



Technical Bulletin

TB 0247 – Correct installation of heat shrink products

Purpose

Following recent failures this technical bulletin has been issued to highlight the importance of the correct installation of heat shrink products.

This technical bulletin is not associated with any network standards and is provided to clarify the installation methods required on these products.

Initial investigation

An investigation was carried out on a failed A phase 22kV single core 240mm² Cu conductor termination. Preliminary examination showed a hole approximately 20mm in diameter in the insulation heat shrink. The hole penetrated between heat shrink layer, through to the core strands. The hole is in the region where the semi-conductive layer has been removed from the conductor (Figure 1). The insulation was removed for further examination. There were signs of high partial discharge (PD) activity at the semi conductive layer removal cut and a clear tracking path to the earthed screen wires (Figure 2).



Figure 1



Figure 2

The B phase and C phase cores from the same termination were also examined. The insulation heat shrink was easily removed from the XLPE insulation and lugs on both cores indicating insufficient heat had been applied during installation (Figures 3 and 4). When sufficient heat has been applied to the termination, the green stress relief mastic layer on the inner surface of the heat shrink tubing bonds to the XLPE insulation and is extremely difficult to peel off.



Figure 3



Figure 4

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Additional tests on terminations

Two kits (manufacture dates 2004 and 2012) were taken to the Technical Training Centre to determine if age of the components is a possible contributing factor in the stress relief mastic layer not bonding.

The 2004 kit instructions contain the instruction to “Pre-heat lug barrel and post heat lug palm until a bead of mastic appears around the lug barrel at the top of the insulation tube and a thin band around the bottom edge of the tube”.

*The 2012 kit instructions and current instructions contain an additional step to “Pre-heat lug barrel and post heat lug palm **and the entire termination length** until a bead of mastic appears around the lug barrel at the top of the insulation tube and a thin band around the bottom edge of the tube”.*

Findings

Test installations were constructed on six cores using various degrees of heating for various time periods as shown in figures 5, 6 and 7.

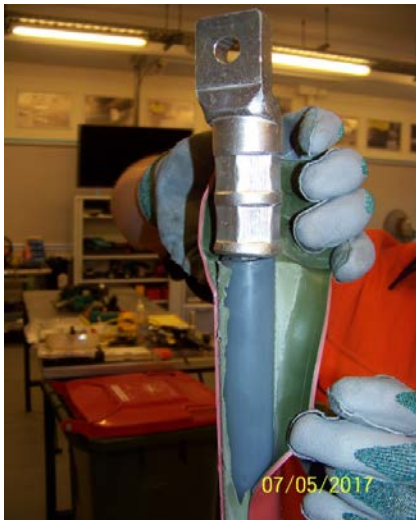


Figure 5: Pre-heat lug barrel and post heat lug palm. Soft blue flame for 3mins until a thin bead appeared top and bottom of the insulation tube



Figure 6: Pre-heat lug barrel and post heat lug palm. Soft blue flame for 4 mins until a thin bead appeared top and bottom of the insulation tube



Figure 7: Soft blue flame. Pre-heat lug barrel and post heat lug palm and the entire termination length until the length starts to contract, a bead of mastic appears around the lug barrel at the top of the insulation tube and a thin band around the bottom edge of the tube. Note the green mastic has bonded to the XLPE and lug so well it could not be peeled away

It was found that:

1. The age of the kits was not a factor in the bonding capability of stress relief mastic layer.
2. The additional instruction step in the 2012 kit instructions to post heat the termination is significant to ensure the stress relief mastic layer has successfully bonded.
3. Heating the insulation layer shrink tube with an aggressive flame for a shorter period of time will achieve a sufficient bond though is not recommended as scorching occurred. This scorching may affect the long term reliability of the insulation.

Conclusion

When installing these components, it is not sufficient to heat the insulation tube until a bead of green stress relief mastic appears on the lug barrel alone.

It is critical to ensure the mastic flows and bonds to the lug and core filling all voids for the entire length of the termination, therefore eliminating the effects of PD. This is only achieved consistently by pre-heating the lug barrel and also post-heating the entire length and circumference of the tube until it starts to contract longitudinally.