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QUICK LOOK AT THE WARM BORE TUBE

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INTRODUCTION

The warm Bore Tube in the Design "D" 1.290" cold bore has 0.062" radial clearance. The proposed thermal design incorporates a sandwich of;

one layer nexus paper
ten layers aluminized mylar
one layer nexus paper
ten layers aluminized mylar
one layer nexus paper

The outer layer of nexus paper is then wrapped with one inch teflon tape with 50% overlap. The tape is then heat sealed to the paper and itself.

It should be noted that this "insulation" deviates from the MLI standard practice of alternating layers of aluminized mylar and insulating spacer. Over the last month there have been a number of horror stories about this design at National Meetings:

1. 20 watt heat leak (equivalent of 10 Design "D" dipoles).

2. The tube must be kept and installed under vacuum to protect the "superinsulation".

Either item by itself may be reasonable but taken together they are totally inconsistent with the measured properties of superinsulation. We have investigated several possible designs for the warm bore tube support and insulation. The designs address the two major sources of heat load to the cold bore; radiation and conduction. Also, the durability of the sliding surfaces are considered as well as vacuum pumping impedance.

RADIATION

We have looked at several alternatives the results of which are shown in Table I.

Warm Bore Radiative Heat Load

Surfaces	Heat Load (Watts)
Polished Copper	20.9
Taped Surface	7.2
Five layers of MLI *	3.6
Ten layers of MLI *	7.2

* Multilayer insulation consisting of alternating layers of aluminized mylar and an insulating paper.

Table I

Note that the heat load increases going from 5 to 10 layers of MLI. This is due to overcompressing the layers as shown in Fig. 7-18 of Barron's Cryogenic Systems.

We recommend the taped warm bore for its low radiative heat load and high vacuum pumping properties.

CONDUCTION

Conduction losses are in the form of warm to cold bore tube standoffs. There is a 62 mil radial gap in which to work with. The longitudinal spacing depends in the stiffness of the standoffs as well as the 15 mil thick warm bore tube. Two possible designs are shown in Figures 1 and 2. Table two summarizes the relative merits of each design.

Warm Bore Standoffs

	Individual Unit		Spacing			
Design	Conduction	Max. Load	#	Distance	Total Conduction	Comment
	mw	lbm		m	watts	
Fig. 1	61	4.8 (7.2)	2	1	2.0	Note 1
Fig. 2	250	*	1	1.5	5.4	Note 2

* Stiffer than spacing required to keep bore tube from sagging

Note 1 This suspension will bottom out as the coil passes over it, locally increasing the heat load by < 0.7 watts.

Note 2 There is an additional 0.5 watt radiative load for these suspensions.

TABLE II

CONCLUSIONS

This investigation shows that a warm bore tube design can be made with less than 20 watts heat load to the cold bore and also have a low vacuum pumping impedance. The insulation design is rugged and the suspensions are easily replaced in the event of wear or breakage.

JP

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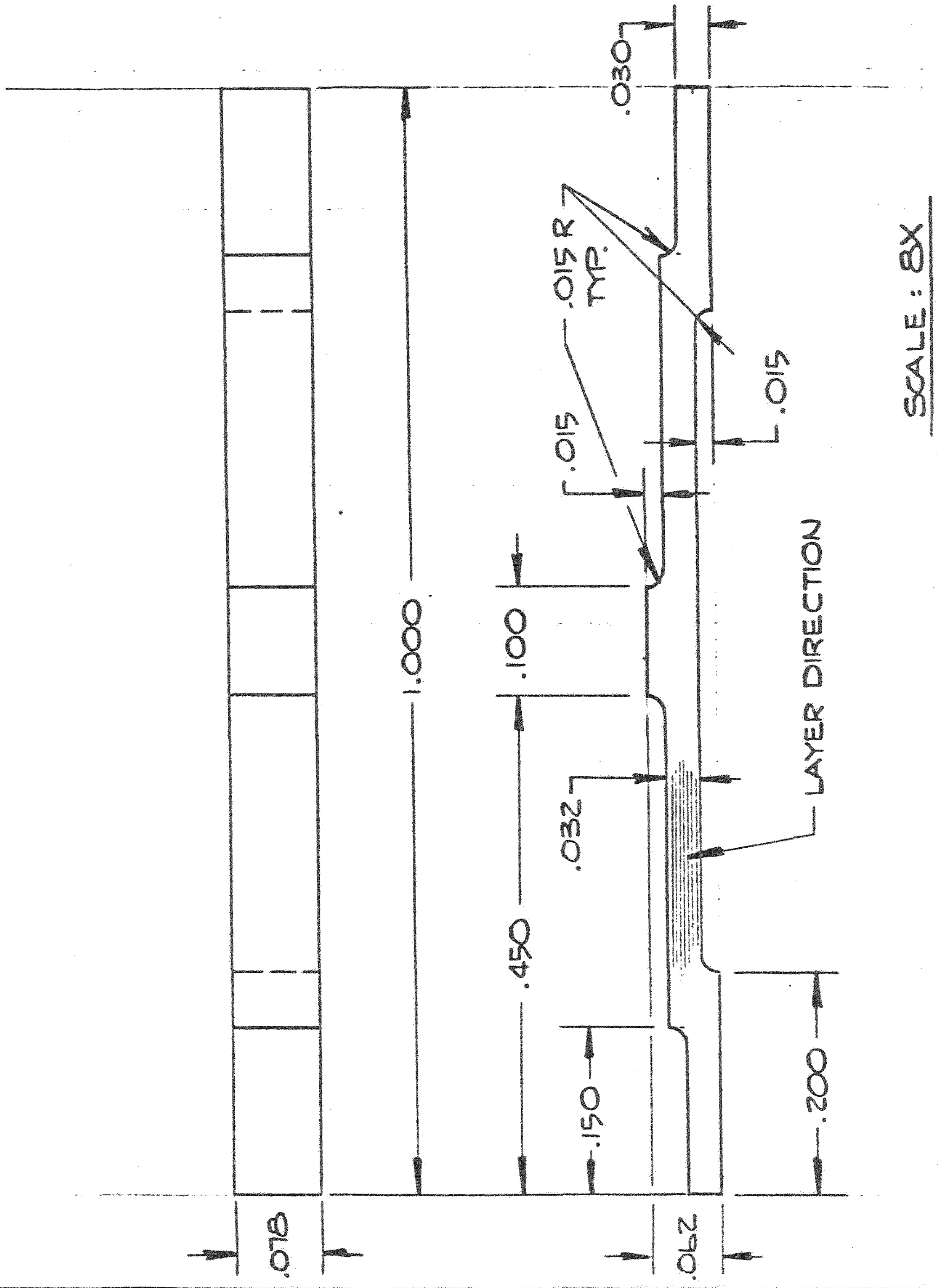

