Metallized Fabric Tapes for EMI/RFI Shielding

WILLIAM M. STRATTON, III, Adhesives Research, Inc. and
RICHARD M. CRIBB, Monsanto Company Chemical Group

INTRODUCTION

The trend toward faster, more powerful electronic equipment and denser circuitry increases the possibility of electromagnetic interference (EMI) and radio frequency interference (RFI) among components, assemblies, and entire systems. This development presents challenges for exporters of electronic equipment, challenges which are compounded by increasingly strict international regulations for controlling EMI emissions.

New flexible metallized fabric shielding tapes represent a technological advance for alleviating interference problems. They have proven to be effective in many applications — from shielding cable assemblies in notebook computers to protecting critical equipment in hospitals.

Flexible metallized fabric tapes are a versatile alternative to conventional metal foil tapes.

This article explains the basic technology of flexible metallized fabric shielding tapes, their general benefits, and what they offer in terms of specific applications.

TECHNOLOGICAL ADVANCE

The new tapes result from a corporate agreement between a manufacturer of a shielded fabric and a manufacturer of metallized tapes. The tapes are manufactured using patented technology for electrolessly plating microscopically thin, uniform, metal layers onto various fabric constructions, and anchoring the layers to the base fiber with a proprietary polymer.

The unique combination of patented and proprietary technologies yields metallized materials with the desirable properties of both the metal and the substrate material. It produces copper nylon ripstop or silver/copper nylon ripstop materials which offer both the lightweight flexibility of cloth and the shielding characteristics of metal. The metallized fabric is then coated with either a conductive pressure sensitive adhesive or with high tack nonconductive acrylic pressure sensitive adhesive (PSA).

The conductive PSAs are homogeneous, with uniform, continuous conductivity throughout the adhesive mass regardless of changes in temperature, pressure or other conditions. They provide strong, reliable bonds and conductivity in the X, Y and Z axes. They are used in applications requiring electrical grounding of the shielding tape.

Typical flexible metallized fabric shielding tapes are described in Table 1.

BACKING	ADHESIVE	PEEL STRENGTH	COMMENTS
Copper nylon ripstop	High tack acrylic pressure sensitive	30 oz/in	Excellent adhesion to drywall and wood for architectural shielding applications.
Silver/copper nylon ripstop	High tack acrylic pressure sensitive	30 oz/in	Silver topcoat enhances oxidation resistance.
Copper nylon ripstop	Patented homogeneous conductive pressure sensitive	25 oz/in	Conductive adhesive provides stable electrical contact.
Silver/copper nylon ripstop	Patented homogeneous conductive pressure sensitive	25 oz/in	Conductive adhesive provides stable electrical contact. Silver topcoat enhances oxidation resistance.

