

## CABLE SELECTION GUIDELINES

John Elias, Feb 5, 1999  
(revised Apr 27, 2000)

Wires, cables and fiber optics will be reviewed in three areas, fire safety, electrical characteristics, and mechanical considerations for purposes of ES&H compliance and installation/integration. Performance and suitability for the intended purpose is the responsibility of the designer. Documentation as per the checklist below is needed for the review.

### Fire Safety

The two principal issues are flame propagation and smoke characteristics. Cables must be rated by a recognized standard for flame propagation that shows they are self-extinguishing when the heat source is removed and cannot spread a fire. The oxygen index is a good measure with a value of 28 or higher guaranteeing non-propagation even in a vertical configuration. Also, IEEE, IEC and Underwriters Laboratories provide tests and ratings for flame spread which some manufacturers cite instead of the oxygen index.

Low smoke density, low toxicity and corrosivity of gasses from fires is highly desirable. This is entirely a materials selection issue and is discussed in detail in two CERN documents available on the web as referenced below (note that PVC is absolutely banned at CERN). The best cables are halogen free with minimal sulfur and phosphorous content.

If the termination of cable assemblies require encapsulation in some type of plastic or resin the engineers must provide us with the appropriate information.

### Electrical Characteristics

Pin-out documentation is needed for any connectors. This should be "signed-off" by both parties, those doing the cable and those doing the circuit with the receptacle.

For conductors carrying low voltage power, document both the ampacity rating of the conductors and the method of overcurrent protection. If a ribbon cable or other multiconductor cable is involved, document the connector polarization or other technique for preventing misplugging.

For conductors carrying high voltage, > 50 VDC, provide a copy of the manufacturer's maximum voltage rating. If a special usage is involved and the vendor rating is not available or not relevant, provide documentation on testing

and/or engineered protection to allow use at high voltage. As always, the color red is preferred for the jacket.

If specialized assembly techniques are required to terminate cables, written instructions and drawings are required.

### Mechanical Considerations

For cables to be installed into the cable trays, the bend radius is xxx inches. Experience has shown that round cables are much preferred over ribbon cables. Note that there are random-and-flat alternatives to twist-and-flat ribbon cable which are round but still allow mass terminating connectors.

For fiber optic cables, provide documentation on the gravity loads especially for vertical runs, and on how the cable withstands the stresses. A crush pressure test fixture has been built to validate optical cables to be installed in the cable trays. "Core-Locked" structures are much preferred because the fibers are locked to the coating and jacket layers.

References:

1. IS41 - The Use of Plastics and other Non-Metallic Materials at CERN with respect to Fire Safety and Radiation Resistance

[http://cern.web.cern.ch/CERN/Divisions/TIS/safdoc/IS/is41/is41\\_en.html](http://cern.web.cern.ch/CERN/Divisions/TIS/safdoc/IS/is41/is41_en.html)

2. IS23 - Criteria and Standard Test Methods for the selection of Electrical Cables, Wires and Insulated Parts

[http://cern.web.cern.ch/CERN/Divisions/TIS/safdoc/IS/is23/is23\\_en.html](http://cern.web.cern.ch/CERN/Divisions/TIS/safdoc/IS/is23/is23_en.html)