# High Power Test of the Input Coupler for KEKB SC Cavity

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The superconducting cavity for the KEK B-Factory needs a high power input coupler of more than 500 kW. A coaxial antenna coupler is used as an input coupler, which is the same type as what has used for the TRISTAN SC cavities. The ceramic window of the coupler is a 152D coaxial. The inner conductor is cooled by water and the outer conductor is cooled by cold He gas. To increase heat exchange efficiency and to prevent a local heating spot, Cu fins were attached on the outside surface of the outer conductor of the coupler. Three ports were welded near the ceramic window. Those ports are used for measuring a vacuum pressure, electron and discharging light during RF conditioning.

After 9 hours of RF conditioning, a CW traveling RF power of 800 kW could be successfully supplied to the first two couplers in a test bench for more than 30 minutes. Most of the processing time was spent to overcome the multipactoring level of 50 kW and 160 kW. Less processing was needed at higher levels.

The second two couplers were treated by ozonized ultra pure water rinsing, and the multipactoring level of 50 kW disappeared. After almost same conditioning time the second couplers reached 800 kW. Both pairs of coupler could be operated in a short time at 850 kW which is our klystron power limit.

## 1 Design

The input coupler for KEKB superconducting cavity is almost same design as used for TRISTAN superconducting cavity [1] and is shown in Fig.1 and Photo.1. The inner conductor is made of OFHC copper pipe having a diameter of 52 mm and a thickness of 1mm. The surface is treated by elector polishing . The outer conductor is made of 2 to 2.5 mm thick 316L stainless steel and OFHC copper indium joint flange. These are copper plated by about 15 $\mu$ m. The inner conductor is cooled by water and the outer conductor is cooled by counter flow of cold He gas with copper fin. The ceramic window is a coaxial disk type same as TRISTAN[1] made from $Al_2O_3$ of 95 % purity and the vacuum side of the ceramic is TiN coated by about 100 Å. Three ports are set between the ceramic and the conflat flange. These ports used for monitoring vacuum, electron current and light of arc.

## 2 high power test

The first pair of coupler is rinsed with demineralized ultra pure water and second pair of couplers rinsed with ozonized ultra pure water and ultra pure water. Then the coupler are mounted on test stand used TRISTAN copular aging, evacuated and baked at 110 ℃. The vacuum increase

upto 5 X $10^{-7}$ Torr . After 9 hours of RF processing, CW traveling RF power of 800 kW could be successfully supplied to one of pair coupler rinsed with ultra pure water for more than 30 minutes, shown as Fig 2. Most of the processing time was spent to overcome the multipactoring levels of 50 kW and 160 kW same as TRISTAN coupler[1)] Less processing was needed at higher power level. Fig. 3 shows number of aging (number of interlock by vacuum and arc plus number of vacuum peaks higher than 8X$10^{-6}$ Torr) and suggesting tow multipactoring levels of 50 kW and 160 kW. A peak power of 850 kW ,That was limited by the Klystron out put power ,could be supplied to the pair of couplers for 5 minutes, and no cracking occurred on the ceramics. The other pair of couplers rinsed with ozonized water was also RF processed upto 800 kW. Fig. 4 shows in this case 50 kW multipactoring level is not clear compared to the ultra purer water rinse case. Fig.5 shows aging history of this pair of couplers. The aging time needed to reach 800 kW is almost same in two cases.

To simulate the vacuum condition in case of the coupler assembling on cavity, the coupler exposed to air for 3 hours and evacuated, and power tests with total reflecting RF were made up to 150 kW, which is limit of cooling of RF load, without heavy conditioning (Fig.6).The wave guide length was changed three positions corresponding within quota wave length of the wave guide.

## 3 Conclusions

The coaxial antenna type couplers same as TRISTAN superconducting cavity were successfully tested upto 850kW without cracking of ceramics.

The RF processing is strongly dependent on final rinsing method ,so we should continue experiment.

The improved monitor around ceramic window is helpful reliable aging, may more at cold operation.

