NORTHWIRE INC

WHITE **PAPER**

Optimizing Custom Cable Solutions for Aerospace & Defense Applications

2025

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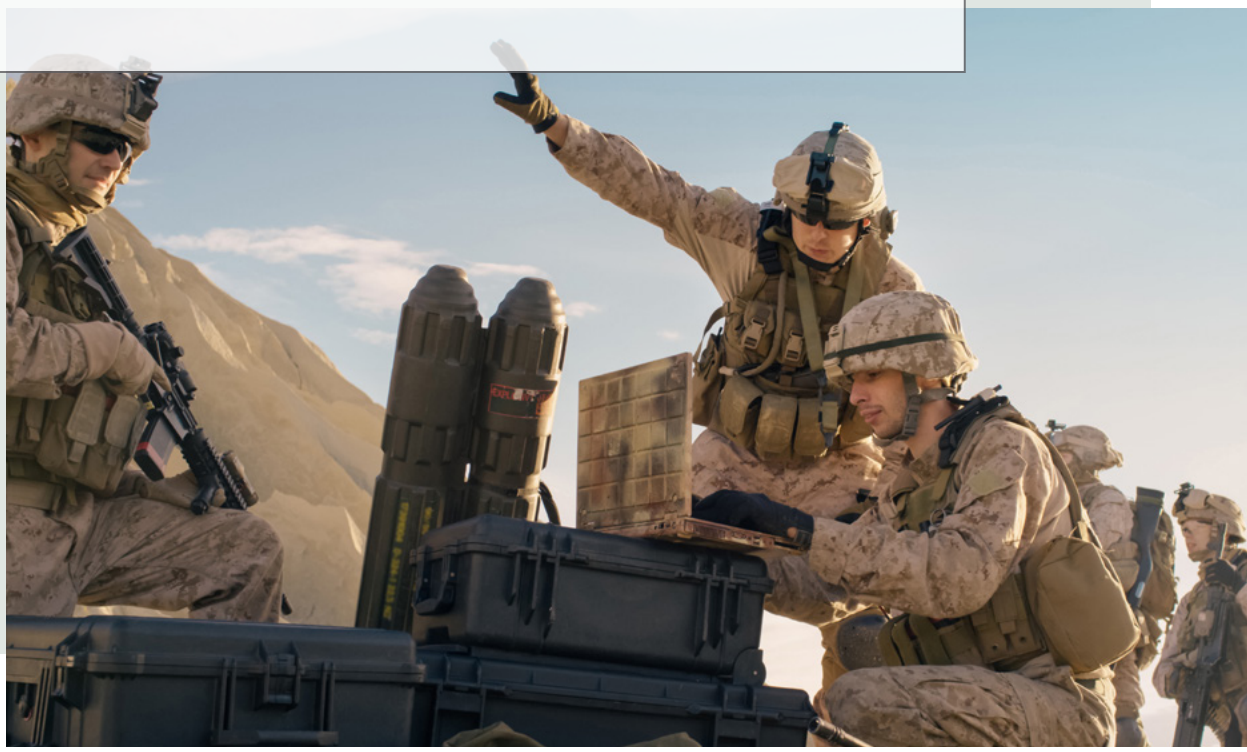


Introduction

The aerospace and defense industries, also known as military and aerospace, or Mil/Aero, demand highly specialized cables and cable assemblies that can withstand extreme conditions while ensuring reliable operation. These interconnects are designed to meet stringent performance standards, often exceeding those found in commercial applications.

Custom cable solutions play a critical role in meeting the unique requirements of aerospace and defense applications. These cables are tailored to specific needs, often incorporating specialized plastics, connectors and shielding to optimize performance and reduce the risk of failure during critical missions.

This White Paper explores the requirements of custom cables and cable assemblies in aerospace and defense applications, highlighting the benefits of custom cables, best practices, materials, and design recommendations. Much of the content is also relevant to other markets, such as robotics for first responders, medical and other highly demanding industrial applications.

The Benefits of Custom Cables

In most cases, custom cables and cable assemblies incur higher costs during the initial low-volume prototype phase. However, the cost benefits of custom solutions become evident as production scales. Once full-scale manufacturing is reached, the pricing stabilizes, leading to significant long-term savings. Custom cables offer enhanced durability, reducing replacement costs and minimizing downtime, thereby improving operational efficiency and product reliability.

