

# DEVELOPMENT OF STF INPUT COUPLERS FOR ILC \*

M. Satoh \*, E. Kako, S. Shishido, S. Noguchi, K. Watanabe, Y. Yamamoto  
High Energy Accelerator Research Organization (KEK)

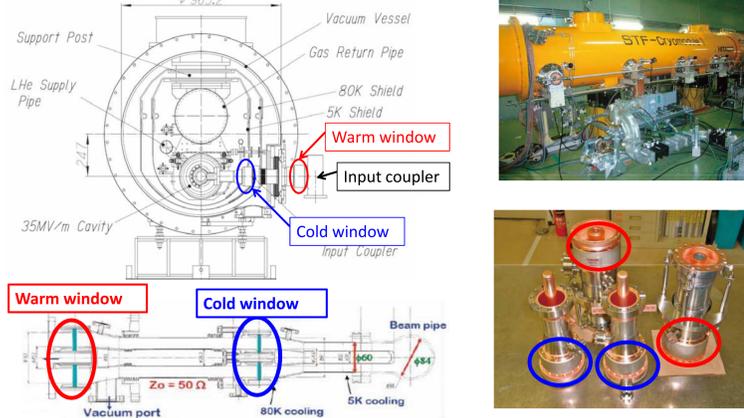
## Abstract

Vacuum leak at cold ceramic RF window was found after the STF-1 cryomodule test. Thermal cycle tests of the improved RF windows were carried out. The improved structure to reduce thermal strain was confirmed in the successive cryomodule test in S1-Global.

## Vacuum leak at cold windows

Low temperature cryomodule test from 2007 to 2008 test for ILC.

### Cross section of STF cryomodule



## Status in STF-1

Ceramic RF windows have troubles at the brazing joint between ceramics and Cu pipe.

Vacuum leak on 3 couplers among 4 ones

Cavity No.	#1	#2	#4	#3
Coupler No.	No.1	No.3	No.4	No.2
Pin/kW	143	272	156	134
Eacc/MV/m	20.0	30.1	22.3	21.5
BG: 7.1E-8 Pa m <sup>3</sup> /s	1.0E-4	4.5E-5	7.1E-8	1.6E-4

Vacuum leak due to thermal cycles?!

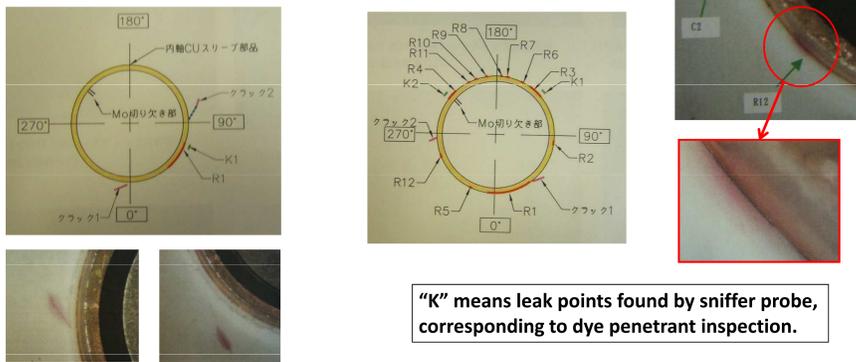
3 times of cooling period  
Preliminary test: 10/2007 ~ 11/2007 (only 1 cavity)  
1st cooling: 5/2008 ~ 7/2008 (4 cavities)  
2nd cooling: 9/2008 ~ 12/2008 (4 cavities)



Leak point (inner brazed joint)

Cold windows

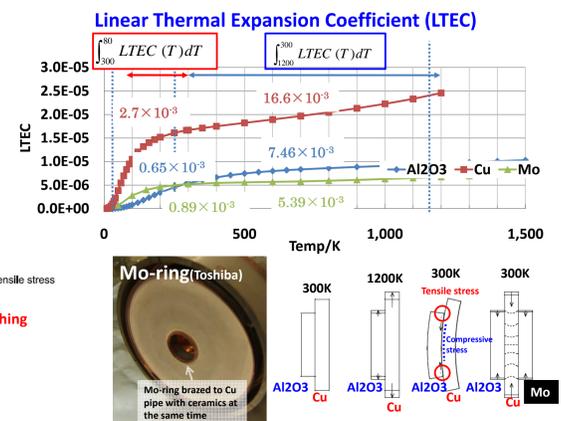
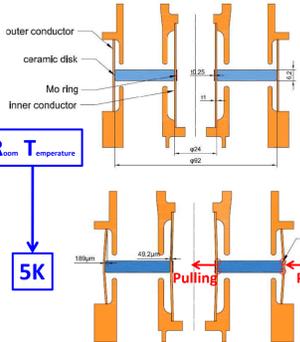
## Dye penetrant inspection



"K" means leak points found by sniffer probe, corresponding to dye penetrant inspection.

