

## Your Cable Your Way: A Guide to Custom Cable Design

### Why Create a Custom Cable?

Having trouble finding a standard cable that meets all of the application requirements?

Want to combine a number of cables into one cable, for easier installation?

Need a custom print legend or color match jacket?

If you answered yes to any of these questions, then you need to design a custom cable!

Creating a custom cable allows the designer to have control over conductor counts, AWG sizes, color codes, tolerances, insulation and jacket materials, shielding and print legends. Special designs also allow for the adjustment of overall diameters so that the cable will fit in existing ancillary components like grips, connectors, and grommets. Moreover, custom cables make it easier to ensure that inferior cables are not substituted.

### Things to be Mindful of

Many different types of cables can be made with a custom design. The following information is just some things to keep in mind when creating a custom cable.

First, there are a number of conductor choices. The conductor sizes available are between 30awg to 4/0 and it is possible to have up to 85 conductors. Conductor types include bare copper, tinned copper, and silver coated copper (used for high temperature cables). Conductors are also available in either stranded or solid constructions.

The standard offering of insulation materials include polyvinylchloride (PVC), Fluorinated ethylene-propylene (FEP), Polyethylene (PE), polypropylene (PP) and thermoplastic elastomer (TPE). Below is a short description of these common materials.

- **PVC:** is most commonly available with a temperature range of -10°C and 105°C, it is a relatively inexpensive compound that can be made oil and UV resistant as well as flame retardant. However, the dielectric properties of PVC vary between different types of PVC.
- **FEP:** is perfect for high temperature applications, has a maximum temperature range of 200°C, it also works well for plenum applications and situations where a small overall diameter is required.
- **PE:** has a relatively low dielectric constant, which makes it useful for a wide range array of applications. It's temperature ratings range from -65°C to 90°C.

- **PP:** exhibits many of the same electrical properties as PE and it offers good resistance to abrasion, chemicals, heat and moisture. In a foamed state it has better mechanical characters than PE.
- **TPE:** It has a temperature range of -60°C to 125°C and is resistant to fuels, oils, solvents and water.

Furthermore, there are also a number of options when it comes to cabling, which is how the conductors are organized within the cable. The possible options are pairing conductors, grouping conductors and even grouped conductors with individual shields. Moreover, there are different lay ups for flexing and torsion arrangements.

After the cabling, it is necessary to consider shielding. Shielding options include foil, braid and spiral as well as any combination of the three. Foil shields are best at protecting against high frequency electromagnetic interference (EMI) and braid and spirals work best at protecting against lower frequency EMI.

In addition, there are a number of choices when it comes to jacketing materials. The popular offerings include polyvinylchloride (PVC), Polyethylene (PE), fluorinated ethylene-propylene (FEP) and thermoplastic elastomer (TPE). These are the same materials that were explained above.

Regulatory approvals are also very important to pay attention to when creating a custom cable. Picking certain materials can rule out certain approvals, conductor counts, and gauge sizes. If you are basing your cable design on a standard part but switching the materials in the cable, be aware that it will likely have implications with regards to the available approvals. The standard offerings of approvals include environmental, Underwriters Laboratory (UL) and Canada Standards Association (CSA) approvals.

Some examples of environmental approvals are California Proposition 65 and RoHS.

- **RoHS:** Is the abbreviation for Restriction of certain Hazardous Substances. RoHS falls under Directives 2002/95/EC and 2002/96/EC and will become law by July 2006. It forbids any products entering the EU that contain lead (Pb), hexavalent Chromium (Cr+6), cadmium (Cd), other heavy metals, Deca-BDE, PBB and PBDE (chemicals used as flame retardants in compounds). However, naturally occurring trace amounts are acceptable.
- **California Proposition 65:** Requires that the outer surfaces of goods must not contain greater than 300 parts per million (ppm) of lead (Pb) for goods entering California.

For the UL approvals, the standard offerings include, but are not limited to:

- Appliance Wire Material (AWM styles)
- Tray Cable and Tray Cable with Exposed Run (TC and TC-ER)
  - Only available in gauge sizes 6 to 18AWG
  - This is generally a 90°C, 600V rating
  - Can also include wet ratings, UV resistance and direct burial
- Power Limited Tray Cable and Power Limited Tray Cable with Exposed Run (PLTC and PLTC-ER)
  - This is generally a 105°C, 300V rating

- Communications Cable (CM, CMG, CMR, CMP, CMX)
- Machine Tool Wire (MTW)
- Wind Turbine Tray Cable (WTTC)
  - This is generally a 90°C, 1000V rating
- Photovoltaic (PV)
  - This is generally a 90°C, 1000C rating
- Oil Resistant I and Oil Resistant II.
- UV Resistant
- Flame Rating (VW-1)

For the CSA Approvals, the standard offering includes, but is not limited to:

- Appliance Wire Material (AWM I/II A/B FT1, FT4)
- Communications Cable (CM, CMG, CMR, CMP)
- Tray Cable

Generally, the voltage ratings on multi-conductor cable cables are 300V, 600V, or 1000V. There are occasions where they are 30V, 150V or 250V but that is not very common. For temperature ranges, the high temperature standards are 75°C, 80°C, 90°C, 105°C, 125°C, 150°C, and 200°C. For the low temperature range the standards are -80°C, -40°C, -20°C, -10°C, and -5°C.

### **How Do I Get A Custom Cable?**

#### *Work with our Team*

There are two ways to create a custom cable with Alpha Wire. The first is with the assistance of our experienced sales and engineering teams. All that is necessary to get a quote is to call 1-800-52ALPHA and provide the following information:

- Quantity
- Number of conductors or pairs
- AWG size(s)
- Shielding requirements
- Regulatory agency approvals
- Insulation and Jacket materials
- Color code & jacket colors
- Voltage rating
- Temperature range (upper & lower ends)
- If this cable is going to be used in a flexing application
- Any additional application information (sunlight or oil resistant, etc.)
- Desired distributor

If guidance or assistance is needed when creating a custom cable our engineering team is available to make sure the cable has all the desired capabilities and characteristics.

### *Do it Yourself*

To make it even easier to get a custom cable, Alpha Wire offers the Cable Design Center™. The Cable Design Center can be found on our website under the Online Tools tab. Once an account is created, up to fifty cables designs can be saved. The Cable Design Center allows for the creation of a custom cable from scratch or the designer can pick a standard Alpha Wire part number to work from. Once the design is submitted, within 24 hours our engineers will review the design and then our sales team will contact the designer with a quote. This quote will come with a specification, so that it is easy to see detailed information for the cable that was quoted. If the special cable is ordered, there will be a more detailed specification provided for the designer to sign before the cable goes to production. This ensures that the designer is getting the perfect cable for their application.

### **Success Stories**

#### *Multiple cables combined into one Military-tough cable:*

A cable was created for a military application that involved base camp surveillance. This cable was a multiconductor/multipair/coax composite that was daisy-chained to reach around the portable military camp.

#### *Energy solutions:*

For a customer, we created a 25 pair, low capacitance cable made of FEP that out performed our competition on all tests. The cable is installed and working perfectly in a gas turbine.