Appendix 2

Dielectric Properties of Various Materials

Excerpted, by permission of the publisher, from von Hippel, ed. *Dielectric Materials and Applications.* ©1954 by The MIT Press.

Solids, Inorganic Crystals	°C	1×10^2 Hz ε_r	tan δ $\times 10^3$	1×10^3 ε_r	tan δ $\times 10^3$	1×10^4 ε_r	tan δ $\times 10^3$	1×10^5 ε_r	tan δ $\times 10^3$
Ice, from conductivity water	−12							4.8	800
Snow, freshly fallen	−20			3.33	492	1.82	342	1.24	140
Snow, hardpacked followed by light rain	−6							1.9	1530
Aluminum oxide, sapphire									
Field ⊥ optical axis	25	8.6	< 1	8.6	< 0.2	8.6	< 1	8.6	< 1
Field ∥ optical axis	25	10.55	< 1	10.55	<0.2	10.55	< 1	10.55	< 1
Ammonium dihydrogen phosphate									
Field ⊥ optical axis	25	56.4	40	56.0	4.6	55.9	0.46	55.9	< 0.5
Field ∥ optical axis	25	16.4	240	16.0	24	15.4	7	14.7	7
Lithium fluoride	25	9.00	1.5	9.00	< 0.3	9.00	< 0.2	9.00	< 0.2
	80	9.11	12.0	9.11	2.0	9.11	1.1	9.11	0.4
Magnesium oxide	25	9.65	< 0.3	9.65	< 0.3	9.65	< 0.3	9.65	< 0.3
Potassium bromide	25	4.90	0.7	4.90	0.7	4.90	0.8	4.90	0.45
	87	4.97	1.6	4.97	0.7	4.97	1.1	4.97	0.9
Potassium dihydrogen phosphate									
Field ⊥ optical axis	25	44.5	9.8	44.3	1.5	44.3	< 0.5	44.3	< 0.5
Field ∥ optical axis	25	21.4	17.0	20.7	2.4	20.5	< 2	20.3	< 0.5
Selenium, multicrystalline	25								
Sodium chloride, fresh crystals [Harshaw]	25	5.90	< 0.1	5.90	< 0.1	5.90	< 0.1	5.90	< 0.2
	85	6.35	17.0	6.11	24.0	6.00	7.0	5.98	0.6
Sulfur, sublimed (U.S.P.)	25	3.69	0.3	3.69	0.2	3.69	< 0.2	3.69	< 0.2
Thallium bromide	25	31.1	130	30.3	12.8	30.3	1.33	30.3	0.2
Thallium iodide	25	22.3	95	21.8	12	21.8	1.2	21.8	0.12
	193								
Titanium dioxide, rutile									
Field ⊥ optical axis	25	87.3	11	86.7	3.2	86.4	0.9	86	0.4
Field ∥ optical axis	25					200	350	170	60

Solids, Inorganic Ceramics	°C	1×10^2 Hz ε_r	tan δ $\times 10^3$	1×10^3 ε_r	tan δ $\times 10^3$	1×10^4 ε_r	tan δ $\times 10^3$	1×10^5 ε_r	tan δ $\times 10^3$
AlSiMag A-35	23	6.10	15	5.96	10	5.89	7	5.86	5
	85	6.84	89	6.37	37	6.11	17.5	5.96	10.3
Ceramic F-66	25	6.22	1.45	6.22	0.9	6.22	0.5	6.22	0.2
Steatite Type 302	25	5.80	3.2	5.80	2.0	5.80	1.6	5.80	1.3
Steatite Type 400	25	5.54	16	5.54	10	5.54	7.2	5.54	6.0
Steatite Type 410	25	5.77	5.5	5.77	3.0	5.77	1.6	5.77	0.9
Steatite Type 452	25	8.15	6.5	8.15	2.8	8.15	1.7	8.15	1.2
Porcelains									
Ziroconium porcelain Zi-4	25	6.44	5.9	6.40	4.0	6.35	3.1	6.32	2.7

