

Dielectric Strength Of Insulator Materials

Edvard

The atoms in [insulating materials](#) have very tightly-bound electrons, resisting free electron flow very well. However, insulators cannot resist indefinite amounts of voltage. With enough voltage applied, any insulating material will eventually succumb to the electrical "pressure" and electron flow will occur.

However, unlike the situation with conductors where current is in a linear proportion to applied voltage (given a fixed resistance), current through an insulator is quite nonlinear: for voltages below a certain threshold level, virtually no electrons will flow, but if the voltage exceeds that threshold, there will be a rush of current.

Once current is forced through an insulating material, breakdown of that material's molecular structure has occurred. After breakdown, the material may or may not behave as an insulator any more, the molecular structure having been altered by the breach.



Medium voltage mastic tape - self-amalgamating insulating compound designed for quick, void-free insulation layering

There is usually a localized "**puncture**" of the insulating medium where the electrons flowed during breakdown.

Dielectric strength comparison between materials

Material *	Dielectric strength (kV/inch)
Vacuum	20
Air	20 to 75
Porcelain	40 to 200
Paraffin Wax	200 to 300
Transformer Oil	400
Bakelite	300 to 550
Rubber	450 to 700
Shellac	900
Paper	1250
Teflon	1500
Glass	2000 to 3000
Mica	5000

*

= *Materials listed are specially prepared for electrical use.*

Thickness of an [insulating material](#) plays a role in determining its breakdown voltage, otherwise known as dielectric strength. Specific dielectric strength is sometimes listed in terms of volts per mil (1/1000 of an inch), or kilovolts per inch (the two units are equivalent), but in practice it has been found that the relationship between breakdown voltage and thickness is not exactly linear.

An insulator three times as thick has a dielectric strength slightly less than 3 times as much. However, for rough estimation use, volt-per-thickness ratings are fine.

Resource: *Lessons in electric circuits – Vol. II*

Source:

<http://electrical-engineering-portal.com/dielectric-strength-insulator-materials>