Compared to off-the-shelf cable solutions, custom cables and assemblies provide substantial cost advantages and superior performance, particularly in response to increasing market competition and stringent application requirements.

Custom cable solutions provide several primary benefits. A key advantage is the ability to tailor materials to meet specific environmental, mechanical, electrical, and aesthetic requirements, ensuring optimal functionality and compliance to any military standards or operational requirements.

Another important benefit is that working with an experienced cable manufacturer not only helps tailor your material selection but allows the cable manufacturers to customize process parameters to enhance several unique cable characteristics.

Process changes can improve several cable characteristics:

- Flex life
- Flexibility
- Crush resistance
- EMI
- Ease of stripping

Additionally, custom cables allow for the integration of multiple technologies and applications into a single composite cable, where data and power are together under a single jacket. This eliminates the need for extra connectors, shrinks the form factor and simplifies the supply chain.

By partnering with a custom cable manufacturer offering value-added cable assembly services, your custom cable will be designed for optimal manufacturing efficiency while meeting your specific system requirements.

Custom cables often feature primary color rotations to streamline connector termination and incorporate specially designed strength members tailored to each connector termination method. This ensures compliance with cable pull-out and axial strength requirements outlined in Mil-Std-202 and Mil-Std-1344.

These design enhancements improve both manufacturing efficiency and tensile strength (axial tensile load), ultimately saving time and reducing costs.

Key Benefits: Custom Cable vs. Off the Shelf

- Custom materials and design that meet all your aerospace and defense requirements.
  - Environmental
  - Mechanical
  - Electrical
- Incorporating process techniques that improve various cable characteristics.
- Composite construction reduces the number of cables needed.
- Designed to save time and money during cable assembly manufacturing.

Prioritizing Design for Cost-Effective Aerospace & Defense Compliance

To optimize the performance-to-cost ratio of cables and cable assemblies, it is recommended to engage with a custom cable supplier early in the initial concept phase, ideally soon after defining your cable requirements. Mil-STD-810F is a valuable resource for determining many of those environmental requirements that are not always intuitive.

Don't forget these often-missed requirements:

- Chemical resistivity
- EMI
- Storage Temperatures (typically more extreme than working temperatures)
- Flex life and minimum bend radius
- Pull strength for cable and cable/connector interface
- Handling pre and post deployment (Can be very abusive)
- Radiation
- Altitude

In these demanding applications the cable and cable assembly will be the primary source of electrical failures in your electronic devices. Incorporating cable design considerations into the Design Failure Mode and Effects Analysis (FMEA) helps address potential issues proactively, preventing costly design constraints later in the development process.

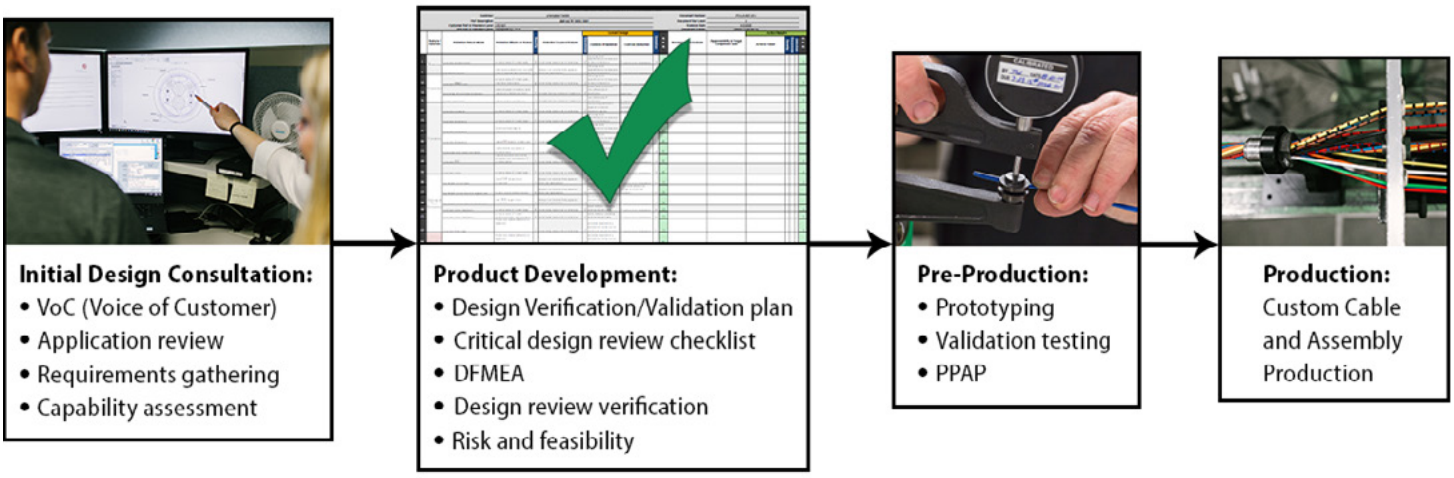
Cables are frequently overlooked until the final stages of design, leading to unnecessary restrictions that can negatively impact performance and increase costs. A common challenge arises when the electronic device or enclosure is designed first, dictating the connector interface and imposing outer diameter (OD) constraints based on the chosen connector.

