Building Qualified High-Reliability Cable Assemblies: *Shipped Same Day*

White Paper

By Peter McNeil

Pasternack
17792 Fitch, Irvine, CA 92614
sales@pasternack.com | pasternack.com
Toll-free: 866-PASTERNACK (866-727-8376)

Building Qualified High-Reliability Cable Assemblies:
Shipped Same Day

Introduction

The failure of a coaxial cable assembly during operation can be costly, and not just monetarily. The cost failure could also amount to loss of life, complete mission failure, or the downtime of essential communication, radar, location, or jammer systems. For military, aerospace, and other critical applications, failure of systems that rely on coaxial cable assemblies is unacceptable, and, for this reason, assemblies are often required to meet stringent military specifications (MIL-SPEC) for use in such applications.

However, the procurement of high-reliability (Hi-Rel) coaxial cable assemblies has traditionally followed a build-to-print model, which means new designs and programs with equipment under maintenance could potentially require weeks to months for a new order of coaxial cable assemblies to arrive. Because many assemblies are damaged during installation, unless a company has stockpiled, program delays due to standard shipment times for cable assemblies are common. Furthermore, it is challenging to predict a new program's exact requirements, making it nearly impossible to preemptively order the correct number of assemblies upfront.

This state of affairs poses substantial challenges in a world that is seeing increased technological change in almost every aspect of civil and military operations. Moreover, there are many government initiatives to reduce spending while accelerating the design and procurement cycle. These commercial off-the-shelf (COTS) initiatives, though already valuable and effective in many aspects of the military supply chain, have had little impact on coaxial cable assemblies due to their unique requirements, until now.

Pasternack is revolutionizing the industry purchasing model for high-reliability cables, which have typically required long lead times anywhere from 12 to 18 weeks, by introducing a line of pre-tested, military-grade cable assemblies that are designed to meet the needs of the majority of Hi-Rel applications and can also be shipped same day. This pre-testing and rapid shipment capability is being offered by Pasternack to fill the gap between traditionally long lead times and the often and unfortunate urgent need of purchasers for high-reliability cables. With this capability, Pasternack is able to supply small and medium volumes of cables to customers with military, aerospace, government, industrial, and other applications that require Hi-Rel assemblies urgently – who can't afford to wait weeks or months for delivery.

This white paper will explain:

- The key standards and requirements for MIL-SPEC and Hi-Rel coaxial cable assemblies
  - Material Control
  - Processes
  - Workmanship Criteria
- Other desirable features for Hi-Rel assemblies
- The Pasternack process of making Hi-Rel assemblies that ship same day
- The Pasternack offering of MIL-DTL-17 and temperature conditioned Hi-Rel assemblies

Key Standards and Requirements for MIL-SPEC and Hi-Rel Coaxial Cable Assemblies

Though there are a plethora of MIL-SPEC and Hi-Rel standards and qualifications for coaxial cables, connectors, materials, and assembly, there is a subset that is more commonly applicable. These standards impose specific requirements on materials, processes, and workmanship to ensure traceability, reliable performance, and the quality of RF test reporting for the specific assemblies being delivered. Following is an overview of the required standards and processes for fabricating and shipping MIL-SPEC and Hi-Rel coaxial cable assemblies.

Material Control

MIL-DTL-17 Requirements (MIL-C-17)
The MIL-DTL-17, formerly MIL-C-17, is the most comprehensive and applicable standard for flexible and semi-rigid cables with solid and semi-solid dielectric cores and inner conductor(s). The scope of this standard specifies a wide range of requirement classifications, including:

- Qualification
- Materials
- Design and construction
- Visual and mechanical
- Operational
- Marking
- Weight
- Workmanship

MIL-DTL-17 also relies on several other military, government, and industrial standards to supplement the standard in the above requirement classifications. Moreover, the standard details methods specific to the standard for military acceptance not otherwise included in other standards. MIL-DTL-17 includes four main types of inspection requirements: materials inspection, qualification inspection, conformance inspection, and final inspection.

The material inspection section of MIL-DTL-17 provides details and reference to standards documentation that is utilized in certifying the materials used in cable assemblies. Materials for jacketing, barrier tape, dielectric, inner conductors, outer conductors, and shielding are included, with the applicable reference standards shown in MIL-DTL-17J Table II.