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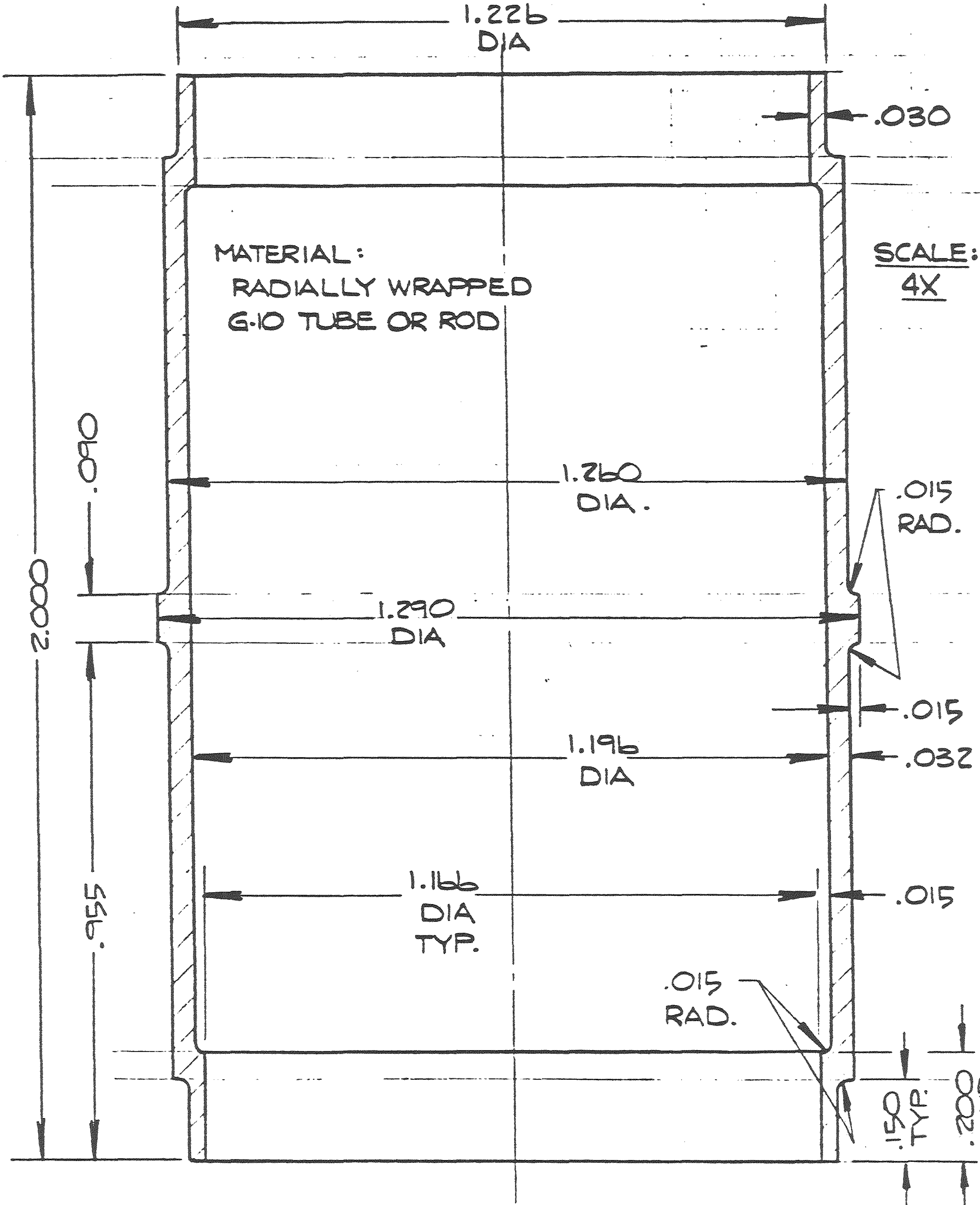

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