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NATIONAL RADIO ASTRONOMY OBSERVATORY

LOW NOISE DEVICES LAB

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LOW LOSS COAXIAL LINE FOR CRYOGENIC APPLICATIONS

1. Introduction

Low insertion loss, low VSWR, vacuum integrity, and maximum thermal isolation of the refrigerator temperature (≅15°K) from room temperature are a few design requirements for a rigid stainless steel coaxial line. A satisfactory line is a result of precision connectors, conductive plating, soldering techniques, and epoxy.

2. Description

2.1 Connectors

A Weinschel model M1510N connector is used @ one end of the line. A brass sleeve (Fig. 1A) soldered to the outer connector is the support for the connector. The inner conductor of the connector (Fig. 1B) must slip into and out of the connector relatively easy. This allows for the difference of contraction and expansion rates of the stainless steel inner and outer conductors. To insure a vacuum on the inner of the line, a vent hole (Fig. 1C) is drilled into the inner of the connector.

At the other end of the line an amphenol precision 7mm connector is similarly attached using a brass sleeve (Fig. 2A) soldered to the outer conductor. Parts of this connector (Fig. 2B) are used to make the vacuum seal. The gold plated rings are carefully removed from the support bead. A thin layer of epoxy is

is applied to surface "A" and "B" (care should be taken to insure an even smear over the complete surfaces) and quickly re-assembled. Remove any excess epoxy, being careful not to mar the surfaces of the spacer. Before attaching to the inner conductor, epoxy (preferably conductive) is applied to surface "C" where contact is made with the spacer, add spacer to the inner conductor and quickly attach to the stainless steel inner conductor. Remove any excess epoxy. To maintain vacuum integrity, allow epoxy to cure, and do not disturb spacer or inner conductor. Do not attach connector shell (Fig. 2C) until line is ready to use. This shell should not be removed after assembly because of the difficulty in again obtaining vacuum integrity.

2.2 Conductors

The stainless steel outer conductor has an I.D of .276" and an O.D of .313". A gold plating .00012" to .0002" is applied to the I.D surface. The stainless steel inner conductor has an O.D of .119" and ends prepared as shown in figure 3. The O.D surface has a gold plating .00012" to .00018" thick. The inner conductor prepared .020" shorter than the outer conductor to allow for slippage if a difference in temperature develops between the conductors. The inner conductor must be absolutely straight for satisfactory assembly and performance.