## Structure & deformation

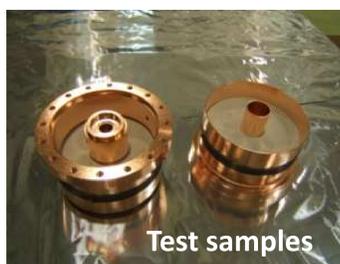
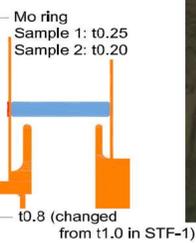
Structure to reduce thermal strain



## Test samples

Change of design to make stress half

Modified inner conductor & Mo-ring → stress: 0.8<sup>3</sup> ~ 0.5



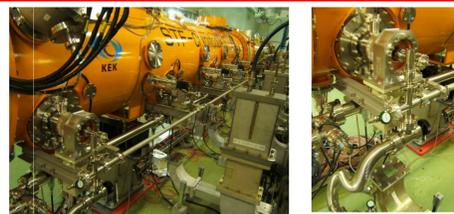
Stress ∝ (thickness)<sup>3</sup>

t0.8 (changed from t1.0 in STF-1)

Test samples

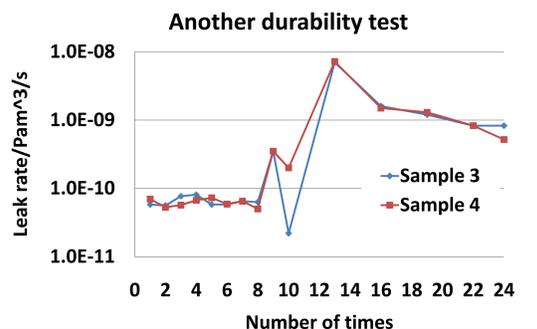
## High durability against thermal strain

There was no leak after S1-G



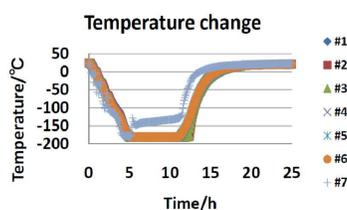
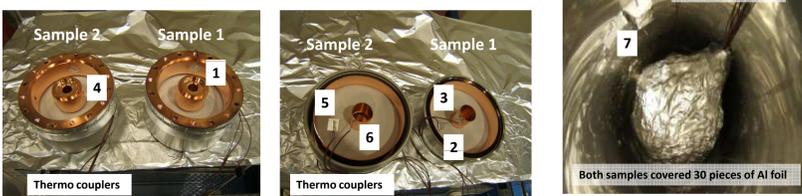
Cool down same as STF-1

3 times of cooling period  
1st cooling: 6/2010 ~ 7/2010  
2nd cooling: 9/2010 ~ 12/2010  
3rd cooling: 1/2011 ~ 2/2011



Another durability test for cold windows was carried out in parallel with S1-G from April 2010 to July 2011. Sample 3 and Sample 4 have the same specification as Sample 1

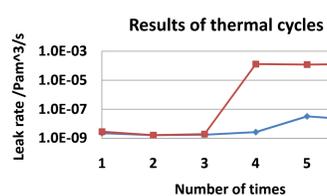
## Thermal cycle test



Cool down to take 5 hours



Vacuum leak check after cool down



Sample 1 was adopted for S1-G

Sample 2 caused vacuum leak from 4th cooling.

## Summary

- STF-1 cryomodule test had vacuum leak trouble on 3 cold windows among 4 ones and the leaks were on brazed part with inner conductor.
- To make internal stress half, the thickness 1.0 mm of the inner conductor was changed to 0.8 mm.
- Test samples were manufactured and applied thermal cycle tests of 24 times, and no vacuum leak was observed. The improved input couplers were used without problem in S1-G cryomodule test.