# Shielding Effectiveness in Broadband Networks
## Technical Report

## Introduction

The convergence of voice, video and data technologies into the broadband network has raised the standards of performance for the components of these exciting new networks. Signal integrity has become a focal point for service providers in ensuring that customer satisfaction can be guaranteed. A drop cable's performance is a function of its design and is a major part of that signal integrity.

## The Cable Evolution

Historically, the predominant drop cable is the RG6 size, 60% braided drop cable, commonly known as the F660. The F660 drop cable, whether it is flooded, fire resistant, direct burial, or messengered is the workhorse in the 75-ohm world of drop cable. It is a great compromise between cost and performance. More than adequate for many applications, the F660 design falls short in performance compared to cables like "Tri-Shield" and "Super-Shield" variations. However, these high-performance cables come with added cost. From these facts comes two questions, how much better are these designs, and how much do they cost? The following discussion will answer these questions by comparing the list price to the average shielding effectiveness of the three cable designs.

## Aging of Cable

Like everything else, cables experience degradation throughout their life. While handling and installation of a cable creates stress on the cable's components, most degradation is attributed to constant exposure to the environment. To that point, shielding performance after handling and flexure is of greater importance than shielding performance before installation or flexure.

It is not practical to rely on the actual aging of cable for research and development of products, and engineering case studies. Obtaining accurate test results in the shortest period of time requires the use of simulated aging techniques.

The rotary flex fatigue test method outlined in SCTE 166 2010 was employed to provide accelerated aging in Commscope's labs. The resulting flexure has been shown to simulate 10 years in the plant after 10,000 rotations.

## The Laminated Shielding Tape (LST)

Laminated shielding tapes are a crucial element of the drop cable shield. The tape is made up of two separate layers of aluminum tape that are bonded to either side of a substrate material. The relatively thin layers of aluminum provide the necessary electrical characteristics to allow signal propagation and reduce signal ingress and egress while still maintaining a high degree of flexibility. Laminated shielding tapes provide high frequency shielding, but must be supported to last through the rigors of installations. Without support, the tape will develop microcracks or "gaps", increasing DC resistance, resistivity and attenuation.

## The Braid

The braid in drop cables provides both electrical and mechanical benefits critical to the cables performance.

Electrically, the aluminum braid provides low frequency signal shielding, improved DC loop resistance and better long term shielding.

Mechanically, the braid greatly enhances the tensile strength the cable. It also provides the mechanical base for connectors to grip.

A cumulative effect of the electrical and mechanical characteristics of drop cable braid can be most clearly seen in long-term conductivity. Without a braid, the laminated shielding tape cannot withstand the effects of physical stress produced by the environment and installation. That stress results in substantially increased DC resistance for cables without braid.

*CommScope has many years of testing experience that demonstrates the critical relationship between the braid and the laminated shielding tape.*

## Shielding Effectiveness

Drop cable shielding is a function of the condition of, as well as the amount of shielding material present. The majority of the high frequency shielding in a drop cable comes from aluminum composite tapes, so their integrity must be maintained. Braid wire in a drop cable, rather than damaging the tape will support and extend the life of the tape when correctly applied.

The measure of drop cable shielding is shielding effectiveness. Shielding effectiveness may be directly measured utilizing a broadband device like CommScope's GTEM, or calculated with a transfer impedance measurement. Either measurement can reveal both the shielding effectiveness of a new piece of cable, and perhaps more important, a piece of aged cable.

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The data in Figure 1 compares the shielding effectiveness of seven shielding styles of drop cable before and after accelerated aging. The rotary flex fatigue test was employed to obtain the results of aged cable. Clearly the braid is performing its intended function bridging the gaps and physically reducing the effects of flexure on the laminated shielding tapes. Test results indicate shielding effectiveness degrades to a certain point with no further degradation with flexure. The data in Figure 1 also shows that the shielding effectiveness of the various cables is maintained in a relative close approximation to one another even after flexure.