The cooling fin attached around outer conductor is effective to decrease temperature of outer conductor in air.

## 4 Acknowledgment

We wish to thank our colleagues Dr. Noguch to use TRISTAN coupler test stand, Dr.H.Nakanishi for preparing high power WG system and 1 MW RF load and S.Yoshimoto for tuning 1 MW klystron.

1) S.Noguch,E.Kako and K.Kubo , Proc.4th Workshop on RF Superconductivity ,Vol.1 pp. 397

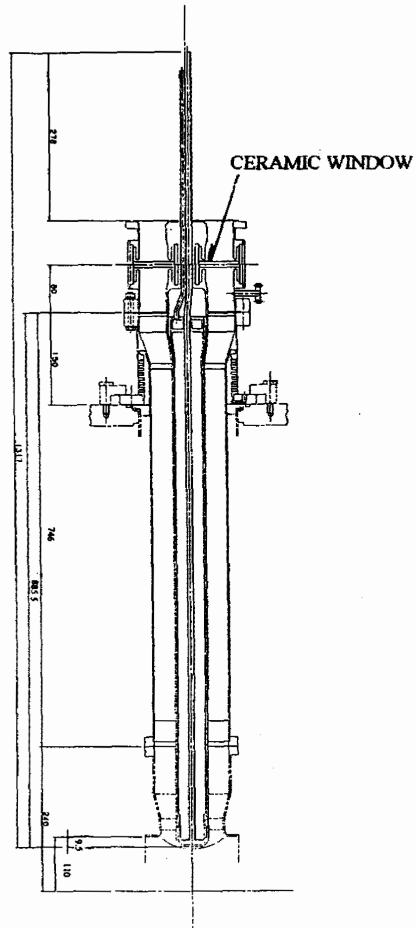


Fig. 1 Coaxial input coupler for KEKB SC cavities

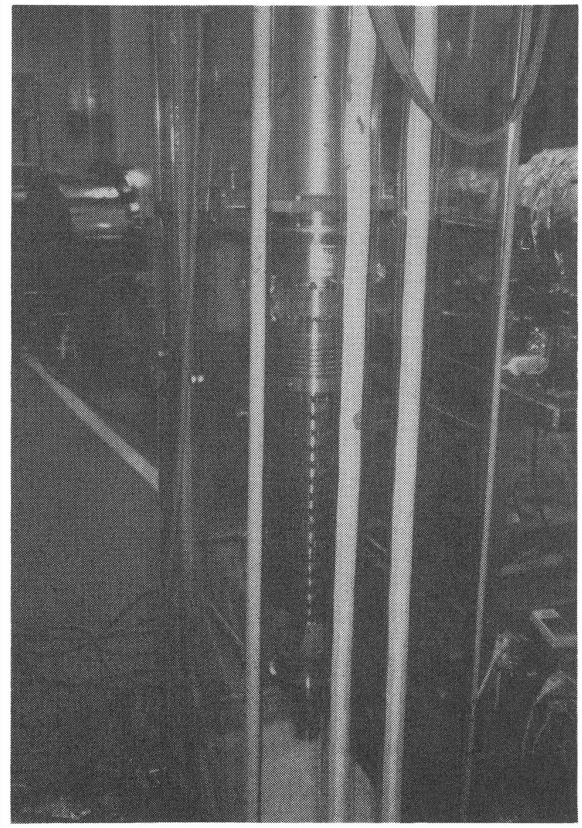