Table 1: MIL-DTL-17J Table II. Materials Inspections

Material	Applicable Documents
Ethylene Tetrafluoroethylene (ETFE)	ASTM D3159
Ethylene Chlorotrifluoroethylene (E-CTFE)	ASTM D3275
Fiberglass	MIL-Y-1140
Fluorinated Ethylene Propylene (FEP)	ASTM D2116
Paint, Aluminum	----------
Polyethylene (PE)	ASTM D1248
Polytetrafluoroethylene (PTFE)	ASTM D4894 and ASTM D4895
Polyolefin, Cross-Linked	----------
Rubber, Butyl, Insulating Synthetic	ASTM D1352
Rubber, Insulating Synthetic	ASTM D470
Rubber, Polychloroprene	----------
Rubber, Synthetic, Semiconductor	FED-STD-601
Tape, Polyethylene-Terephthalate	MIL-I-631
Tubing, Aluminum, Seamless	SAE-AMS-WW-T-700
Tubing, Copper, Seamless	ASTM B88

Wire, Aluminum-Alloy (Alclad 5056)	ASTM B211
Wire, Aluminum, Copper-Clad	ASTM B566
Wire, Copper, Bare	ASTM B3
Wire, Copper, Beryllium (Alloy 172)	ASTM B197/B197M
Wire, Copper, Silver-Coated	ASTM B298
Wire, Copper, Tin-Coated	ASTM B33
Wire, High Resistance	ASTM B344
Wire, Steel, Copper-Clad	ASTM B452
Wire, Steel, Copper-Clad, Silver-Coated	ASTM B501
Wire, Steel, Galvanized	ASTM A411
Rubber, Polyurethane	----------
Stranded Inner Conductors	ASTM B8
Copper Conductors for Use In Hook-Up Wire For Electronic Equipment	ASTM B286

The *Qualification Inspection* detailed in MIL-DTL-17J requires the use of laboratory facilities acceptable to the government and sample units produced with equipment and procedures that are normally used for production of the qualified cables. Samples for *Qualification Inspection* must be of sufficient length to perform all applicable tests, of which, a subsection of the cable assemblies in Group I will be taken and used for Group II inspections. Any failure during *Qualification Inspection* can be deemed a reason to refuse qualification approval.

Table 2: MIL-DTL-17J Table IV – Qualification Inspection Excerpt

Group I	**Group II**			
In-Process Inspection	Corona Extinction Voltage	Mechanically Induced Noise Voltage	Flammability	Abrasion Resistance
Continuity	Characteristic Impedance	Time Delay	Flame Propagation	Tear Strength
Spark Test	RF Transmission Loss (Attenuation)	Aging Stability	Acid Gas Generation	Heat Distortion
Voltage Withstanding	Standing Wave Ratio (Return Loss)	Stress-Crack Resistance	Halogen Content	Physicals (Aged)
Insulation Resistance	Capacitance	Outer Conductor Integrity	Immersion	Tensile Strength and Elongation
Visual and Mechanical Inspection	Capacitance Stability	Cold Bend	Smoke Index	Weight
Physical Dimensions	Capacitance Unbalance	Dimensional Stability	Toxicity Index	
Marking	Transmission Unbalance	Contamination	Durometer Hardness	
Workmanship	Inductance	Bendability	Weathering	

Conformance Inspection is performed on products for delivery and consists of three inspection groups: A, B, and C. For the *Conformance Inspection,* sample specimens are taken randomly from the inspection lot of product units – all produced during the same production period, with the same materials and processes. During *Conformance Inspection,* for Group A and Group B inspections, if defects are found, the inspection lots are screened for similar defects, with the defective samples being removed from the lot. New specimens are then taken from the culled inspection lot, and if defects are found in the second round of sample specimens, the whole inspection lot is rejected. Group C inspections, however, are derived from passing sample units from Group A and Group B inspections. And, if any specimens fail during Group C inspection, the inspection lot is considered to have failed *Conformance Inspection.*

Table 3: MIL-DTL-17J Excerpts from Tables V, VI, and VII – Listing Group A, B, and C Conformance Inspection

Group A	Group B	Group C
Visual and Mechanical Inspection	Corona Extinction Voltage	Capacitance Stability
Physical Dimensions	Capacitance	Aging Stability
Marking	Capacitance Unbalance	Stress Crack Resistance
Workmanship	Transmission Unbalance	Outer Conductor Integrity
Characteristic Impedance	Mechanically Induced Noise Voltage	Dimensional Stability
RF Transmission Loss (Attenuation)	Time Delay	Contamination
Standing Wave Ratio (Return Loss)	Cold Bend	Bendability
Adhesion of Conductors	Weight	Flammability
Eccentricity of Inner Conductor	Tear Strength	Heat Distortion
	Inductance	Tensile Strength and Elongation
		Physicals (Aged)

Prior to delivery, MIL-DTL-17J requires a final inspection of a cable lot, in which continuity, spark test, voltage withstanding, insulation resistance, and out-of-roundness jacket measurements are made. In the case of semi-rigid cable, only continuity and voltage withstanding are tested during final inspection. Selection of sample units from the inspection lot is performed in the same manner as *Conformance Inspection*. In the case of failure, for anything other than a spark test for non-semi-rigid cable, the failure can be considered cause for refusal of the lot.