TABLE 1. *Typical Flexible Metallized Fabric Shielding Tapes.*

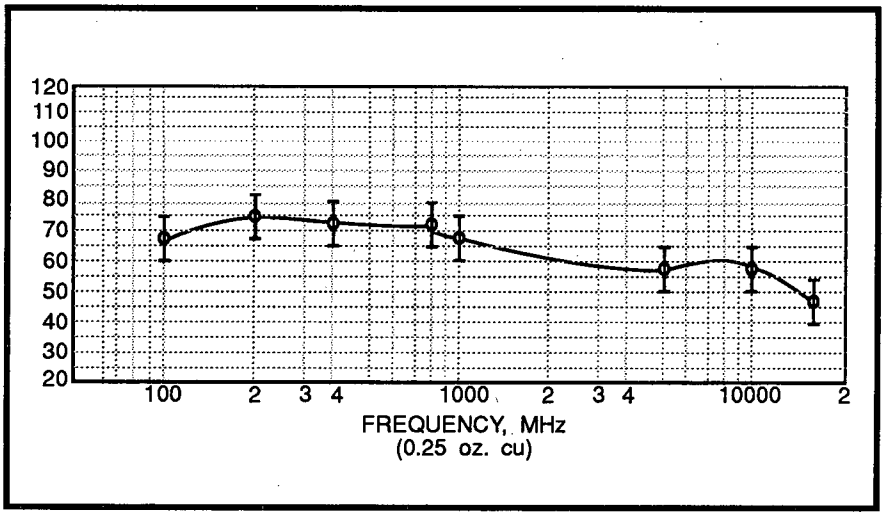

FIGURE 1. *Far-field Shielding: Cu on Nylon Ripstop.*

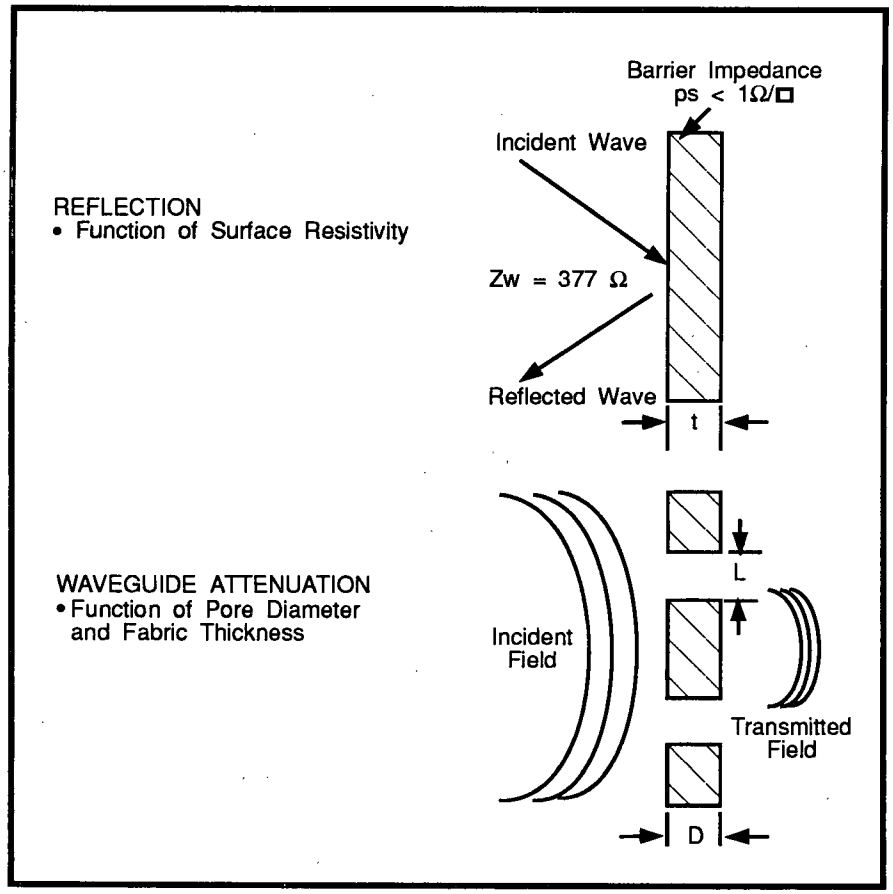

FIGURE 2. *Shielding Mechanisms of Metallized Material.*

SHIELDING EFFECTIVENESS

The shielding effectiveness of flexible metallized fabric tapes is shown in Figure 1. They provide more than 60-dB attenuation from 100 kHz to 10 GHz, shielding against both high impedance electric fields (near field) and plane waves (far field). The tapes perform best in high impedance fields, since by using thin metal coatings, much of their shielding is via reflection loss and not absorption loss.

As illustrated in Figure 2, the reflection mechanism and waveguide attenuation mechanism have the most significant impact on shielding effectiveness. Surface resistivity impacts the reflection mechanism. Pore dimension, pore aspect ratio, and fabric thickness affect the waveguide attenuation mechanism. Figures 3 through 6 show how shielding depends on the surface resistivity (R_s), fabric thickness, pore aspect ratio and aperture length of the shielding material.

The tapes were tested for shielding effectiveness in accordance with MIL-STD-285. Table 2 shows results of these tests.

ADVANTAGES

Flexible metallized fabric tapes are an alternative to conventional metal foil tapes in many applications. Advantages of fabric tapes for solving EMI/RFI radiation problems include:

- Good shielding effectiveness, approaching that of metal foil tapes.
- The tapes are pressure sensitive and immediately adhere to the intended surfaces without a cure time and without solvents. The tapes with conductive adhesive permit electrical contact for grounding. Their homogeneously conductive bond assures that shielding properties are maintained when the tapes are overlapped.
- The fabric backing is easy to handle. It does not cut fingers, as can happen with copper foil tapes.

