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Semi Rigid Cables

Dipl. Ing. Thomas Weber | elspec group

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The Semi Rigid coaxial cable is easy to bend, wrap, strip, mechanically heard and solder.

Semi-Rigid cables are mainly used for applications in high frequency bands up to 110GHz. The cable is unique and it is easily bent to finished shape and still maintains its set after bending. This property makes it ideal for the use with automated bending equipment as well as hand forming. Our vendors are qualified to MIL-DTL-17 and is listed on the Qualified Products List of the U.S Defense Logistics Agency.

A very special advantage of it is the 100% shielding with low VSWR, available cable diameters range from .020inch to .500 inch and available impedance range from 10 Ohms to 100 Ohms.

1 MIL-DTL-17 QPL

Our diverse range of 27 QPL cables includes copper and aluminum jacketed cables in sizes of .034, .047, .086, .141 and .250 diameters. These are available in copper, tinned copper or silver-plated copper.

Low Loss 50 Ohm Cable: Low Damping Semi Rigid coaxial cables transmit higher performance with low line losses.These cables reduce attenuation by a further 20% and extend the operating temperature to up to 250°C. Please request detailed test reports.

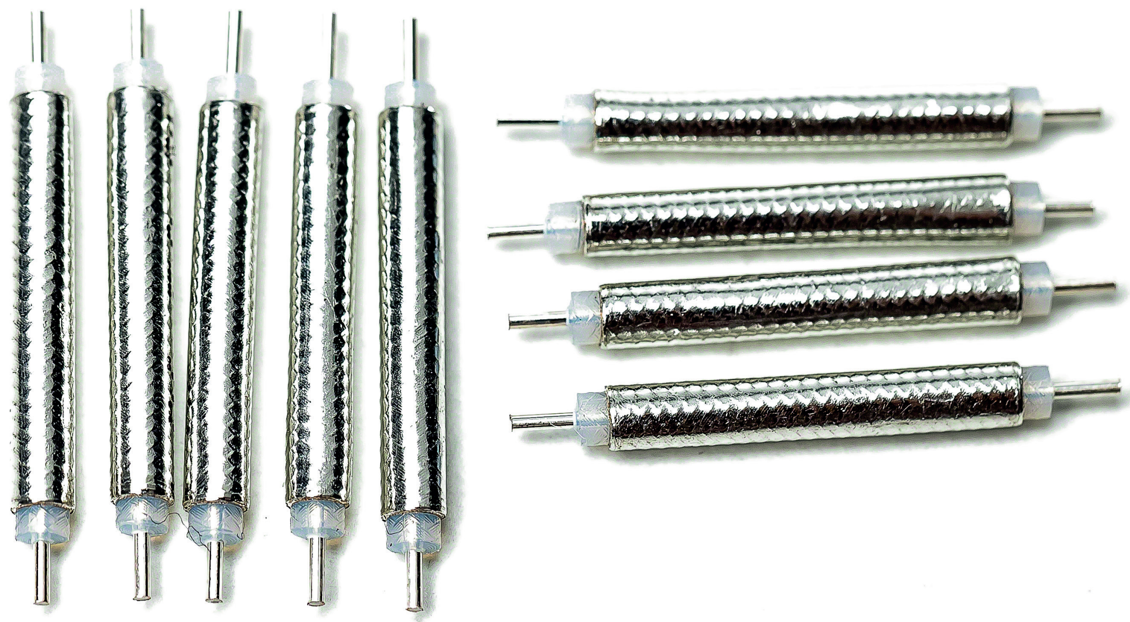
Stainless steel cable 50 Ohm: Stainless steel cables meet cryogenic or medical applications where low thermal conductivity is required.

- Diverse range of 27 QPL cables
- Available in copper, tinned copper or silver-plated copper
- Low Loss 50Ohm Cable transmits higher performance
- Reduced attenuation by a further 20%

Description	Shortterm	Impedance	External Diameter	Outer Conductor
M17/154-00001	CR-034-M17	50	0.034inch / 0.86mm	Copper
M17/154-00002	CR-034-M17-TP	50	0.034inch / 0.86mm	Tinned Copper
M17/151-00001	CR-047-M17	50	0.047inch / 1.2mm	Copper
M17/151-00002	CR-047-M17	50	0.047inch / 1.2mm	Tinned Copper
M17/133-RG405	CR-085-M17	50	0.085inch / 2,2mm	Copper
M17/133-00001	CR-085-M17-TP	50	0.085inch / 2,2mm	Tinned Copper
M17/130-RG402	CR-141-M17	50	0.141inch / 3.6mm	Copper
M17/130-00001	CR-141-M17-TP	50	0.141inch / 3.6mm	Tinned Copper

2 Center Conductor

The center conductor is either a solid or stranded metal wire which acts as the primary electrical signal carrier for any coaxial cable. Most attenuation occurs at the surface of the center conductor due to the „skin effect“ of microwave signals making the finish or plating a very important element. Stranded center conductors are generally only used in flexible cable constructions for added flexibility and longer flex life. In comparison, solid center conductors have lower attenuation and tend to be more amplitude stable with flexure while stranded center conductors tend to be more phase stable with flexure. For larger Semi-Rigid cables, a tubular center conductor can be substituted. The tubular center conductor reduces weight and thermal conductivity without any impact to the electrical performance.



