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HELIUM TRANSFER LINE TESTS

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PROGRAM - PROJECT - JOB				
ESCAR - MECHANICAL FACILITIES - REFRIGERATION DIST.				
TITLE				
HELIUM TRANSFER LINE TESTS				

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SUMMARY

Test results obtained with two prototype sections of the ESCAR 2 inch helium transfer line are reported. One of these sections was 10 feet long and the other, 20 feet. The results indicate that approximately $\frac{1}{4}$ w/m can be expected to the ESCAR helium transfer line.

TEST ITEMS

The test lines consist of an inner 2 inch OD x .035 wall, stainless steel tube insulated with 40 layers of $\frac{1}{4}$ mil aluminized mylar and an outer vacuum jacket of 3.5 inch OD (3 inch schedule 5) aluminum pipe. The 10 foot section was tested first without supports between the inner and outer lines and then subsequently two types of supports were tested.

The first support tested consisted of an intermediate collar outside of the insulation with ^{three} tapered stainless steel pins which were screwed radially inward from the collar so as to locally compress and bear on the mylar insulation (in some cases the small diameter end of the pin would cut thru the mylar). Six round head nylon machine screws spaced the collar from the vacuum jacket. This support is shown in drawing 1BK4672. The stainless steel pins tested differed from those shown in 1BK4672. Rather than the short taper shown there the 8-32 allen head set screws were tapered over the entire cantilever length.

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of 0.34 inch from 0.125^{diameter} inch at the large end to approx. .025 inch at the small end. The support rings were located at four positions ; 15, 45, 76 & 107 cm from the closed end of the test section.

The second design tested utilized tapered fiberglass (NEMA G10) pins which extend radially from a NEMA G10 collar which is glued to the inner tube. These parts are shown on Fig 1. Circular cut outs were made in the mylar insulation to allow the fiberglass pins to extend thru to the vacuum jacket. Specification MS19 describes the installation of these supports.

The 10 foot test section is shown on fig 2.

The 20 foot test section which was located approx. horizontally was closed on one end and connected thru a right angle bend and short vertical section to the bottom of a 8.25 inch diameter x 4 foot high dewar. A test assembly, with the exception of the inner line supports is shown on 18K5084. Three inner line supports which were the same as the second design tested in conjunction with the 10 foot transfer line were used on the horizontal section at the locations indicated on 18K5084. A similar design which used a larger diameter pin was used at one location on the short vertical section. The larger diameter pin was 5/16 diameter and was tapered over a length

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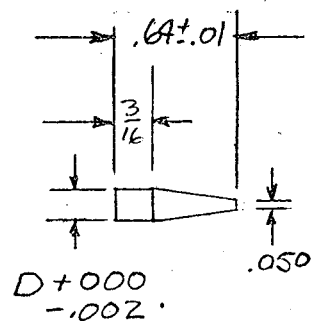
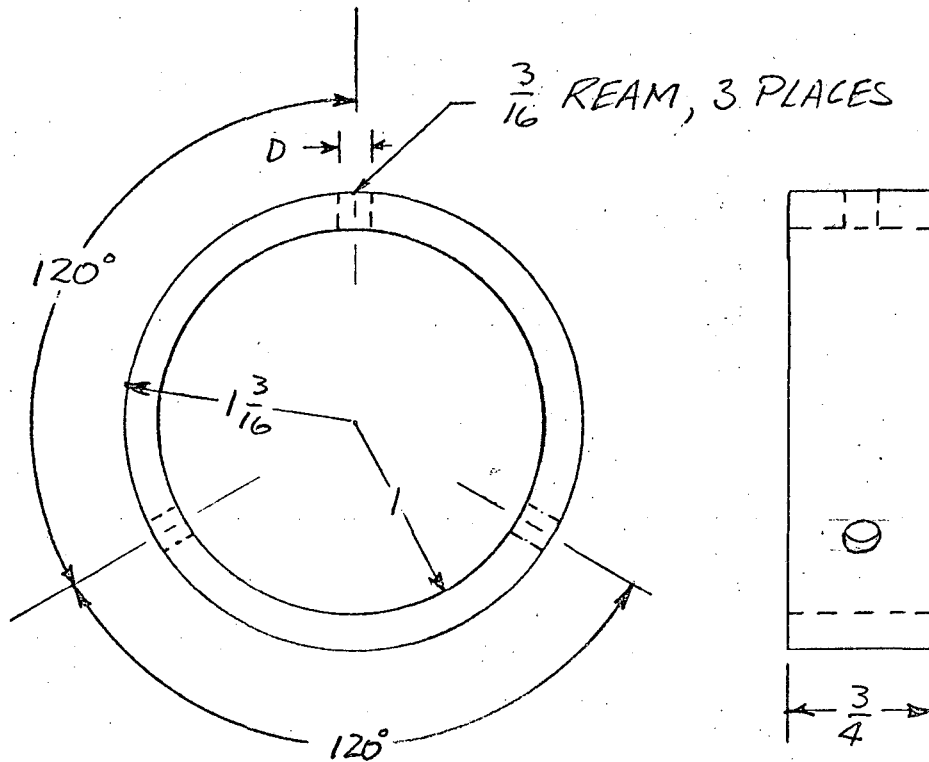
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FIG 1

