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**SQUIB DEVELOPMENT PROGRAM**

**REPORT**

to

**U. S. NAVAL WEAPONS LABORATORY  
DAHLGREN, VIRGINIA**

Contract N 178-8081

Third Quarterly Report

**1 January 1963 To 31 March 1963**

THE *Bundy* CORPORATION  
**SCINTILLA DIVISION**  
SIDNEY, NEW YORK, U. S. A.

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**Third Quarterly Report**  
**for**  
**Period Ending March 31, 1963**  
**on**  
**Squib Development Program**  
**for the**  
**U. S. Naval Weapons Laboratory**  
**Dahlgren, Virginia**

**Contract N178-8081**

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**SCINTILLA DIVISION**  
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**U. S. A.**

THIRD QUARTERLY REPORT  
FOR  
PERIOD ENDING MARCH 1, 1963  
CONTRACT N178-8081

1.0 Introduction

- 1.1 This is the third of four quarterly technical progress reports concerning the design and development of an electro-explosive device embodying a spark gap shunted by a semi-conductive material. The intent of this design is to render the device immune to stray radio frequency energy. Various investigations and tests conducted during the report period are included.

2.0 Summary

- 2.1 Improvements have been made in the manufacture of the ceramic squib bodies. Methods of high temperature sealing have been investigated. Squibs in quantity have been built and tested both at Scintilla Division and at Flare-Northern Division of Atlantic Research Corporation. These tests are reported herein. Future work is also outlined.

3.0 Detailed Report

3.1 Production Mold

- 3.1.1 The ceramic bodies first used for this project were manufactured by machining the shapes from un-fired ceramic rods. This is, of course, a relatively slow and expensive method of making ceramic parts. As soon as the initial pieces were proven feasible, a steel mold was designed and built. This mold allows eight ceramic bodies to be injection molded simultaneously. Ceramics produced in this mold thru an exclusive Scintilla process are of high quality and dimensional uniformity. The material used for these ceramics is a 95% alumina body.

### 3.1.2

With ceramic bodies available the following sequence of operations is required to produce squibs ready for loading with an explosive mix.

1. Assembly and fusing of electrodes into body using the Kovar and glass materials described in the second Quarterly Report.
2. Fill cavity of ceramic body with semi-conductor powder.
3. Fuse semi-conductor.
4. Grind assembly to expose electrode gap. (See figure 1)
5. Clean assembly ultrasonically.

Five hundred squibs were built by this process.

### 4.0

#### Sealing

### 4.1

All squibs to date have been made using a simple steel shell. An epoxy cement was used to seal the ceramic body in the shell and prevent loss of pressure. This was adequate for room temperature testing. The next group of squibs to be built will be of the final design in which the shell will conform to standard connector MIL Specification dimensions and will require sealing which will tolerate 600° F.

### 4.2

Since inorganic materials only will withstand this temperature without deteriorating, a glass type seal must be used. Four different glasses have been tried to date without complete success. The problem here lies in effecting a seal without disturbing the electrical characteristics of the semi-conductor. Table I describes these four materials:

Material		Processing		Resistance in Ohms	
		Time	Temp. F	Before	After
#1	Corning Solder Glass #7572	1 Hr.	850°	90K	160K
#2	Corning Solder Glass #7574	1 Hr.	1382°	70K	320K
#3	Lead Borate	5 min.	1000°	80K	100K
#4	75% Lead Borate 20% Cabosil (SiO <sub>2</sub> ) 5% Cr <sub>2</sub> O <sub>3</sub>	5 min.	1200°	70K	65K

