tube
- The taper area of 1-cell and 2-cell





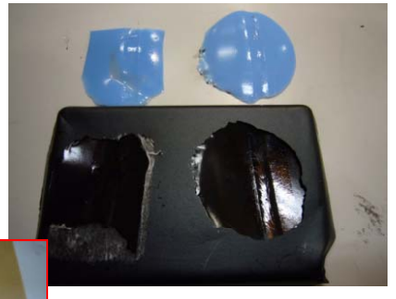


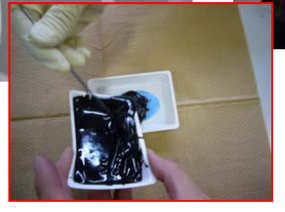




Replica (2)

1.Copy to the stycast (to make a positive shape).





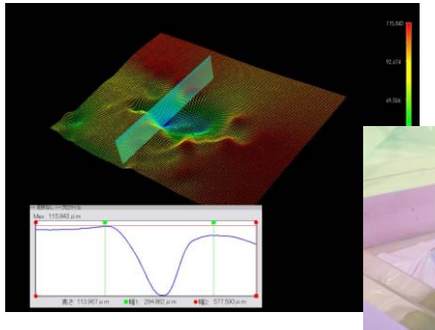
2. The real defect and the replica copied to stycast

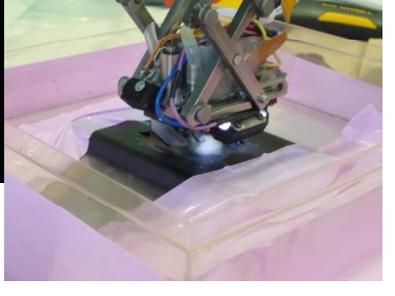
The replica is good reproduce for the mirror surface.

The replica of silicon rubber is reproduce a negative shape.
To make a positive shape, the staycast is used.
The stycast is very hard material after hard, then this positive replica also can use the fitting check for the local grinding.
And the shape of the surface of before and after grinding also can check by positive replica.

3. 3D-Analysis by the digital microscope etc..

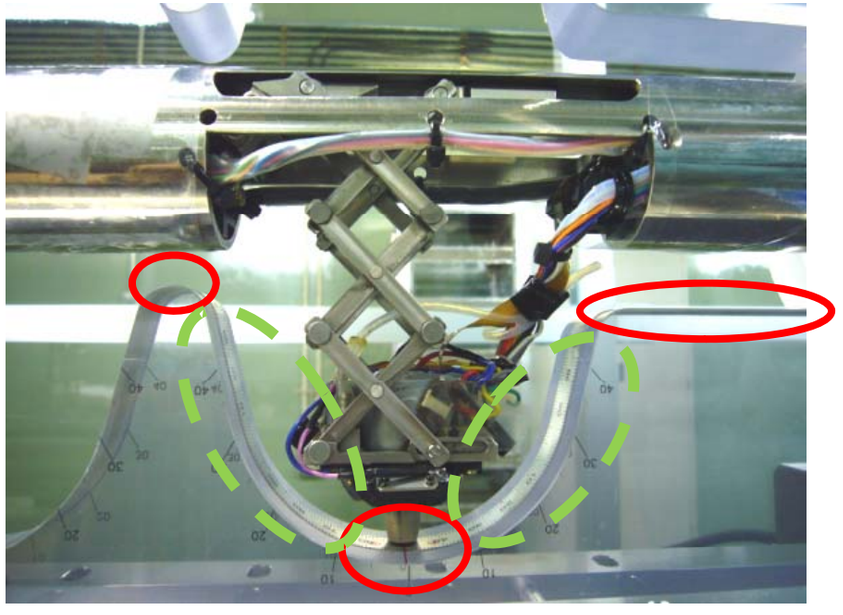
Make a Bench test for the Local grinding.





Local Grinding (1)

Grinder #1



To grind at a plane parallel to the beam axis.

