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Drop Cable Shielding

White Paper

How Do Bi-, Tri- and Quad-Shields Stack Up?

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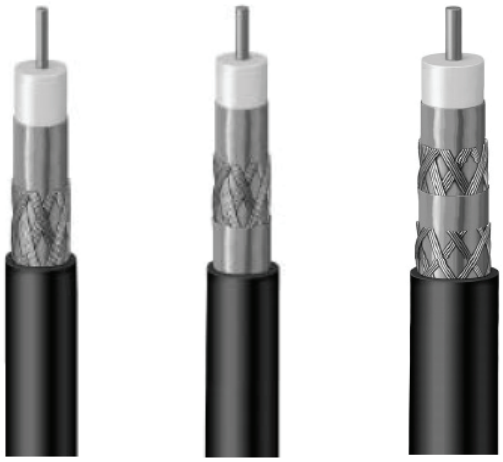

Abstract

Drop cables are shielded to keep noise signals out of the cable (ingress) and to prevent signal from escaping (egress) which leads to signal loss or radiated interference. Flexible drop cable shields are manufactured with layers of aluminum foil and wire braids. The layers are selected to optimize flexibility, cost and shielding performance. This white paper will compare the measured shielding performance of several design options.

1. Shield Design

The building blocks for shield construction are:

- Foil - made of aluminum / polyester / aluminum laminate (APA)
- Braid - made of woven aluminum wires

Braid alone has properties of low resistance and thickness to provide excellent shielding at low frequencies but the openings or holes in the braid allow signal to leak a little at high frequencies. Foil alone has no openings (100% coverage) providing excellent shielding at high frequencies but the thin metal leaks signal at low frequencies. Combined, these two components are very effective over the entire broadband spectrum (5 to 1,000 MHz).

Bi-shield construction (Figure 1) is made of a single foil laminate covered by a single braid as shown. The foil is glued to the foam core using a hot melt adhesive (EAA).

Figure 1

Tri-shield (Figure 2) adds another foil layer over the braid to increase shielding effectiveness. The foil must be applied longitudinally, not in a spiral.

Figure 2

Quad-shield (Figure 3) adds another braid layer over the second foil to further increase shielding effectiveness.

Figure 3

2. Braid Coverage

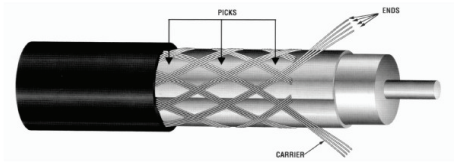

Figure 4

Optical coverage of the braid wires (Figure 4) is typically chosen to be 60%, 77% or 90% and is calculated as follows:

Unit	Definition
ends	strands per carrier (typically 3..12)
Car	number of carriers (typically 16 or 24)
d	strand diameter [in]
D	core diameter [in]
α	braid angle [deg]
P	picks/inch
Cov	optical coverage (%)

$$\alpha = \tan^{-1}\left[\frac{2\pi P(D+2d)}{Car}\right] \qquad F = \frac{ends \cdot Pd}{\sin\alpha}$$

$$Cov = (2F - F^2)x100\%$$

3. Test Method

Shielding performance of drop cable samples was measured in a GTEM cell (Figure 5) according to ANSI/SCTE 48-3 "Test Procedure for Measuring Shielding Effectiveness of Braided Coaxial Drop Cable Using a GTEM Cell." Samples tested were one (1) meter long, unconditioned and the frequency was swept from 5-1,000 MHz. The results are in units of dB (decibel) with higher dB numbers indicating better shielding performance.

Figure 5

4. Test Results

Bi-shield cables with 60% and 90% coverage are compared in Figure 6. Higher braid coverage improved the broadband (averaged over 5-1,000 MHz) performance by only 3 dB.

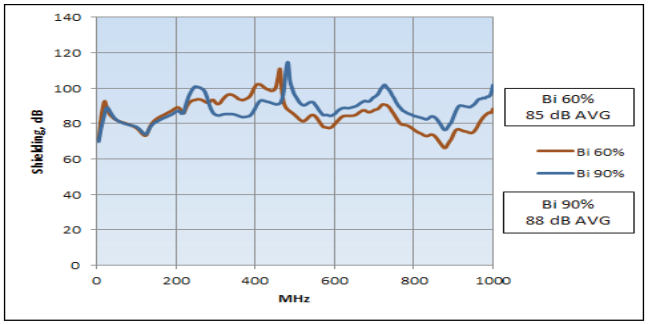

Figure 6

Tri-shield cable with an additional foil placed over the braid improved the broadband performance by 15-22 dB for 60% and 77% designs, respectively (Figure 7).

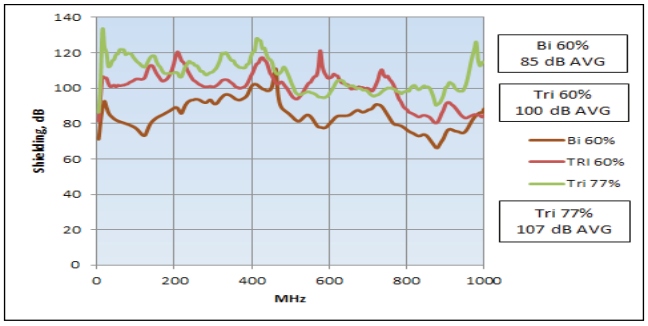

Figure 7

Quad-shield cable (60% / 40%) with an additional foil and braid improved the broadband performance by 26 dB relative to 60% bi-shield (Figure 8).

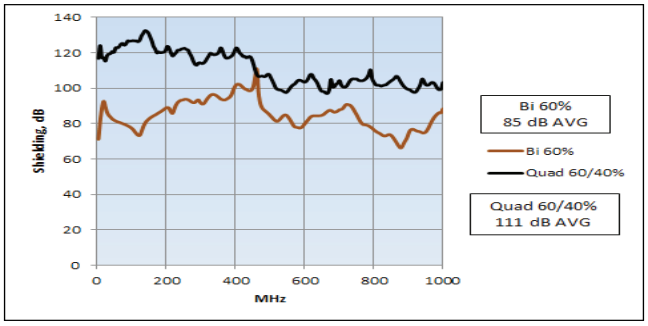

Figure 8

Shielding averaged for 5-1,000 MHz:

Coaxial Shielding	dB
Bi-shield 60%	85
Bi-shield 90%	88
Tri-shield 60%	100
Tri-shield 77%	107
Quad-shield 60% / 40%	111

Conclusion

The data provides a comparison of shielding performance of several standard cable designs.