Table I

- 4.3 As can be seen #3 and #4 do not seriously affect the semi-conductor resistance. None of these materials produce a satisfactory seal however. Several other glasses are being evaluated.
- 5.0 Firing Tests at Flare-Northern Division Atlantic Research Corp.
- 5.1 As has been indicated in the Second Quarterly Report, and subsequent Monthly Reports, considerable effort has been expended to find an explosive mix which would allow our squib to meet the design parameters of 1 joule all fire input energy, tolerance to 600<sup>o</sup>F, and a function time of 1-2 milliseconds.
- 5.2 The copper oxide-titanium mix as previously reported met the temperature requirements easily, and the function time fairly well. The 1 joule all fire energy requirements could not be met until the diaphragm separating the spark chamber from the powder was reduced to .00025" in thickness.
- 5.3 This very thin diaphragm is, naturally, extremely delicate and easily punctured. In view of this, plus the fact that a low all fire value limits the RF sensitivity of the squib, it was decided to raise the all fire energy to 2 joules. This decision was made by Naval Weapons Laboratory personnel and Scintilla personnel at Dahlgren March 15, 1963.
- 5.4 This change in energy is a compromise between the 4 joules originally proposed by Scintilla and the 1 joule requested by NWL October 15, 1962, shortly after the first Quarterly Report. Measures were immediately taken to raise the all fire point. Returning to previous test results, pre-formed pills of explosive were tested. This not only raised the all fire points but also increased the function time which was undesirable.
- 5.5 The simplest and perhaps the most logical means of controlling the all fire energy is the varying of the diaphragm thickness. To raise this energy, therefore, the thickness was increased progressively from .00025" to .0005" to .001" and to .002". This latter proved to be satisfactory, giving an all fire point of 2.2 joules and a 50% fire point ( $\bar{x}$ ) of .94 joules.
- 5.6 A total of three hundred fifty squibs have been sent to Flare-Northern during this period for loading, testing, and evaluation. These were all spark tested at Scintilla prior to shipment.
- 5.7 Results of tests run during this period are described by Bruceton Curves in figures 2 through 5.

6.0 Radio Frequency Tests

6.1 Fifty squibs have been sent to Franklin Institute Laboratories for Research and Development. These preliminary RF tests will be conducted in five different frequency ranges, both CW and pulsed.

7.0 Future Work

7.1 During the next, or last, report period the following work will be done:

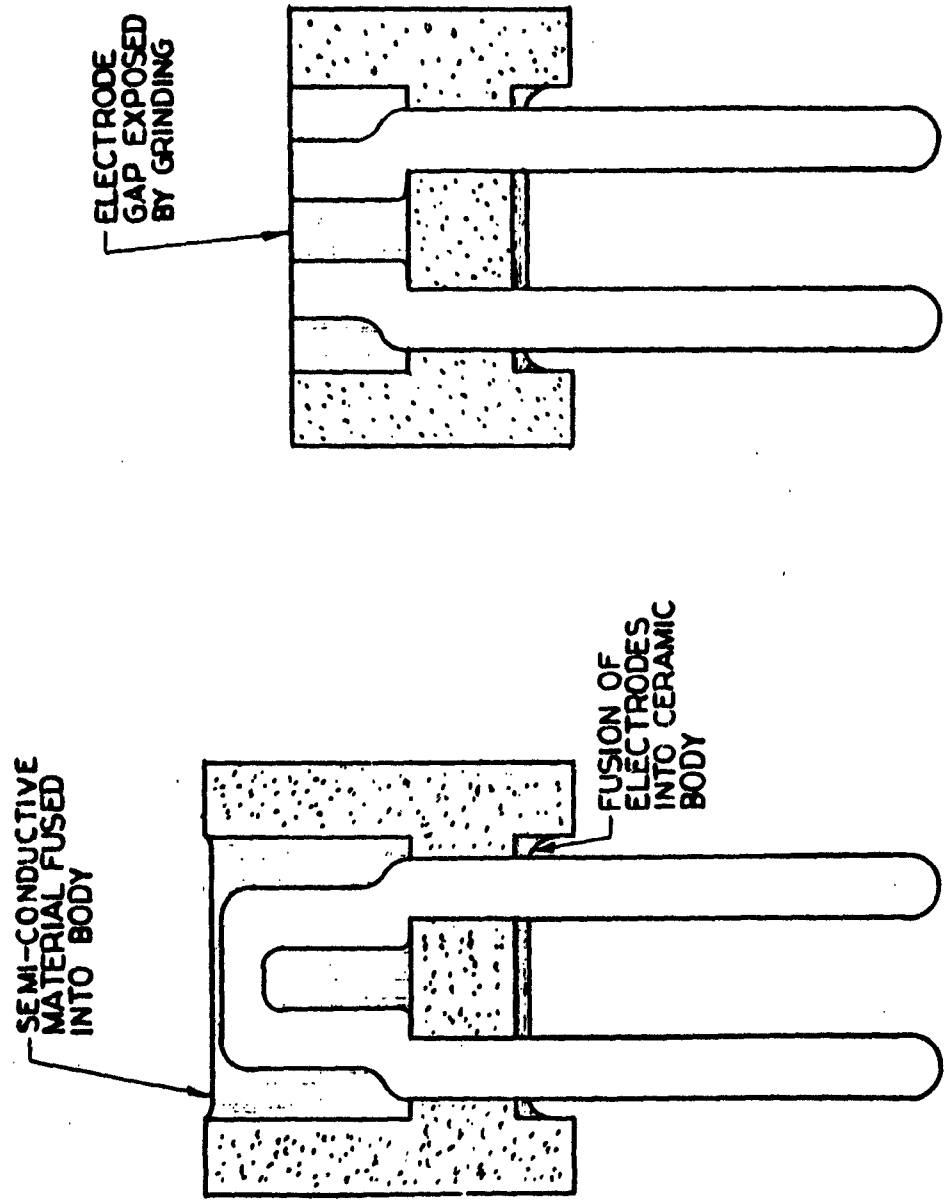
Scintilla Complete evaluation of sealing glasses.  
Manufacture 550 squibs to latest design.  
Ship 525 squibs to Flare-Northern for loading and test.  
Build and ship one test ignition unit.

