SUMMARY OF MECHANICAL PROPERTIES OF COMPOSITES

W. Craddock

It is important to understand the mechanical properties of the composite which is to be chosen for the 30" Bubble Chamber Magnet supports. There are presently only five candidates worth considering. Some potentially useful rods such as Glastic are not considered because they cannot be brought in large enough sizes. The properties of these materials is summarized below:

1) High Lite Rod - Uniaxial fiberglass epoxy 90 ksi material; Stiff, $E = 5 \times 10^6$ psi. Longitudinal cracks appear throughout specimens when cold shocked but do not appear to degrade performance of 4" long samples. Longer samples may be weaker.

2) Randolite Rod - Woven fiberglass epoxy 80% of the fibers are in the axial direction - 75 ksi material; Stiff, $E = 4.5 \times 10^6$ - Excellent resistance to cold shocking. Interior of rod may be different from the outer layers.

3) G-10 Plate - 50 ksi material. Good cold shock resistance. $E = 3 \times 10^6$.

4) G-10 rod - 50 ksi material. Relatively poor cold shock resistance. Concentric circular cracks appear from thermal cycling. Rods probably have major to minor internal flaws. $E = 2.5 \times 10^6$ psi.

5) G-30 plate - Properties similar to G-10 plate but mostly unknown.

Material	σ_{us} (ksi)	Yield or First Crack	Diameter/ Lenth	Machined From	End Constraints	Young's Modulus (psi)
G-10 Plate (warp)	54	52	2"/4"	2" plate	yes	3.08×10^6
G-10 plate (warp) thermally cycled ten times 77K	54	45	2"/4"	2" plate	yes	3.00×10^6
G-10 Plate (Fill)	47	47	2"/4"	2" plate	yes	2.45×10^6
G-10 rod	51	48	2"/4"	---	yes	2.55×10^6
G-10 rod, thermally cycled ten times to LN_2	48	45	2"/4"	---	yes	2.55×10^6
G-10 sheets (0.036" thick glued together with Crest 7344, and cured under pressure for 2-1/4 hrs at 210 F) loaded in plane of the cloth.	38	--	cube 0.742" x 0.755"	---	No	---
	39	--	cube 0.755" x 0.745"	---	No	---
Same as above but thermally cycled 3 times to 77K	40	--	cube 0.756" x 0.720"	---	No	---
Randolite Rod	57	--	1/2" x 2-1/2"	---	Yes	---
Randolite Rod	58	--	1/2" x 2-1/2"	---	Yes	---
Randolite Rod	64	62	2"/4"	---	No	---
Randolite Rod	76	73	2"/4"	---	Yes	4.48×10^6
Randolite Rod thermally cycled ten times to 77K	79.6	--	2"/4"	---	Yes	4.52×10^6
Glastic HIR pultruded rod	94.4	--	1/2" / 2-1/2"	---	Yes	---
Polygon pultruded rod	76	--	1/2 / 2-1/2"	---	Yes	---

Material	σ_{us} (ksi)	Yield or First Crack	Diameter/ Lenth	Machined From	End Constraints	Young's Modulus (psi)
High Lite Compression Molded Rod	102	92.8	5/8"/2-1/2"	---	Yes	---
High Lite Compression Molded Rod	117	107	7/8"/2-1/2"	---	Yes	---
High Lite Compression Molded Rod	80.6	61	2"/4"	2-1/2" rod	No	---
High Lite Compression Molded Rod	83	--	1.75/5-1/8"	---	No	4.67×10^6
High Lite Compression Molded Rod	79	73	1.5/3.375	1-3/4" rod	No	4.78×10^6
High Lite Compression Molded Rod	92.4	91	2"/4"	2-1/2" rod	Yes	4.87×10^6
High Lite Compression Molded Rod, Thermal shocked in LN_2 ten times	> 94	86	2"/4"	2-1/2" rod	Yes	5.16×10^6
High Lite Compression Molded Rod, 13" high column, one 4" and one 8" section	75.2	79 (brass) yielded)	2"/4",8"	2-1/2" rod	Yes, Brass CDA360	6.03 x 106