MIL-DTL-17J Table III – Final Inspection Excerpt

Semi-Rigid Cable
- Continuity
- Voltage withstanding

All Other Cables
- Continuity
- Spark test
- Voltage withstanding
- Insulation resistance
- Out-of-roundness of jacket measurements

The rigorous inspection and requirements of MIL-DTL-17 make it a particularly attractive standard for ensuring the highest quality coaxial cable is used for assemblies. Hence, MIL-DTL-17 coaxial cables are commonly used in aerospace/avionics, interference friend or foe (IFF) radar, satellite communications (SATCOM), electronic countermeasure (ECM), and other electronic warfare (EW) applications. Many industrial applications, such as oil & gas, construction, and chemical systems, benefit from MIL-DTL-17 coaxial cable, as failures in these applications can have catastrophic effects.

MIL-PRF-39012 Connectors

In the case of coaxial connectors, the military qualification and conformance specification for both flexible and other coaxial transmission line connectors is MIL-PRF-39012 (currently MIL-PRF-39012F with Amendment 3). Similarly, as with MIL-DTL-17 covering coaxial cables, MIL-PRF-39012 requires several layers of inspection, including material, qualification, conformance, and periodic inspections. The details of these inspections, as well as references to other applicable specifications, are indicated in MIL-PRF-39012. MIL-PRF-39012 describes the required visual, mechanical, and electrical testing necessary to qualify and inspect coaxial cable connectors.

Due to the exacting specifications of MIL-PRF-39012, RF connectors that pass this specification are ideal for use in most high-performance and Hi-Rel applications, including SATCOM, radar, RF instrumentation and test equipment, indoor/outdoor antennas, CATV, microwave radios, and aerospace. Moreover, this standard covers a wide range of common coaxial connectors, such as BNC, N, TNC, SMA, SMB, SMC, SMP, SSMP, SOP, OSSP, OSMM, SSMA, SC, QMA, UMCC, SSMT, and MMCX, and requires gold-plated, captivated contacts for minimal insertion loss and maximum electrical contact-quality over time and regardless of environment.

Table 4: MIL-PRF-39012F Table I – Materials

Material	Applicable Specifications
Steel	ASTM A484/A484M, ASTM A582/A582M
Brass	ASTM B16/B16M, ASTM B36/B36M, ASTM B121/B121M, ASTM B455
Phosphor Bronze	ASTM B139/B139M
Soft Copper	ASTM B152/B152M
Copper	ASTM B88, ASTM B124/B124M
Copper-Beryllium	ASTM B194, ASTM B196/B196M, ASTM B197/B197M
PTFE Fluorocarbon	ASTM D4894, ASTM D4895
FEP Fluorocarbon	ASTM D2116
Silicon Rubber	A-A-59588

Furthermore, MIL-PRF-39012 requires the manufacturer to maintain quality systems that enable parts covered by the specification to be listed on the *Qualified Products List* (QPL). Several of the *Qualification Inspection* tests are performed only during initial qualification of a static design and manufacturing process, whereas *Conformance Inspection* is done prior to delivery, with the exception being some *Periodic Inspection* tests. *Periodic Inspections* consist of Group C inspections and are performed at prescribed intervals.

Table 5: MIL-PRF-39012F Table II – Qualification Inspection Excerpt

Group I	Group II	Group V
Visual and Mechanical Examination	Center Contact Retention	RF Leakage
Material	Corrosion	
Finish		**Group VI**
Dissimilar Metals	**Group III**	RF Insertion Loss
Configuration and Features (Dimensions)	VSWR (Cabled)	
Marking	Connector Durability	**Group VII**
Mating (Visual Indication)	Safety Wire Hole Pullout	Contact Resistance
Force to Engage/Disengage		
Bayonet and Threaded Types	**Group IV**	
“Push-on” Connector Types	Contact Resistance	
Coupling Proof Torque	Dielectric Withstanding Voltage	
Mating Characteristics	Vibration	
Permeability of Nonmagnetic Materials	Shock (Specified Pulse)	
Workmanship	Thermal Shock	
Hermetic Seal (Pressurized Connectors Only)	Moisture Resistance	
Leakage (Pressurized Connectors Only)	Corona Level	
Insulation Resistance	RF High Potential Withstanding Voltage	
	Cable Retention Force	
	Coupling Mechanism Retention Force	

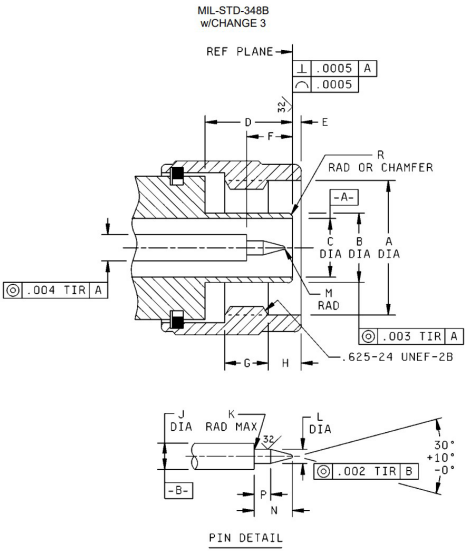
Table 5: MIL-PRF-39012F Tables III, V, and VII Excerpt

