Insulation and Jacket Shrinkback

Shrinkback is the tendency for the insulation of a wire to pull back from a splice or termination connector. If shrinkback occurs, an excessive amount of copper (or aluminum) conductor can be exposed and increase the risk of a short circuit. Shrinkback can also occur with the jacket of a multiconductor cable. If the jacket pulls back from a splice or termination, it can permit the entrance of dirt and/or moisture into the cable. Typical causes of shrinkback and industry methods used to measure and control it are discussed below.

What Causes Shrinkback?

Shrinkback can occur when built-in mechanical stresses are present in the insulation or jacket material as the result of the manufacturing process. For example, if a copper conductor moves through an insulation extruder head at a speed slightly faster than the molten insulation compound coming out of the extruder head, the molten insulation becomes stretched. When the insulation compound is cooled, the insulation can become "frozen" in this stretched condition. When the wire is later cut into short lengths, the insulation may pull back if friction with the copper conductor is too low to hold it in position. "Shrinkback" is the result. High temperatures and wide temperature excursions tend to accelerate the process. Polymers vary in their susceptibility to shrinkback as a result of their basic chemical structure. For example, the thermal coefficient of expansion of a polymer can affect shrinkback.

Industry Test Methods

To minimize shrinkback, the wire and cable industry has developed test methods and standards to measure and control it. One test method frequently used to evaluate the shrinkback of communication cable insulation is contained in ANSI/ICEA Standard S-56-434.[1] Section 5.4.1.3 of the document details the test method. In this case, the test is performed on a sample of the insulated conductor obtained by cutting 8 inches (200 mm) from the center of a 5 foot (1.5 m) sample and then trimming it to 6 inches (150 mm) by cutting 1 inch (25 mm) from each end. The 6-inch (150 mm) samples are then placed in a circulating air oven for four hours at a temperature of 115°C for PE (polyethylene) and 130°C for PP (polypropylene) insulation. Shrinkback is defined as the total shrinkage of the insulation from both ends of the sample. The pass/fail criterion for this test is 0.38 inches (10 mm).

[1] ANSI/ICEA S-56-434 *Polyolefin Insulated Communication Cables for Outdoor Use*, available from IHS Inc. at http://store.ihs.com.

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Section 5.4.3.3 of the same ANSI/ICEA document contains the test method for a shrinkback test on cable jackets. It requires the removal of a 0.5 inch (13 mm) wide by 2 inch (50 mm) long strip of material from the jacket. This specimen is then measured in length before and after oven conditioning at 100°C (115°C for some materials) for 4/hours. The percent shrinkage is then calculated from these measurements. The maximum jacket shrinkage permitted with this test is 5 percent.

Insulation Clearance

The distance between a termination device and the end of a wire's insulation is called "insulation clearance." This distance is shown as measurement "C" in Figure 1 for three types of terminals. Shrinkback can contribute to excessive insulation clearance and the risk of a short circuit. Maximum recommended insulation clearance is defined in Section 4.4.1 of IPC/WHMA-A-620.[2] This document requires the insulation clearance to be less than two wire diameters (shown as "D" in Figure 1) or 0.06 inches (1.5 mm) whichever is greater. One way to minimize the effect of shrinkback on insulation clearance is to use terminations that employ insulation support crimps as discussed in Section 5.1.1 of IPC/WHMA-A-620 and as illustrated in Figure 2.

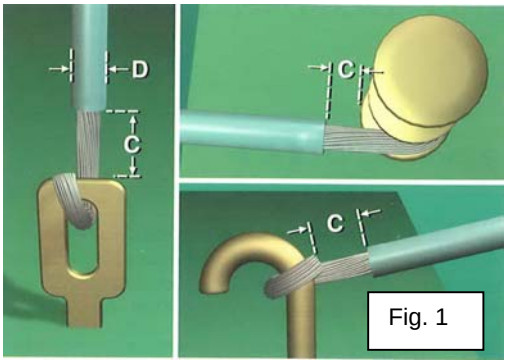

Fig. 1

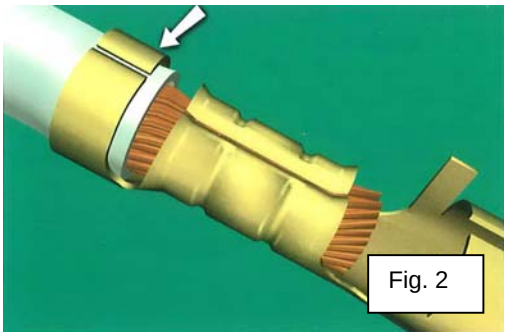
Fig. 2

In Summary

One or more of the following methods can be used to minimize the potentially negative effects of insulation and jacket shrinkback:

- Choose an insulation (or jacket) material that is inherently less prone to shrinkback.
- Include shrinkback requirements in your wire or cable purchase order
- Increase the amount of friction between insulation and conductor, i.e., increase the wire's insulation strip force requirement
- Employ splice and termination devices that are equipped with insulation support crimps.

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[2] IPC/WHMA-A-620 *Requirements and Acceptance for Cable and Wire Harness Assemblies*, Wiring Harness Manufacturer's Association, www.whma.org.