13-001213-CLN-01

TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: TENSILE STRESS ON TF INNER LEG BUNDLE TURN INSULATION

References

[1] 13-001208-HMF-01, "Stress Analysis of Loss of Coolant on Cool Down of TF Coil Inner Leg"

In ref. [1] it was projected that a tensile stress of order 1.9 ksi could appear in small regions near the ends of the TF inner leg bundle. I asked P. Heitzenroeder to evaluate this and he concluded that it is not a problem, as noted in the e-mail correspondance attached. However, I should like to emphasize the final sentence in his note, that we do not push further beyond the 30 ^{o}C adiabatic rise under the present circumstances.

E. Baker	M. Bell	W. Blanchard	A. Brooks
J. Chrzanowski	L. Dudek	H. Fan	R. Hatcher
R. Hawryluk	P. Heitzenroeder	M. Kalish	R. Maingi
R. Marsala	M. Ono	G. Pearson	S. Ramakrishnan
E. Synakowski	A. Von Halle	M. Williams	NSTX File

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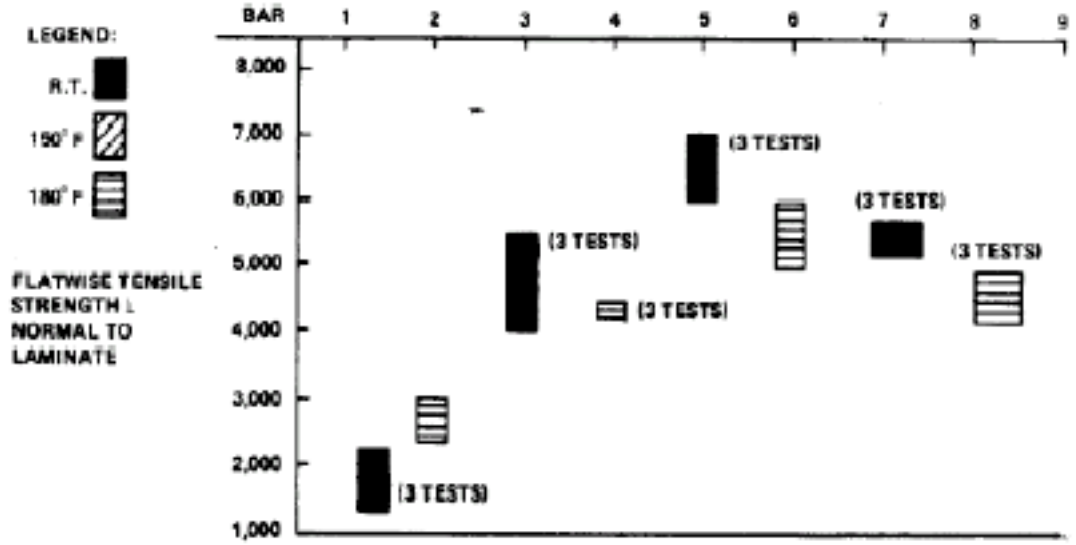
From: "Phil Heitzenroeder" <pheitzen@pppl.gov>
To: "Chas Neumeyer" <cneumeyer@pppl.gov>
Subject: NSTX Operation with an adiabatic temp. rise of 30 C
Date: Tue, 12 Dec 2000 17:06:17 -0500
X-Priority: 3 (Normal)
Importance: Normal



DEVELOPMENTAL BUNDLE NO.	BAR	LOADING	INSULATION	INSTALLATION PROCESS	SURFACE PREP	PRIMER	CURE PRESSURE	FAILURE MODE
1	1-2	TENSILE	DOW 332LC EPOXY 520 WOVEN DRY GLASS	1/2 LAPPED · 0.012/PER PLY 2 PLY/BAR	DRY HONE 18 PSI	EA9232	VACUUM IMPREG	COMBINED ADHESION/ INTERLAMINAR
2	3-4	TENSILE	HEXCEL	1/3 LAPPED 0.012/PER PLY	DRY HONE 18 PSI	EA9232	24 PSI	ADHESION/ INTERLAMINAR
3	5-6	TENSILE	DOW 332LC EPOXY 520 WOVEN GLASS	1/2 LAPPED 0.012/PER PLY 2 PLY/BAR	DRY HONE 18 PSI	DZ90	VACUUM IMPREG	INTERLAMINAR
4	7-8	TENSILE	HEXCEL 150	1/2 LAPPED 0.007/PLY 2 PLY/BAR	DRY HONE	DZ90	24 PSI	INTERLAMINAR

Fig. 2-10 Flatwise Tensile Test Results of Turn-To-Turn Insulation

As we discussed. the 30 C adiabatic temp. rise should result in a max. dT of .7 x this, or 21 C, which is the dT Art and HM used in their calculations. The figure above is from the TFTR RDAC and shows the flatwise tensile strength in several glass/epoxies. I would expect the DOW DER-332 to be very similar (if not weaker) than the CTD-112 used in NSTX. This data is, fortunately, also based on the use of DZ-80 primer as in NSTX.. (The top axis shows the bar numbers; 5&6 are for the DER-332). This shows the flatwise tensile strength to be in the range of 4.5-7 ksi. HM's analysis (13-001208-HMF-01) indicates a maximum tensile stress of 1.9 ksi. and a maximum combined shear of 2.07 ksi. If we assume that the tensile load reduces the shear allowable by (tensile stress x 0.3) or 570 psi, the allowable would be 2.9-.57, or 2.33 ksi. Based on this, I conclude it is safe to proceed with the 30 C adiabatic temp. rise. As we are getting close to the shear allowable, I recommend that be considered the limit.