Group A	Group C
Visual and Mechanical Examination	Subgroup 1
Material	Center Contact Retention
Finish 1/	Corrosion
Dissimilar Metals	Subgroup 2
Configuration And Features	VSWR (Cabled)
Marking	Connector Durability
Workmanship	Safety Wire Hole Pullout
Mating (Visual Indication)	Subgroup 3
Dielectric Withstanding Voltage	Contact Resistance
Hermetic Seal (Pressurized Connectors Only)	Vibration
Leakage (Pressurized Connectors Only)	Shock (Specified Pulse)
	Thermal Shock
Group B	Moisture Resistance
Force to Engage/Disengage	Corona Level
Bayonet and Threaded Type	RF High Potential Withstanding Voltage
“Push-on” Connector Type	Cable Retention Forces
Coupling Proof Torque	Coupling Mechanism Retention Force
Mating Characteristics	Subgroup 4: RF Leakage
Permeability of Nonmagnetic Materials	Subgroup 5: RF Insertion Loss
Insulation Resistance	Subgroup 6: Contact Resistance
VSWR (Cabled)	

MIL-STD-348

Wherein MIL-PRF-39012 specifies the reliability qualifications for RF connectors, MIL-STD-348 details the exact dimensions and geometries of RF connector interfaces. Specifically, MIL-STD-348 includes the RF connectors and adapters referenced in other MIL-SPEC documents: MIL-DTL-3643, MIL-DTL-3650, MIL-STD-3655, MIL-DTL-25516, MIL-PRF-31031, MIL-PRF-39012, MIL-PRF-49142, MIL-PRF-55339 and MIL-DTL-83517. The specifications in this standard are deemed United States standards for RF connector interfaces and are accepted by all U.S. military services.

MIL-STD-348 is an essential standard, as it ensures interoperability of RF connectors throughout U.S. military services, regardless of manufacturer. As the basis for RF connector design and construction, this standard also provides the foundation for reliable connector performance.



MIL-STD-348B w/Change 3
Figure 402-1 Interface, test connector, series N, pin contact

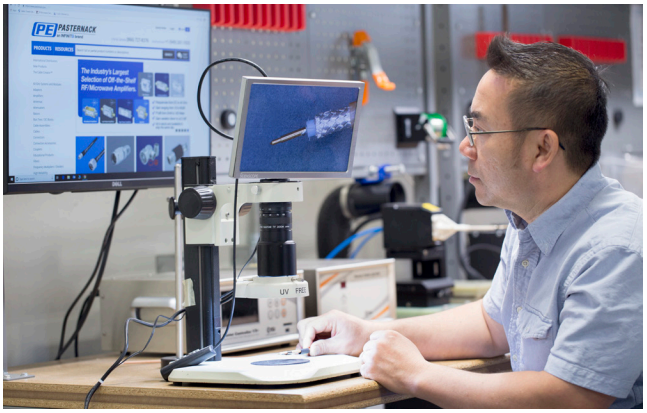
SAE AS23053 Insulation General Specification and SAE AS5942 Marking of Electrical Insulation Materials
SAE AS23053 (also referred to as M23053, SAE-AMS-DTL-23053 standard and formerly the cancelled MIL-DTL-23053 standard) is the industry and military standard for heat shrinkable insulation sleeving. This type of insulation sleeving is commonly used for protecting the joint between coaxial cable and connectors, often enhancing the environmental and mechanical ruggedness of a coaxial cable assembly. “This specification includes provisions for demonstrating compliance with qualification requirements (see Section 4 and 7.3), in process inspection, and statistical process control inspections (see 4.4).”

Coinciding with SAE AS23053, SAE AS5942 “establishes the performance requirements for the identification of wire and cable by indirect markings that have been applied to electrical insulating materials including heat shrink sleeving, wrap around labels and “tie-on” tags as well as any other types of material used for indirect marking.” Included in this specification are the processes and methods used to make the mark, which can include impact ink marking, thermal transfer, laser marking, hot stamp, etc. However, SAE AS5942 does not cover direct marking on electrical wire and cable. Hence, SAE AS5942 covers the heat shrink sleeve commonly installed on coaxial cable assemblies, but not the outer insulating jacket of the assembly.

Qualified (QPL) Cable and Connectors (MIL-STD-790)
Qualified Products List (QPL) is a system established by the U.S. Department of Defense (DOD) to simplify and provide assurance to buyers that they are purchasing products that have met the essential qualification requirements of applicable specifications. Ultimately, the QPL, and Qualified Products Database (QPD), is a listing that provides approved supplier sources for government activities. To qualify for many military standards, a manufacturer must submit their products to the QPL.