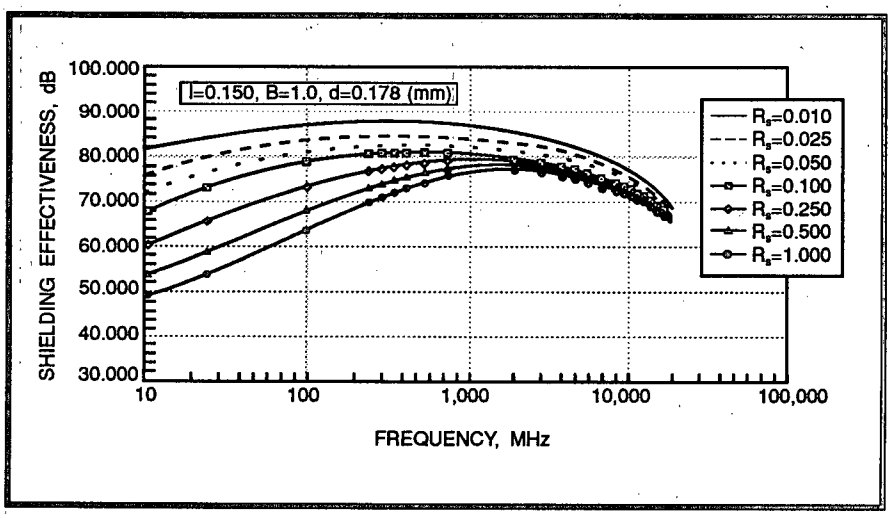

FIGURE 3. Dependency of Surface Resistivity (R_s) on Shielding Effectiveness.

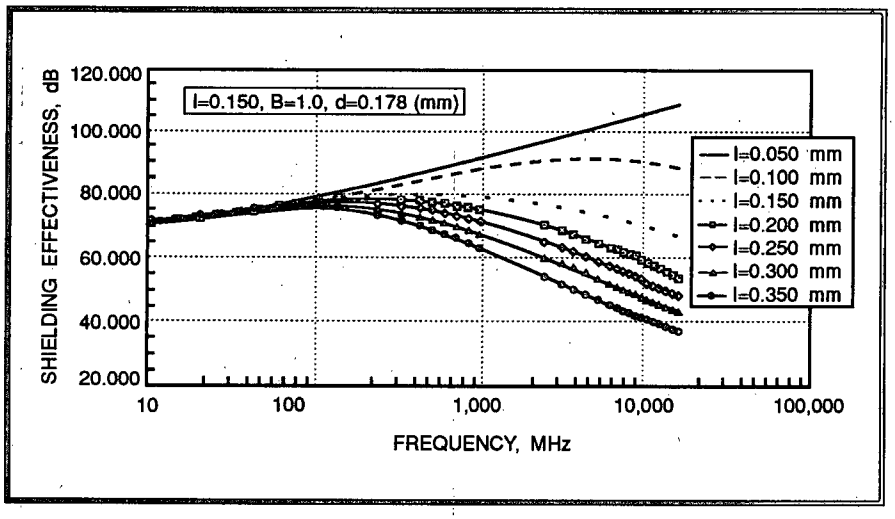

FIGURE 4. Effect of Aperture Length on Shielding Effectiveness.

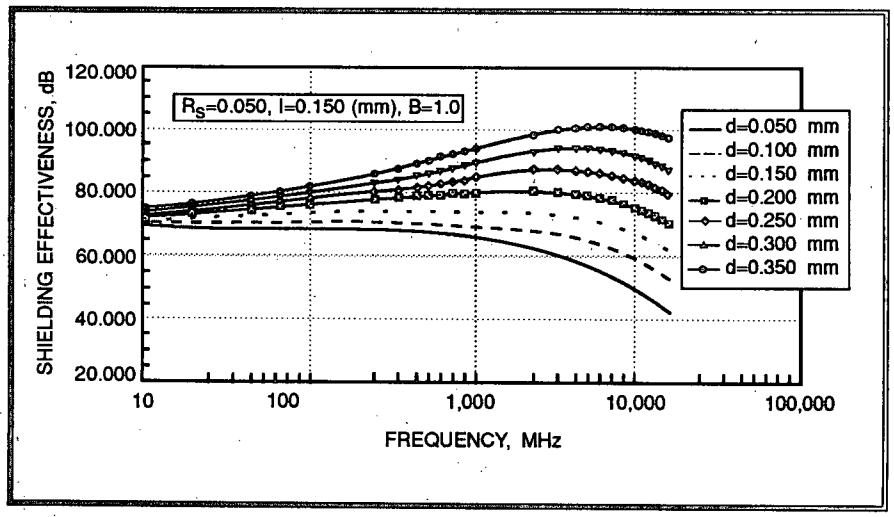

FIGURE 5. Effect of Fabric Thickness on Shielding Effectiveness.

