Cables Type IV – Broken Insulation of Power Wires

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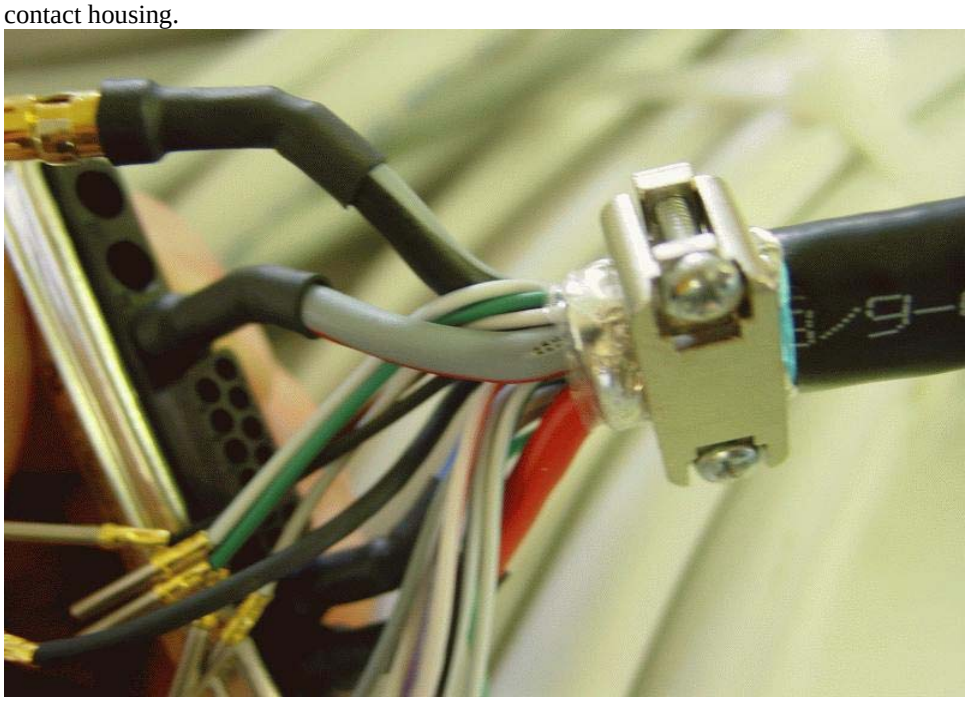
Summary of problem:

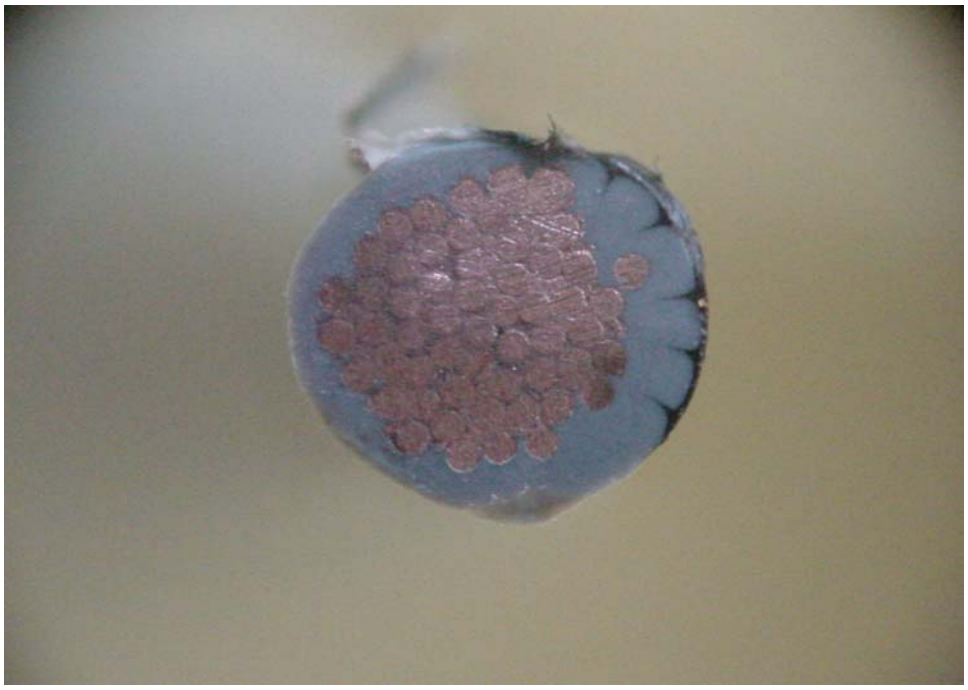
Insulation of power wires is broken during assembly of connector to Type VI cable, when power wires (after crimping of contacts) have to be bent and slightly twisted to fit to the corresponding openings of contact housing.