Processes

J-STD Soldering (IPC J-STD-001 and IPC J-STD-006)
Since the cancelation of MIL-STD-2000, J-STD soldering is the industry and military standard for soldering. The J-STDs are run by the Institute for Printed Circuits (IPC), which regularly issues updates to a range of standards. For soldering coaxial cable assemblies, specifically coaxial cable connector parts, J-STD-001 and J-STD-006 are the most applicable to military and aerospace applications. J-STD-001 (currently J-STD-001G), includes “methods and verification criteria for producing quality soldered interconnections and assemblies.” J-STD-006 (currently J-STD-006B) with Amendments 1 & 2, “prescribes nomenclature, requirements and test methods for electronic grade solder alloys; for fluxed and non-fluxed bar, ribbon, and powder solders for electronic soldering applications; and for “special” electronic grade solders.”



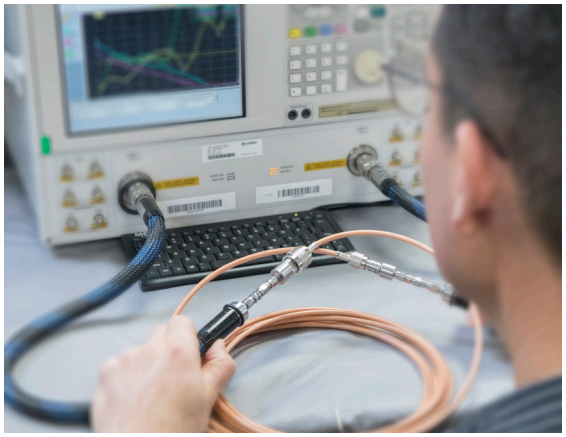
Specifically, the J-STDs apply to the types of solder, and methods of use, when attaching the center pins, outer conductor, and shielding of coaxial cable to the coaxial connectors. Given the rugged environments to which military-grade coaxial assemblies are subjected, anything less than high-quality soldered connections could result in faults of the electrical or mechanical performance of an assembly’s pin and/or outer conductor/shielding connection. Crimp/pinch-type coaxial connectors are also more susceptible to corrosion and failures from pulling or flexure than J-STD soldered connections.

SAE AS22520 Crimping Tools, Wire Termination General Specification
Superseding MIL-DTL-22520, SAE AS22520 specifies the requirements for inspection gages, accessories, and crimping tools used when connecting removable contacts from coaxial connectors and other electrical connectors, components, and systems. This standard is highly important to ensure interoperability of coaxial connectors and consistent pin placement and geometry within military and industrial standard coaxial connectors.

Lot Traceability

To satisfy DoD requirements, as well as other aerospace and avionics national agencies, manufacturers must implement *Lot Traceability*. What this enables is the ability for a manufacturer to trace all components of a part back to their original source. This is a valuable qualification, because in the event of part failure, component traceability makes it possible to determine the root cause of failure, and instead of scrapping the entire assembly, the failing component source or its manufacturing process can be modified. With extremely complex systems, such as modern military and aerospace systems, *Lot Traceability* is essential to diagnosing and preventing failures. What this means for RF coaxial cable assemblies, is that each component of the connection, cable, jacketing, shielding, insulating heat shrink, etc. can be individually traced back to its source in the event of assembly failure.

Testing



100% Testing and Test Reporting

Though datasheets can be effective tools to gauge the nominal, minimum, and maximum performance of a coaxial cable assembly, datasheets do not provide information on a given cable's actual performance. Having test reports for each coaxial cable assembly provides a proof-of-performance, quality assurance, and also helps with traceability in the event of assembly failure. This is only possible if every single coaxial cable assembly is tested prior to delivery. Though conformance inspection is required by many military standards, having actual test reports for assemblies, including RF performance test plots, provides an additional assurance that every coaxial cable assembly meets, or exceeds, military and industrial standards.

Workmanship

IPC/WHMA-A-620 Workmanship Criteria

The IPC/Wire Harness Manufacturer's Association WHMA-A-620 standard is the only industry-consensus standard for determining acceptable workmanship quality for cable and cable harness assemblies. This standard details practices and requirements for materials, methods, tests, and acceptance criteria for cable assemblies. Section 1.17 (1-5) of IPC/WHMA-A-620 specifically deals with workmanship/handling of cable assemblies and harnesses, and focuses on methods that ensure optimal quality while reducing defects during manufacturing.

Desirable Hi-Rel Coaxial Assembly Features

Be it for military, aerospace, communications, industrial, mobile, laboratory, or scientific use, reliable cable assemblies are becoming increasingly valued for applications where the cost of cable assembly failure and maintenance are excessive. Though the applications requiring Hi-Rel coaxial cable assemblies are diverse, there are several common features that are desirable for the majority of these applications. These features include commercial availability, enhanced shielding, durable jacketing material, a wide operating temperature range, temperature conditioning of cables, sealed connectors, superior assembly, and test reporting.

