

Nothing is Perfect



by **Britt Storkson**
Owner, P2FlowLLC

This is not a perfect world, but things don't always have to be perfect to be useful. The electrical world is governed by conductors and insulators (or dielectrics). Conductors "conduct" electricity well, meaning they allow the flow of electrons with relatively little resistance (not zero resistance) to the flow of electrons. Insulators or dielectrics do not conduct electricity well, so they are often used to separate conductors from each other.

However, even good insulators do conduct a tiny amount of electricity, but it's not enough to be a problem. To get better insulation qualities, one can make the insulation layer thicker or use better quality insulation.

PVC is the cheapest wire insulation

available, but it isn't ideal. It becomes stiff and brittle with old age and cold temperatures. Better quality silicone wire insulation is available, but it's more expensive. Since it is a better insulator, less is needed. (It can be thinner.) It also doesn't get stiff in cold weather and holds up better over time. But given these advantages, it still costs more than PVC.

Moderately good conductors (but not great conductors) such as steel used for a car body can be used as electrical conductors too. In nearly every car, the negative terminal of the battery is connected to the steel car body and/or frame. About half of the "wiring" in the typical car is the negative "return" path for the wiring through the steel body and frame.

Although steel is not a great conductor of electricity, it is good enough for this application because the distances are short and there is a great mass of steel to make for a fairly low resistance path back to the battery. This also makes the car cheaper to build because about half of the wiring is replaced by the steel car body. It's not perfect, but it's adequate for this application.

High-voltage power lines use the insulating properties of air to separate the conductors. Air is a good insulator,

so all that is needed is to determine the proper distance between the lines and the ground so the current will not travel between them. Plus, there is no need to use insulated wire. The air is the insulator.

How much current flows through the insulator depends on the resistance of the insulator and the voltage applied. Ohm's law is used to determine this value. If the insulator has a resistance value of 1 million ohms and 120 volts is applied to this resistance:

Current = voltage divided by resistance = 0.00012 amps of current.

That's a tiny amount and not a problem. Most insulation values are many times 1 million ohms to allow for insulation breakdown over time (aging and cracking).

So while materials and processes are not perfect, oftentimes they don't need to be to be useful.

Britt

Britt Storkson may be contacted via e-mail at admin@worldwidedrillingresource.com

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