- Metallized fabric shielding tapes weigh less than copper foil tapes.
- High conformability and flexibility. The tapes can be used on curved surfaces with minimal shrinking and can be repositioned and reapplied with no wrinkling. The flexibility of the tapes is a major advantage when they are used as a shielding wrap in cable assembly applications.
- The aggressive tack of the metallized tapes using nonconductive acrylic PSAs is a major advantage for bonding difficult surfaces.
- Tapes with a silver coating layered over the copper provide added corrosion resistance.

Though metallized fabric tapes are superior in many applications, copper and/or aluminum foil tapes are still important. They shield better at some frequencies, for instance, and they can be soldered. (Metallized fabric tapes are not solderable.) Users need to weigh the relative advantages of each approach.

APPLICATIONS

One of the foremost applications for metallized fabric tapes is as a flexible cable wrap for high-impedance circuits, where they can significantly reduce emissions and help shield sensitive electronics in the aerospace, automotive, and electronics industries. Since metallized fabric tapes are more flexible and resistant to cracking than traditional foil tapes, they provide a long service life.

		SHIELDING EFFECTIVENESS (dB)				
BACKING	ADHESIVE	100 kHz	1 MHz	500 MHz	1 GHz	10 GHz
Copper nylon ripstop	High tack acrylic	84	67	60	68	60
	Conductive acrylic	>102	89	71	72	64
Silver copper nylon	High tack acrylic	>101	84	65	60	55
	Conductive acrylic	>101	82	65	70	65

TABLE 2. *Shielding Effectiveness of Metallized Tapes per MIL-STD-285.*

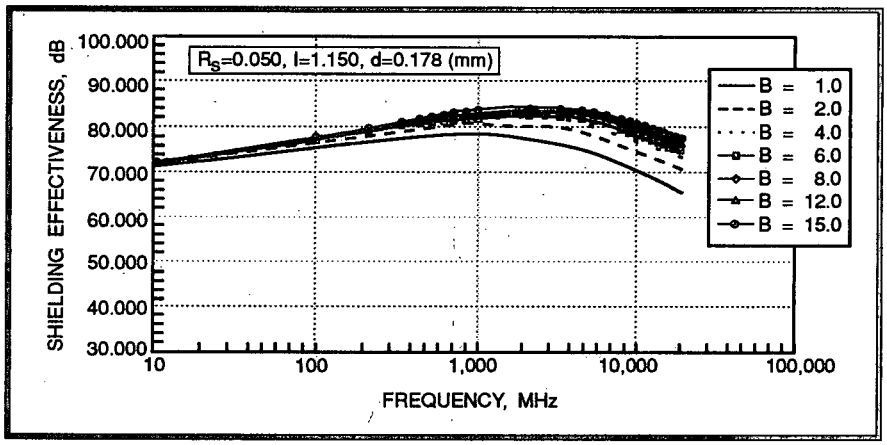

FIGURE 6. *Effect of Pore Aspect Ratio on Shielding Effectiveness.*

Other application areas include:

- Architectural shielding. Metallized fabric tapes adhere very well to difficult-to-bond surfaces, including drywall and wood. During installation, the tapes can be easily repositioned along seams and joints without fear of wrinkling.

- EMI test labs. Metallized fabric tapes offer a convenient method for sealing EMI/RFI "leaks."

- Composite structures. The weight savings of metallized fabric shielding technologies are a major benefit for new-design aircraft and automobile structures employing lightweight composites. Since aluminum, a natural shielding material, is being replaced by composites in new aircraft designs, EMI shielding is becoming a greater challenge for aerospace engineers.

- Antenna ranges. The new tapes shield antenna equipment effectively while being much easier to handle than metal foil tapes.

CONCLUSION

New flexible metallized fabric shielding tapes represent a generation of products whose technology will have a major impact upon EMI/RFI shielding applications. Developments now on the horizon promise that this technology will continue to advance, expanding the shielding applications even further.

WILLIAM M. STRATTON, III *is Marketing Manager, Electronics Products at the Glen Rock, PA, headquarters of Adhesives Research, Inc., a manufacturer of pressure sensitive adhesive tape products serving the electronics, construction, appliance, automotive, health care, paper, consumer and other industries. Mr. Stratton holds an M.S. in organic chemistry from Pennsylvania State University and an M.B.A. from Lehigh University (717-235-7979).*

RICHARD M. CRIBB *is Sales Representative, Flectron Metallized Materials, at Monsanto Company's Chemical Group in St. Louis, MO. He holds a B.S. in electrical engineering from the Georgia Institute of Technology, and an M.S. in electrical engineering from the University of Missouri - Rolla. His previous position with Monsanto was as Flectron Applications Development Engineer in the Chemical Group's Advanced Performance Materials Technology Department (1-800-843-4556).*