Appendix 1

Safety Tests of Cooper/Belden Style 1015 Wire, Internal High Voltage Distribution, and PMT Base PC Boards

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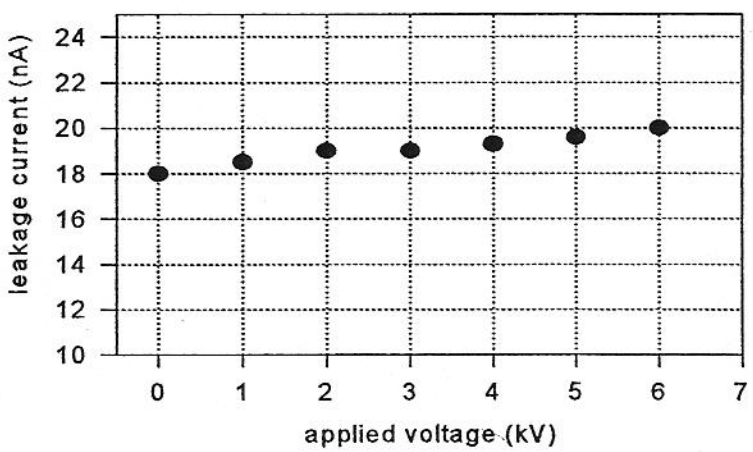
Tests were conducted to determine whether Cooper/Belden style 1015 type 9924 was suitable for the wiring of the internal high voltage distribution to photomultiplier bases in EM Cal supermodules, and that the internal HV distribution network and pmt base pc boards are stable up to 5 kV (three times the maximum 1.6 kV operating voltage)

Leakage Current from Wires

To check for leakage current, an 11 meter long piece of wire was coiled around a 50 cm x 10 cm sheet of steel. Two additional plates were clamped over the wire-coiled plate. Voltage was applied through the wire using a Power Designs 1556 DC power supply (20 mA max current). The voltage was stepped up from 0 to 6 kV and the current leakage through the plates to ground was measured with a Keithley 485 Picoammeter.

At the maximum applied voltage (6 kV) a leakage current of 2 nA above a background current of 18 nA was measured. Figure below shows leakage current as a function of applied voltage.



Distribution Circuit Boards

The 11 meter coiled wire was attached to an etched distribution circuit board and observed as the applied voltage was stepped up from 0 to 6 kV. Arcing between solder joints to circuit board traces occurred when the applied voltage reached 5.3 kV. The smallest distance between traces was 3mm. The circuit board was not coated or insulated.

Distribution Cables and Connectors

A supermodule high voltage distribution network including an etched board, about 10 meters of wire, and connectors for 36 bases, was tested with no load at -5kV for 24 hours. No arcing was observed.

PMT Base PC Boards

An unstuffed, uncoated sample of the final version of the pmt base pcb was tested under high voltage. This board layout was manually corrected to assure that the separation between traces was greater than 2mm/kV. The applied voltage was stepped up to 5 kV, and then left at 5 kV for 1 hour. No arcing was observed.