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DEPENDENCE OF RF CONTACT ON TIGHTENING FORCE

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1. Abstract

With metal O-rings, silver wires and copper braid as rf contactor, Q values of a coaxial resonator were measured at 100 MHz versus contact force. The metal O-rings give 90 % of theoretical Q value with contact force less than 20 % of that required for vacuum seal. It was not shown that the chromate film on the surface thinner than 1 μm deteriorates Q value.

2. Introduction

In several RFQ linacs metallic vacuum seal are used as rf contactor between the tank and vanes.[1,2,3] For vacuum use large contact force and fine surface finish are required. In order to improve the vane mount method, dependence of rf contact on contact force and surface was studied.

3. Experimental

Resonator A coaxial resonator was made to test rf contactors. The structure and dimensions are given in Figs.1,2. The resonator is made of copper plated mild steel. The copper plating has a thickness of 50 μm and surface roughness is 1.6 μm. The surface is coated with chromate film thinner than 1 μm against oxidation. Theoretical Q value calculated with SUPERFISH code is 6800 for pure copper surface. The contactors have diameters around 180 mm. The contactors can be tightened with an oil press of 20 ton maximum force, or 350 kgf/cm on unit length of the contactor. Without the oil press a force of 0.2 kgf/cm is applied owing to the weight of the inner conductor.

Contactors The parameters of the used metal O-rings are given in Table 1. The copper braid is one used as shield of coaxial cable RG57U and has neoprene round cord of 4 mm dia. inside to be elastic. For reference, Q values were measured with two annealed silver wires of 1 mm and 3.2 mm in diameter. The silver wires and copper braid were immersed 5 minutes in a bath of 20 % phosphoric acid to remove oxide on the surface. Before measurement the contact surface was cleaned by aceton. The strains were measured with three dial indicators.

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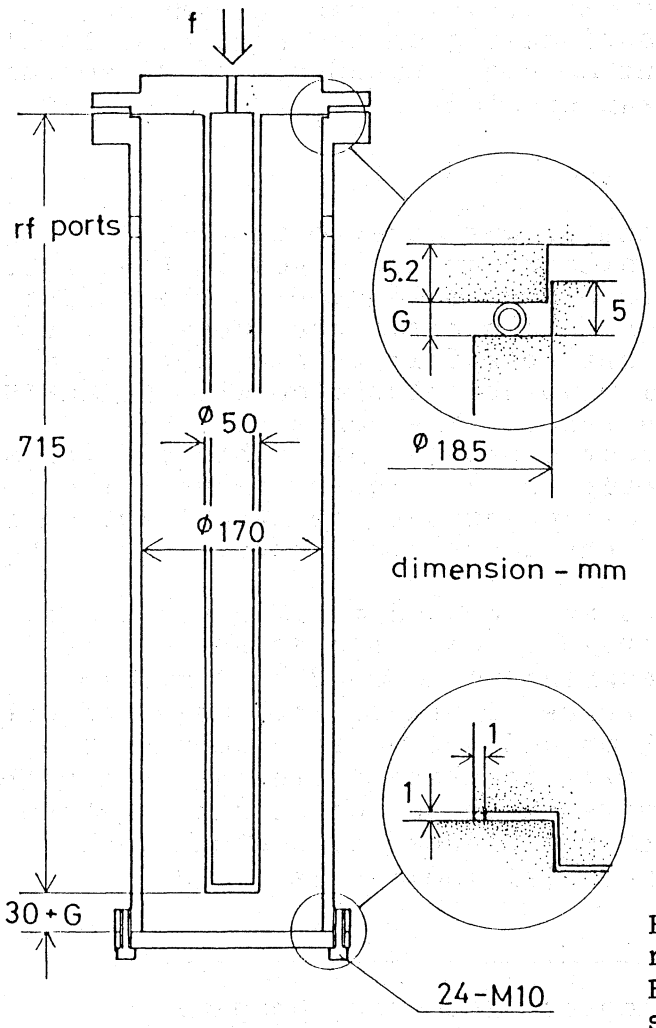
RF measuerement The Q values were obtained from resonance width with a weak loop coupling. It was assured that the coupling had little effect to the Q value, by varying the coupling strength. They agreed with those obtained from the decay time of the stored rf energy in the resonator. The resonant frequency was varied from 100.0 to 99.7 MHz as the contactor was strained.

DC resistance Also dc resistance of the contact was obtained by measuring the voltage across the flanges with 10 A electric current.

4. Results

By use of no contactor the Q value was measured with the chromate film. Then the the film was removed with fine sand paper and Q value was measured again (Fig.3). Significant difference could not be observed. With the metal O-rings and a silver wire, also difference was not observed betwenn with and without the chromate film. In Figs.5,6 the measured Q values vs. contact force are shown with the metal O-rings and silver wires.