This problem was announced, by Kosyka comp., even in the early beginning of connectors assembly, when it happened only in a few of percents of connectors ("reasonable" amount for rework). Unfortunately in the last delivery of cables from Novacavi comp., number of wires with broken insulation increased up to approximately 30 percent, what was not accepted by Kosyka comp. and they stopped the production.

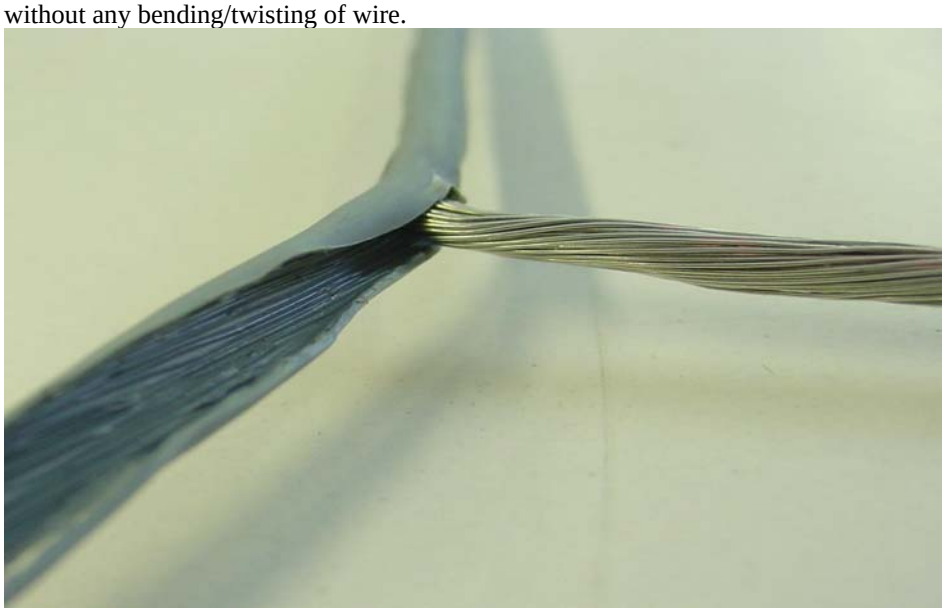
Reason of broken insulation:

1. Bundle of conductors and outer insulation of the wire are not homocentric and insulation is too thin on one side of wire.

