smiths interconnect

Advantages using

Semi-Rigid Cable Assemblies

for Mission-Critical Applications

Overview

The Strength of Semi-Rigid Cable Assemblies

Mission-critical semi-rigid cable assemblies are a coaxial cable with a outer conductor formed from a solid seamless metal tube – usually copper or aluminum. Within the metal tube there is a metal wire conductor running down the center of the tube which is wrapped and supported by a dielectric (tubular insulating layer) material keeping the wire centered in the tube. The wire conductor is on the same axis as the outer conductor providing the highest frequencies and lower noise levels when compared to flexible coaxial cable assemblies.

To obtain the best overall radio frequency (RF) performance, semi-rigid cable assemblies must have very consistent dielectrics and high shielding properties. The most important difference between a flexible coaxial cable assembly and semi-rigid coaxial cable assembly is the replacement of the braided outer or film shield to a solid metal outer tube which provides the best stability, environmental protection and determines the flexibility of the cable.

Therefore, a properly made semi-rigid cable assembly successfully connects other components in the system, supports RF signal transmission up to 65 GHz (standard), supplies power and endures the stress during deep space exploration, satellite integration and ground space robotics.

Below are 5 reasons semi-rigid cable assemblies are ideal for ESA (European Space Agency) and NASA (National Aeronautics and Space Administration) missions:

- They offer shielding, attenuation, and return loss performance in a compact configuration
- They can be formed into precise shapes to allow proper fit into the system for which they are designed
- They have optimum electrical stability
- They limit the risk of RF signal leakage/outflow in or out of the cable
- They can be configured to exact dimensions, precise cable routing and unbent or pre-bent configurations

Electrical Performance and Shaping

Shielding

Semi-rigid cable assemblies offer a superior RF shielding, forming a conductive barrier that allows the cable assembly to either reject surrounding nearby systems interference or prevent signal outflow or leakage into the environment compromising the overall system performance.

Shielding effectiveness is the ratio between the RF energy transmitted on one side of the shield and the RF energy transmitted to the opposite side. Shielding effectiveness depends upon the design, level or quality of the application.

Space qualified semi-rigid cable assemblies should meet the NASA standards for shielding to ensure reliable performance and transfer data for mission-critical systems.

Precise Shaping

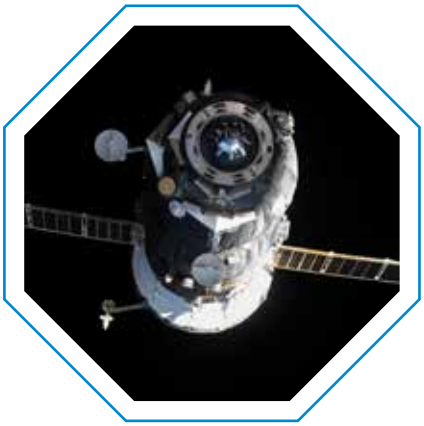
Semi-rigid cable assemblies can be formed into multiple shapes and they will keep their shape in all types of environments. By bending and forming into precise shapes, semi-rigid cable assemblies can properly fit into tight locations for mission-critical systems for which they are designed.

Although most are flexible enough by hand, reforming a semi-rigid cable can be risky and should be done with caution and with the use of specialize tools. Damage could occur to the wall of the outer tube affecting quality, reliability and electrical performance.

Having the ability to bend and form precise cable shapes is an advantage that should be leveraged during the design and manufacturing phases.

Electrical Stability and Outflow

Optimum Electrical Stability



Optimal electrical stability is crucial in space missions as cables must supply power, transfer data and ensure reliability.

Semi-rigid cable assemblies are made with high quality material, and have optimal electrical stability compared to flexible coaxial cable assemblies that use a braided outer conductor. Having a solid metal outer tube and using consistent dielectric materials (insulation within the tube) allows semi-rigid cable assemblies to provide superior phase stability and advanced electrical performance.

The properties of the metal tube and dielectric materials will change with temperature variation, which is why it can also be important to us phase stable dielectric materials in many critical space missions.

Signal Leakage/Outflow

Cable signal leakage refers to the loss of RF signals from a cable system. This can occur from a handful of causes (loose connectors, damaged or cracked cables) but usually the result of shielding defect is within the cable system.

Semi-rigid cable assemblies have reliable dielectric properties and shielding qualities. The dielectric is the insulating material between the center and outer tube, allowing optimized alignment and flexibility, while maintaining the same characteristics throughout the design.

These characteristics allow semi-rigid cable assemblies to minimize any signal leakages or outflows, and to ensure constant communications from deep space explorations to Earth.

