Dielectric Strength Note
Note 12

10 Nov 1966

Breakdown of Transformer Oil

by
Ian D. Smith
Atomic Weapons Research Establishment

The table shows the data used in the original note[1] (1 - 13, 19 and 21) but now with equal area data averaged to give one point. New data is shown (14 - 18, 20, 22, and 23 - 25) and the graphs show the original plot $Ft^{1/2}d^{-1/4}$ versus area, and a more straight forward $Ft^{1/3}$. The three prints obtained with non-uniform fields are corrected for field divergence, and the d used in the total electrode separation.

It is clear that the fast pulse data is in much better agreement with $t^{1/3}$ than $t^{1/2}$. The full lines are based on all uniform field experiments and the broken lines on fast pulse data only.

The effect of eliminating the $d^{1/4}$ term has been:

1. The scatter is increased at the right hand end and decreased somewhat at the left hand end.

2. Asymmetric field data lies on average just above rather than just below the line.

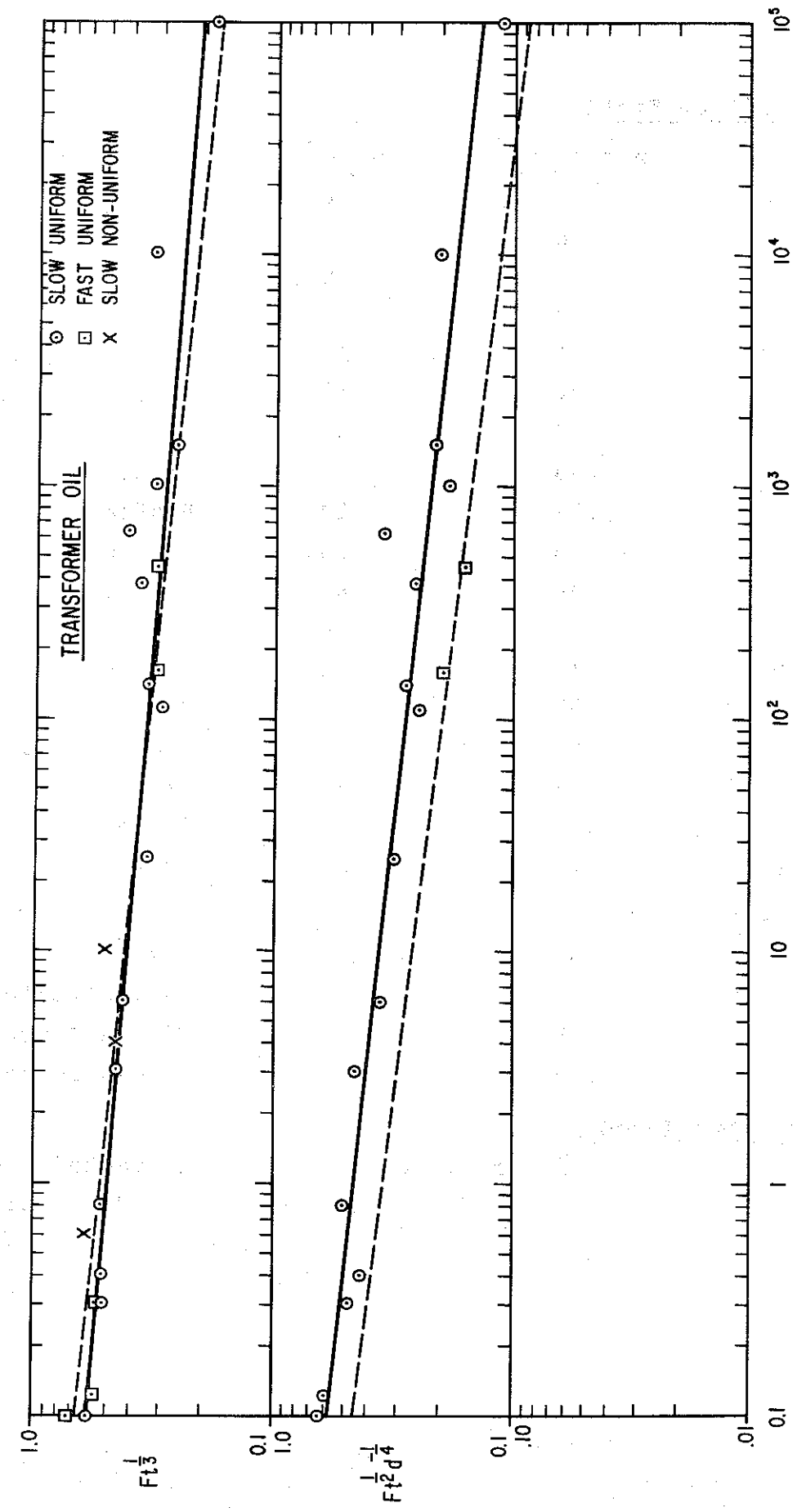
3. The slope is reduced from .105 to .078.

The disagreement for $Ft^{1/3}$ between the asymmetric field data and the uniform field data is most noticeable in the case of the ball plane gap where shielding by the ball support has been neglected.

There seems to be little evidence on the whole for variation with d, though a smaller d dependence (say $d^{1/6}$) might be considered.

1. Dielectric Strength Note 2

	A cm^2	Uniform Field $Ft^{1/2}d^{-1/4}$	Slow $Ft^{1/3}$	Method
1.	.05	.72	.70	Balls
2.	.07	.50	.45	Balls
3.	.10	.63	.59	Balls
4.	.30	.47	.51	Balls
5.	.80	.50	.52	Crossed Cylinder
6.	3.0	.44	.45	Cylinder Plane
7.	6.0	.34	.42	Plates
8.	25	.30	.33	Plates
9.	110	.24	.29	Plates
10.	380	.25	.36	Plates
11.	630	.34	.41	Plates
12.	1500	.21	.26	WOBL
13.	100,000	.11	.18	GUSHER
14.	.12	.59	.56	Balls
15.	.4	.42	.51	Crossed Cylinder
16.	140	.27	.33	Plates
17.	1000	.18	.32	Plates
18.	10,000	.20	.33	Coax
	U.F. Fast			
19.	.1	.60	.71	Balls
20.	.3	.30	.53	Balls Impulse
21.	160	.19	.30	Plates (Dagwood)
22.	450	.15	.31	Plates Gusher
	Non-uniform (Slow)			
23.	10	.34 Corrected	.28	.60 corrected .50
24.	0.6	.47 "	.39	.72 " .60
25.	4	.35 "	.33	.48 " .45


TRANSFORMER OIL
SLOW UNIFORM
FAST UNIFORM
SLOW NON-UNIFORM
$\frac{1}{Ft^{\frac{1}{3}}}$
$\frac{1}{Ft^{\frac{1}{2}}d^{\frac{1}{4}}}$
AREA (cm^2)
1.0
0.1
1.0
0.1
.10
.01
0.1
1
10
10^2
10^3
10^4
10^5