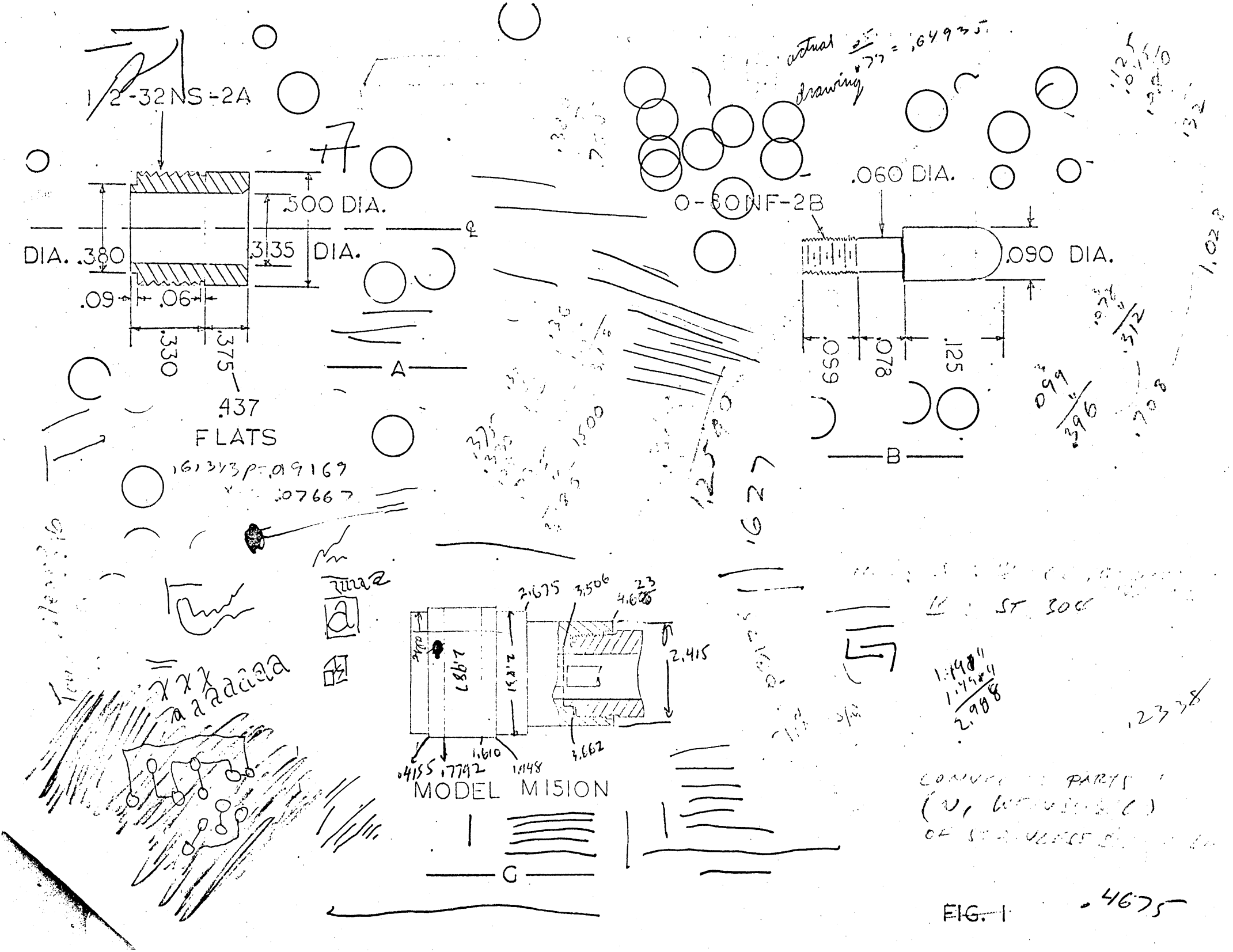
3. Assembly

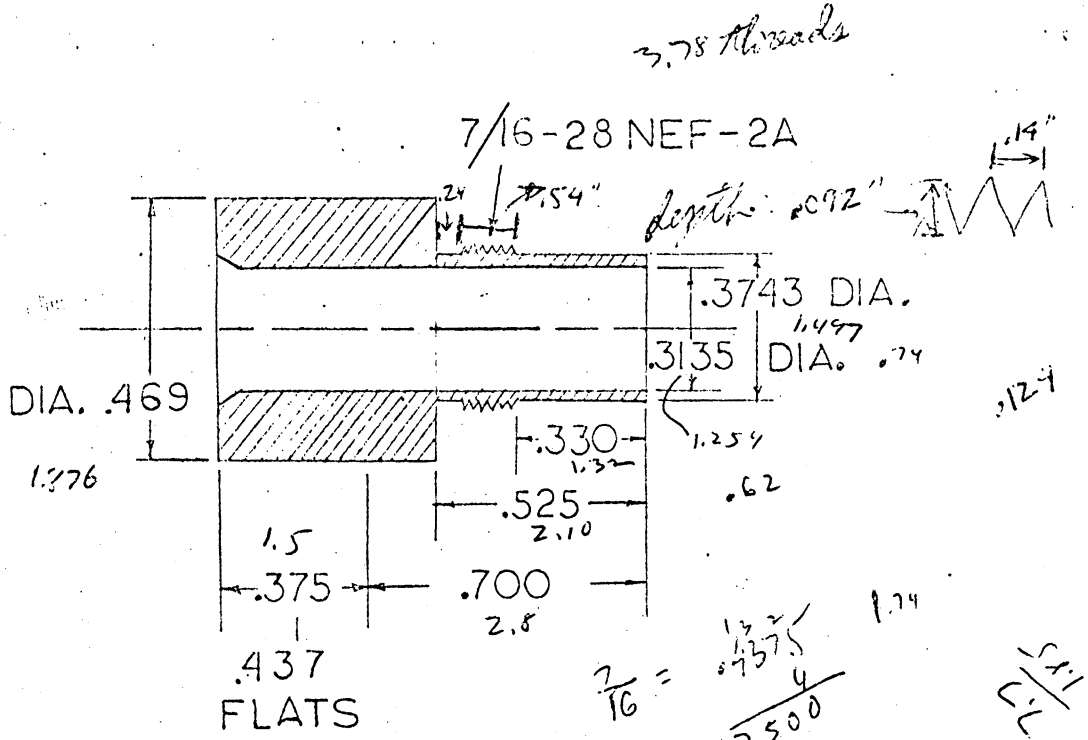
The first step is to epoxy the inner conductor parts as previously explained. In preparing the outer conductor allow $\cong$ .010" (.005" per sleeve) to be faced off after soldering, being

