Accelerator Department
BROOKHAVEN NATIONAL LABORATORY
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Upton, L.I. N.Y.

AGS DIVISION TECHNICAL NOTE

No. 4

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During the testing of the resistors for the new short column, one of the test resistors failed at 114,000 volts. The present column design calls for a 15-section column with resistors running at 50,000 volts. The column may be shortened at some later date to a 10-section column with resistors running at 75,000 volts. It was the general feeling at the time of the failure that the resistors should not at any time be the limiting factor on the column design. Since the properties of the resin and the effect of high voltage on the resin over long periods of time are not known, a program was started to improve the overall properties of the resistor assemblies. The general idea is to improve the thermal conductivity of resin without any loss of electrical properties. The first test indicated a few things of interest.

1. Small amounts of filler will settle out of the casting unless a fast cure cycle is used.
2. Small amounts of filler have little effect on the properties of the casting.
3. The fillers used do not seem to lower the dielectric strength of the resin.

The second test in which a thermistor was bonded to the resistors indicated the following:

1. The temperature rise in Block 1 was about half that in Block 4.
2. Block 1 and Block 2 show a small difference even though there is twice as much filler in Block 1 as in Block 2. (Filler-boron-nitride).
3. Block 3 filled with alumina with the same ratio as Block 1 has a temperature rise about one third greater than Block 1.

The author feels that the resin system in Block 2 being lower in viscosity using only one half as much filler is the system to use in the casting of the final resistors.

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TABLE I

BLOCK # 1. 11 GRAMS BORON NITRIDE
205 GRAMS RESIN

2 5 1/2 GRAMS BORON NITRIDE
202 GRAMS RESIN

3 104 GRAMS ALUMINA
203 GRAMS RESIN

4 52 GRAMS ALUMINA
201 GRAMS RESIN

5 53 GRAMS SILICA FLOUR
201 GRAMS RESIN

6 26.5 GRAMS SILICA FLOUR
202 GRAMS RESIN

7 200 GRAMS RESIN
NO FILLER.

RESIN-RATIO 50 GRAMS SHELL EPON 815
50 GRAMS " " 871
20 GRAMS " " Z

SPECIAL BLOCK # 8

RESIN RATIO

200 GRAMS 815 (SHELL EPON)
40 GRAMS Z
98 GRAMS BORON NITRIDE

[illegible] FOR 24 HOURS - NO POST-CURE

TABLE II

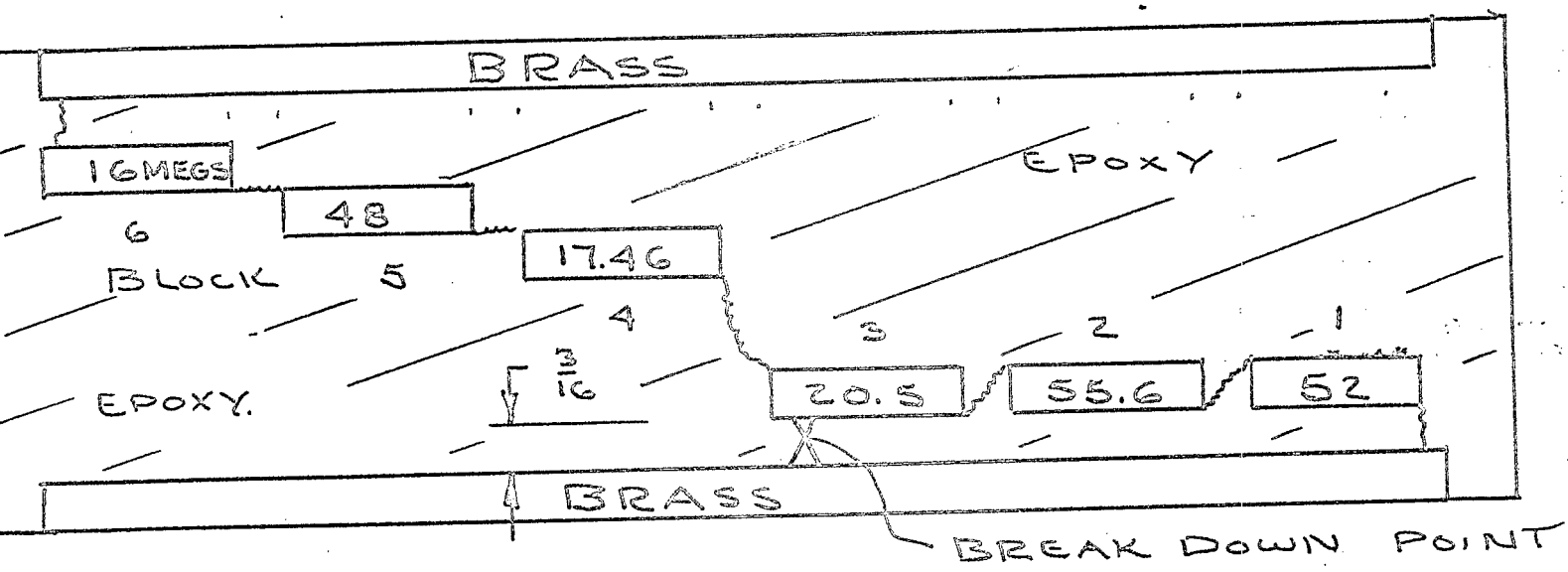
CASTINGS WITH THERMISTORS BONDED TO RESISTORS.