Flare-Northern

1. Load 525 squibs.
2. Conduct a 25 piece Bruceton test.
3. Ship 50 pieces to Franklin Institute.
4. Qualification test based on MIL-STD-300 specification including such tests as vibration, jolt, jumble, drop, thermal cycling and humidity.
5. Ship 100 pieces to Naval Weapons Laboratory.

Franklin Institute Laboratories for Research and Development

Final radio frequency tests. The exact nature of these tests will be determined later.



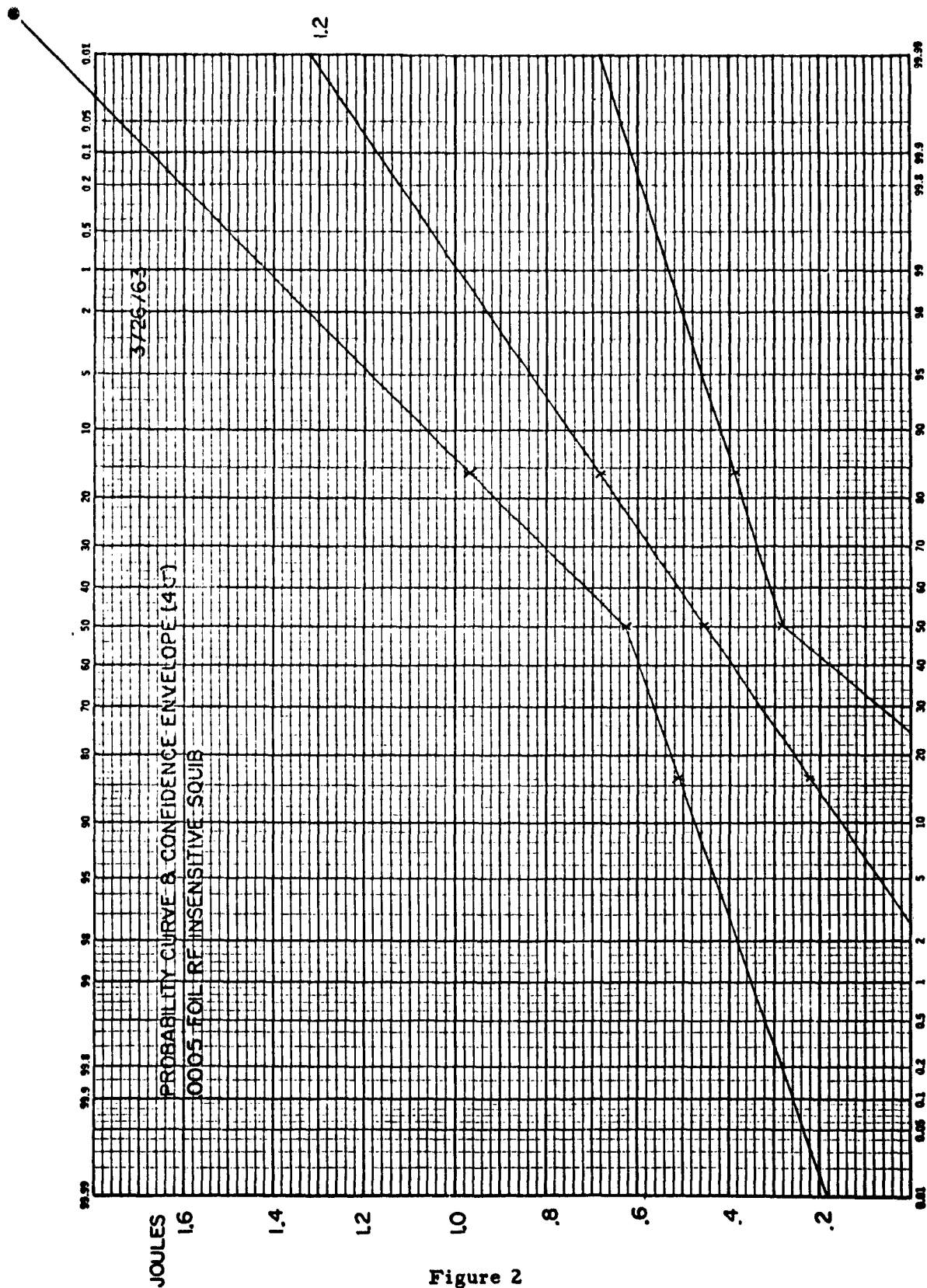


Figure 2