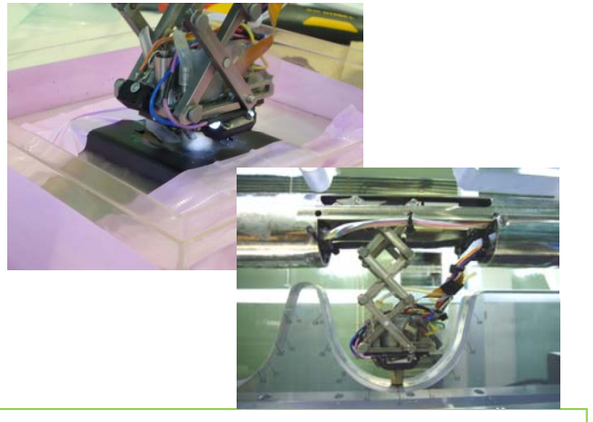
- Equator and Outside weld area on the equator
- Top of the Iris
- Beam tube etc..

Grinder #3

To grind at the reverse side of stiffner ring and the slant face etc..

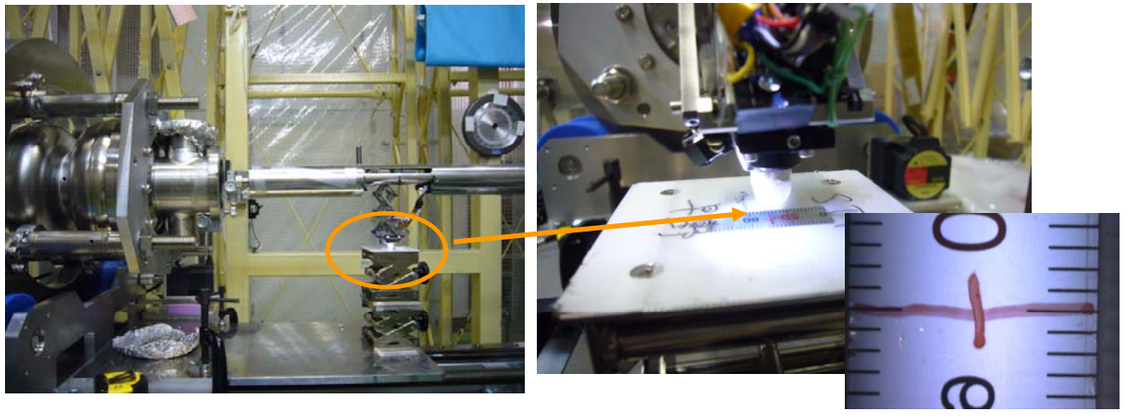
- Iris
- Taper locations

Local Grinding (2)

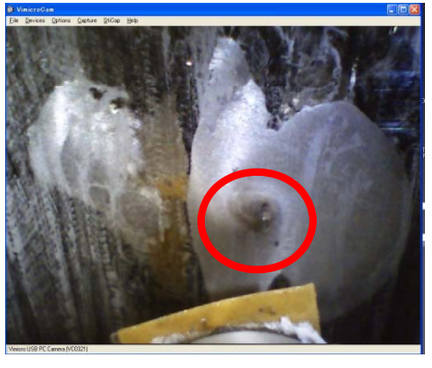


0. The Grinding test by positive replica

Fitting check by mock-up.



1. Grinder head positioning to the target. The target monitored using by the camera systems (USB camera on the grinder head and Kyoto camera).



