



---

## EMI Braid, Overbraid, and Shielding Sleeves: What Actually Works in EW Environments

### Introduction

Electromagnetic interference (EMI) poses a critical challenge in modern electronic warfare (EW) environments, where systems must operate reliably amidst intense electromagnetic activity. The proliferation of high-power radar, jamming systems, and direct-energy devices demands that interconnects, cables, and sensitive electronics maintain signal integrity and avoid cross-system disruption. One of the most effective strategies to mitigate EMI involves the use of shielding solutions such as EMI braids, overbraids, and protective sleeves. However, not all shielding solutions perform equally under EW conditions. Factors including material composition, coverage percentage, termination techniques, and the specific operational environment profoundly impact shielding effectiveness. This white paper explores practical considerations for implementing EMI shielding solutions, providing guidance for system designers and engineers who require robust performance in highly contested electromagnetic environments.

### EMI Shielding Materials

Selecting the appropriate shielding material is foundational to achieving desired EMI protection. The most common options include:

- **Tinned Copper:** Offers a balance of conductivity, corrosion resistance, and flexibility. Effective for low- to mid-frequency EMI shielding.
- **Silver-Plated Copper:** Provides superior conductivity and corrosion resistance, particularly valuable for high-frequency applications.
- **Aluminum/Mylar Laminates:** Lightweight and cost-effective, though less flexible and prone to mechanical damage if over-bent or abraded.
- **Nickel-Copper Alloys:** Highly resistant to oxidation and suitable for harsh EW environments with extreme temperatures or chemical exposure.



- **Conductive Polymers:** Emerging materials provide moderate EMI shielding while enabling lighter weight and greater flexibility.

Material choice must account not only for electrical performance but also for mechanical durability, environmental exposure, and manufacturability.

### Coverage Percentages

Shield coverage percentage significantly influences EMI attenuation:

- **60–80% Coverage:** Typically, adequate for low-frequency EMI and benign environments but insufficient for high-power EW applications.
- **85–95% Coverage:** Standard target for most military-grade cabling, offering good attenuation across a wide frequency range.
- **>95% Coverage:** Required for high-intensity electromagnetic environments such as jamming operations or directed-energy exposure. Achieving near-total coverage often involves multiple layers of braiding or combined braid-and-foil constructions.

Higher coverage generally improves shielding effectiveness but can reduce flexibility and increase weight, creating a tradeoff that must be carefully considered in tactical applications.

### Termination Methods

Proper termination guarantees that the shield performs as intended. Common termination techniques include:

- **Soldered Lugs or Braid Attachments:** Provide low-resistance connections ideal for high-frequency EMI and high-current paths but require precise workmanship.
- **Crimped Shields:** Faster assembly and reliable for rugged applications, though electrical contact quality may vary.
- **Heat-Shrink Termination:** Combines mechanical retention and environmental protection, often used with metallized sleeves for additional coverage.
- **Compression Fittings:** Allow consistent pressure over large areas of shielding, useful in bulkhead penetrations and connector interfaces.

Poor termination can dramatically reduce shielding effectiveness, often negating the benefits of even the highest-quality braid or sleeve.



---

## Performance Limits

While shielding solutions can dramatically improve immunity to EMI, they are not unlimited:

- **Frequency Dependence:** EMI shields perform differently across the spectrum; braids may attenuate low-frequency interference effectively but require foil or layered constructions for high GHz (Gigahertz) signals.
- **Mechanical Constraints:** Bends, abrasion, or compression can open gaps in braid coverage, reducing shielding efficiency.
- **Environmental Stress:** Corrosion, thermal cycling, and vibration can degrade material integrity over time.
- **Insertion Loss vs. Flexibility:** Multi-layer or tightly woven braids provide superior shielding but can reduce cable flexibility and increase system weight.

Understanding these performance limits allows engineers to design shielding solutions that are both effective and practical for fielded EW systems.

## Conclusion

In high-intensity EW environments, the right EMI braid, overbraid, and shielding sleeve solution can be the difference between mission success and system failure. Material selection, coverage percentage, and termination methodology must be carefully aligned with operational requirements, balancing shielding effectiveness, mechanical durability, and flexibility. While no single solution universally addresses all EMI threats, combining multiple strategies—such as high-coverage braids, metallized sleeves, and precision terminations—delivers robust performance even under extreme electromagnetic conditions. By adhering to these principles, system designers can assure that critical electronics remain resilient and fully operational in the most demanding electromagnetic warfare scenarios.

Reference: Table 1 (Page 4)



**Table 1: EMI Shielding Options and Performance Considerations**

Shielding Type	Material Options	Typical Coverage %	Termination Methods	Performance Notes / Limits
<b>EMI Braid</b>	Tinned Copper, Silver-Plated Copper, Nickel-Copper Alloy	60–95% (up to 99% with multi-layer)	Soldered lugs, Crimped, Compression fittings	Excellent low- to mid-frequency attenuation; coverage gaps reduce effectiveness; flexible but may fray over time
<b>Overbraid</b>	Copper, Tin-Plated Copper, Silver-Plated Copper	85–98%	Soldered, Crimped, Heat-shrink with metallized sleeves	Provides additional shielding over existing cable; improves mechanical protection; may reduce flexibility
<b>Shielding Sleeve / Metallized Fabric</b>	Aluminum/Mylar laminate, Conductive Polymers, Nickel-Copper Mesh	90–100% (depending on weave and layers)	Heat-shrink termination, Compression fittings, Wrap-and-bond	Ideal for high-frequency EMI; lightweight; protects against abrasion and environmental exposure; less flexible than braid
<b>Foil-Braid Hybrid</b>	Aluminum foil + Copper braid	95–99%	Soldered or Compression fittings	Combines foil’s high-frequency shielding with braid’s mechanical strength; best for multi-GHz EW environments; thicker construction can reduce bend radius