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## Grounding and Bonding Best Practices Using Cable Shields and Braid

### Introduction

In modern mission-critical systems, such as electronic warfare (EW) platforms, radar arrays, and communication networks, grounding and bonding are more than safety measures, they are performance enablers. Poor grounding can compromise signal integrity, reduce electromagnetic compatibility, and increase susceptibility to noise and interference. In high-reliability environments, these issues can result in missed detection, degraded radar resolution, disrupted communications, and system malfunctions that impact operational effectiveness.

Cable shields and braids serve as the first line of defense against these threats. Properly applied, they provide low-impedance paths for unwanted currents, maintain signal fidelity, and reduce electromagnetic interference (EMI). This whitepaper outlines best practices for grounding and bonding using cable shields and braids, emphasizing maintainability, system performance, and EMI mitigation.

### Fundamentals of Cable Shielding

#### Types of Shields:

- **Foil Shields:** Aluminum or copper foils providing 100% coverage; effective for high-frequency EMI but delicate mechanically.
- **Braided Shields:** Woven copper or tinned copper offering mechanical robustness and flexible grounding paths. Coverage typically 70–95%.
- **Combination Shields:** Foil over braid for high-frequency EMI suppression with mechanical strength.

#### Shield Function:

- Diverts EMI from sensitive conductors.
- Provides low-resistance grounding paths to reduce voltage differentials.
- Protects signal integrity in EW, radar, and communications systems.



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## **Grounding Best Practices**

### **Shield Termination**

- **Single-Point Grounding:** Prevents ground loops in low-frequency systems.
- **Multi-Point Grounding:** Essential for high-frequency circuits to suppress EMI over long cable runs.

Assure tight, low-resistance connections using proper terminations (solder, crimp, or mechanical clamps).

### **Continuity**

- Maintain electrical continuity across the shield's entire length.
- Avoid breaks, gaps, or sharp bends that increase impedance and degrade EMI suppression.
- Use conductive grommets and grounding lugs at panel entry points.

## **Effects of Poor Grounding on Performance**

Poor grounding and bonding directly degrade EW, radar, and communications systems:

- **Electronic Warfare (EW):** Increased noise and leakage reduce jamming effectiveness and sensitivity to threat signals.
- **Radar Systems:** Ground loops and high-impedance paths introduce phase errors and amplitude noise, reducing detection range and resolution.
- **Communications Networks:** Signal integrity suffers from crosstalk and EMI, causing reduced data throughput, corrupted signals, and potential system failures.

These effects highlight that grounding is not only a safety requirement but a critical factor in mission effectiveness.

## **Bonding Practices**

- **Cable-to-Chassis Bonding**
  - Bond shields to chassis at entry/exit points to safely divert EMI.
  - Use dedicated bonding straps or integrated braid terminations for optimal performance.



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### **Braid Integration**

- Braids provide mechanical reinforcement and low-impedance paths.
- Establish coverage is sufficient to maintain EMI suppression, typically 50–70% braid overlap.
- Avoid excessively tight braids that stress conductors or insulation.

### **Installation Guidelines**

- Maintain recommended bend radius to avoid mechanical stress.
- Protect cables from sharp edges using grommets or sleeving.
- Minimize loops and avoid unnecessary twists to reduce inductive coupling.
- Label and color-code shields for maintainability and troubleshooting.

### **Testing and Verification**

- Measure continuity and resistance to guarantee low-impedance grounding paths.
- Conduct EMI testing under operational conditions.
- Inspect mechanical terminations for wear, corrosion, or loosening over time.

### **Essential Recommendations**

1. Choose the appropriate shield type (foil, braid, or combination) for both EMI and mechanical needs.
2. Apply correct termination methods to maintain low-resistance paths.
3. Implement bonding strategies aligned with system topology (single vs. multi-point).
4. Maintain continuity and mechanical integrity along shield paths.
5. Regularly inspect and test grounding and bonding systems.

### **Conclusion**

Grounding and bonding using cable shields and braids are essential for both safety and system performance in EW, radar, and communications platforms. Poor grounding can severely degrade signal integrity, reduce detection and jamming capabilities, and compromise operational effectiveness. By applying best practices—careful shield selection, proper termination, effective bonding, and routine



verification—engineers can promote reliable, high-performance systems that maintain mission readiness and protect critical assets.

**Information Table on Poor Grounding Issues:**

<b>Grounding Issue</b>	<b>System Affected</b>	<b>Effect on System</b>	<b>Practical Impact / Performance Degradation</b>
High ground impedance	EW, Radar, Comms	Reduced ability to shunt noise and transients	Increased system noise floor, reduced sensitivity, higher false alarms in radar, weaker signal detection in EW
Ground loops	EW, Radar, Comms	Circulating currents introduce interference	Spurious signals, distortion, ghost targets in radar, disrupted comms, increased susceptibility to jamming
Poor bonding between chassis	EW, Radar, Comms	Unequal reference potentials	Unstable system reference, timing errors, phase noise in radar arrays, degraded antenna performance
Inadequate earth connection	Radar, Comms	Inefficient current return paths	Reduced antenna efficiency, lower radiated power, decreased link reliability, shorter effective range
Shared or noisy grounding	EW	Cross-coupling of interference between subsystems	Masking of weak signals, degraded electronic attack effectiveness, increased false positives
Lightning or surge susceptibility	EW, Radar, Comms	Inadequate transient suppression	Equipment damage, system downtime, sudden loss of detection or communications
Improper shielding-to-ground	Radar, Comms	Incomplete EM containment	Radiated emissions leak; system becomes more susceptible to external EM interference, compromised stealth or comms integrity