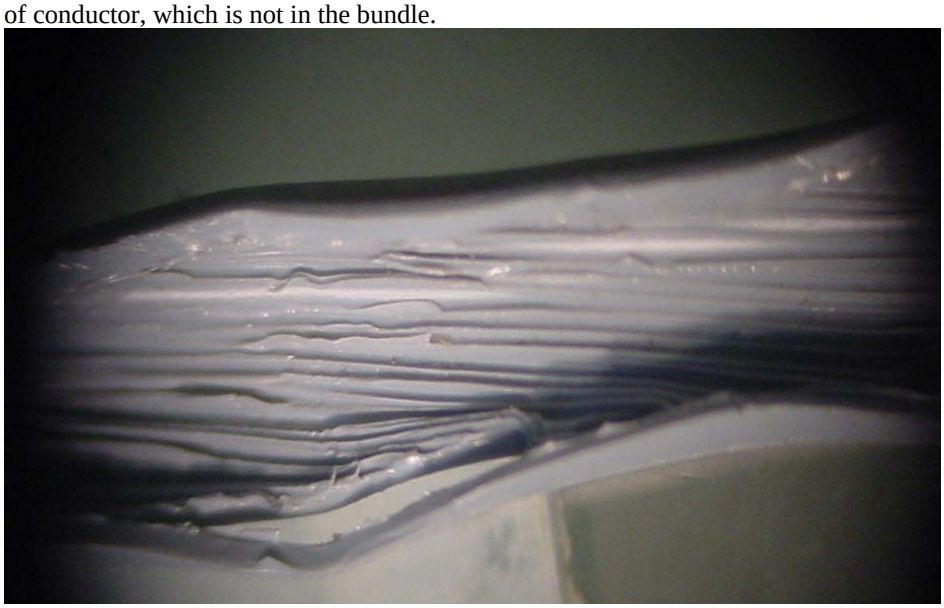


2. One conductor is even outside of the bundle and not regularly twisted together with other conductors (upper right hand side of the previous snap). Insulation is between this conductor and the rest of bundle (problem for wire stripping). Squeeze of this conductor from outer insulation of wire is clear from the next snap.

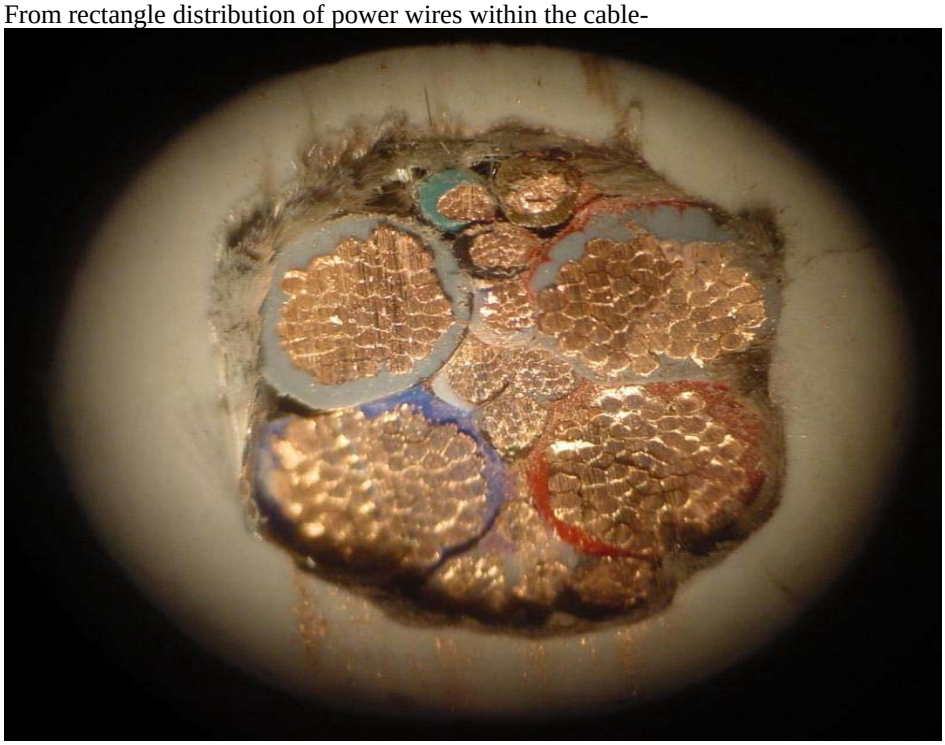
We made the test, when insulation was cut along the wire and the bundle of conductors was removed without any bending/twisting of wire.