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$
4.15	120	3.7	18					3.20	0.9	3.17	0.7		
1.20	21.5	1.20	4			1.20	1.2	1.20	0.29	1.26	0.42		
1.55	290							1.5	0.9				
8.6	< 1	8.6	< 1	8.6	< 1	8.6	< 0.1					8.6	1.4
10.55	< 1	10.55	< 1	10.55	< 1	10.55	< 0.1						
55.9	< 0.5	55.9	< 0.5	55.9	< 0.5	55.9	< 1.0						
14.3	6	14.3	1			14.3	0.5			13.7	5		
9.00	< 0.2	9.00	< 0.2			9.00	0.07			9.00	0.18		
9.11	< 0.2	9.11	< .0.2							9.11	0.33		
9.65	< 0.3	9.65	< 0.3	9.65	< 0.3								
4.90	< 0.2	4.90	< 0.2			4.90	< 0.1			4.90	0.23		
4.97	0.5	4.97	0.3			4.97	0.24			4.97	0.35		
44.3	< 0.5	44.3	< 0.5	44.3	< 0.5								
20.2	< 0.5	20.2	< 0.5	20.2	< 0.5								
						11.0	250	10.4	154			7.5	110
5.90	< 0.2	5.90	< 0.2									5.90	< 0.5
5.98	< 0.2	5.98	< 0.2									5.97	< 0.39
3.69	< 0.2	3.69	< 0.2					3.62	0.04	3.58	0.015		
30.3	0.1	30.3	0.04										
21.8	0.05	21.8	0.05										
		37.3	82										
85.8	0.2	85.8	0.2										
170	8	160	1.6										

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$	ε_r	$\tan\delta \times 10^3$
5.84	3.8	5.80	3.5	5.75	3.7			5.6	4.1			5.36	5.8
5.86	7.7	5.80	5.0	5.75	5.0			5.50	4.7				
6.22	0.1	6.22	0.15	6.22	0.3			6.22	0.55			6.2	1.1
5.80	1.2	5.80	1.2	5.80	1.2			5.80	1.9	5.80	3.6		
5.54	5.0	5.54	4.5	5.54	3.9			5.5	3.9	5.5	5.3		
5.77	0.7	5.77	0.6	5.77	0.6			5.7	0.89	5.7	2.2		
8.15	1.0	8.15	1.0	8.15	1.0			8.15	2.0	8.15	3.10		
6.32	2.3	6.30	2.1	6.30	2.5	6.30	2.7	6.23	4.5	6.18	5.7		

Solids, Inorganic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Glasses	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Porcelain, wet process	25	6.47	28	6.24	18	6.08	13	5.98	10.5
Porcelain, dry process	25	5.50	22	5.36	14	5.23	10.5	5.14	8.5
Coors AI-200	25	8.83	1.4	8.83	0.57	8.82	0.48	8.80	0.38
Porcelain #4462	25	8.99	2.2	8.95	0.91	8.95	0.60	8.95	0.30
Coors AB-2	25	8.22	2.0	8.18	1.34	8.17	1.14	8.17	1.05
AlSiMag 491	25								
Miscellaneous ceramics									
Beryllium oxide	25	4.61	17	4.47	8.4	4.41	7.4	4.34	7.2

