Weekly Whitepaper
Week #69

Understanding "Fixing of Wiring"

UL – CSA – EN - IEC

Fixing of Wiring: The term "Fixing of Wiring" relates to the routing, securement, and termination of internal wiring. It is part of the product construction requirements included in most product safety standards, but is often overlooked or misunderstood by product manufacturers. Fixing of wiring relates to these two areas of product safety compliance:

a) Creepage & Clearance Distances: As part of the Creepage & Clearance distance evaluation, all internal parts are to be pushed/moved with up to a 10N force. (The terms creepage & clearance distance mean over-surface and through-air electrical spacings.)
b) Double & Reinforced Insulation: Determining if any double or reinforced insulation can be bridged by a single insulation fault (basic insulation).

Movement of Insulated Wiring: During the construction review of the product, internal wiring is permitted to be moved around using up to 10N of force to determine what circuits the wiring can reach. In addition, single faults are considered that may extend the reach of internal wiring. The objectives are:

1) Voltage Rating: Verify that all insulated wiring is rated for the maximum voltage to which it can contact. This involves moving low voltage rated wiring to determine if it can contact a higher voltage circuit. If low voltage wiring can contact a higher voltage circuit, the wire insulation must be rated for the higher voltage. Alternatively, changes can be made to routing or the wire length, such that low voltage wiring cannot contact uninsulated mains or hazardous voltage circuits.

2) Insulation Type: Verify that all insulated wiring is using the appropriate type of insulation for the circuits that the wire insulation can contact (basic, supplementary, reinforced, or double insulation). This involves moving SELV (or PELV) wiring to see if it can contact any uninsulated high voltage or mains parts. It also involves moving mains and hazardous voltage wiring to see if it can contact any uninsulated SELV parts. Wiring that can bridge reinforced or double insulation is the target = if a SELV wire can contact mains or hazardous voltage circuits or, if mains wiring can contact a SELV circuit, the wire must be double or reinforced insulated. Alternatively, changes can be made to routing or the wire length, such that low voltage wiring cannot contact uninsulated mains or hazardous voltage circuits.

3) Crimp Connectors: Single fault considerations include internal wiring. Since breakage of an insulated wire would be considered two faults (conductor & insulation), single fault consideration falls primarily on the wiring termination method. If wiring is secured by a single point method, it is assumed that the connection can fail. If the termination point fails, the end of the wire is free to be moved around to determine if it can bridge double or reinforced insulation.

Can a SELV wire termination point fail from a single fault and allow the SELV wire to reach a mains circuit? Can a mains wire connection point break from a single fault and allow the mains wire to reach a SELV circuit? When connectors are used, are they single or double crimp connectors? Single crimp connectors secure only to the stripped end of the wire and will fail in a single fault. Whereas, double crimp connectors have two separate crimp areas - one crimp on the stripped end of the wire and a second crimp on the insulated wire. So if either crimp breaks, the wire has not broken free allowing it to move around freely. Another solution is to put a wire tie around multiple wires close to the wire termination, so if any one wire breaks free, there is only a very short length of wire that is loose.

Conclusions: It is common for internal wiring to need additional slack to allow for the manufacturing process. However, if the slack wiring can bridge mains or hazardous voltage circuits to SELV circuits, the wire needs to be double or reinforced insulated. Wire routing and wire ties can also be used to keep longer wires separated from other circuits. Wire connections must also be considered for double protection – if a broken wire can bridge double or reinforced insulation, a secondary means of securement should be provided at or near the termination points = which means using double crimp connectors or adding a wire tie around the wire bundle at the connection point.