Grinding : Diamond sheet on the head

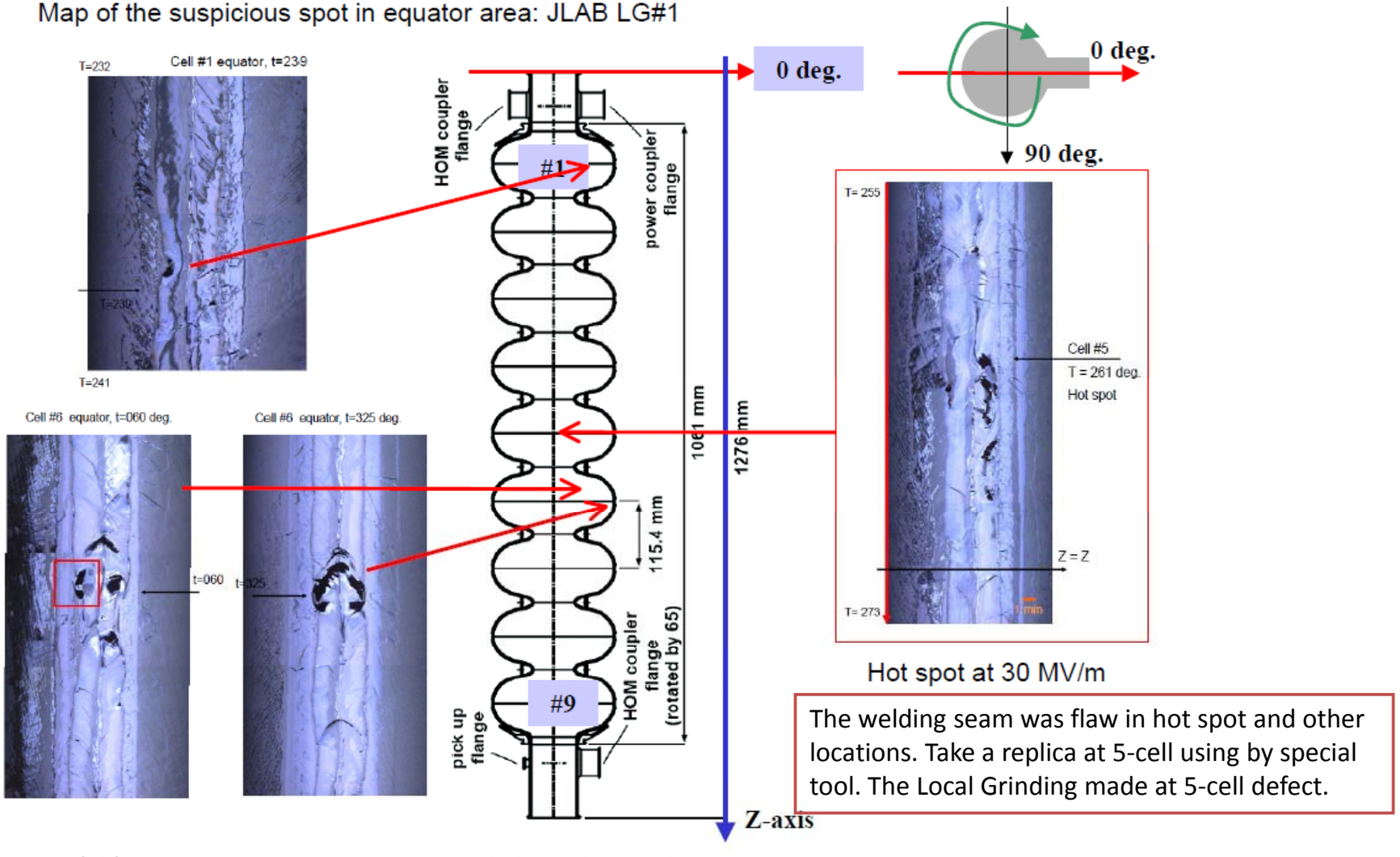
Cleaning: attached a paper towel on the head for wiping.

