WHITE PAPER

CABLE DAMAGE CAUSED BY FASTENING ERRORS

When laying copper data cables installers must take care to ensure that fixing and fastening elements such as cable ties and clamps do not deform or damage the cables. Even relatively minor deformation can result in error messages – particularly when fastening distances are the same.

The installation of high-performance copper data cables makes two conflicting demands on the individuals laying them. On the one hand the work requires great strength, for example when bundles of cables need to be laid in riser zones. On the other it requires a high degree of sensitivity, for the cables are information technology transmission channels, the capacity of which is constantly increasing as data rates continue to rise.

On top of everything else this balancing act generally has to be pulled off under economic constraints.

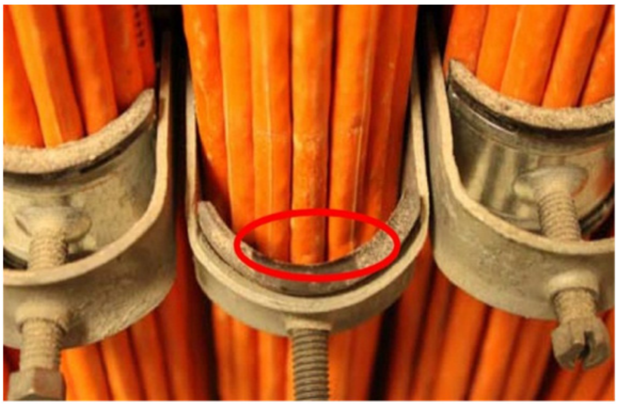

Image 1: Cables squashed by hammerfoot clamps. (Source: www.MaPaCom.EU)

Effects of deformation on copper data cables

In data cables – as in all telecommunications systems – there is a fundamental link between their mechanical structure and their transmission characteristics. This link becomes even more noticeable as the bandwidth or transmitting frequency increases, which means that every squash or kink also affects return loss, attenuation, characteristic impedance, etc.

In many cases the effects of such mechanical influences make no difference to the cable's transmission characteristics, but occasionally they may produce error messages or even massive performance losses.

Frequency-selective attenuation poles

The impact on transmission characteristics is particularly serious when deformation occurs with equal spacing (is equidistant). Equidistant deformation creates "ideal conditions" for the reflection of a single wavelength – and hence a single frequency – by overlapping. This reflected frequency-selective signal is absent in the forward direction, which in the course of attenuation is expressed by a pole, a peak visible during measurement (see images 2 to 4).

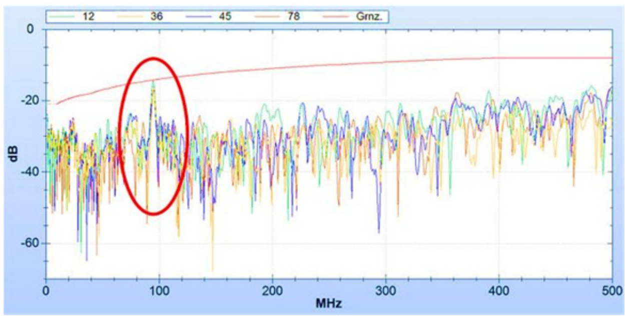

Image 2: Pattern of return loss with a pole at approx. 100 MHz.

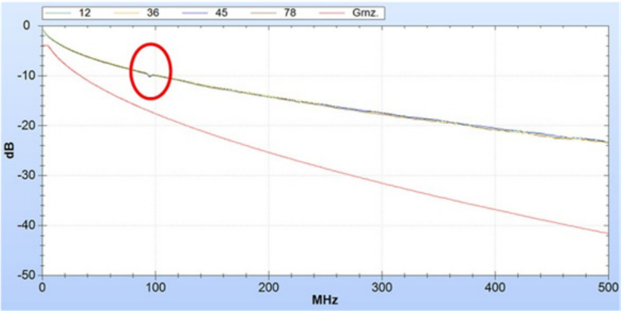

Image 3: Attenuation pattern with a pole at approx. 100 MHz.

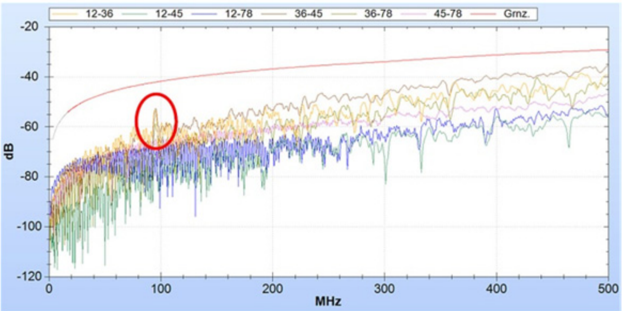

Image 4: Near-end crosstalk with visible peak at approx. 100 MHz.

These effects therefore tend to occur in an particularly tidy installation with precisely dimensioned, even fixing distances rather than in one with non-equidistant fastening.

Troubleshooting and defect rectification

If attenuation poles occur in a cabling system, the best thing is not to begin a search immediately (which in some cases can be very protracted). Rather it may be advisable to check whether the effects have been caused by fastening-related damage.

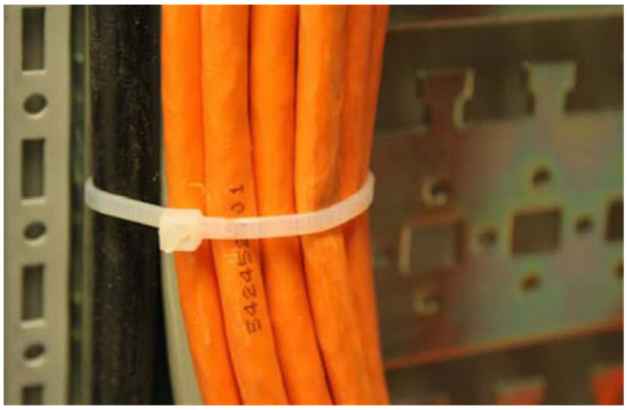

Image 5: Cables squashed by cable ties. (Source: www.MaPaCom.EU)

The following mathematical relationship governs the distance between deformation $a_{deformation}$ and pole frequency f_{pole}:

$$a_{deformation}\,[m] = 1.5\,\frac{NVP[\%]}{f_{pole}[MHz]} = 1.5\,\frac{76}{95} \approx 1.2$$

If the data from measurement and the cable installed (here e.g. CU 7120 4P) are now inserted into the formula, this gives the concrete fastening distance (here 1.2 metres). If the calculated distance corresponds to the actual fastening distance of the installation, the reason for the error message is clearly attributable to equidistant deformation of the cable.

The reason for a frequency-selective attenuation pole is a damaged cable in every case. In individual cases it may help to “loosen” the fastening of the cable and to move a few fastening points. If this fails, the cable needs to be replaced.