- Silver plated copper (SPC) per ASTM B-298 and silver plated copper clad steel, also referred to as silver plated copper weld (SPCW) per ASTM B-501, are the two most common center conductor materials. Silver plating, besides being an excellent electrical conductor, prevents oxidization during manufacture and improves the solderability of the finished cable.

- Stainless steel and beryllium copper are also used when low thermal conductivity is a priority. Other materials, including many copper alloys are available on special request.

3 Dielectric

The most commonly used dielectric for high performance microwave coaxial cable is Polytetrafluorethylene (PTFE), in both full density and low density (a.k.a. low loss or microporous) forms. PTFE is an excellent choice for a cable dielectric due to its low reactivity to chemicals, an operating temperature that can withstand the heat of soldering. Cables with a low dielectric constant, while offering lower bulk dielectric losses, also require a larger center conductor diameter to maintain the same characteristic impedance. The larger center conductor can significantly lower the overall cable attenuation. In addition, the dielectric determines the velocity of propagation, temperature range, power rating, phase and amplitude stability, and contributes to cable flexibility.

The insulating material between the center and outer conductor maintains the spacing and geometry of the cable and ensures mechanical integrity during forming and bending. Most transmission losses are caused either directly or indirectly by the dielectric.

4 Outer Conductor

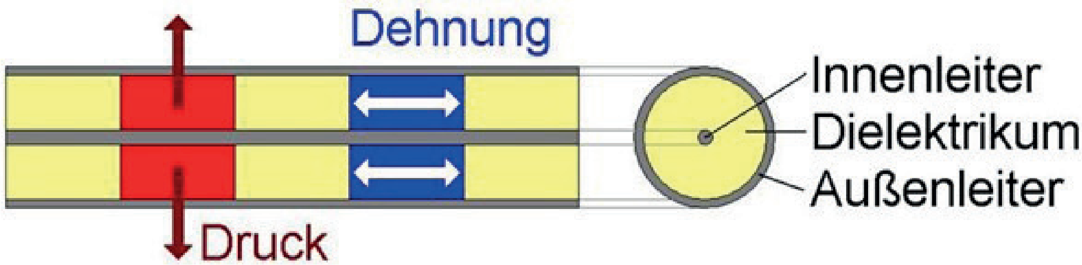
The outer conductor serves many purposes. It is the electrical shield which contributes to cable attenuation and controls RF leakage. Through precision mechanical tolerances, the outer conductor minimizes return loss (VSWR) by maintaining a constant characteristic impedance. The outer conductor is the primary strength member that keeps connectors firmly attached to the cable. It often provides environmental protection and determines the flexibility or how easy the cable can be formed or bent.

The most commonly used materials can be in many forms such as tube for Semi-Rigid cable, tin coated braid for conformable cables, or a foil in high performance flexible cables. Material selection typically involves trade-offs between electrical performance, size, and flexibility.

5 How to use a Semi Rigid Coaxial Cable

The electro-mechanical performance specified for Semi-Rigid Cables is achieved by a compression fit between the outer conductor and the dielectric core which, in turn, necessitates manufacturing processes that cause deformation of the core by compression and elongation. The resulting stress that is initially non-uniform tends to equalize by cold flow within a few weeks after manufacturing, and will cause withdrawal of the core into the cable. If this occurs in cable that has become part of a cable assembly, the resultant development of an air-void of the cable-connector interface may cause VSWR increases. It is therefore advantageous to achieve core stress relief by preconditioning cable before it becomes a cable assembly.

Preconditioning is not effective on long lengths of cable. Bending of cable, which is usually involved with the manufacture of cable assemblies, tends to introduce non-uniform core stresses; therefore, *CarlisleIT* recommends preconditioning after bending and before attaching the connectors. Since preconditioning will result in the withdrawal of the dielectric into the cable, preparation of the cable assembly should allow for a ¼ inch length on each cable end beyond the design dimension. The outer conductor and the core should not be cut to the final dimensions until preconditioning has been completed.