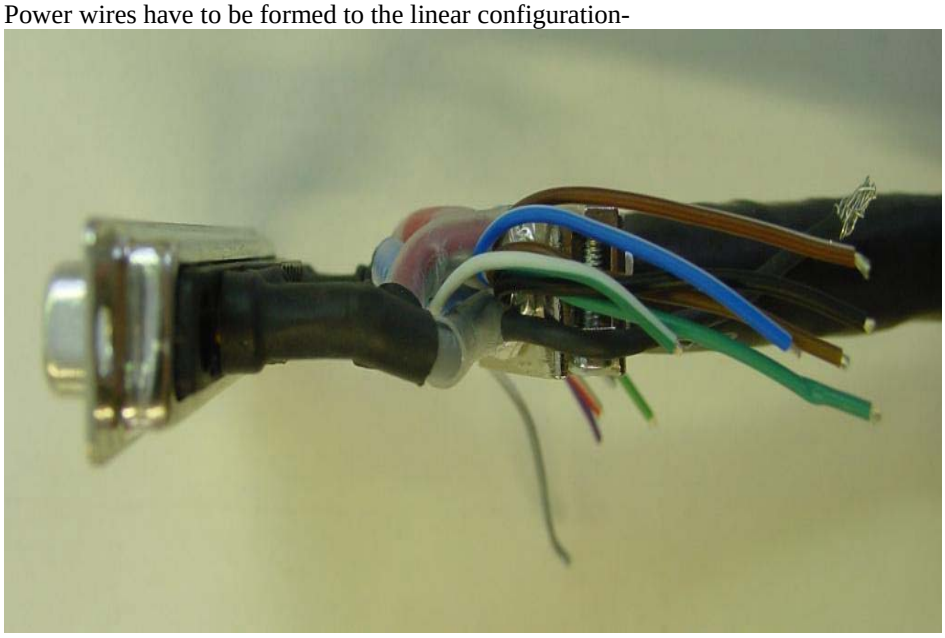
Even after this very standard procedure, there is broken part of insulation corresponding to the position of conductor, which is not in the bundle.



Power wires assembly procedure:
It is not possible to avoid bending and twisting of power wires during their insertion to the corresponding openings in contact housing of connector (proposed solution from Novacavi).
From rectangle distribution of power wires within the cable-

