ICEA Medium Voltage Insulation Shrinkback Test

Why is the test done?

Under certain extrusion parameters polyethylene or crosslinked polyethylene (includes TRXLPE) may exhibit insulation shrinkback. During extrusion of the insulation on to the conductor there are mechanical stresses which may be built into the insulation. If the insulation is not cooled properly these stresses are locked into the insulation. When the cable is subject to changes in ambient temperature or during load cycling of current through the conductor these stress are relieved in the form of the insulation shrinking back. This is of concern as this shrinkback can disrupt the stress relief interface of the extruded cable insulation shield and the splice or termination. This shrinkback phenomenon can be especially great on solid conductors with larger wall thicknesses. The shrinkback can be as much as a foot in length every time the cable is cut on a solid conductor from the same reel of cable. Shrinkback on stranded conductors tends to be less than on solid conductors because the conductor shield fills in the outer stand interstices allowing the conductor shield to grip the conductor. Therefore the less strand interstices the more prone the insulation is subject to possible shrinkback. Ethylene propylene rubber cable does not experience shrinkback of the insulation.

What does the test tell us?

The shrinkback test establishes that the extrusion process is in control and shrinkback of the insulation has been kept to an acceptable level as not to interfere with the splice and terminations operation.

How is the test done?

After extrusion of the insulated cable core, a 17.5 foot sample is taken every 50,000 feet of an extrusion run of insulated core. Five feet of each end of the cable length is cut with a fine tooth saw and the remaining length is cut into 1.5 foot specimens for test. All five 1.5 foot specimens are placed in a 50^{o}C oven for a period of 2 hours the samples are then removed from the oven and allowed to cool at room temperature for 2 hours. At the end of the cooling period the specimens are measured for shrinkback along the conductor at both ends of the specimens. The following requirements are to be met during the testing found in the ANSI/ICEA S-94-649 and S-97-682, CSA C68.5 and C68.10 Standards.

Shrinkback Test Requirements
Cables Having Sealed Strand Conductors and/or a Tape Over the Conductor

Oven Cycle	Total Shrinkback mils (mm)	Action
1	0 to 20 (0.51) > 20 (0.51)	Pass: Terminate Test Record and Continue Cycling
2	0 to 40 (1.02) > 40 (1.02)	Pass: Terminate Test Record and Continue Cycling
3	0 to 320 (8.13) > 320 (8.13)	Pass: Terminate Test Fail: Terminate Test

Shrinkback Test Requirements
All Cables Not Covered by Table Above

Oven Cycle	Total Shrinkback mils (mm)	Action
1	0 to 20 (0.51) > 20 (0.51) but ≤ 60 (1.52) > 60 (1.52)	Pass: Terminate Test Record and Continue Cycling Fail: Terminate Test
2	0 to 40 (1.02) > 40 (1.02) but ≤ 100 (2.54) > 100 (2.54)	Pass: Terminate Test Record and Continue Cycling Fail: Terminate Test
3	0 to 100 (2.54) >100 (2.54)	Pass: Terminate Test Fail: Terminate Test

Test Evolution

There have been various test methods done prior to this test. Two historical methods were the AEIC Dimensional Stability test which used 121°C for 20 hours and 2 hours cooling on 1 foot samples and the VEPCO shrinkback test which used a 20 foot samples and load cycled the conductor at 90°C for 10 cycles, 4 hours on and 4 hours off. These tests either used more cable or took too much time or did not always determine if the cable would have a shrinkback problem in the field. The test today is the result of a 1984 ICEA Working Group which conducted round robin testing of insulated cores at various temperatures test lengths and test protocols which conclude in the latter part of 1986.