13-980106-CLN-01

TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: REWORK OF TF BUNDLE OUTER LAYER TURN TO TURN INTERFACE REGION

After thinking further about the condition of the kapton fins between the contact faces of the turns on the outer layer of the inner leg bundle, I am leaning now towards the idea of having Everson use the "excavation" method to restore all of the fins to the original design scheme.

Upon the return of J Chrzanowski and T Meighan from Everson, I would like to convene a meeting to further discuss this matter.

Yesterday at Everson we discussed three possible rework scenarios, which have the advantages and disadvantages as listed below...

1) The excavation technique, with which the insulation/epoxy between turns in the contact region would be milled out to a depth of 1/8 to 1/4", resin would be injected into the milled slot, and a new kapton fin inserted.

Advantage: If done correctly can restore original configuration with good quality continuous kapton barrier; permits insertion of bundle into OH tension tube with fins folded over and taped down.

Disadvantage: Need custom tooling and very good hygiene to avoid contamination of turn to turn space with copper dust.

2) The fin rebuild technique, with which a random fiber glass mat with epoxy would be clamped to the remaining projection of the kapton fin using clamps attached to the keenserted bolt holes at the neighboring turns.

Advantage: Does not require milling out of turn to turn space.

Disadvantage: Laborious process to clean up contact surfaces while trying to preserve kapton fins; questionable quality of result; lack of continuous kapton barrier; precludes insertion of bundle into OH tension tube, so must be done at PPPL after assembly.

3) The silicone gasket technique, with which a bevel will be machined on to the edges of the lead flags to accommodate the gasket which would be compressed to form a turn to turn seal after attachment of the flag.

Advantage: Does not require milling out of turn to turn space. Permits insertion of bundle into OH tension tube.

Disadvantage: Loss of contact area; lack of continuous kapton barrier; re-design.

I feel now that the excavation technique is the best choice to restore the condition of the coils to what we originally expected, planned on, and contracted Everson to deliver, and that this re-work should be performed by Everson as a condition to our acceptance of their product for shipment.

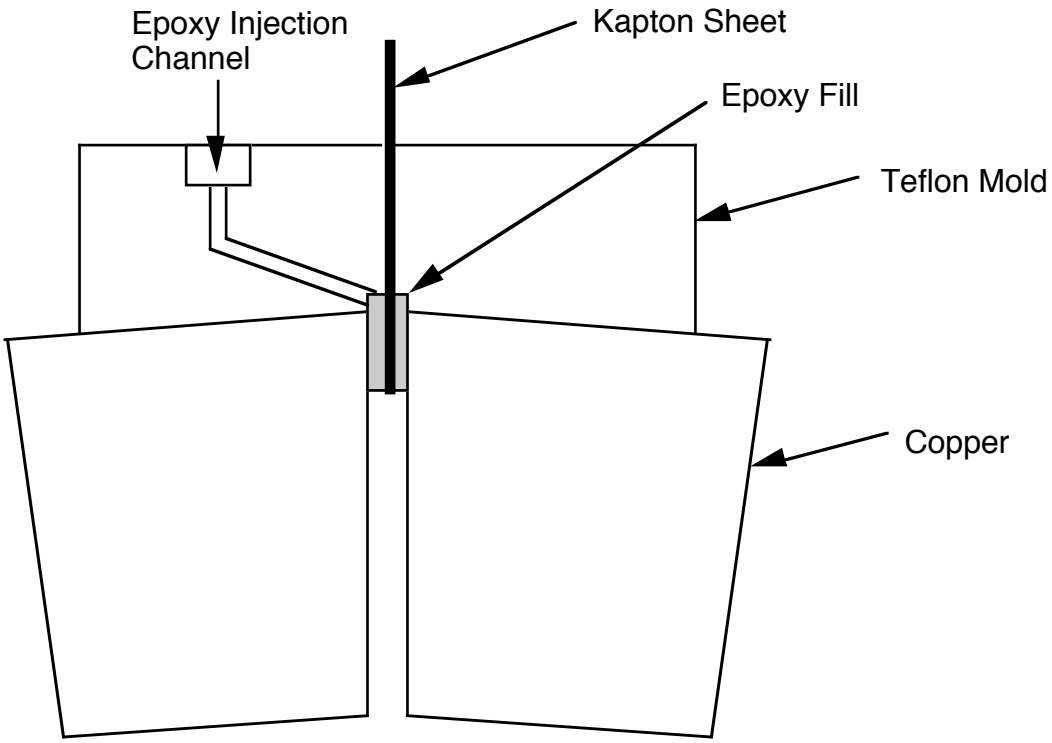
To perform this operation the following approach should be used, ideally on all damaged kapton fins (on both ends of the quadrants):

1) Prior to assembling the quadrants, while they are still separate, all contact surfaces are cleaned up (epoxy removed and surface finish restored), defective kapton fins cut back to level of contact faces, and keenserts cleaned out.