| CABLE DESIGN | DB SHIELDING EFFECTIVENESS BEFORE FLEXURE | DB SHIELDING EFFECTIVENESS AFTER 10K CYCLE FLEXURE |
|---|---|---|
| F6 Super-Shield | 122 - 127 | 115 - 121 |
| F6 77% Tri-Shield | 119 - 125 | 104 - 120 |
| F6 Tri-Shield | 107 - 121 | 93 - 105 |
| F6 90% Shield | 98 - 110 | 92 - 101 |
| F6 60% Shield | 88 - 99 | 76 - 87 |
| F6 77% TS XP | 129 - 136 | 112 - 122 |
| F6 60% TS XP | 116 - 125 | 101 - 110 |

Figure 1

## Dollar for dB

Just how much bang for the buck do the various shielding levels provide? Using the standard list price for these CommScope products, we divided the list price by the dB shielding effectiveness of each cable before and after flexure. We can now compare the "Dollar for the dB" of these seven cable designs on a linear scale (Figure 2).

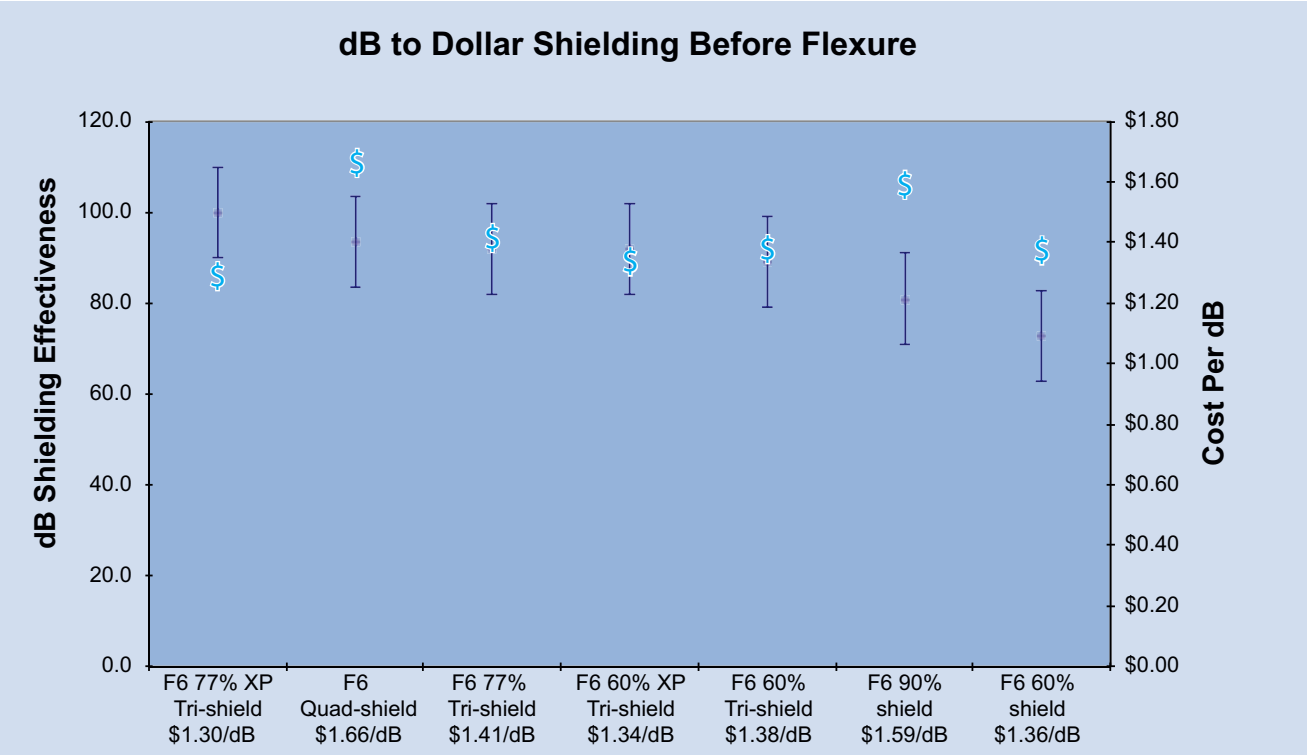


Figure 2

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As the graph (Figure 3) clearly indicates, 77% TS XP cable offers the most shielding performance for the dollar. As stated before, the F660 design is more than adequate in many applications but the 77% TS XP cable design is clearly superior in performance versus price at ~$1.06 per dB after flexure. In some applications, Quad shield cables are more appropriate than other designs, such as extreme noisy environments, which are typically more commonplace indoors.