Shielding

Many common coaxial cable assemblies use a single shield as an outer conductor, and for flexible coaxial cables, this shield is often of braided metal wires which may be coated. If any amount of stress or pressure is placed on single-shielded cable assemblies, the physical deformation of braided shielding may cause substantial electrical performance variations and even possible failure. Hence, the use of double-shielded coaxial cables is preferred, especially for applications in harsh installation and operating environments, to help ensure reliable electrical performance. Moreover, double shielding a coaxial cable can prevent signal leakage and external interference in the presence of high-powered electromagnetic energy and RF signals.

For example, in an equipment cabinet with transmitters and receivers, a variety of relatively high-powered RF signals at various frequencies are likely to be conducted by coaxial cable assemblies. If improper shielding is used, signals may leak from a cable assembly and cause interference (or at least to the noise floor) with other transmitters and receivers or other radio components. Conversely, poorly-shielded cable assemblies may only marginally attenuate outside interfering signals, allowing for potential receiver overload or ingression of interfering signals.

Jacketing
There are several common jacket materials and methods of assembly for Hi-Rel coaxial cable assemblies. The three main materials are Polytetrafluoroethylene (PTFE), Perfluoroalkoxy (PFA), and Fluorinated Ethylene Propylene (FEP). These three fluoroplastic materials offer many similar benefits for use as coaxial cable jackets. However, there are a few areas where FEP provides advantages over PTFE or PFA. Namely, FEP presents a lower melting point and curing temperature, allowing these assembly jackets to be more easily manufactured. Also, FEP exhibits similar corrosion resistance to PTFE and PFA, but additionally exhibits enhanced detergent resistance; both PTFE and FEP have better weather resistance compared to PFA. All three fluoroplastics have similar dielectric constants; however, FEP demonstrates superior dielectric strength compared to PTFE. Moreover, FEP has a much higher dissipation factor than both PTFE and PFA, and an arc resistance comparable to PTFE.

Operating Temperature Range
Automotive and industrial operational temperature ranges are considerable, but often inadequate for military and aerospace applications. Many materials and assembly methods are unable to maintain specified performance at the wide operating temperature ranges required by military specifications. Furthermore, exposure to harsh environments with limited cooling capability, in often clustered cabinets containing heat-producing RF electronics, is a common occurrence for Hi-Rel coaxial cable assemblies. Hence, cable assembly components and manufacturing methods designed to ensure higher-than-average operating temperatures can help to ascertain reliable performance over a long lifetime and reduced risk of degradation due to environmental stresses.

Common Operational Temperature Ranges for Electronics and Electrical Components*

- Commercial: 0 °C to 85 °C
- Industrial: −40 °C to 100 °C
- Automotive: −40 °C to 125 °C
- Extended: −40 °C to 125 °C
- Military: −55 °C to 125 °C

**Actual operating temperature range depends on cable type.*

Temperature Conditioned Cables
Thermally pre-conditioning cables in a temperature chamber prior to assembly serves to increase the electrical and mechanical stability of the cables over time. An industrial temperature chamber is programmed to cycle pre-cut cables multiple times from cold to hot temperature extremes, in order to “pre-age” and stabilize cables prior to cable assembly construction.

Seal Gaskets
Seal gaskets, though not electrical in nature, ensure the long-term operational reliability of coaxial cable assemblies. These gaskets help to prevent environmental intrusion from moisture, chemicals and debris, that in the best case increase insertion loss and in the worst case result in cable destruction. Silicone rubber gaskets are a standard for sealing gaskets and tend to provide years of maintenance-free environmental protection.

COTS
Commercial-off-the-shelf (COTS) components are increasingly sought after by military and government agencies, in an attempt to reduce acquisition time, mitigate the high cost of custom-ordered components, and develop a more competitive purchasing process. However, COTS components must still meet rigorous MIL-SPEC and industry standards to be viable for military or government use. Moreover, even if MIL-SPEC cables and connectors are used, the assembly process must also meet a variety of other military standards. Although there

are suppliers of coaxial cable assemblies who design products specifically to meet military and government standards, their assemblies are rarely available outside of a lengthy quote and ordering process.

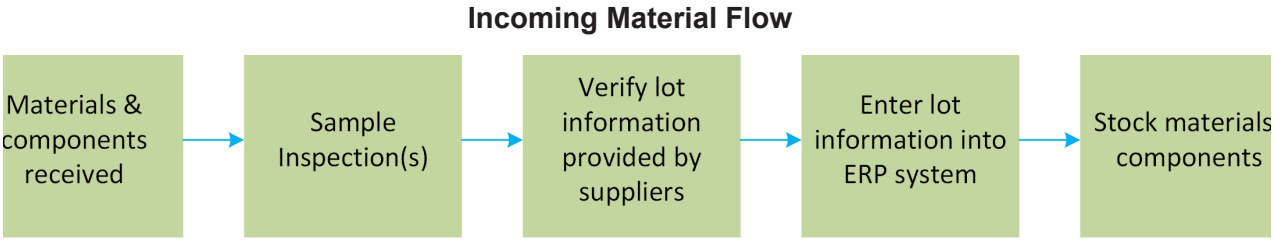
In-Stock and Same-Day Shipping, Even on Custom Cable Assemblies

The RF industry, until more recent years, has predominantly been a provider for military, aerospace, government, scientific, SATCOM, and large-scale communication network applications. Hence, the model for manufacturing and supplying RF components, devices, and assemblies has traditionally been a build-to-print or quote-based ordering system. This is largely how the acquisition of coaxial cable assemblies has occurred. The main focus of this method has been on fulfilling 100% of the desired features, with assemblies being customized for particular applications.