Solids, Inorganic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Glasses	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Corning 8871	25	8.45	1.8	8.45	1.3	8.45	0.9	8.45	0.7
Corning 9010	25	6.51	5.05	6.49	3.62	6.48	2.67	6.45	2.27
Corning Lab. No. 189CS	25	19.2	1.25	19.2	1.3	19.2	1.65	19.1	2.1
"E" glass	23	6.43	4.2	6.40	3.4	6.39	2.7	6.37	1.8
Foamglas	23	90.0	150	82.5	160	68.0	238	44.0	320
Fused silica 915	25	3.78	0.66	3.78	0.26	3.78	0.11	3.78	0.04
Fused quartz	25	3.78	0.85	3.78	0.75	3.78	0.6	3.78	0.4
Soda-silica glasses									
9% Na_2O, 91% SiO_2	25	6.4	250	6.2	82	5.7	40		
20% Na_2O, 80% SiO_2	25	10.8	400	8.3	150	7.3	67	6.8	36
30% Na_2O, 70% SiO_2	25	18	1100	12	390	10.4	130		
Alkali-silica glasses									
12.8% Li_2O, 87.2% SiO_2	25	9.94	970	6.54	360	5.45	100	5.1	31
12.8% Na_2O, 87.2% SiO_2	25	8.09	305	6.61	137	6.00	45	5.8	24
12.8% K_2O, 87.2% SiO_2	25	7.53	50.2	6.49	36	6.25	20	6.17	12.1
12.8% Rb_2O, 87.2% SiO_2	25	5.39	9.8	5.32	8.9	5.23	5.8	5.22	4.6
6.4% Li_2O, 6.4% Na_2O, 87% SiO_2	25	5.15	14.5	5.08	8.7	5.05	4.7	5.05	2.8
3.3% Li_2O, 6.6% K_2O, 71% SiO_2	25	5.23	5.3	5.19	4.7	5.17	3.7	5.15	2.8
6.4% Na_2, 6.4% K_2O, 87.2% SiO_2	25	5.68	10.2	5.62	7.5	5.58	4.2	5.56	3.1

Solids, Inorganic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Miscellaneous	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Ruby mica (muscovite)	26	5.4	2.5	5.4	0.6	5.4	0.35	5.4	0.3
Canadian mica									
(field ⊥ sheet)	25	6.90	1.5	6.90	0.2	6.90	0.1		
(field ∥ sheet)	25	11.5	230	8.7	98	7.3	40		
Marble S-3030 (after drying)	25	15.6	200	12.8	110	11.4	63	10.6	39
Selenium, amorphous	25	6.00	1.8	6.00	0.4	6.00	<0.3	6.00	<0.5
Sandy soil, dry	25	3.42	.0196	2.91	0.008	2.75	.0034	2.65	0.002
2–18% moisture	25	3.23	0.064	2.72	0.013	2.50	.0056	2.50	0.003
3.88% moisture	25				150			5.0	1.9
16.8% moisture	25				342.5		36.7		

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
5.87	9.0	5.82	11.5	5.80	13.5	5.75	14			5.51	15.5		
5.08	7.5	5.04	7.0	5.04	7.8	5.02	9.8			4.74	15.6		
8.80	0.33	8.80	0.32	8.80	0.30			8.79	1.0	8.79	1.8		
8.95	0.20	8.95	0.20	8.95	0.40			8.90	1.1	8.80	1.4		
8.16	0.9	8.16	0.75	8.16	0.9			8.14	1.6	8.08	2.7		
8.74	2.2							8.60	1.7	8.50	2.3		
4.28	3.8	4.24	1.9	4.23	1.25					4.20	0.5		

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
8.45	0.6	8.43	0.7			8.40	1.4	8.34	2.6	8.05	4.9	7.82	7.0
6.44	2.15	6.43	2.26	6.42	3.0	6.40	4.1			6.27	9.1		
19.0	2.7	19.0	3.7	19.0	5.7			17.8	12.4				
6.32	1.5	6.25	1.7	6.22	2.3					6.11	6.0		
17.5	318	9.0	196							5.49	45.5		
3.78	0.01	3.78	0.01	3.78	0.03	3.78	0.05			3.78	0.17		
3.78	0.2	3.78	0.1	3.78	0.1			3.78	0.06	3.78	0.1	3.78	0.25
5.4	13					5.1	10			5.05	13	4.9	16
6.6	22	6.3	18			5.9	14			5.6	20	6.1	28
8.5	40					7.5	19			7.2	24	7.0	35
4.95	17.4	4.92	12.4			4.9	7.9			4.80	10.2		
5.66	15.9	5.57	12.6			5.4	11.8			5.33	18.2		
6.09	9	6.02	8			5.8	9.9			5.8	22		
5.21	4.1	5.20	3.8			5.15	5.9			5.05	12		
5.04	1.9	5.03	1.7			5.00	2.6			4.95	5.2		
5.14	2.4	5.10	2.4			5.07	4.0			5.04	8.3		
5.56	2.5	5.54	2.3			5.51	4.0			5.50	11.5		