Photo.1 Coaxial input coupler with coolingfin

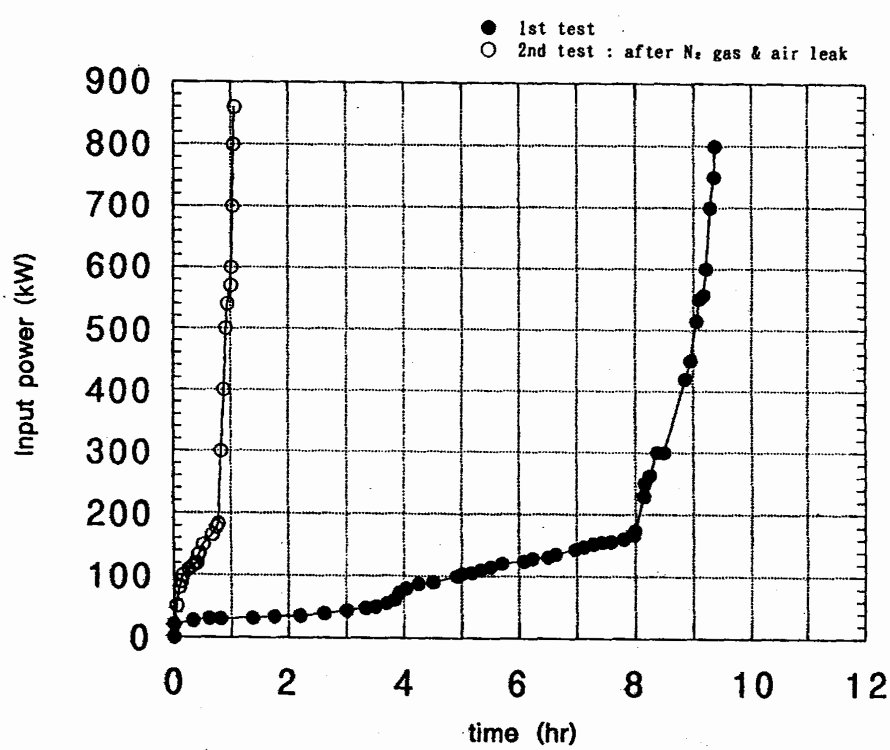


Fig.2 ultra pure water rinsed Coupler aging history

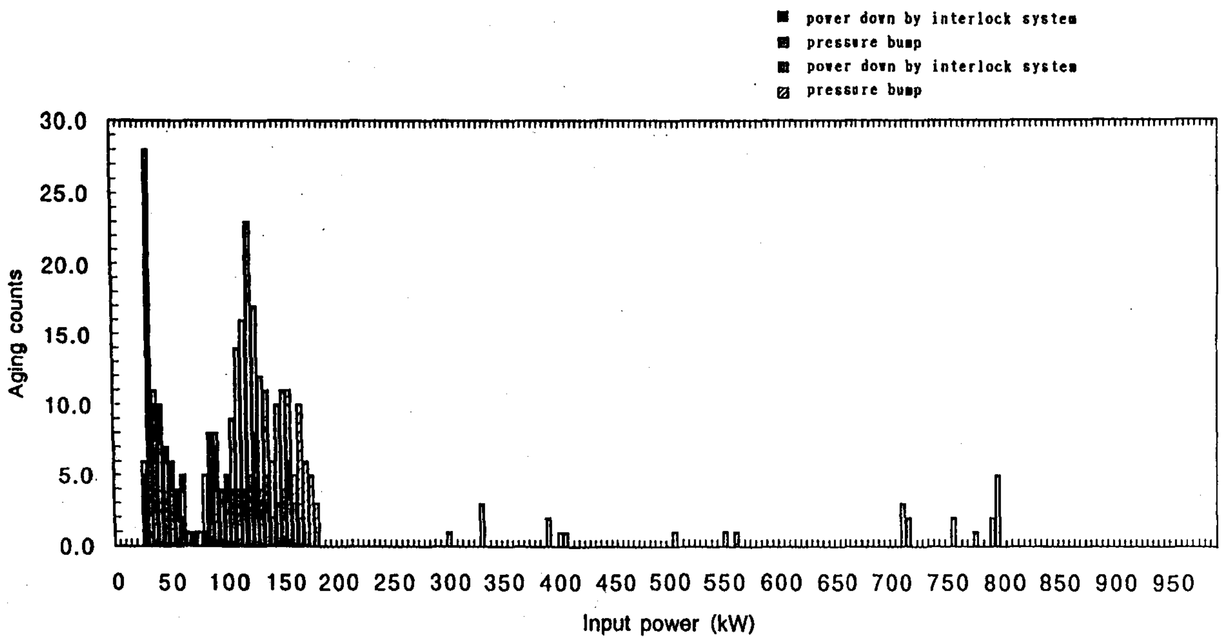


Fig.3 ultra pure water rinsed Coupler aging counts

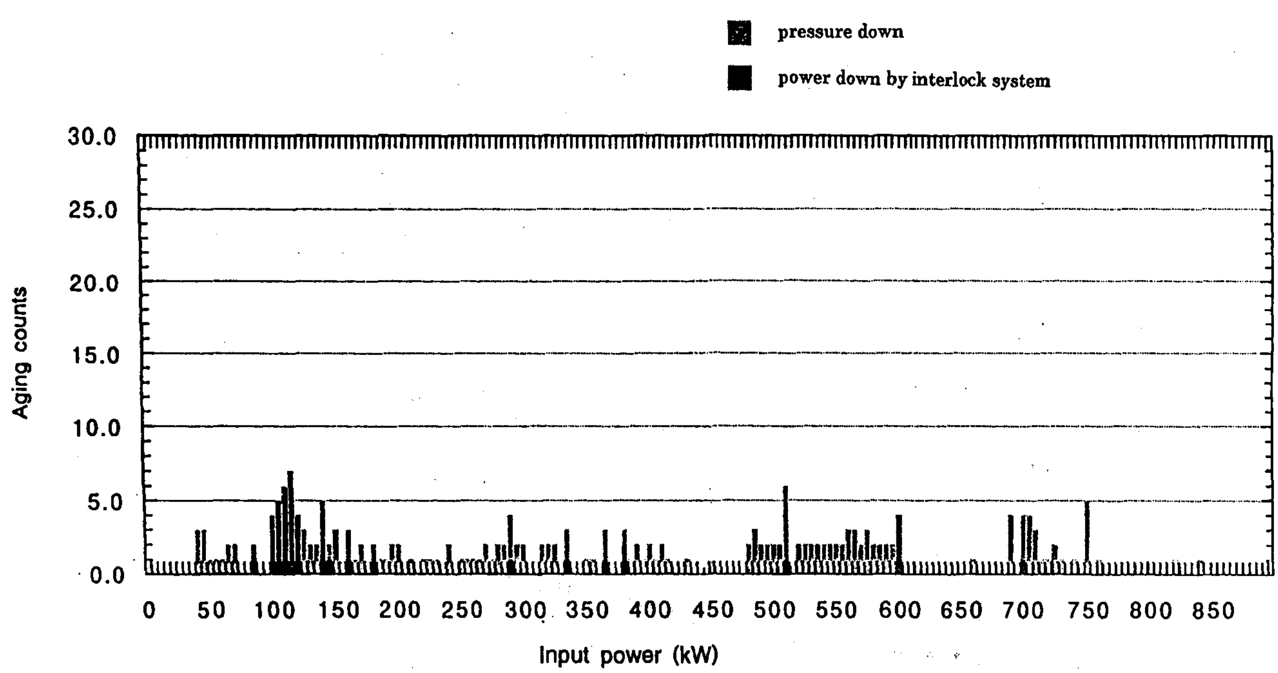