BLOCK # 1.	100 GRAMS	SHELL EPON 815
	20 "	" " Z
	50 "	BORON NITRIDE (325 MESH)
BLOCK # 2	100 GRAMS	SHELL EPON 815
	20 GRAMS	" " Z
	25 "	BORON NITRIDE
BLOCK # 3	100 GRAMS	SHELL EPON 815
	20 "	" " Z
	50 "	ALUMINA
BLOCK # 4	50 GRAMS	SHELL EPON 815
	50 "	" " 871
	20 "	" " Z

PREHEAT RESINS BEFORE MIXING

CURE AT 140° F FOR 24 HOURS.
NO POST-CURE

FIGURE I



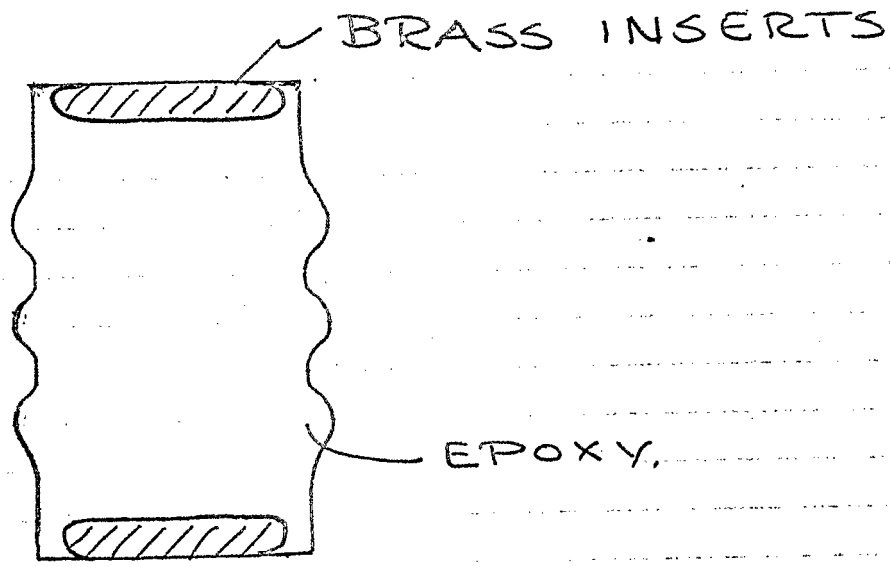
RESISTANCES GIVEN IN MEG-OHMS

POTTING RESIN RATIO 50 GRAMS SHELL EPON 815
50 " " " 871
20 " " " Z

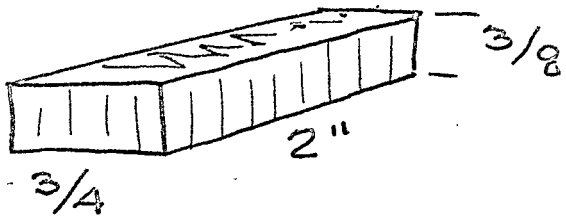
BREAK DOWN AT ABOUT 114,000 VOLTS D.C.
IN A SF_6 BAG.

RESISTANCE MEASURED AFTER BLOCKS
WERE CUT APART.