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
5.4	0.3	5.4	0.3	5.4	0.2			5.4	0.3				
10.0	36	9.5	37	9.1	29	8.8	25			8.6	12		
6.00	<3	6.00	<0.2	6.00	<0.2	6.00	<0.5	6.00	0.18	6.00	0.67	6.00	1.3
2.59	.0017	2.55	.0016			2.55	.0010	2.55	.00062	2.53	.00036		
2.50	.0025	2.50	.0025			2.50	.0026	2.50	0.003	2.50	0.0065		
4.70	0.175	4.50	0.03			4.50	0.003	4.40	.0046	3.60	0.012		
20	0.4	20	0.035			20	0.003	20	0.013	13	.029		

Solids, Inorganic Miscellaneous	°C	1×10^2 Hz ε_r	 tan δ $\times 10^3$	1×10^3 ε_r	 tan δ $\times 10^3$	1×10^4 ε_r	 tan δ $\times 10^3$	1×10^5 ε_r	 tan δ $\times 10^3$
Loamy soil, dry	25	3.06	0.007	2.83	0.005	2.69	.0035	2.60	0.003
2.2% moisture	25				0.21	18	0.16		
13.77% moisture	25				849		97		
Clay soil, dry	25	4.73	0.012	3.94	0.012	3.27	0.012	2.79	0.01
20.09% moisture	25				780		100		

Solids, Organic Plastics	°C	1×10^2 Hz ε_r	 tan δ $\times 10^3$	1×10^3 ε_r	 tan δ $\times 10^3$	1×10^4 ε_r	 tan δ $\times 10^3$	1×10^5 ε_r	 tan δ $\times 10^3$
Nylon 610	25	3.60	15.5	3.50	18.6	3.35	20.8	3.24	22.1
	84	13.5	235	11.2	140	9.0	158	6.3	203
Nylon 610, 90% humidity	25	4.5	65	4.2	64	4.0	60	3.7	50
Cellulose derivatives, acetates									
LL-1	25	3.82	9.5	3.77	15	3.67	20	3.53	23
	85	3.98	3.4	3.96	7.5	3.90	13.5	3.77	21
Silicon resins									
Dilecto (silicone glass laminate) 50%	25	3.56	1.35	3.56	1.29	3.56	1.29	3.55	1.11
DC2103, 50% glass, field ⊥ sheet	90	3.41	2.64	3.39	1.62	3.38	1.49	3.38	1.61
	200	3.18	23.6	3.18	4.3	3.18	2.3	3.17	19.5
Field ‖ sheet	25	6.55	125	5.72	91	4.94	108	3.96	51.6
	215	10.93	200	8.6	208	6.65	180	4.92	141
Measured after temperature run	25	5.71	62.4	5.16	88	4.54	94	3.98	64
Polyvinyl resins									
Polyethylene DE-3401	25	2.26	<0.2	2.26	<0.2	2.26	<0.2	2.26	<0.2
Polyvinyl chlorides									
Polyvinyl chloride W-176	25	6.21	73	5.52	94	4.70	107	3.96	96
Plasticell	25	1.04	2.1	1.04	1.1	1.04	<1.5	1.04	<1.5
Polyvinylidene and vinyl chloride									
Saran B-115	23	4.88	45	4.65	63	4.17	88.5	3.60	8.45
Polychlorotriflouroethylene									
Kel-F	26	2.72	21	2.63	27	2.53	23	2.46	13.5
Polytetraflouroethylene									
Dilecto (Teflon Laminate GB-112T, 67%	25	2.76	0.89	2.74	0.61	2.74	0.6	2.74	0.6
Tef., 33% glass), field ⊥ laminate	250	2.48	8	2.46	3.6	2.46	1.8	2.46	1.4
After heating	25	2.70	0.47	2.68	0.39	2.69	0.47	2.69	0.48
Polyacrylates									
Polyethyl methacrylate	22	2.90	42	2.75	29.4	2.65	18.5	2.60	11.8
	80	3.87	81	3.36	106	2.86	96	2.70	71
Polyisobutyl methacrylate	25	2.70	11.1	2.68	7.0	2.63	5.0	2.55	3.7
	80	2.9	83	2.7	60	2.5	36	2.5	21
Polystyrene									
Polystyrene (molded sheet stock)	25	2.56	<0.05	2.56	<0.05	2.56	<0.05	2.56	.05
	80	2.54	0.9	2.54	0.2	2.54	<0.1	2.54	<0.2

