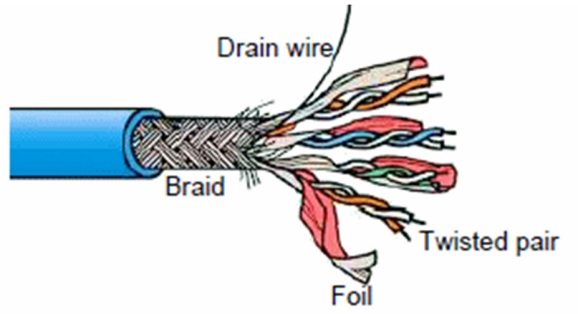
The strange case of S/FTP LAN cables with a drain wire

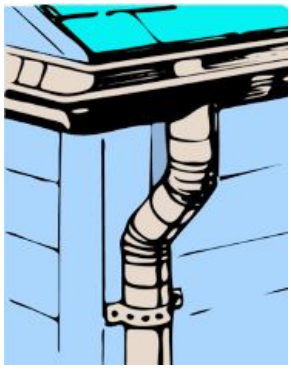


Abstract

Braid shielded LAN cables must be grounded using the entire braid as a drain wire. Having an additional drain wire laid under the braid may mislead the installer to use it for connecting to the ground instead of the braid.

Shielded LAN cables must be properly grounded so the electrical energy absorbed by the shield can be properly drained.
Proper grounding must provide good passage from the shield to the ground. This is done by bonding the shield of the cable to the ground, at least in one of its ends (*). This bonding is normally done with a drain wire. The efficiency of the shield is related to the quality of the ground, which is related to the DC resistance of the drain wire. The size of the drain wire should be proportional to the amount of energy that needs to be drained.
When the DC resistance of the drain is too high, some of the energy accumulated on the shield will penetrate into the cable (and will be radiated out of the cable).
When the drain is disconnected the cable performance is identical to an unshielded cable.

A good analogy is the roof drainage system:
If the drain pipe is too small (partly or fully blocked) the rain water accumulated in the troughs will eventually overflow around the roof and the system will operate as if there is no drainage at all.



Shielded LAN cables may have a braided shield, but may contain only metal foils.
When the shield is made of foils only (F/UTP, U/FTP, F/FTP) the cable must contain a drain wire which is laid in close contact to the metal side of the foils shield. In these cables the drain wire is the only valid option to create an electrical connection to the ground because it is difficult the use the foils as drain wires.

Evidently, the size of the drain wire has a direct effect on the grounding quality so it must be large enough to drain all the energy created on the shield.
On the other hand, the drain wire cannot be too large as it must be easy to handle and terminate.
In addition, the ability of a single drain wire to collect all energy from a large foil (or 4 individual foils) is doubtful, so a very common solution is to place a copper braid over the foil shields. The braid is made of many wires laid helically around the cable thus creating an efficient drain wire system.

Braid shielded LAN cables are available in several constructions (i.e. S/UTP, SF/UTP & S/FTP) but in all these cables the overall braid has one purpose only: To serve as a drain wire. The braid coverage in these LAN cables has no significance, as the only critical parameter is the DC resistance.

This fact has been recognized lately in IEC 61156 which now specifies the minimum DC resistance of the shield: 15 Ohm/Km.

Copper braids are more expensive than single drain wires because they contain more metal and they require an additional (and slow) production stage, so they better be used when available.
Most producers and users of LAN cables recognize the risks involved in having an additional drain wire in braid shielded cables, but for some obscure reasons there are specifications and tender documents demanding it.
When a drain wire is available in braid shielded cables, the installer has the option to cut and remove the braid, and use only the drain wire for grounding the cable shield.
When this is done, the braid becomes ineffective, as the draining is done only by the single wire, not by the entire braid. As a result the customer that paid for an expensive cable with a copper braid gets the relatively low draining efficiency of a single drain wire.

It is impossible to make sure that all installers will ignore the temptation of using the single drain wire instead of the entire braid for grounding the cable, so the only way to prevent the installers from cutting the braid and using the drain wire is not to insert a drain wire into S/FTP cables.
It will also save the customer the cost of this redundant wire.

(*) It is highly recommended to ground the channel on both ends but this is not a must and in real life this is not always done, even if all the components are shielded and bonded properly. While the end in the telecommunication room is bonded through the panel to the rack and from there to the building ground, the user wall outlet is usually not grounded so the ground continuity must be done with the shielded cord, the shielded socket of the peripheral equipment and the ground of the power cord. Unfortunately, many of the desktop and laptop computers do not have shielded RJ45 sockets, and their connection to the building ground is not always ensured (the power socket has no ground, the power cord has no ground or the laptop user do not bother to plug in the power cord).
The bottom line is that many of the channels in standard LANs are effectively grounded in one end only, but this does not seem to create a major problem. In fact this is highly beneficial when short channels are running 1GBASE-T and 10GBASE-T, where the ground loop voltage is usually much larger than the signal voltage.