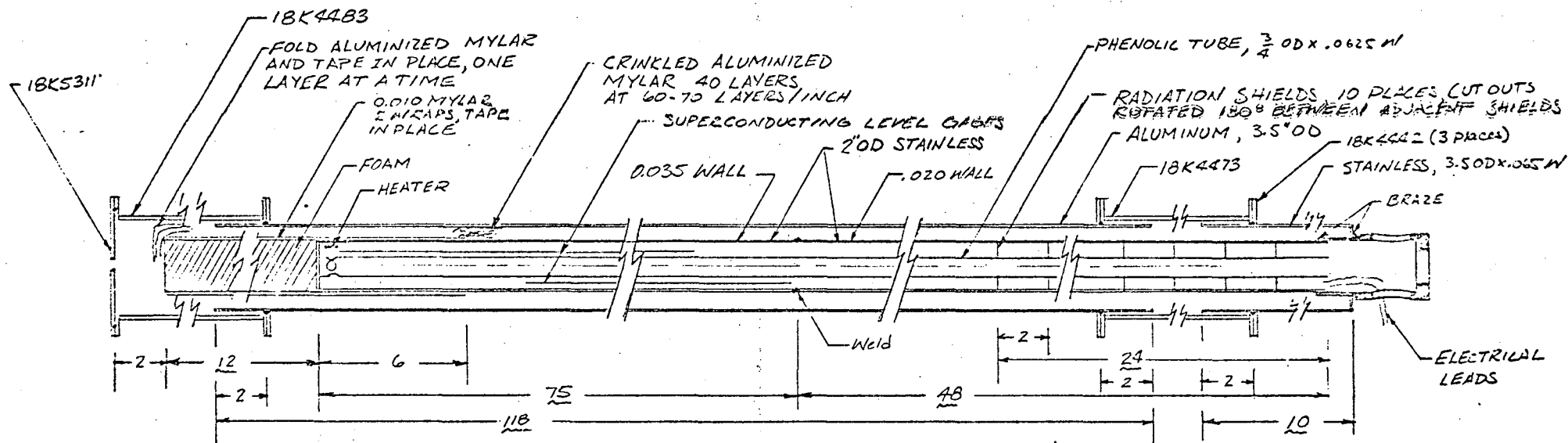
TITLE

HELIUM TRANSFER LINE SUPPORT



Material: NEMA 610

REQ.	ITEM	PART NUMBER	DESCRIPTION
2			



NOTES
 1. ELECTRICAL LEADS TO BE THERMALLY ANCHORED TO LOWER TWO RADIATION SHIELDS

FIG 2

M5086

UNLESS OTHERWISE SPECIFIED		SHOP ORDERS			LAWRENCE BERKELEY LABORATORY UNIVERSITY OF CALIFORNIA - BERKELEY			
1. TOLERANCE .06		ACCT. NO.	DATE RECD.	SER. NO.	ESCAR REFRIGERATION			
2. SURFACE FINISH	✓	DATE ISS'D.	DATE RECD.	NO. REQD.	MAGNET COILS DIST. SYSTEM			
3. SAWED, FLAME CUT, SHEARED OR STOCK FINISH	✗	DELIVER TO			SHORT TRANSFER LINE TEST			
4. THREADS CLASS 2.		SURFACE TREATMENT IDENTIFIC. METHOD			PAT. CLEAR.	DWG. TYPE	SHOWN ON	SCALE: 1/2
5. CHAMFER ENDS OF ALL SCREW THREADS 30°		DWN. BY: R. Wagon			MICROFILMED	DESIGN ACCT. NO.	CATEGORY CODE	SCALE: 1/2
6. 1 1/2 PITCH RELIEF WITH ROUND NOSE TOOL ON ALL MACHINE CUT THREADS.		DATE 5/4/77						SCALE: 1/2
7. BREAK EDGES 1/16 MAX. ON MACHINED WORK.		CHK. BY						SCALE: 1/2
8. REMOVE BURRS, LOOSE SCALE AND WELD SPATTER.								SCALE: 1/2
9. REFERENCE—USASI OR ASA STDS. SECT. Y-14 & B46.1								SCALE: 1/2

REV.	OWN.	CHK.	DATE	CHANGES	REV.
					2

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of 0.33 inch to a hemispherical end with radius of $\frac{1}{16}$ inch. Since the 20 foot test section corresponded closely in length and support spacing to the modules contemplated for the ESCAR transfer line and incorporated an insulated elbow, its heat leak should be representative of the prototype transfer line.

The aluminized mylar insulation was perforated with $\frac{1}{4}$ inch diameter holes on approximately 4 inch centers and applied per specification M 497 to the straight sections of each test section. Following application of the mylar insulation to the straight sections of the 20 foot test section the elbow was wrapped as follows. The insulation on the straight sections at the ends adjacent to the elbow was slit for a length of about 3 inches parallel to the tube axis at two locations 180 degrees apart and folded back. With the insulation folded back the length of the bare section of tube at the elbow was now on the order of 8 inches. This section was then wrapped with aluminized mylar of about this same width and the straight section insulation interleaved by folding in the portions which were previously folded back. The excess material at the inside of the elbow was simply gathered up.