RESISTANCE OF BLOCKS BEFORE CASTING
60 MEGS ± 10%



CROSS SECTION OF RESISTOR (FULL SCALE)



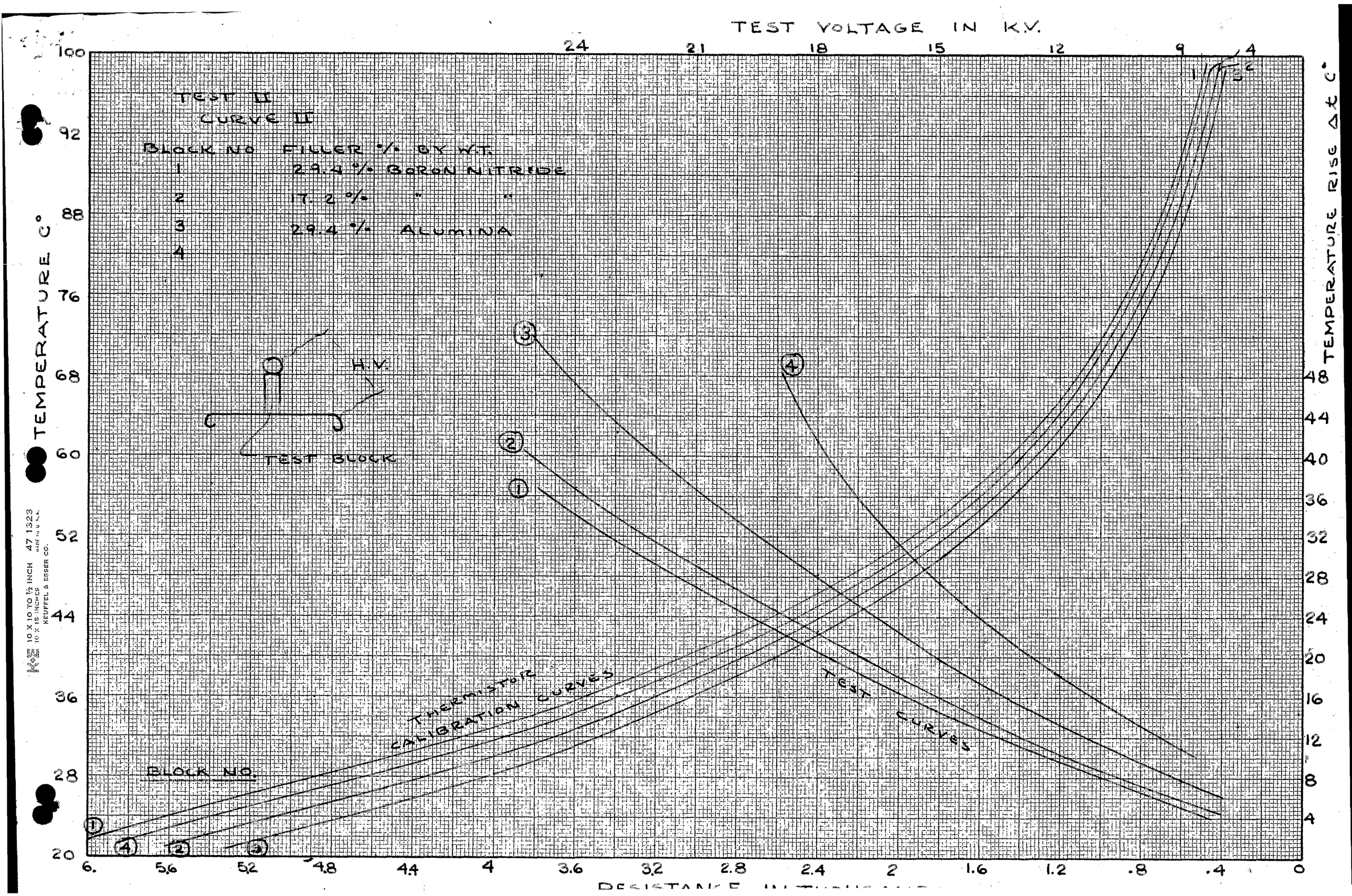
RESISTOR BLOCK 60 MEGS.