Image capture by Kyoto-camera

2. Repeat a grinding with water, cleaning and taking a image by camera system until removing the defect.

JLAB LG#1 (1) Initial

Map of the suspicious spot in equator area: JLAB LG#1

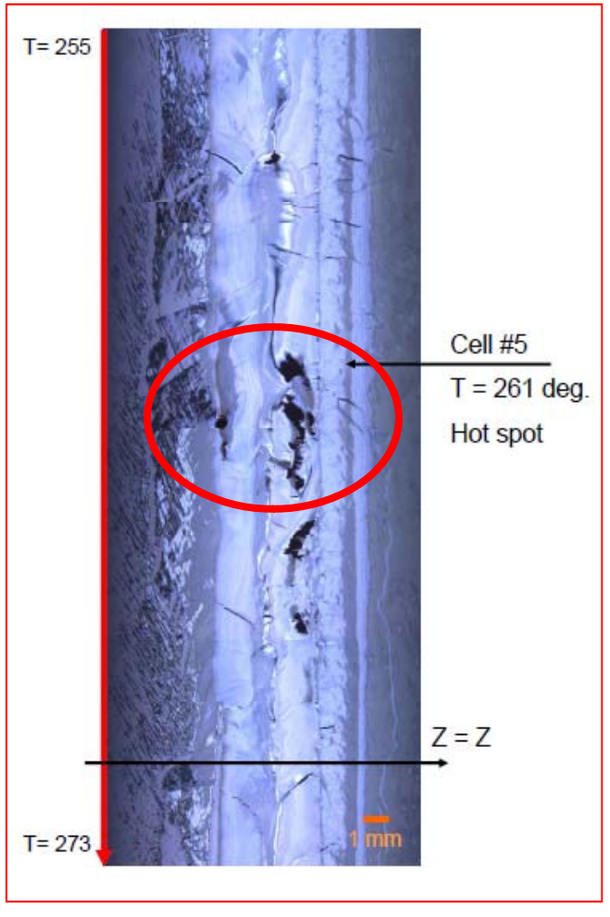


Hot spot at 30 MV/m

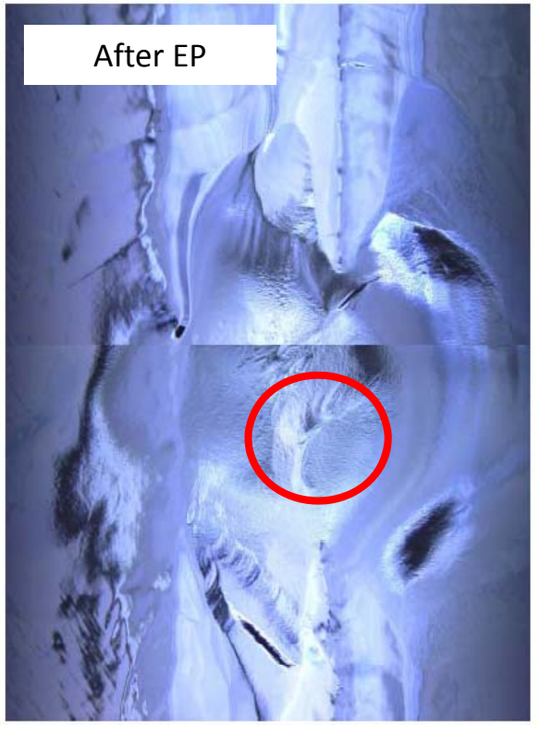
The welding seam was flaw in hot spot and other locations. Take a replica at 5-cell using by special tool. The Local Grinding made at 5-cell defect.

JLAB LG#1 (2)

Initial: Pit-type defect (funk hole)



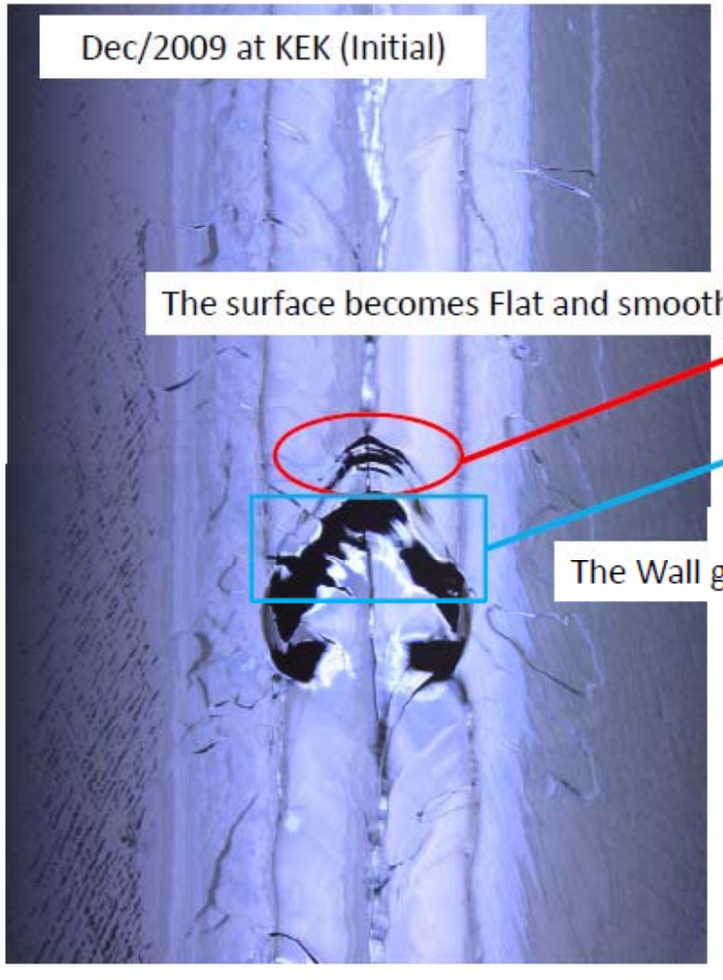
After grinding and additional EP (85 um) at STF