A New Product Introduction (NPI) process can help mitigate the use of high-cost materials, smaller gauge conductors, and reduced outer jacket wall thickness, resulting in compromised cable performance, and incurring higher expenses.

It is recommended to prioritize cable design early in the development process and engage with the cable supplier to ensure an optimal solution tailored to your specific requirements—without unnecessary restrictions.

This proactive approach helps determine the most suitable connector solution and defines the minimum necessary enclosure size, ensuring all performance and compliance requirements are met while minimizing overall costs.

Northwire's NPI Process:



The Engineer's Guide to Custom Cable Design is a comprehensive guide on Northwire's design process. Learn more about it on our website: https://www.northwire.com/resources/engineers-guide-custom-cable-design

Conclusion

Custom cable solutions are essential for ensuring reliable operation in rugged aerospace, defense, military and first responder applications. By utilizing specialized materials, connector and construction techniques, these cables can withstand harsh environments, while delivering high performance data, and power transfer. Defining requirements early and collaborating with a custom cable manufacturer's design team during your design planning phase ensures that high- performance cable and interconnect solutions are delivered at the lowest possible cost.

As technology continues to advance, the demand for custom cable solutions will only grow. Northwire is committed to continually developing and innovating new materials and techniques to meet the evolving needs of these applications and markets.

Northwire, Inc. is your responsive partner in the design and development of custom interconnectivity solutions. Whether you have a napkin sketch or fully identified solutions, our cable design experts are available to help ask the right questions in the requirements gathering phase and select proper materials to optimize form, fit, function, and of course, cost! The earlier a cable design engineer gets involved in a project, the better for mitigating the risk of missing your project deadlines!

Northwire's Capabilities

- Requirement and Design support
- Thermoplastic extrusion
- Fluoropolymer extrusion
- Custom composite cabling
- Value added capabilities
    - Cut/Strip/Tin
    - Coil Cords
    - Cable assembly
    - Mold Design
    - High pressure thermoplastic injection molding
    - Low pressure epoxy injection molding

About Us

Northwire is a leading designer and manufacturer of custom cables, cable assemblies, and wire solutions for demanding applications across various industries, including aerospace, defense, medical, industrial, and automation. With a strong focus on engineering excellence, Northwire specializes in developing high-performance, durable, and reliable interconnect solutions tailored to meet stringent environmental, electrical, and mechanical requirements.

As a subsidiary of the LEMO Group, Northwire leverages advanced technology, rapid prototyping, and in-house testing to ensure compliance with industry standards such as UL and RoHS/REACH. We are Quality Management System certified to ISO 9001:2015, AS9100 D, ISO 13485:2016, and ISO 17025:2017 as a CSA Group quality testing facility. Our company is committed to providing customers with custom-engineered solutions, short lead times, and exceptional support, helping to optimize performance, cost efficiency, and long-term reliability.

With a customer-centric approach, Northwire offers direct collaboration with design engineers, enabling seamless integration of cables and assemblies into complex systems. Whether for mission-critical aerospace applications or high-flex industrial automation, Northwire delivers innovative and tailored cable solutions that meet the evolving demands of modern industries.

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