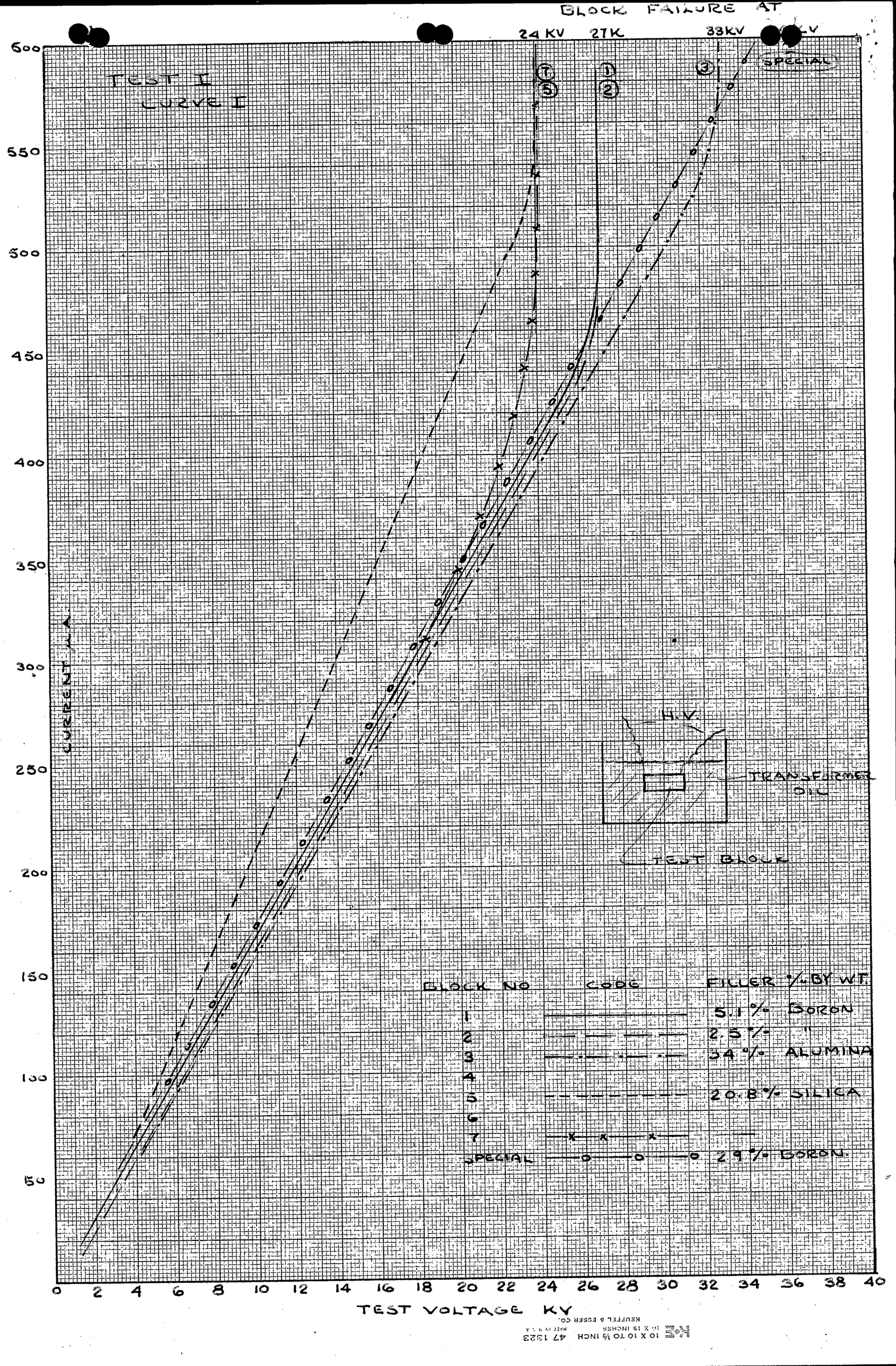
160 - 1.5 MEG - CARBON RESISTORS

PRINTED CIRCUIT FORMS CONNECTIONS

6 RESISTOR BLOCKS IN SERIES IN

FINISHED RESISTOR - 360 MEGS.


TEST VOLTAGE IN K.V.
24
21
18
15
12
9
4
TEST II
CURVE II
BLOCK NO FILLER % BY W.T.
1 29.4 % BORON NITRIDE
2 17.2 % " "
3 29.4 % ALUMINA
4
H.V.
TEST BLOCK
TEMPERATURE C°
100
92
88
76
68
60
52
44
36
28
20
TEMPERATURE RISE Δt C°
48
44
40
36
32
28
24
20
16
12
8
4
THERMISTOR CALIBRATION CURVES
TEST CURVES
BLOCK NO.
6.
5.6
5.2
4.8
4.4
4
3.6
3.2
2.8
2.4
2
1.6
1.2
.8
.4
0


BLOCK FAILURE AT
24 KV
27K
33KV
SPECIAL
TEST I
CURVE I
CURRENT
TEST VOLTAGE KV
H.V.
TRANSFORMER OIL
TEST BLOCK
BLOCK NO
CODE
FILLER % BY WT.
1 5.1 % BORON
2 2.5 % "
3 34 % ALUMINA
4
5 20.8 % SILICA
6
7
SPECIAL 29 % BORON