2) A machining fixture is devised which mounts on to the contact surfaces/keenserted bolt holes neighboring the defective kapton fin. The fixture guides a "Dremel" type cutter (either a horizontal axis saw blade or vertical axis cutter) precisely along the turn to turn space over the length of the contact face region, such that a slot of 1/8 to 1/4" in depth was milled out in the gap (turn to turn gap 0.064", approx 1/16") between the turns. The fixture would include an attachment to vacuum away the dust from the cutting process.

3) Teflon blocks are devised which mount on to the contact surfaces/keenserted bolt holes neighboring the defective kapton fin which has been milled out. These blocks are designed such a new kapton fin can be inserted/sealed between them, and such that a channel is provided for injection of epoxy into the milled region.

4) Epoxy resin is injected, and then the teflon blocks are removed.

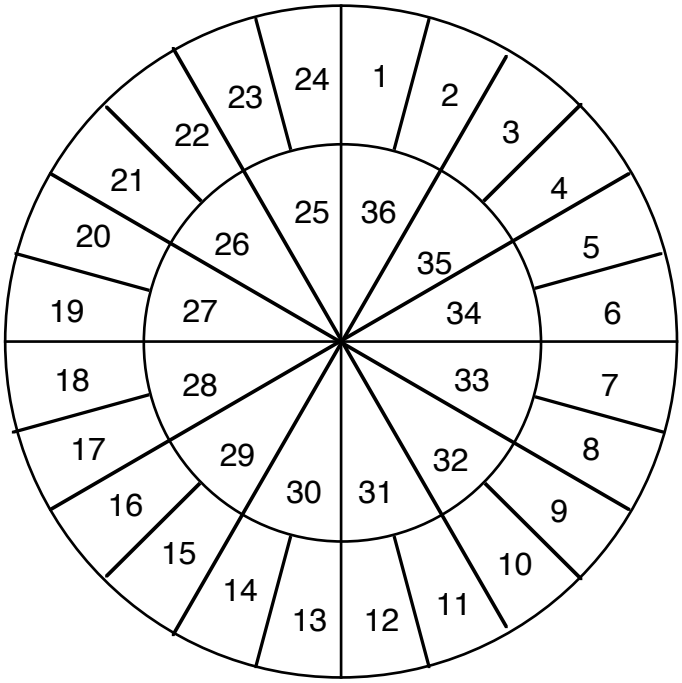


5) During the process of assembling the four quadrants into the press mold, on the end of the bundle which will be inserted into the OH tension tube and which will be under the press mold, Kapton fins are carefully folded back (if necessary spacers included to avoid creasing the kapton) and taped over (all four quadrants) such that the OD of the contact face area is less than the ID of the press mold, and such that the contact area is protected from the ingress of epoxy during the pressing of the 4 quadrants and subsequent processing. Modification of the press mold may be required to allow for the build at the contact face area.

6) During the above and all subsequent processing and shipment, the kapton fins need to be suitably protected from damage. They are extremely delicate.

As a matter of additional information, the following shows the winding pattern of the inner leg bundle. As can be seen the voltage between adjacent turns on the outer layer is simply the voltage per turn (1012.85/36 = 28 volts) except for the location where turns 1 and 24 face each other (24* 28= 672 volts). Clearly it is important to position the more robust quadrant to quadrant gap at this location in the winding pattern.

One could argue that at 28/64 ≈ 0.5 volt/mil in the turn to turn gap there is simply no concern and no need for the kapton fins. However, I feel that in order to maintain the integrity of this gap in service with dirt/contamination/motion of parts, the fin remains an important element that we should not sacrifice.



cc:

J Chrzanowski
P Heitzenroeder
F Malinowski
T Meighan
M Ono

NSTX File