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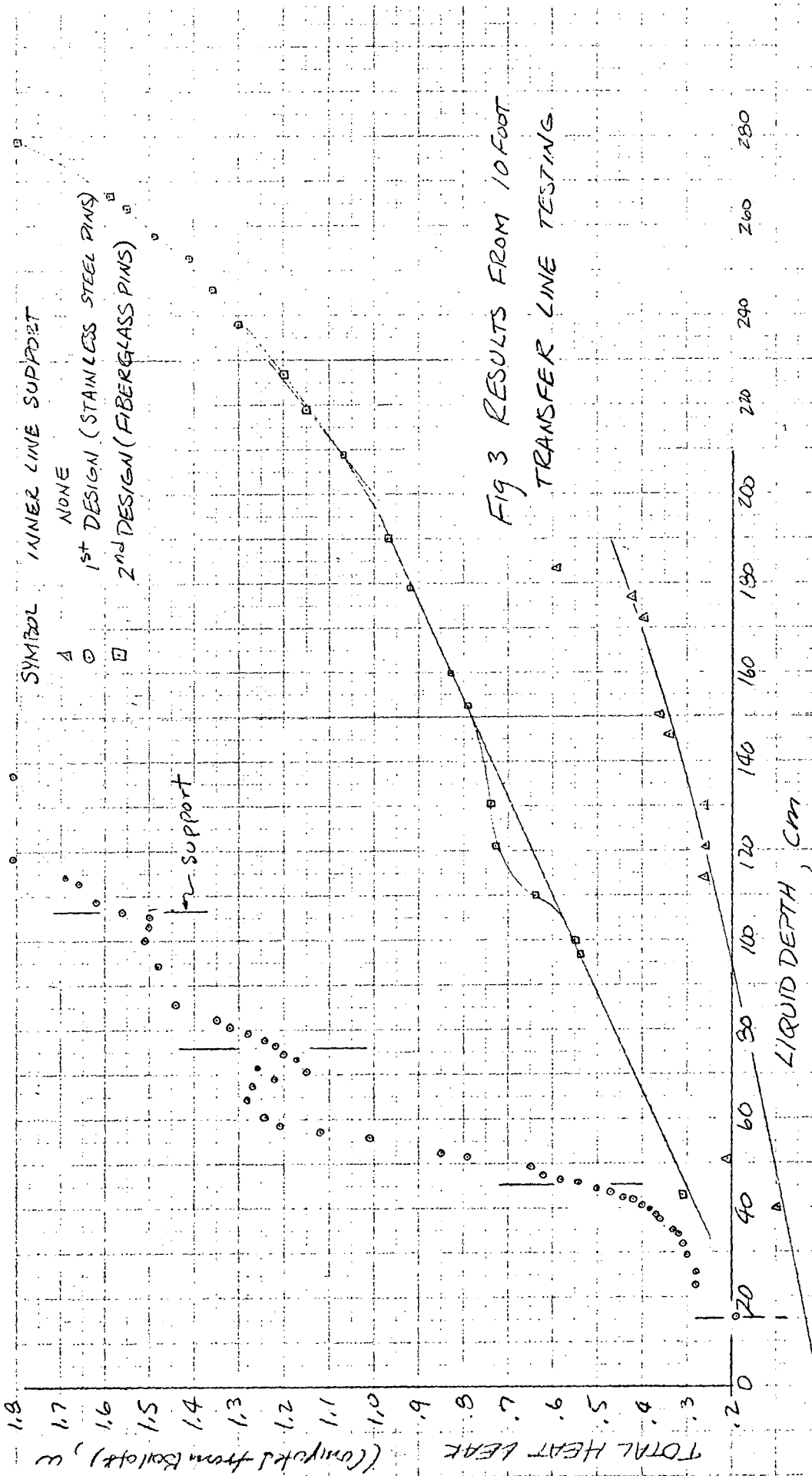
Test Procedure

The 10 foot section was oriented vertically for the initial tests without inner line supports and for those with the first support design. The second support design was tested with the 10 ft. test section inclined approximately 30° from the horizontal. The superconducting liquid level gage functioned only very erratically so that liquid level ultimately had to be inferred from the integrated vent flow following termination of liquid transfer. This is entirely satisfactory for data reduction, however, one does not have any information on liquid levels until the liquid is completely evaporated. Both integrated flow readings (from a wet test meter) and flow rate readings (from a rotometer type meter) were obtained.

The 20 foot section was raised about one foot at the dewar end to enhance filling. Flow instrumentation was as above.

Test Rosetts

Total heat rate to the 10 foot test specimen (computed from the vent rate) is plotted as a function of liquid level on fig 3 for the three test configurations. During the initial testing with no inner line supports attempts were made to "strike" the superconducting level gage by electrical heating



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at the upper end. This intermittent heating greatly effected the total boil off rate which results in some roughness to the data. Attempts to use the level gage were discontinued in subsequent testing. From the results from the unsupported line, the slope of the heat leak vs depth curve is about 0.22 w/m. Considering the heat rate at a liquid depth of 120 cm, approximately 1.8 w were observed with four supports of the first design vs 0.25 w with no supports. The heat leak per support is

$$\frac{1.8 - 0.25}{4} = 0.4 \text{ w}$$

With the second support design at 150 cm liquid depth, 0.78 w are observed vs 0.34 w with no supports. The heat leak per support is then

$$\frac{0.78 - 0.34}{4} = 0.1 \text{ w}$$

The total vent rate from the 20 foot test section with dewar was approximately 600 cm³/s of gas at 18°C which is equivalent to a liquid loss rate of 2.9 l/hr. The dewar has a loss rate of about 1. l/hr. So that the net liquid loss rate attributable to the line is 1.9 l/hr which is equivalent to about 1.6 w or 0.24 w/m.

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