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$
2.53	.0018	2.48	.0014			2.47	.00065	2.44	.00011	2.44	.00014		
6.9	0.065	4	0.045			3.5	0.006	3.5	0.004	3.50	0.003		
		14.5	0.13			20	0.016	20	0.012	13.8	0.018		
2.57	.0065	2.44	0.004			2.38	0.002	2.27	.0015	2.16	0.0013		
		21.6	0.17			20	0.052	11.3	0.025				

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	$\tan\delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$	ε_r	$\tan \delta \times 10^3$
3.14	21.8	3.05	20.5	3.0	20			2.84	11.7			2.73	10.5
4.4	172	3.7	115	3.4	67			2.94	35.6				
3.2	38	3.05	28	3.0	22			2.85	12.5				
3.42	23	3.30	21	3.29	21	3.28	22	3.24	29	3.24	40	3.1	31
3.58	27	3.44	28					3.30	29				
3.54	0.85	3.54	1.14	3.54	1.86								
3.38	1.1	3.38	0.98										
3.15	2.1	3.10	1.54										
3.84	12.8	3.82	3.7	3.80	2.5	3.78	3.9	3.76	5.2	3.70	8.7		
										3.78	8		
2.26	<0.2	2.26	<0.2					2.26	0.31	2.26	0.36		
3.53	72	3.28	52	3.00	50								
1.04	1.0			1.04	1.0			1.04	5.5	1.04	5.0		
3.18	57	2.97	31	2.82	18			2.71	7.2	2.70	5.1		
2.43	8.2	2.35	6.0			2.30	3.0	2.30	2.8	2.29	3.9	2.29	5.5
2.73	0.58	2.73	0.62	2.73	1.18								
		2.44	0.25										
2.55	9.0	2.53	7.5					2.51	7.5	2.50	9.7	2.5	8.3
2.61	40	2.57	26	2.55	14			2.49	9.1	2.48	13.5		
2.45	3.5	2.45	4.6	2.42	5.2	2.40	4.7	2.39	3.1	2.38	3.9	2.37	5.2
2.44	10	2.42	8.0	2.42	7.0	2.40	6.5	2.39	5.4	2.38	5.9		
2.56	0.07	2.56	<0.2	2.55	<0.1	2.55	0.35	2.55	0.33	2.54	0.43	2.54	1.2
2.54	<0.2	2.54	<0.2	2.54	<0.3	2.54	0.27	2.54	0.45	2.53	0.53		

Solids, Organic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Plastics	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Formica LE (after 5 yr. storage)	25	5.92	.0112	5.32	.0057	5.01	.0038	4.86	.004
	100			16.0	.042	8.16	.029	6.22	.0151
Micarta 299	200	12.8	.059	6.7	.036	5.0	.0158	4.75	.0046
Mycalex 400, dry	25	7.45	.00029	7.45	.00019	7.42	.00016	7.40	.00014
after 48 h. in H_2O	25	7.45	.0012	7.45	.00097	7.42	.00068		
Bakelite BM 262, dry	25	4.85	.00095	4.80	.00082	4.74	.00075	4.72	.00060
after 20 days, 90% rel. hum	25	3.87	.00184	3.78	.0015	3.70	.0012		
after 7 mos., 90% rel. hum	25	6.72	.0147	5.78	.009	5.15	.0057		
after 19 mos., 90% rel. hum.	25	9.10	.0244	6.75	.0169	5.51	.0111		
Formica FF-55, dry	25								
after 20 h. in H_2O	25								
GMG melamine, dry	25	8.2	.019	7.0	.0069	6.7	.0019	6.6	.001
after 6 or 8 mos., 90% rel. hum.	25	42.5	.075	16.8	.054	10.4	.027	7.65	.010
Polythene, dry	25								
after 10 days, 90% rel. hum.	25								