6 Preconditioning Procedure

A recommended preconditioning procedure consists of three cycles of the following routing:

- Heat the specimen to the maximum operating temperature.
- Maintain at temperature for one hour minimum.
- Return specimen to room ambient temperature. Trim protruding core, if any, flush with the edge of the outer conductor.
- Maintain specimen at room temperature for one hour minimum.
- Cool specimen to -45°C and maintain for one hour minimum.
- Return specimen to room temperature and maintain for one hour minimum.

After the last temperature cycle, maintain the specimen at room temperature for 24 hours minimum before proceeding with further processing. Important is to test the cable in your assembly condition before you produce the cable assemblies.

7 Fabrication Techniques

Cable cutting:

Cables having conductors of copper and aluminum are readily cut using circular saws equipped with metal cutting blades of high speed steel or cobalt steel. There are several table-top machines commercially available for this specific task. Special cutting techniques may be required for conductors of copper-clad steel, stainless steel or copper alloys. Abrasive cutoff wheels of suitable thickness (.010inch to .062inch) usually will suffice, although burr removal may be necessary.
Dry cutting is preferable to cutting using fluid cooling or lubrication to prevent possible wicking of the fluids into the cable ends

Stripping outer conductor:

Sections of solid tubular outer conductors can be removed by making a circumferential score or scribe mark and breaking the conductor at this mark. (This is similar to the cutting of glass, scribing a line and breaking it on that line.) The scribe line should be of proper depth, singular and the ends should meet together. This prevents a „step" on the broken edge. The edge must then be rolled between two hard surfaces to minimize the burr on the O.D. of the conductor edge. A lathe or a modified rotary wire stripper can be used for scoring the conductor. Do not penetrate into the Teflon while scoring since this would cause the outer conductor edge to be rolled into the dielectric, resulting in an electrical discontinuity at that point. If done properly, the edge will have only slight irregularities and will provide satisfactory electrical performance for non-critical applications.

Cutting the outer conductor with a rotating blade saw or jewelers saw will require subsequent facing operations and careful removal of any chips imbedded in the dielectric. This method is not recommended for applications which require superior electrical performance. Removal of the section of outer conductor which has been scribed off is accomplished by quickly breaking at the line (similar to snapping a piece of glass) by flexing in two opposite directions.

Do not flex too far since this will result in distortion of the conductor edge. The piece can then be pulled off with pliers. Care should be taken not to deform the dielectric by apply ing too much pressure. If a flush strip to the center conductor is required here, a razor blade can be used to cut the dielectric. A twist will remove both conductor and dielectric simult aneously (refer to „Trimming dielectric"). When cutting the dielectric it is important to have a guide to limit penetration, thus avoiding damage to the center conductor. Such damage would not only affect electrical performance but any mechanical Stresses during subsequent fabrication or operating conditions could cause the conductor to break.

Forming or bending:

A suitable fixture should be used for forming, one having a clamping arrangement for the cable and a mandrel of appropriate dimensions. An ideal mandrel should be grooved to allow the cable to nest thereby avoiding flattening. The tool used to bend the cable should also be grooved so that the cable is completely captivated at the bend tangent point. Large diameter bends may be made on flat mandrels with little or no deformation occuring. Dedicated tooling may be required because of form complexity but automated or semi-automated universally programmed machines are available which will allow versatility and high production capabilities.

To avoid wrinkling the cable in the bend area, pressure must be applied against the cable at the bend tangent point, forcing the cable against the mandrel. Too much pressure will cause a bulge in the outer conductor at the end of the bend area on the inside. The cable will have a slight amount of „spring-back“ requiring the mandrel to be slightly smaller than the specified bend. This is not a predictable behavior so some experimentation is necessary (usually the larger the bend, the greater the spring-back). These cables should not be formed smaller than the „Safe bend radius“ specified in the data sheets (see tables). Otherwise, severe electrical and mechanical degradation will occur.

How to form Semi Rigid cables correctly:

We have collected many helpful tips and tricks on the subject of Semi Rigid cables over the past decades. We have put some of them into a practical video: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Impressum

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Concept, text, drawings: Thomas Weber, el-spec GmbH, Geretsried
Layout concept and design: Monika Köteles Stephan, München
Photos: Till Luz | Till Luz Photography
Udo Klünsch | kpr kommunikation

el-spec GmbH
Lauterbachstraße 23c
82538 Geretsried
Geschäftsführer: Thomas Weber
www.elspecgroup.de

Notes

el-spec GmbH
Lauterbachstr. 23c
D-82538 Geretsried-Gelting, Germany
Tel. +49 (0) 8171-4357-23
Fax +49 (0) 8171-4357-99
sales@elspecgroup.de
www.elspecgroup.de