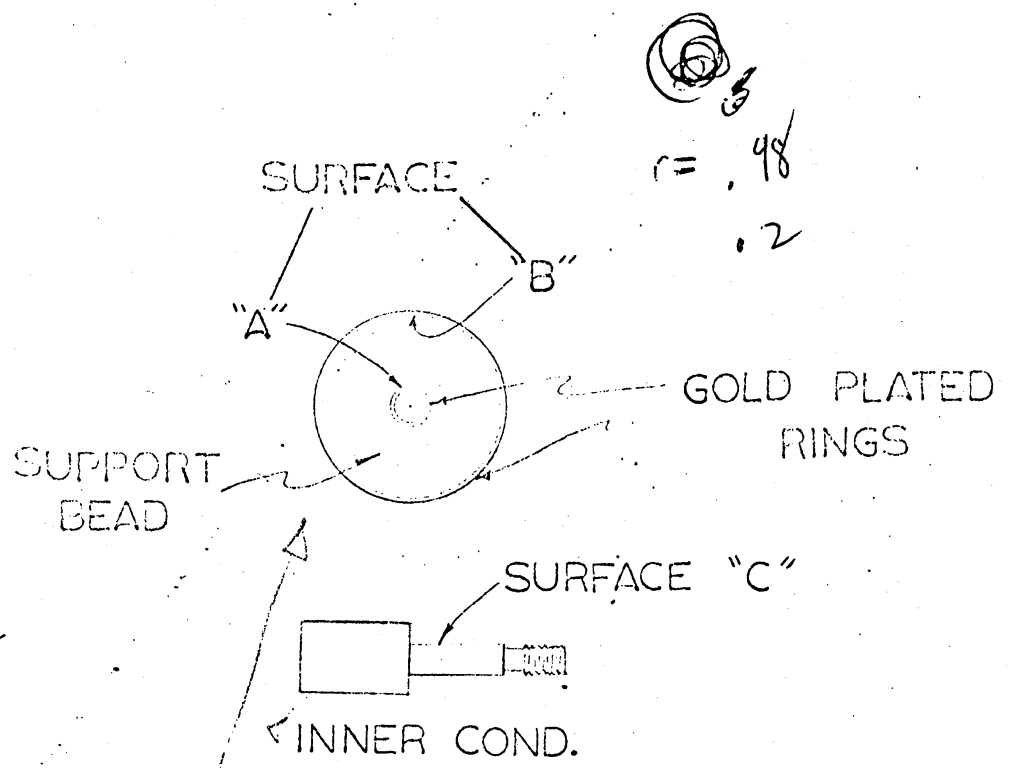
careful not to change the dimensions of the sleeves. A good stainless steel flux (Alpha 90) is used in conjunction with a high temperature solder (above 500°F) to fasten the sleeves to the conductor. To insure vacuum integrity and satisfactory performance the solder must flow completely through the sleeve. Placing the outer conductor end snugly against a heavy cardboard will prevent solder from flowing into the inner of the conductor. Before both sleeves are soldered the stainless steel bushing (Fig. 4) must be placed on the conductor. When installing into a dewar the bushing is first soldered (Fig. 5) to the dewar with a high temperature solder. Afterwards the outer conductor is soldered (below 400°F). By carefully controlling the heat this joint can be successfully soldered without damage to previously prepared joints.

4. Performance

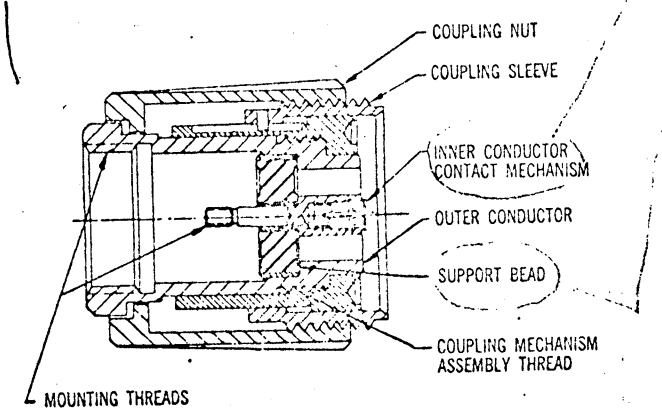
The insertion loss, .13 db $\pm$ .01 per footat room temperature, has an improvement of .03 db $\pm$ .01 when cooled to 15°K due to the gold plating. The VSWR, less than 1.05 at room temperature, is assumed to remain constant when the line is cooled to 15°K. The phase shift was measured to be less than 1 mm when cooled to 15°K. All these measurements refer to the frequency range 1 to GHz.