Though the cable assembly produced often fits the end application well, this legacy system doesn't account for urgent needs or more generic Hi-Rel applications that would benefit from faster acquisition times. Hence, Pasternack has taken the initiative and developed a rigorous, quick-turn manufacturing system that is able to provide small, medium, and even large-sized orders of MIL-DTL-17 coaxial cable assemblies with custom lengths and connectors that can ship same day. Pasternack's unique process enables custom-length coaxial cable assemblies that meet a wide range of Hi-Rel requirements for both military and industrial standards. These can be shipped same day in most cases. Therefore, cable assembly users are no longer limited by a slow-paced, multi-stage manufacturing process and can instead operate at the speed of the modern marketplace.

Making a Hi-Rel Coaxial Cable Assembly that Meets MIL-SPEC

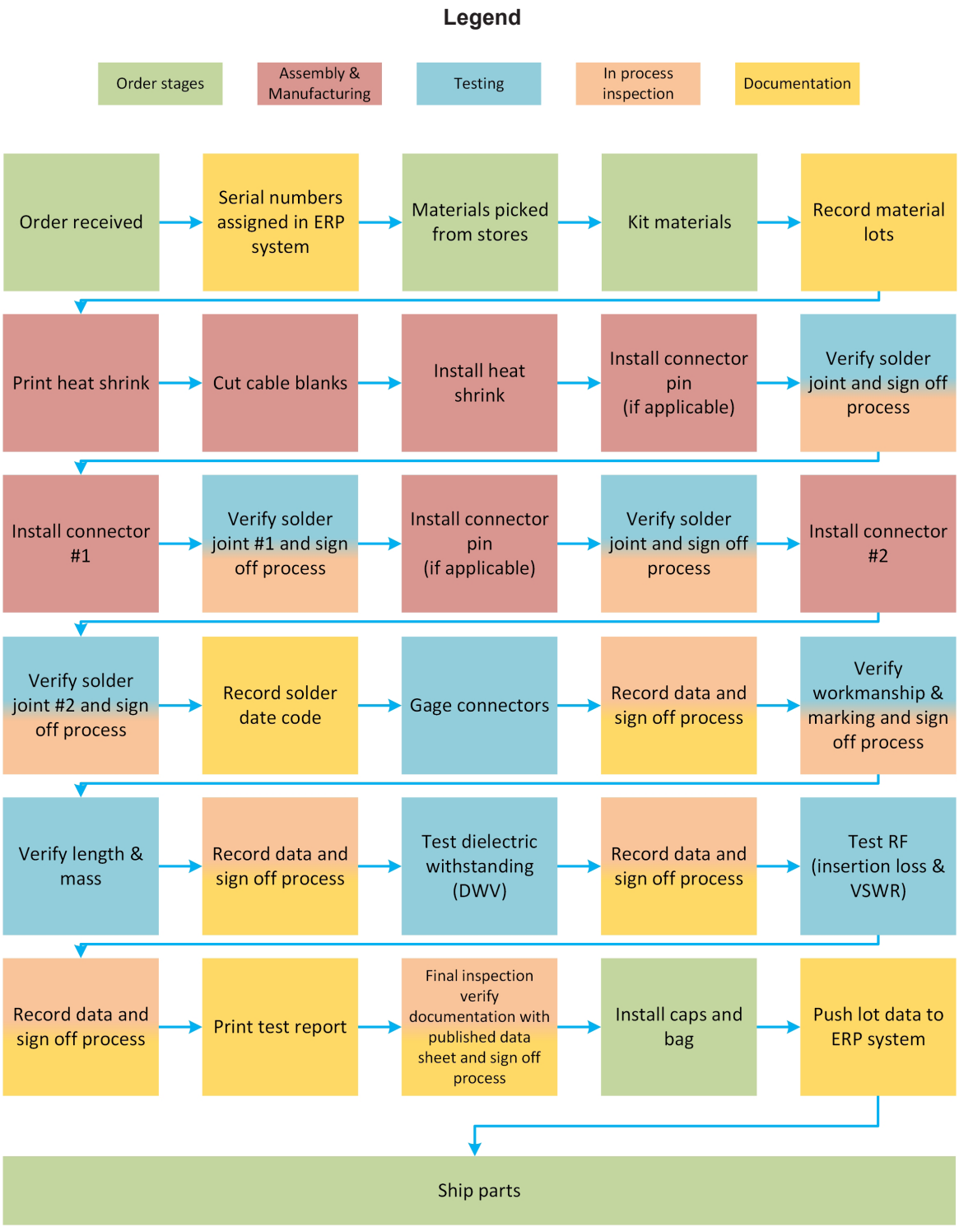
Meeting MIL-SPEC qualifications and inspections is no simple task. This process is double challenged when it attempts to realize orders for military standard cables within hours of an order being placed. Pasternack has made this possible with a standardized system of quality manufacturing steps, along with in-situ tests/inspections designed to ensure component- and assembly-level compliance with all relevant military and industry standards. This capability, especially at volume, is rare among coaxial cable assembly manufacturers, as most manufacturers are dedicated to fulfilling orders with planned lead times negotiated during an already lengthy ordering process.