Solids, Organic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Miscellaneous	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Paper, Royalgrey	25	3.30	5.8	3.29	7.7	3.22	11.7	3.10	20
	82	3.57	17	3.52	7.4	3.49	6.1	3.40	8.5
Leather, sole, dried	25	4.1	45	3.9	35	3.6	30	3.4	28
Leather, sole, about 15% moisture	25	38	1400	14.0	700	9.3	370	6.9	220
Soap, Ivory	25								
Steak (bottom round)	25					24,400	40,500		
Suet	25			750	3000	210	2500		

Liquids, Inorganic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Miscellaneous	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Water, conductivity	1.5							87.0	190
	5								
	15								
	25							78.2	400
	35								
	45								
	55								
	65								
	75								
	85							58	1240
	95								
Aqueous sodium chloride									
0.1 molal solution	25							78.2	$2.4 \cdot 10^6$
0.3 molal solution	25							78.2	$6.3 \cdot 10^6$

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tanδ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
4.85	.0042							3.63	.0037				
5.84	.008							4.10	.0067				
4.6	.0015							4.4	.0016				
7.39	.00013	7.38	.00013							7.12	.00033		
7.39	.00029	7.38	.00021							7.18	.0010		
4.67	.00055												
4.18	.0047												
						5.55	.0027						
						6.5	.0064						
6.4	.0011												
6.57	.0030												
								2.26	$67 \cdot 10^{-6}$				
								2.26	$85 \cdot 10^{-6}$				

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
2.99	38	2.86	57	2.77	66	2.75	66	2.70	56	2.62	40.3		
3.31	23	3.14	44	3.08	63	3.00	72	2.94	80	2.84	82.7		
3.2	28	3.1	30	3.1	38								
5.6	140	4.9	100	4.5	100								
								2.96	176.5				
197	61,000	50	26,000			50	780	40	300	30	370	15	400
14	1700	4.5	930	2.6	150	2.5	120	2.5	70	2.5	50	2.4	50

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
87.0	19	87	2.0	87	7.0	86.5	32	80.5	310	38	1030	15	425
85.5	22					85.2	27.3	80.2	275	41	950	17.5	395
81.7	31					81.0	21	78.8	205	49	700	25	330
78.2	40	78.2	4.6	78	5.0	77.5	16	76.7	157	55	540	34	265
74.8	48.5					74.0	12.5	74.0	127	58	440	41	215
71.5	59					71.0	10.5	70.7	106	59	400	46	275
68.2	72					68	9.2	67.5	89	60	360	49	245
64.8	86.5					64.5	8.4	64.0	76.5	59	320	50.5	125
61.5	103					61	7.7	60.5	66	57	280	51.5	105
58	124	58	12.5	58	3.0	57	7.3	56.5	54.7	54	260		
55	143					52	7.0	52	47				
						76	780	75.5	240	54	560		
						71	2400	69.3	435	52	605		

Liquids, Inorganic		1×10^2 Hz		1×10^3		1×10^4		1×10^5	
Miscellaneous	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
0.5 molal solution	25							78.2	$9.9 \cdot 10^6$
0.7 molal solution	25							78.2	$13 \cdot 10^6$