5-cell performance improved from 30 MV/m to 40 MV/m. However, the cavity performance was limited at 20 MV/m by quench at 6-cell.

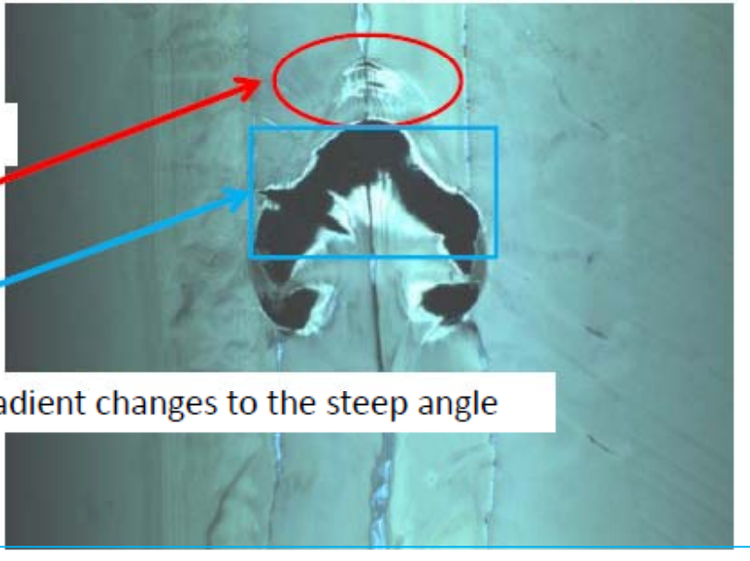
JLAB LG#1 (3)

6-cell, t=325deg. Unstable EBW seam (Pit-type, funk hole)