1/2-32NS-2A
.500 DIA.
DIA. .380
.3135 DIA.
.09
.06
.330
.375
.437
FLATS
A
0-80NF-2B
.060 DIA.
.090 DIA.
.059
.078
.125
B
2.675
3.506
2.415
.4155
.7792
1.610
1.148
3.662
MODEL MISION
G
FIG. 1





SECTION-VIEW OF THE AMPHENOL PRECISION 7mm CONNECTOR



C

MAT : A : BE CO.

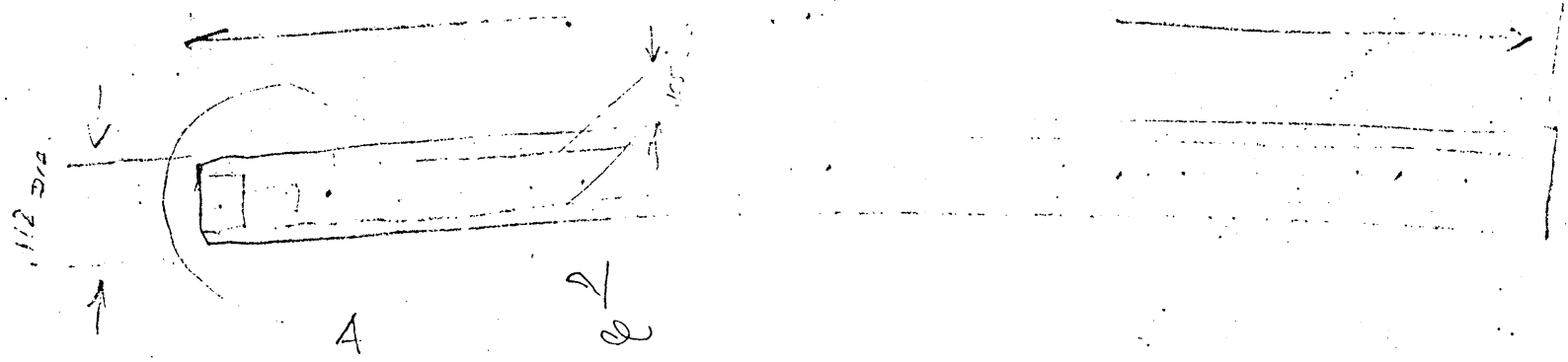
GOLD PLATE : 120 MI.

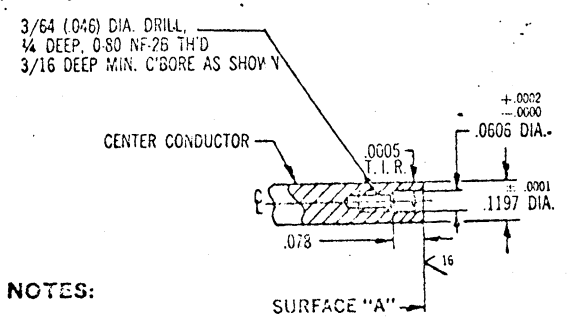
PARTS

(APC 7)

DESIGN : EDI COCHRAN

FIG. 2

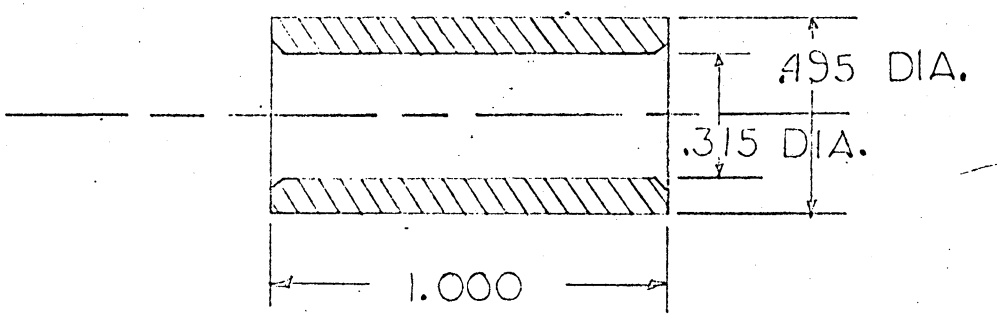




NOTES:

1. Center conductor SURFACE "A" to be flush to .0005 below face of outer conductor SURFACE "B".
2. SURFACE "A" to be perpendicular to .1197 and .0606 dia's within .0005 T. I. R.
3. SURFACE "B" to be perpendicular to .2756 and .3743 dia's within .0005 T. I. R.

FIG. 3



MAT : ST 30 C

SLEEVE FOR
STAINLESS STEEL
LINK

FIG. 4