WIRE WISDOM
Wire & Cable Group

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Low Voltage Cable Shielding -- What's That?

Why are shields used on low voltage (600 volts or less) control, instrumentation and electronic cables? What are the basic types? Which types are most effective? How do you properly ground a shield? Read on for exciting answers to these and other questions.

Why Are Shields Used?

All cables that carry electrical signals radiate (or "leak") electromagnetic energy to their surroundings. Likewise, cables located in an area where electromagnetic energy is present can also "pick up" unwanted energy just as an antenna picks up radio signals. If this stray energy is not properly managed, problems can arise. For example, process control circuits can malfunction, computers may "lock-up", audio circuits may exhibit "hum", and video circuits can develop "ghosts" in the picture. This stray energy is usually referred to as Electromagnetic Interference (EMI).

What Are The Basic Types?

Many types of shields have been developed to meet the electrical and mechanical requirements of thousands of different cable applications. The most common types include:

- Braided copper wire
- Aluminum foil with polyester backing
- Foil/braid combination
- Solid aluminum tube
- Spiral copper wire

Which Types Are Most Effective?

That's a loaded question since the answer depends on the type of signal being carried by the cable. It also usually involves some compromises with regard to cable flexibility.

For low frequency applications (up to about 1 MHz), braid or spiral wire shields are often used. At low frequencies, end-to-end electrical resistance of the shield is an important factor in shield effectiveness. Microphone cables are often made with a spiral wire shield because this type of shield is effective at audio frequencies, is low cost and has the desired flexibility and flex-life.

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For mid frequency applications (1 MHz to about 100 MHz), braid shields are often used. Braid shield effectiveness depends on the "coverage", i.e., the tightness of the weave. Coverage generally ranges from a low of about 65% to a high of about 98%. A higher braid coverage results in better shield performance, but also higher cost. Braid shields are widely used in coaxial and multi-conductor instrumentation cables.

For high frequency applications (above 100 MHz), braid shields are often used in combination with foil. This is because the little "windows" in a braid shield begin to "leak" energy at high frequencies. The addition of an aluminum foil shield under the braid effectively blocks this leakage.

For highly effective shielding at ***all*** frequencies, a solid aluminum shield is often the shield of choice. A solid aluminum tube provides 100% coverage for good high frequency performance as well as low electrical resistance for good low frequency performance. However, as you might have already guessed, cable flexibility is poor.

How Do You Properly Ground a Shield?

Proper grounding of a shield can have as much effect on performance as the choice of shield type. A few recommendations for maximum EMI control are as follows:

- At terminations, strip the shield back as little as possible to keep unshielded areas to a minimum.

- Carefully follow the recommendations of the manufacturer of the attached equipment regarding where and how to connect the shield.

- The shield should not be used as an electrical conductor. It is designed only to provide shielding (coaxial cable is an exception to this rule).

- The shield of each cable should be covered with an insulating jacket to prevent unintentional multiple grounding of the shield.

- The shields of grounded junction thermocouple circuits should be grounded at or near the thermocouple well.

For those of you who *really* want to get into it, more information is available in an IEEE Standard titled Guide on Shielding Practice for Low Voltage Cables (Std. No. 1143).

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