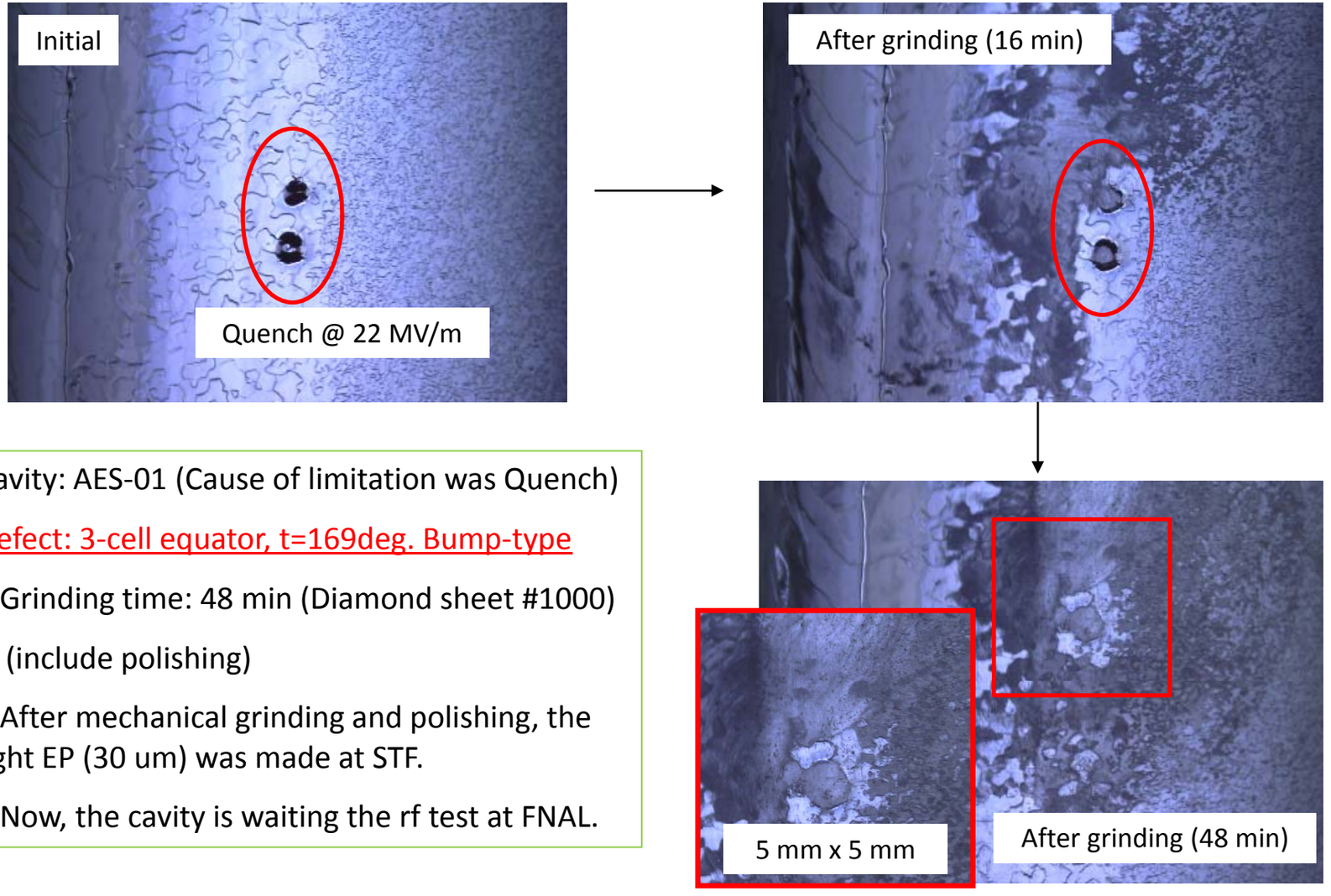
Try again the local grinding for this defect until this summer.

Feb/2011 at JLAB (Additional EP 85 um)



The dark zone grew by additional EP (85 um).
It is a possibility that the defect shape changes to a deeper pit, then the quench field also shifts to the low field. The edges also deformed to the sharp edges around dark zone of defect.

AES-01



Cavity: AES-01 (Cause of limitation was Quench)

Defect: 3-cell equator, t=169deg. Bump-type

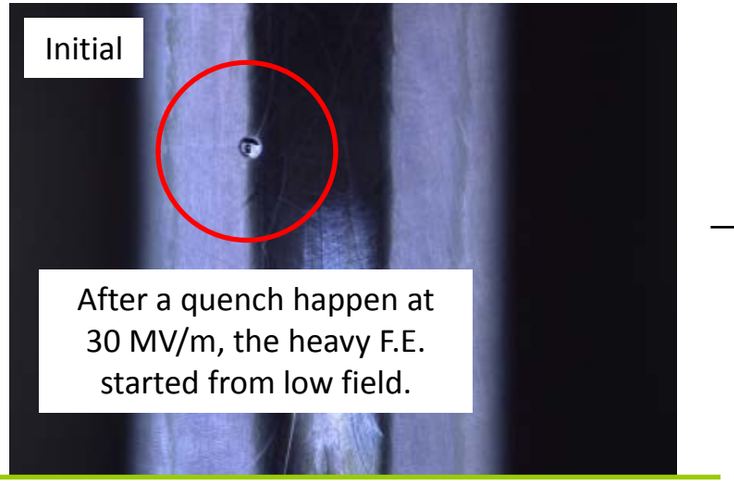
* Grinding time: 48 min (Diamond sheet #1000)

