

Dielectric Strength Notes
Note 7

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Impulse Breakdown of Deionised Water
With Asymmetric Fields

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Investigations of the breakdown strength of water were continued by applying -ve voltages to the field enhanced electrode of sphere-plane and cylinder-plane configurations.

Table I shows the results of 16 such experiments.

The peak or breaking voltage of the waveform is measured together with the time for which the voltage is greater than 63%. A correction has been made for the asymmetric field $\alpha = 1 + 0.12(F \text{ max}/F \text{ mean} - 1)^{1/2}$, and a plot of the resulting points shows as in the case of uniform field data a time dependence expressible as $Ft^{1/3}/\alpha = K$.

In obtaining the above results the necessary voltage waveforms were generated with three different systems. Although the waveforms were of similar shape and displayed on the same oscilloscope each system had its own voltage monitor. Hence it would be unrealistic to claim more than about an 8% agreement between results of each system.

There is an indication that there is a weak dependence upon electrode separation, for separation of 1 cm or more,

$$\text{Hence } \frac{Ft^{1/3}}{\alpha d^{1/6}} = K \text{ for } d \geq 1.$$

d cms	V MV	F max MV	F mean MV	t _{eff} μ sec	σ	Cylinder or Sphere	α	Area sq. cms	$\frac{Ft^{1/3}}{\alpha}$	$\frac{Ft^{1/3}}{\alpha d^{1/6}}$
System 1	0.5	0.31	0.99	0.62	0.13	C	1.09	8.0	0.48	0.54
	0.5	0.40	1.80	0.80	0.09	S	1.13	0.25	0.72	0.81
	0.5	0.44	1.40	0.88	0.09	S	1.09	1.0	0.58	0.65
	1.0	0.42	1.58	0.42	0.15	S	1.20	0.25	0.68	0.68
	1.0	0.44	0.93	0.44	0.18	C	1.13	8.0	0.46	0.46
	1.0	0.47	1.09	0.47	0.20	S	1.14	1.0	0.44	0.44
System 2	1.9	0.80	1.14	0.42	0.11	S	1.16	2.5	0.47	0.42
	2.0	0.81	0.87	0.40	0.21	C	1.13	16.0	0.45	0.40
	2.5	0.78	1.41	0.31	0.23	S	1.23	1.0	0.71	0.61
	2.5	0.92	1.18	0.36	0.17	S	1.18	1.8	0.56	0.48
	2.5	>1.09	>1.16	>0.44	0.26	S	1.15	4.0	>0.64	>0.55
	3.0	1.03	0.89	0.34	0.28	C	1.15	16.0	0.51	0.43
System 3	3.2	1.67	1.04	0.52	0.27	S	1.12	16.0	0.60	0.49
	4.6	>1.61	>0.79	>0.35	0.35	C	1.13	33.0	>0.49	>0.38
	5.1	1.88	1.00	0.37	0.28	S	1.16	16.0	0.57	0.44

Data obtained in earlier work

1.8 0.50 0.55 0.28 0.45 C 1.12 90.0 0.40 0.36