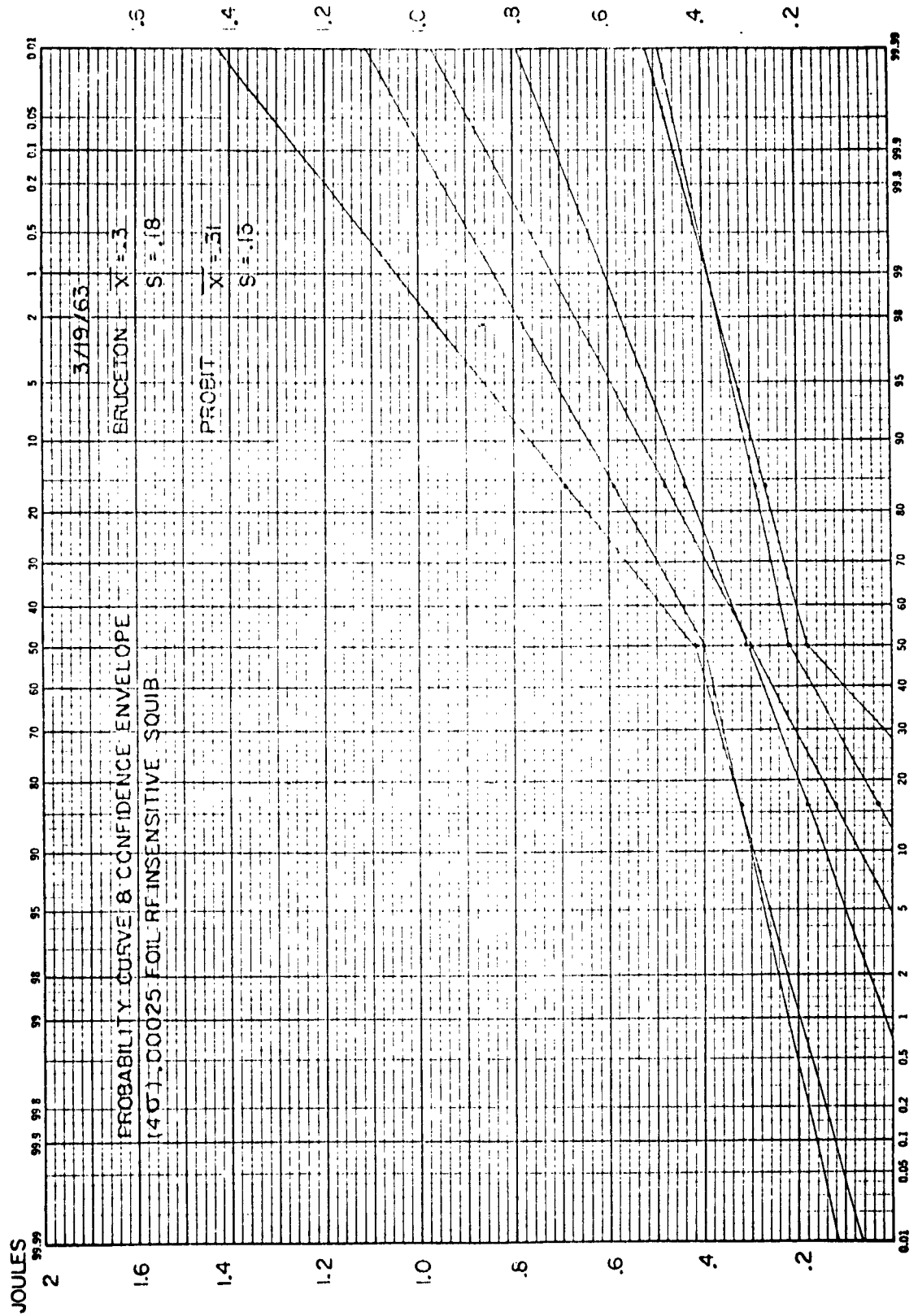


Figure 3  
- 7 -

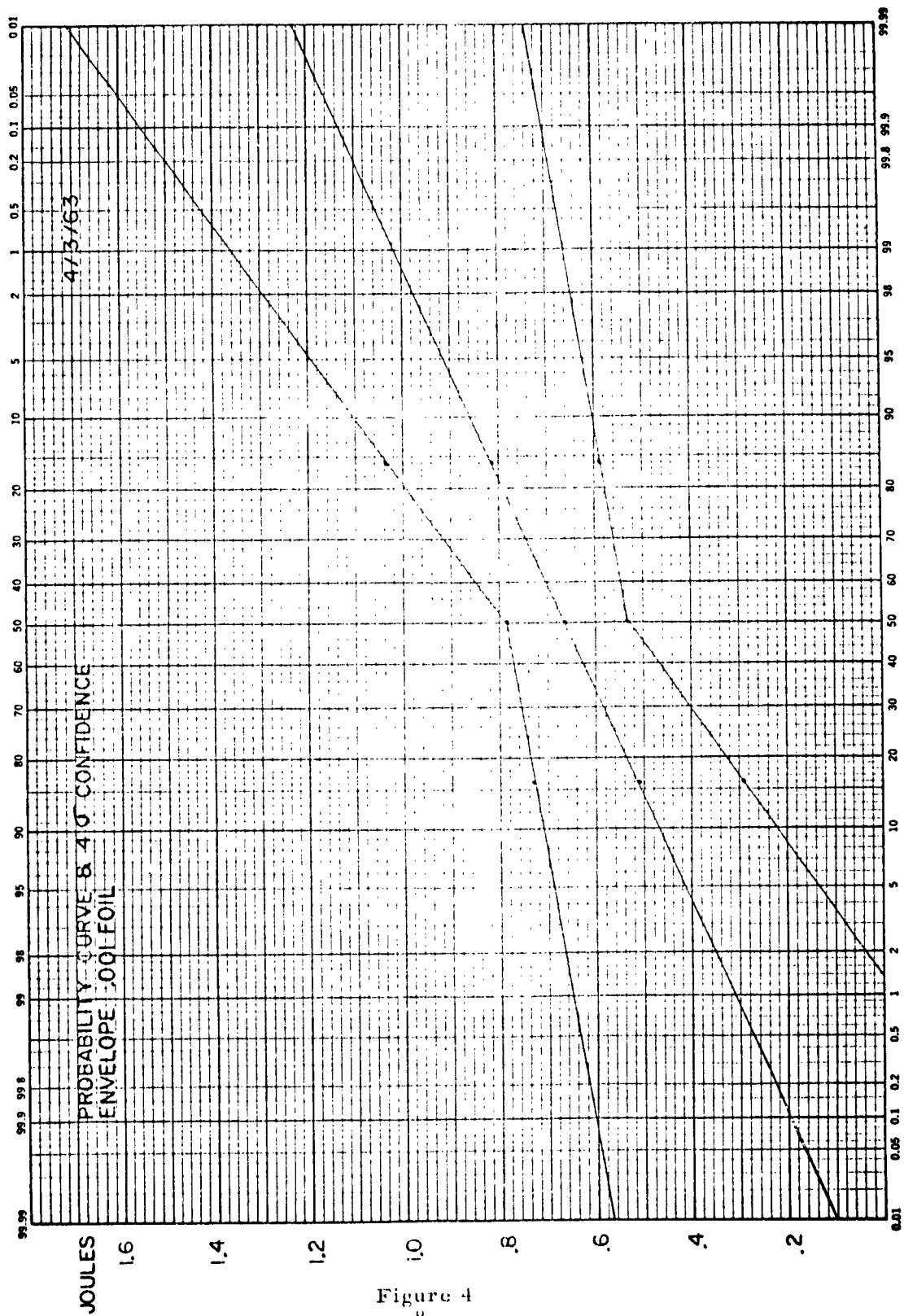


Figure 4  
- 8 -

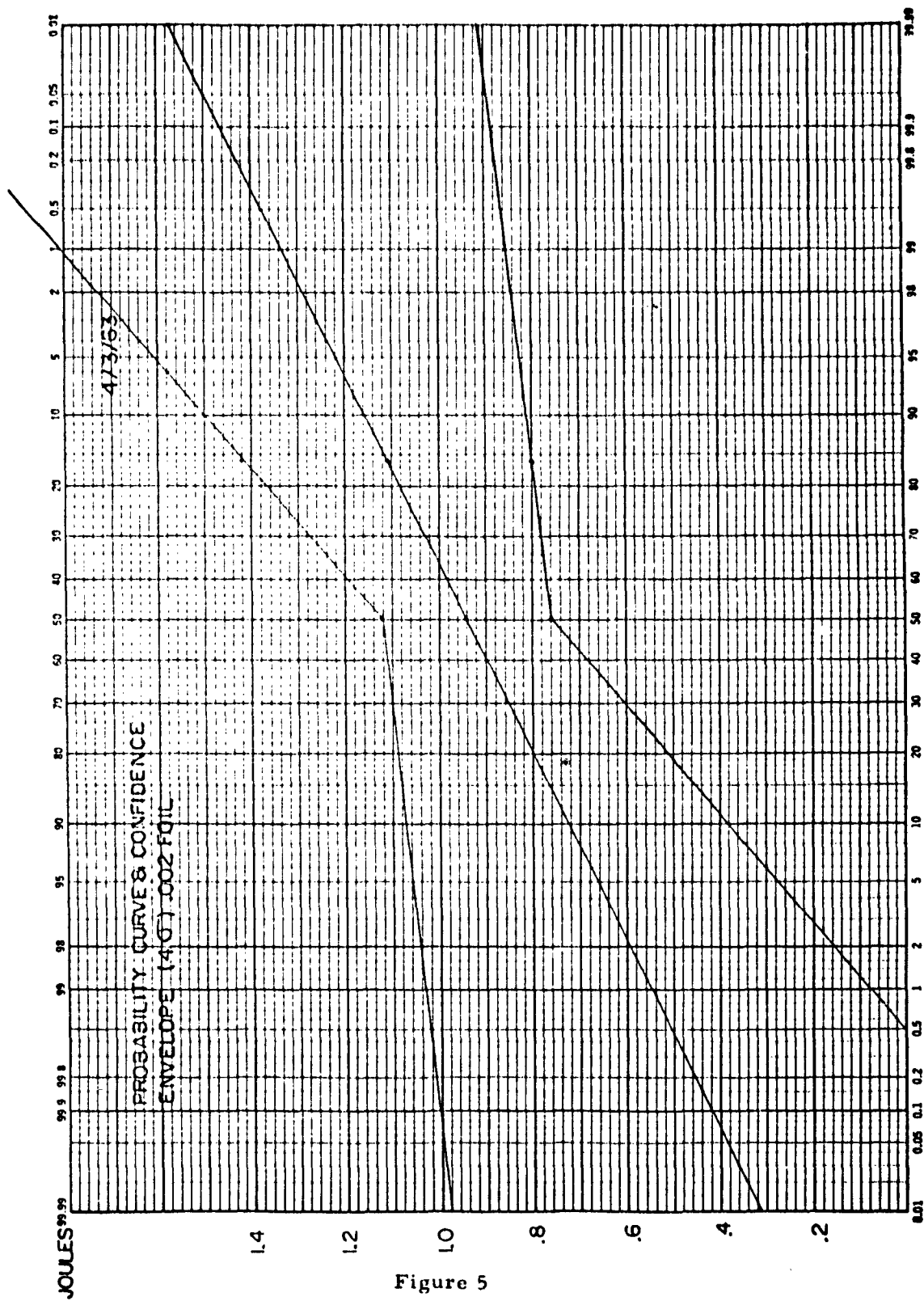


Figure 5