Fig.4 ozonized ultra pure water rinsed Coupler aging counts

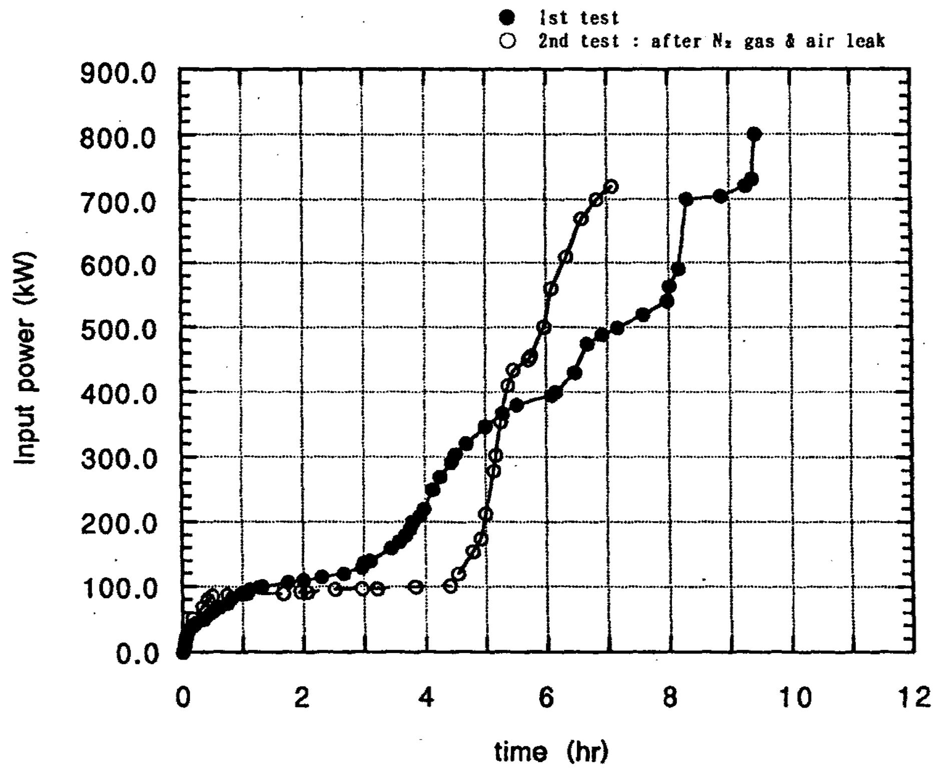


Fig.5 ozonized ultra pure water rinsed Coupler aging history

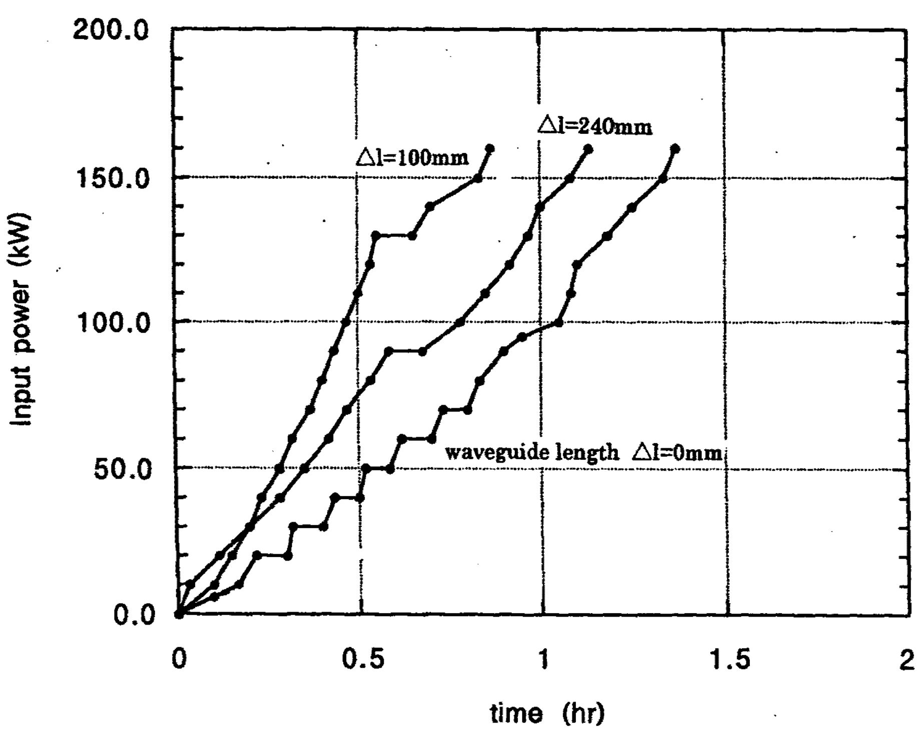


Fig. 6 total reflection test of ultra pure water rinsed Coupler