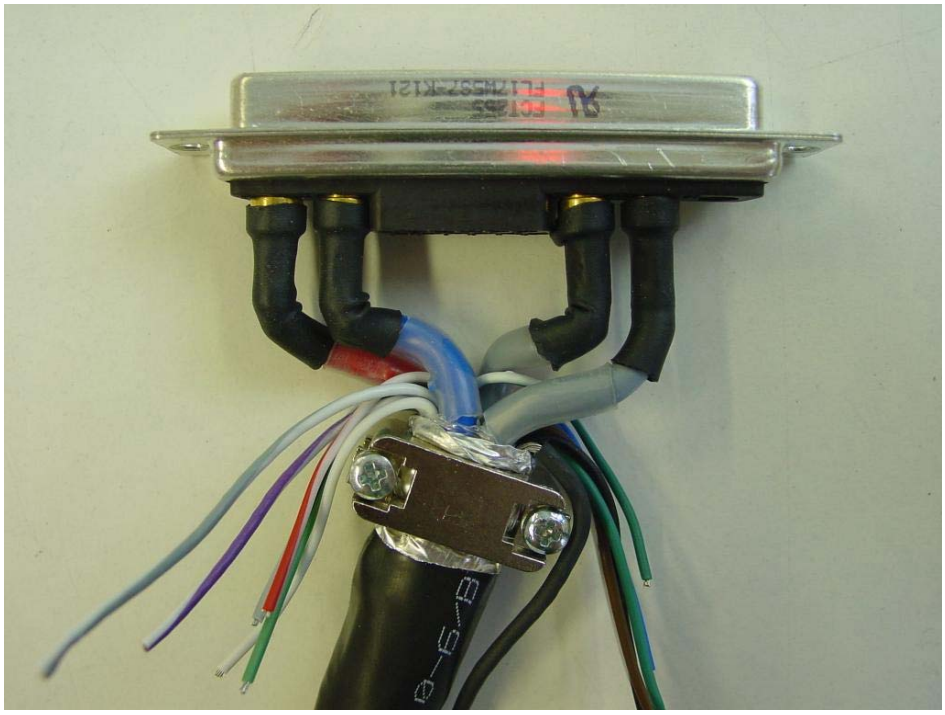


Power wires have to be formed to the linear configuration-

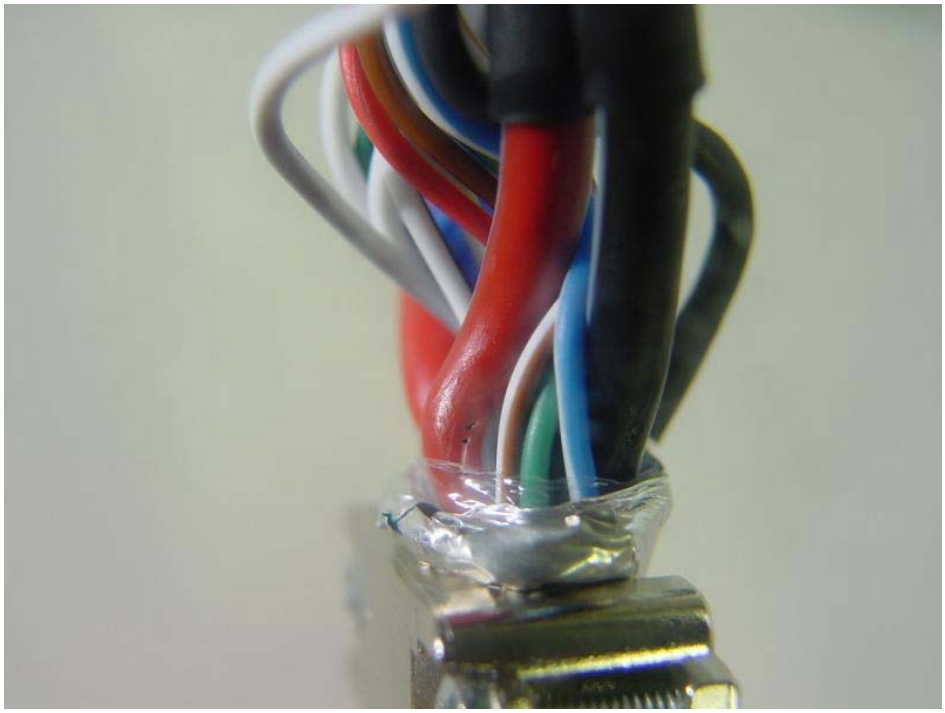


There is nothing what could be changed in this procedure and it was bases for searching for the solution of this situation with current quality of insulation of power wires.
Also I should mention, that I had been twice in Kosyka comp., and I am sure that handling with cables and assembly procedure of connectors are very professional.

Solution proposed by Kosyka comp.:
They proposed to cover power wires by transparent heat shrinkable tubes within the hood of connector, up to folded part of shield. (Transparent tubes are necessary from the assembly point of view, because wires are at first covered and than inserted to the openings of the contact housing.)



Unfortunately from my point of view it is only partly solution of this problem, because the most critical point for broken insulation is the part of the wire, which is very close (and very probably beneath) the fixation clamp of cable, where stress of the insulation is very big because of the biggest bent of wire.



So in fact there is only plastic foil between opening in the insulation and shield foil of cable. This is the most dangerous fact of the problem with broken insulation of power wires, because bundle of

conductors could be in pressed contact with shield, perhaps not just after assembly, but after some time (there is still stress on the wire insulation because of limited space within the hood of connector).

I took advantage of my visit in company and proposed very similar solution, which would be safer, but more complicated for connector assembly procedure. The shield and plastic foil have to be slightly opened after cable stripping and heat shrinkable tubes would be installed on the power wires including part beneath the clamp. In such way wires will be protected very well and there will be proper insulation in case of some openings in wires insulation (not only air gap and plastic foil). Naturally both plastic foil and shield have to be closed again in the way of current procedure of connector assembly. We made together test of this procedure, but unfortunately bundle of wires is then too thick to be fixed in the fixation clamp of connector. Anyway this procedure can not be used for PS side of cables, where outer insulation of cable is fixed under the fixation clamp and there is no room within cable for insertion of protective heat shrinkable insulation tubes.

Conclusion:
Kosyka comp. made connectors assemble for 44 cables from the last delivery from Novacavi comp., which were sent to CERN on 5.12.2005. They explained me that for this batch, they used cables from various bobbins with the same result, approximately 30 percents of connectors had to be reworked (rework means several cuts of finished connector, usually one cut was not sufficient and after assembly of connector, they again found broken insulation). From their point of view this procedure is not possible to make for mass production, so they could not assure quality of the assembled connectors and decided to stop the production and wait for our status. As I understood they had a few contacts with Novacavi without any progress. From their experience in connector assembly such problem with insulation should not happened and they never have had this problem yet.