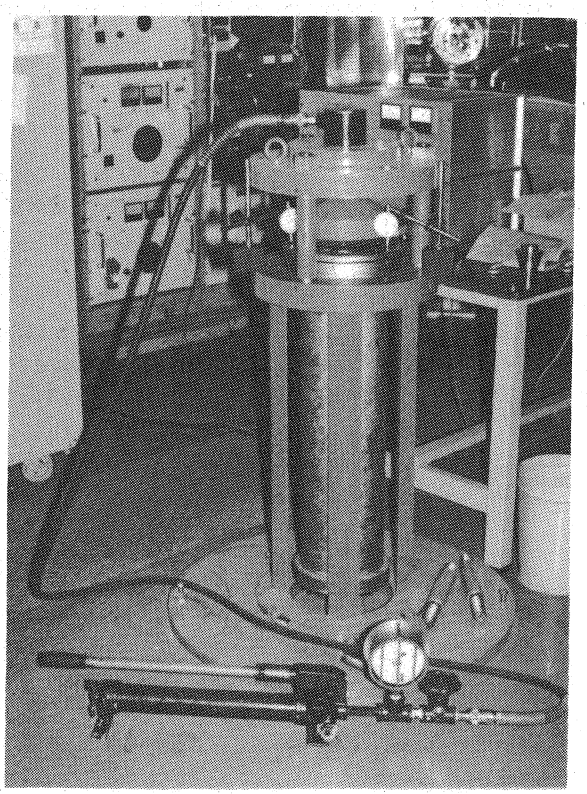


Fig.1. Structure of the coaxial resonator (Left).
Fig.2. Picture of the test stand (Right).

With 5 kgf/cm for N.V. and 20 kgf/cm for D.N.D., Q values nearly 90 % of the theoretical value were obtained. These are satisfactory, considering that the silver wires give the same value. The forces are much smaller than those for vacuum seal, 30 kgf/cm for N.V. and 270 kgf/cm for D.N.D.

References

1) L. D. Hansborough et al., Proc. 1981 Linear Acc. Conf., Santa Fe, NM, USA, LA-9234-C.
2) N. Ueda et al., Proc. 1983 Particle Acc. Conf., Santa Fe, NM, USA, IEEE Trans. Nucl. Sci., August, 1983.
3) N. G. Wilson et al., ibid.

Table 1. Parameters of the metal O-rings.

Makers	Nihon Valqua Co. E180 (N.V.)	Dainichi Nihon Densen Co. (D.N.D.)
Tube Dia.	3.2 mm	3.18 mm
Tube Thickness	0.25	0.35
Outer Dia.	180	180
Material	SUS304	SUS304
Surface	silver coating thickness unknown	silver coating thicker than 50 m
Contact Force for Vacuum Seal	30 kgf/cm	270 kgf/cm

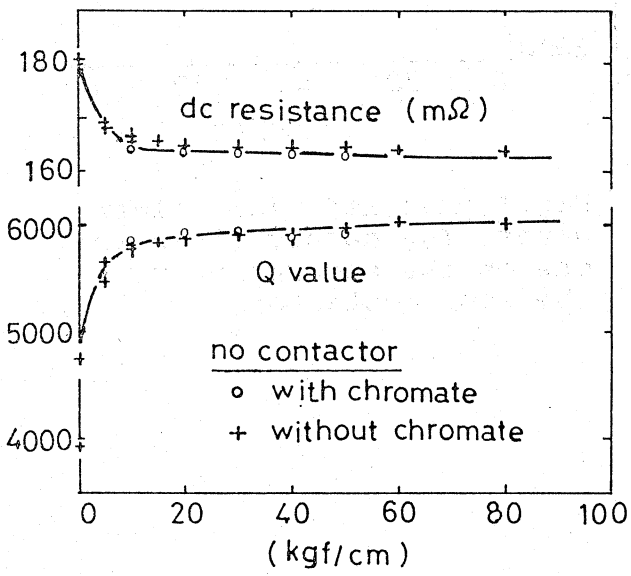


Fig.3. Q value vs. contact force with no contactor (Left).

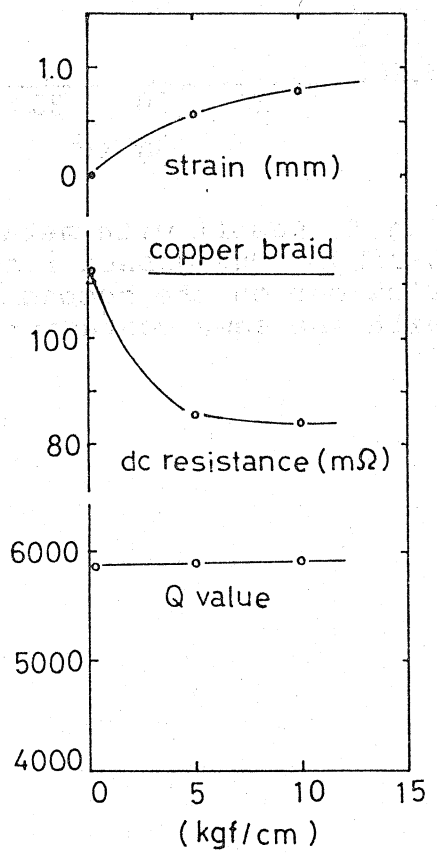


Fig.4. Q value vs. contact force with copper braid having rubber cord inside (Right).