Dimensions, Routing & Configurations

Preformed to Exact Dimensions

Semi-rigid cable assemblies can be manufactured as per the specifications in the design, limiting the material used such as shield, insulation and conductors. Additionally, many semi-rigid cable assemblies undergo stringent manufacturing and testing procedures to meet specifications and offer higher performance as compared to standard coaxial cable assemblies.

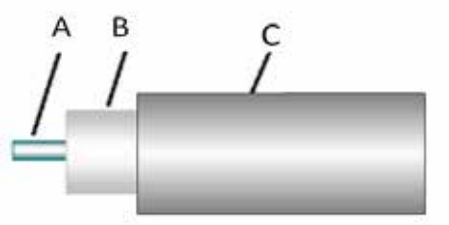
Precise Cable Routing

In the semi-rigid cable production environment the routing of the cable itself is an advantage because it is used to protect the cable from environmental stresses and harsh conditions.

Configurations

Semi-rigid cable assemblies are available unbent or pre-bent. Unbent semi-rigid cable assemblies are either straight or lightly coiled and the shaping is done on-site during installation. Pre-bent semi-rigid cable assemblies are bent to a formed configuration to meet certain specifications before shipment.

Standard Semi-Rigid Cable Assembly Diagram



(A) - Solid Silver Plated Center Conductor
(B) - PTFE Polytetrafluoroethylene
(dielectric insulating material)
(C) - Seamless Tube Shield (standard Copper or Aluminum)

Why Smiths Interconnect?

Our Semi-Rigid Cable Assembly Solutions

Mission-critical systems are exposed to different harsh environments, high level of radiation and extreme vibration. Providing a high-quality RF/microwave transmit signal is crucial for all mission-critical RF electrical systems.

Smiths Interconnect's semi-rigid cable assemblies are well-suited for Satellite Payloads (GEO/MEO and LEO constellations), Deep Space Probes, Ground-based Antenna Networks, Satellite Integration and Space Robotic Systems.

With space orbit qualifications our semi-rigid cables are available with a copper or aluminum jacket, available with a selection of different platings and 4 different diameters (.047", .085", .141" & .250").

Our cable assemblies are available unbent (shaping is done on-site) or pre-bent to your specifications and ready for installation.

High frequency (up to 65 GHz), low insertion loss, superior shielding effectiveness, on-site qualification and years of heritage allow our semi-rigid cable assemblies to be ideal for excellent electrical performance in mission-critical systems.

Our semi-rigid coaxial cable technology can be engineered for a wide variety of applications ranging from space, aerospace, defence and satellite payload.

Features and Benefits

- Pre-formed right angles available on some cable types
- Phase matched pairs and sets available
- Mode free operation 60 to 65 GHz
- Light weight & high vibration resistance
- Semi-Rigid frequency: up to 65 GHz
- High isolation: up to >100 dB
- Direct solder connectors: stainless steel construction (standard)

Options and Phase Matching

Cable Assembly Options

The electrical length of coaxial assemblies is often required to be an exact length. The electrical length is determined by the electrical properties of the cable and its mechanical length. Smiths Interconnect offers phase matching for semi-rigid cables and other kind of cables, supporting several types of phase matching and tolerances. The most common are listed below.

Typical Applications and Phase Matching

- Production and Lab Testing
- Environmental Testing
- Phase-array

Group*	Phase matched in sets - All of the cable assemblies are matched to each other.
Absolute**	Phase matched to an electrical length - As with a mechanical standard, this electrical length measured in degrees or time is determined by the customer or provided upon delivery by Smiths Interconnect.
Pairs**	Phase matched in pairs - Selected from large groups of phase matched assemblies.
Standard**	Phase matched to a standard - All of the cables are matched to a standard. This standard may have been established from a previous lot or provided by the customer.
Offset**	Phased offset matching - One or more assemblies are provided with defined phase offset as compared to other assemblies.

* Standard Phase Matching
** Custom Phase Matching, please consult sales department for more details

Test Solutions

Smiths Interconnect utilizes precision state-of-the-art equipment to test all cable assemblies. We have the capability to perform multiple qualification tests and measurement applications.

We have the systems and processes in place to meet space and defence standards and certifications. From high frequency, lightweight cable assemblies to customized solutions, Smiths Interconnect has the connectivity solution for you.

We aim to be your global partner for innovative connectivity solutions where reliability, high quality, technical expertise, application knowledge, and a reputation for excellence is vital.

more > smithsinterconnect.com