# Bend Radius Management

*by Simon Barnard, Molex Premise Networks*

Cabling standards require that minimum bend radii must be observed.  If they are not, cables may be damaged and their performance impaired.  For example, in copper cabling systems, excess return loss is a common symptom of the failure to properly control bends in cable runs. In fibre optic systems, high attenuation may result. These effects may be apparent at only one wavelength, but it is non-the-less critical that correct installation techniques are used to guard against the possibility of damage.

Two figures are generally quoted for minimum permissible cable bend radius.  The radius used during pulling in is greater than the minimum bend radius when installed.  This is because the cable is under tension when it is being pulled in, and is therefore more likely to suffer damage. The installed cable is free from tension and less prone to damage. With this in mind, larger bends need to be specified throughout containment than at the point of termination on the panel or outlet.

The key thing to remember is that once a bend radius has been exceeded it is highly likely that damage has been done. Simply straightening the cable is no guarantee of performance.



Minimum bend radius

Minimum Bend Radius (R)

Outside Cable Diameter (D)
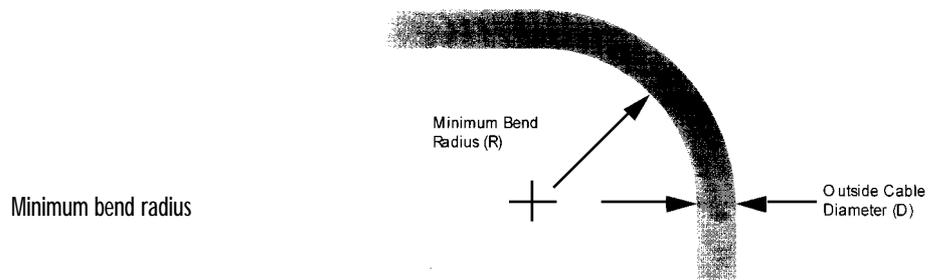
The minimum bend radius is referenced against the cable diameter.  It is usually expressed as a multiple of D (cable diameter).  Category 6 cable is typically larger in diameter than Category 5e cable, so the actual radii for Category 6 systems tends to be greater than those used in a Category 5e system.

Comparison of Category 5e and Category 6 cable
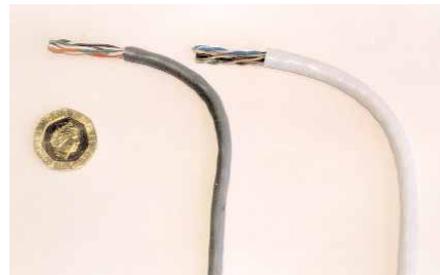


Unfortunately there is no clever tool available for bending cable to the right diameter, or any way of automatically checking that minimum radii have not been exceeded.  If space allows, radii can be measured with a ruler, but for all practical purposes it becomes important for technicians to become visually familiar with correct cable bend radii so that any problems can be identified, and rectified quickly.

To make it even more difficult, the specifications vary between standards and from horizontal to backbone cables.

## HELPFUL HINTS

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The following table shows the minimum bend radii as specified by the telecommunications wiring standards. Where the minimum bend radius given by a cable manufacturer differs, then the greater of the two figures should be applied.

Minimum bend radii for cable during pulling in and when installed

|  | INSTALLED | PULLING IN |
|---|---|---|
| EN 50174-2 | "should not exceed minimum from product standard" | |
| IEC 11801:2nd edition | 25mm 4 pair cable < 6mm<br>50mm 4 pair cable > 6mm | Not Specified |
| Horizontal ANSI/TIA/EIA 568B | 4 x D for UTP 4 pair cables | Not Specified |
| Backbone ANSI/TIA/EIA 568B | 10 x D | Not Specified |
| Fibre TIA 568B | (Multipair) 10 x D | 15-20 x D |

*Where D = outside cable diameter*



Comparison of Category six cables laid out at four times its diameter (as for point of termination) and eight times its diameter (as used throughout containment)
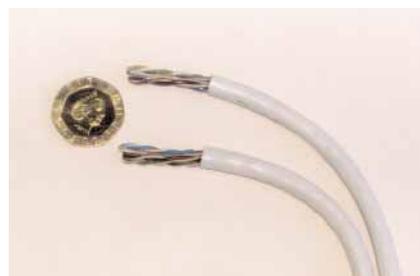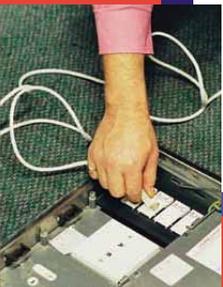


Comparison of fibre backbone cables with bend radii of six, eight and ten times diameter
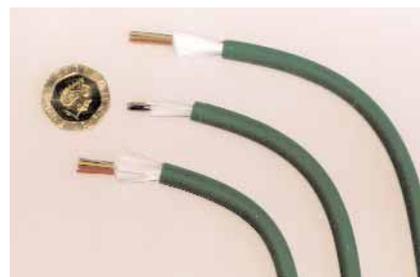


Using an everyday object to illustrate a 40mm bend radius

Bend radii must be considered when sizing conduit and trunking and particularly the bends or corners there in. Remember, even if the containment is adequately sized for straight runs it could still be too small for the minimum bend radius to be observed at the corners.

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