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Update on the HV Barrel Capacitors.

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1. Summary of test results

In a previous note (DUKHEP03-02-10), we reported the arcing and neutron radiation test for Johanson X7R 1000 pf capacitors, which were rated for 2000 volts. Since the test, we have found similar capacitors but with NPO dielectric material. Because the capacitors with 1000pf capacitance did not fit into the capacitor barrel, we settled with 850pf capacitors.

Two types were obtained. One was rated for 2000 volts (Type A), and the other was rated for higher voltage (Type B). The rating for the latter capacitor was not specified by the vendor but it was made for higher than 2000 volts (special order from a cell phone company).

The Type A capacitors went trough the usual qualification test: arcing, long term HV, and neutron and Co^{60} irradiation test.

a) Arcing test – 30 capacitors were connected in parallel and charged to 2000 volts and discharged (directly to the ground) suddenly 500 times. No capacitor was failed and the total capacitance of the 30 capacitors was not changed (within the measurement error). The voltage of the arcing test was increased to 2500 volts, and several capacitors failed with less than 20 arcing.
b) Long term HV test – 30 capacitors which went through arcing test first were connected to 2500 volts for a week and no capacitors developed any problem.
c) Neutron radiation test – 20 capacitors were irradiated with ~$5x10^{14}$ neutrons/cm^2. During the irradiation, the capacitors were under 2000 volts. No capacitor failed.
d) Co^{60} irradiation test – 20 capacitors were irradiated with dosage of 20 MRad. After the test, these capacitors went through arcing test (50 times) without any problem. After the arcing test, the capacitors were under 2500 volts for a week without any problem.

Type B capacitors only went through arcing and long term HV test.

a) Arcing test – 30 capacitors were charged to 2000 volts and discharged 500 times. No capacitors were failed and the total capacitance of the 30 capacitors was not changed (within the measurement error). The voltage of the arcing test was

increased to 2500 volts, and one capacitor failed after 75 arcing, and several failed after 300 arcing.

b) Long term HV test - 30 capacitors which went through arcing test at 2000 volts first were connected to 3000 volts for a week and no capacitors developed any problem.

2. Proposal for the production capacitors

When the production capacitors become available (20,000 in total), 90 capacitors will go through the arcing test (500 arcing at 2000 volts). The test will be done with the assembled capacitors (soldering and coating). After the test, 30 of them will be subjected to a neutron irradiation test and another 30 of them will be subjected to a Co^{60} irradiation test. The capacitors from the tests should not develop any problem under 2500 volts for a month.

As a production QA, all the assembled capacitors will go through 'HV soaking test' and we propose 2750 volts for 10 days.