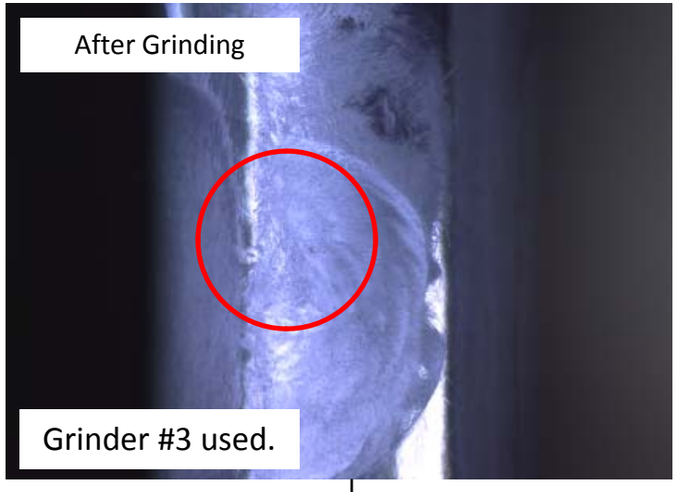
  (include polishing)

* After mechanical grinding and polishing, the light EP (30 um) was made at STF.

* Now, the cavity is waiting the rf test at FNAL.

RI-026





Cavity: TB9RI-026 (Cause of limitation was F.E.)

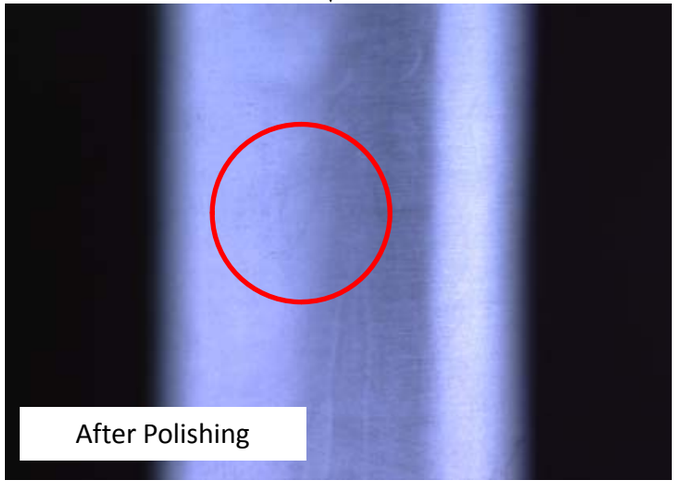
Defect: 8-9 iris, t = 107 deg. Pit-type

*Grinding time: 115 min (Diamond Sheet #400)

Polishing by hand: 30 min (3M Micro fine)

*After mechanical grinding and polishing, the light EP (30 um) was made at STF.

*Now, the cavity is waiting the rf test at FNAL.



Summary: Repaired Cavities by local grind

Cavity	Method (Grinding location)	Results (defect type)
AC71	Local Grinding (#1-#2 iris, t=137deg)	26MV/m (???) -> 30 MV/m
AES-03	Local Grinding (4-cell, t=306deg, 8mm away from joint) (1-cell and 5-cell, many iris)	20 MV/m (Bump, scratch) -> 34 MV/m
MHI-08	Local Grinding (2-cell, t=172deg, edge of EBW seam)	16 MV/m (Pit) -> 38 MV/m
Following items were made from April 2010 to Mar 2011.		
JLAB LG#1	Local Grinding (5-cell, t=261deg, on the EBW seam)	30 MV/m (Pit, Funk hole) -> Cell performance improvement to 40 MV/m
AES-01	Local Grinding (3-cell, t=169deg, 8mm away from joint)	22 MV/m (Bump) -> Now, Waiting a rf test at FNAL
TB9RI-026	Local Grinding (#8-#9 iris, t=107deg)	After quench at 30 MV/m, then F.E. started from low field. 20 MV/m F.E. (pit) -> Now, Waiting a rf test at FNAL