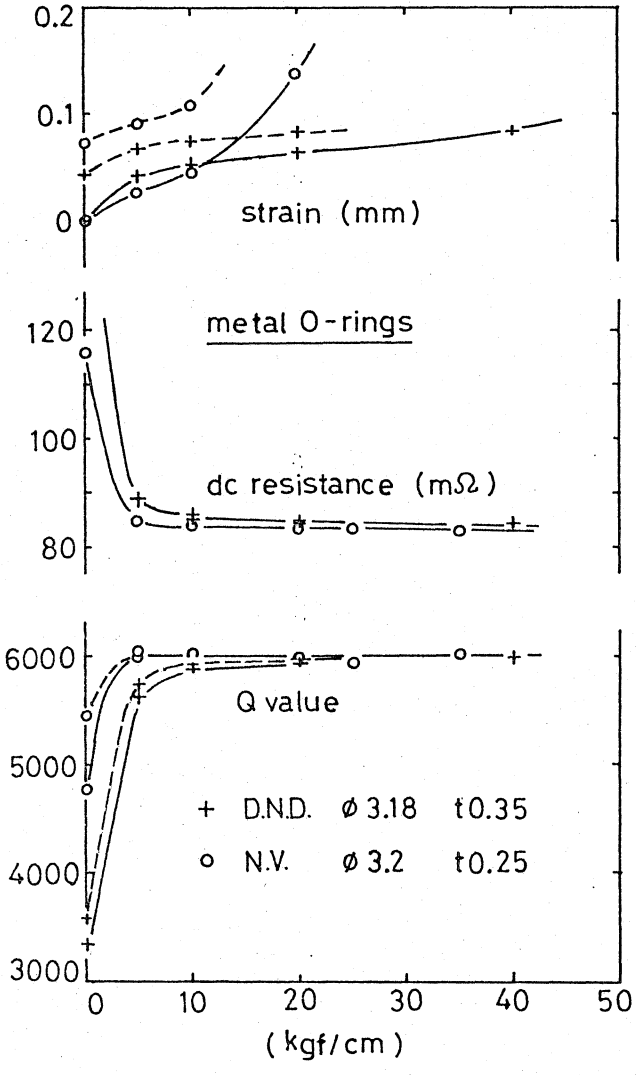


Fig.5. Result with metal O-rings. The dashed lines show one on the second run with the same contactor.

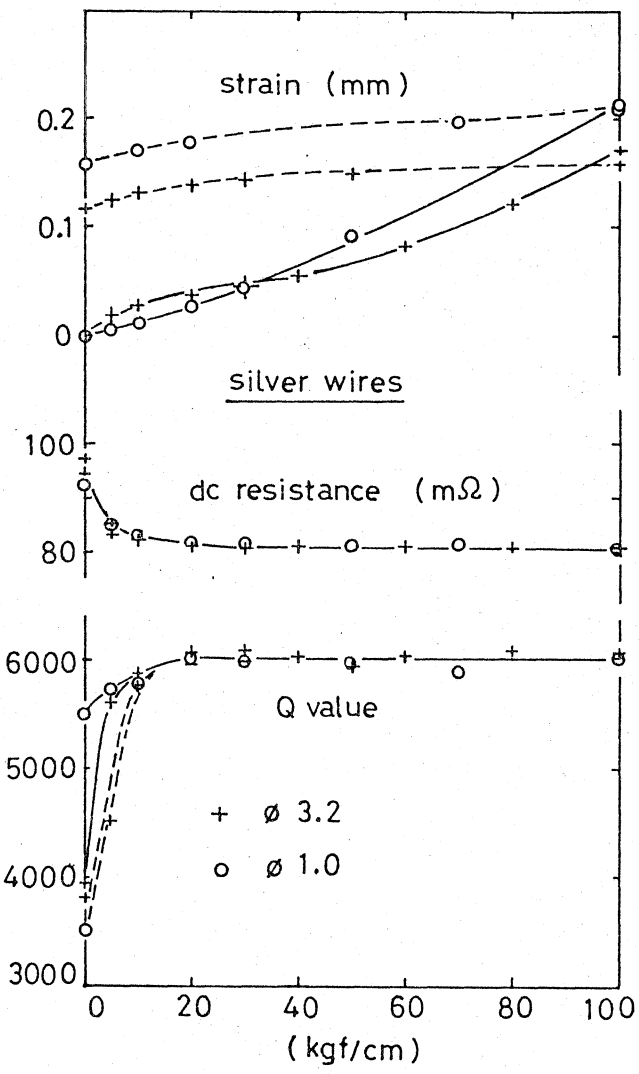


Fig.6. Results with silver wires. The dashed lines show one on the second run with the same contactor.