Liquids, Organic		1×10^2		1×10^3		1×10^4		1×10^5	
	°C	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
Aliphatic									
Heptane	25	1.971	<0.3	1.971	<0.04	1.971	<0.04		
Methyl alcohol	25								
Ethyl alcohol	25								
Ethylene glycol	25					42	3000	41	300
Carbon tetrachloride	25	2.17	6.0	2.17	0.8	2.17	0.04	2.17	<0.04
Tetrachloroethylene	25	2.28	1.5	2.28	0.2	2.28	0.07	2.28	0.1
Dichloropentanes #40	25			334	520,000	17.1	106,000	8.65	13,500
Aromatic									
HB-40 oil	25	2.59	0.13	2.59	<0.04	2.59	<0.04	2.59	<0.3
Pyranol 1467	25	4.42	3.6	4.40	0.3	4.40	<0.4	4.40	0.36
Petroleum oils									
Aviation gasoline, 100 octane	25					1.94	0.1		
Aviation gasoline, 91 octane	25					1.95	0.4		
Jet fuel JP-1	25					2.12	<0.1		
Jet fuel JP-3	25					2.08	<0.1		
Vaseline	25	2.16	0.3	2.16	0.2	2.16	<0.2	2.16	<0.1
	80	2.10	1.6	2.10	0.36	2.10	.09	2.10	<0.1
Cable oil 5314	25	2.25	0.3	2.25	<0.04	2.25	<0.04	2.25	<0.1
	80	2.18	3.8	2.18	0.4	2.18	0.05		
Silicones									
DC500, 0.65 cs. at 25°C	−15	2.20	<0.5	2.20	<0.3	2.20	<0.3	2.20	<0.5
	22	2.20	0.1	2.20	<0.04	2.20	<0.04	2.20	<0.3
DC500, 10 cs. at 25°C	23	2.66	1.2	2.66	0.15	2.66	<0.04	2.66	<0.3
Ignition Sealing Compound #4 (organosiloxane polymer, Dow)	25	2.75	1.5	2.75	0.6	2.75	0.5	2.74	0.4
SF96-40 (General Electric)	25	2.71	<0.03	2.71	<0.003	2.71	<0.003	2.71	<0.03

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
						69	3900	67.0	625	51	630		
										50	660		

1×10^6		1×10^7		1×10^8		3×10^8		3×10^9		1×10^{10}		2.5×10^{10}	
ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$	ε_r	tan δ $\times 10^3$
						1.97	<0.25	1.97	.1	1.97	1.6		
31	200	31.0	26	31.0	38	30.9	80	23.9	640	8.9	810		
24.5	90	24.1	33	23.7	62	22.3	270	6.5	250	1.7	68		
41	30	41	8	41	45	39	160	12	1000	7	780		
2.17	<0.04	2.17	<0.2	2.17	<0.2	2.17	<0.1	2.17	0.4	2.17	1.6		
2.28	0.2	2.28	0.2					2.28	1.0				
		7.76	270			7.57	84	6.81	198				
2.58	1.3	2.57	7.6	2.54	16	2.48	9.3	2.40	3	2.34	1.7		
4.40	2.5	4.40	26	4.08	130	3.19	150	2.84	120	2.62	74		
						1.94	.08	1.92	1.4				
						1.95	.04	1.94	1.15				
						2.12	1.2	2.09	6.8				
						2.08	0.7	2.04	5.5				
2.16	<0.1	2.16	<0.3	2.16	<0.4			2.16	0.66	2.16	1.0		
2.10	<0.1							2.10	0.92	2.10	2.2		
						2.24	3.9	2.22	1.8	2.22	2.2		
								2.18	4.7				
2.20	<0.3	2.20	<0.2					2.20	1.86				
2.20	<0.3	2.20	<0.2			2.20	0.14	2.20	1.45	2.19	3.0	2.13	6.0
2.66	<0.3	2.66	0.3					2.65	6.8	2.63	27	2.48	41
2.75	0.4	2.75	0.6	2.74	1.5	2.72	2.8	2.65	9.2	2.49	27		
2.71	<0.1	2.71	<0.1			2.71	1.1	2.70	9.5	2.67	18.6		