Pasternack's incoming material flow process

Over the course of a 36-step process, of which five steps are dedicated to incoming material flow and 31 are involved with order processing, Pasternack technicians and machines will process, assemble, and verify every critical mechanical and electrical property of a coaxial cable assembly. This includes ensuring the pin and connector attachments are held to J-STD-001 class 3 soldering standards, the crimping is done according to SAE AS2250 standards, the marking meets SAE AS5941 standards, and the overall workmanship is in accord with IPC/WHMA-A-620 class 3 standards. Moreover, each coaxial cable assembly is 100% tested for connector gaging of the pin and insulator position, insertion loss, VSWR, dielectric withstanding voltage (DWV), and is further visually inspected for workmanship, configuration, and marking. Additionally, Pasternack performs sample testing for length and mass.

Order Processing Flow



Pasternack's Order Processing Flow for Coaxial Cable Assemblies

High-Reliability Cable Assemblies Available for Same-Day Shipping from Pasternack

Pasternack offers a complete line of MIL-DTL-17 cable assemblies, built with QPL MIL-SPEC cables and connectors, as well as a complete line of high-reliability, temperature-conditioned, low loss cable assemblies rated for performance up to 18 GHz. For a quick, side-by-side comparison of qualifying features, please refer to the chart below:

High-Reliability (Hi-Rel) Cable Assemblies from Pasternack	
MIL-DTL-17	**Temperature Conditioned, Low Loss**
✓ MIL-SPEC/QPL M17 cables single- or double-shielded coax	✓ Expanded PTFE, triple-shielded low loss coax; thermally pre-conditioned for mechanical and electrical stabilization
✓ MIL-SPEC / QPL M39012 connector	✓ Captivated, stainless steel RF connectors
✓ Max frequency of 12.4 GHz	✓ Max frequency of 18 GHz
✓ J-STD soldering processes	✓ J-STD soldering processes
✓ IPC/WHMA-A-620 workmanship standards	✓ PC/WHMA-A-620 workmanship standards
✓ Lot traceability for cables, connectors,	✓ Lot traceability for cables, connectors,
✓ Detailed test report and plots	✓ Detailed test report and plots
✓ Same-day shipment	✓ Same-day shipment
Learn More	Learn More
In-Stock and Available for Same-Day Shipping	

Conclusion

As military and aerospace systems continue to electrify, there is an increased need for high-reliability (Hi-Rel) coaxial cable and connector assemblies of all shapes and sizes. With interconnect being one of the last steps in system design, and even in production, any delay or errors with interconnect orders can lead to unfortunate and costly setbacks in meeting contract deadlines or fielding viable prototypes necessary for contract wins. The traditional sourcing process for these cables has involved a lengthy process of quotation, inspection, certification, production, and shipment that can require weeks or even months for cable assemblies to arrive. Design changes or errors may result in even longer delays to a program. If expected delays are unacceptable, a special waiver is sometimes requested to substitute non-certified cable assemblies, creating reliability and traceability concerns. Fortunately, Pasternack has now changed this paradigm with a comprehensive offering of pre-certified, COTS, Hi-Rel cable assemblies that are in-stock and available to ship same day.

Resources

1. https://blog.pasternack.com/uncategorized/whats-hype-high-reliability-hi-rel/
2. https://www.ipc.org/4.0_Knowledge/4.1_Standards/SpecTree.pdf
3. http://shop.ipc.org/IPC-J-STD-001G-AM1-English-D
4. http://www.ipc.org/ContentPage.aspx?pageid=IPC-Free-Documents
5. https://whma.org/ipcwhma-a-620/
6. http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-DTL/MIL-DTL-17J_50302/
7. http://everyspec.com/MIL-PRF/MIL-PRF-030000-79999/MIL-PRF-39012F_AMENDMENT-3_55804/
8. http://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=35726
9. https://www.sae.org/standards/content/as22520/
10. https://www.sae.org/standards/content/as23053/
11. https://www.sae.org/standards/content/as5942/
12. http://qpldocs.dla.mil/
13. https://www.chemours.com/Teflon_Industrial/en_US/tech_info/techinfo_compare.html