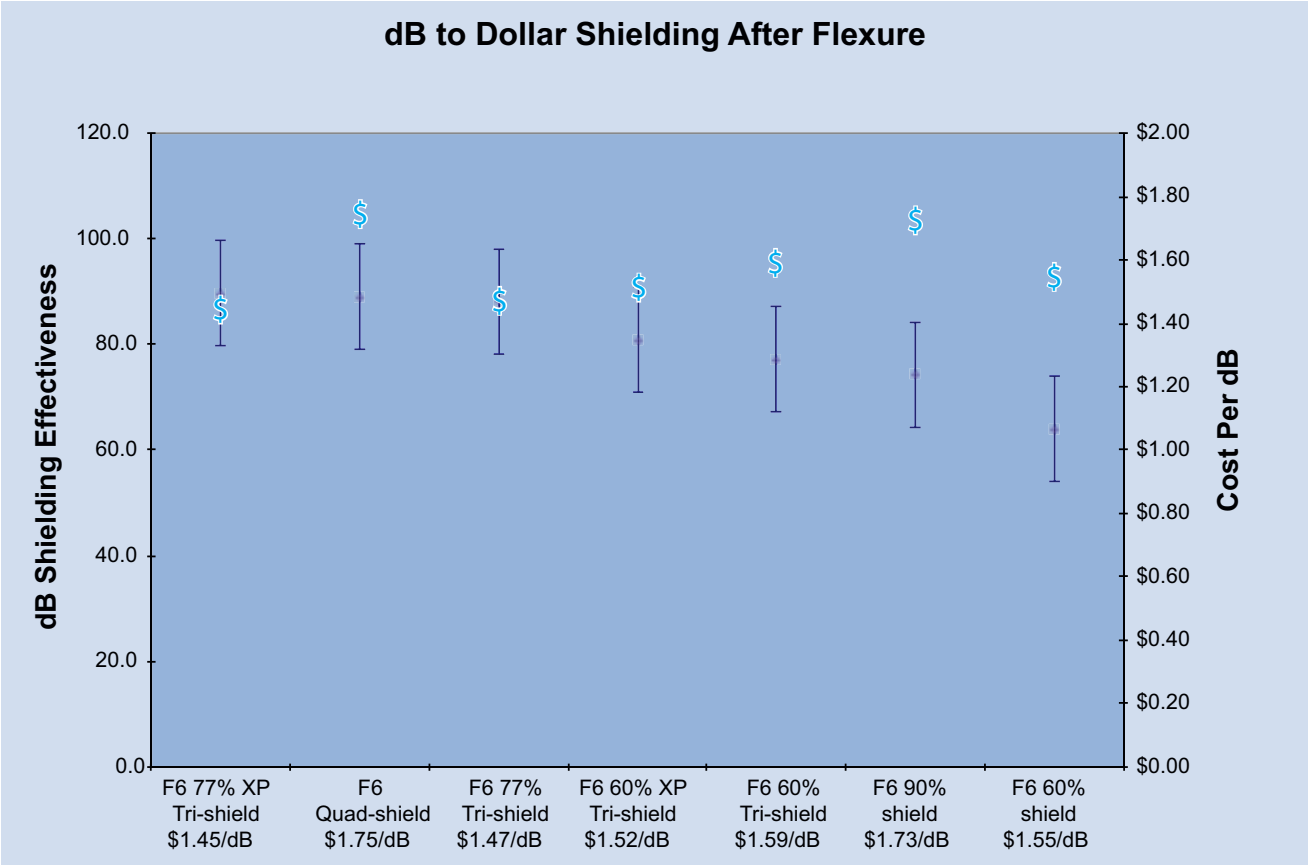


Figure 3


## Summary

Shielding is an important consideration when selecting a cable to deploy into a broadband network. The most important measurement of shielding is shielding effectiveness and the most critical measurement of that is after flexure. For most applications in today's broadband networks, 77% Tri-Shield cable provides the best performance/price based cabling solution, and XpressPrep bonded Tri-Shield designs offer both the ultimate in shielding and the most repeatable and reliable terminations in the field.