

N 69-39462

A Reproduced Copy
OF

Reproduced for NASA
by the
NASA Scientific and Technical Information Facility

Date 15 September 1969

Revised _____

LIMITED REPORT

METALLOGRAPHIC EXAMINATION OF SOLDERING OF MULTILAYER
BOARDS FOR AIRLOCKReport 061-015-76 Model Airlock

N69-39462

FACILITY FORM 802

(ACCESSION NUMBER)

23

(PAGES)

CA-101956

(NASA CR OR TMX OR AD NUMBER)

(THRU)

1

(CODE)

15

(CATEGORY)

Contract No. NAS9-6555Laboratories: MaterialsPrepared By F. M. Huffstutler
F. M. Huffstutler - Test Engr.
Metallurgical LaboratoryApproved By J. F. Krieg
J. F. Krieg - Sr. Grp. Engr.
Metallurgical LaboratoryApproved By G. H. Kesler
G. H. Kesler
Department Manager
Materials LaboratoriesApproved By T. Pandolfi
T. Pandolfi
Laboratory Project Engr.

METALLOGRAPHIC EXAMINATION OF SOLDERING OF MULTILAYER
BOARDS FOR AIRLOCK

The object of this test was to evaluate the solder connections of components on multilayer boards. This test became necessary when Electro-Mechanical Research (EMR) Co. requested a deviation from MDC. P.S. 22800 in soldering components on multilayer boards. EMR indicated that incomplete solder flow into the plated holes occurs because of the heat sink created by eleven copper layers, ground planes, and shields.

A multilayer board (P/N 52-203-403-80041) which had not been fully soldered was obtained from EMR, and various fluxes and soldering techniques were applied. A photograph of the as received multilayer board with arrows indicating connectors selected for examination is shown as Figure 1 on page 4. The conditions under which the connections were prepared and the visual results are shown in Table 1 on page 3.

The selected hole areas were sectioned and mounted for metallographic examination. Photomacrographs and photomicrographs of each of the examined hole areas are shown in Figures 2 through 12 pages 5 through 13. The following observations were made during the examination of the hole areas:

1. Connections C, DE, and F showed incomplete solder flow as shown in Figures 4, 5, and 6, respectively.
2. Hole "U" (designated as the unsoldered hole), which had been copper-tin-lead plated but which did not have a solder connection, showed evidence of a void in the solder plate and a crack in the copper plate. This condition is shown in Figure 10 on page 13. Repolishing of the specimen confirmed that the copper plate was fractured 0.07 inch below the top face of the board, (Figure 11 on page 13).

DATE _____

REVISED _____

REVISED _____

PAGE 2REPORT 061-015-76MODEL Airlock

3. Thickness measurements of the solder layer and the copper plate were made on the unsoldered hole from the photomicrograph in Figure 13 on page 13. The thicknesses were as follows: average copper plate-0.0024 inch, solder layer-0.0013 inch.

DATE _____

REVISED _____

REVISED _____

NCDONNEL
ST. LOUIS, MISSOURI

PAGE 3

REPORT 061-015-76

MODEL Atlock

TABLE 1CONNECTION PREPARATION FOR MULTILAYER BOARD P/N 52-203-403-80041

PC BOARD SECTION	PC BOARD CLEANER	PC BOARD FLUX	SOLDER TEMPERATURE RESERVOIR	MACHINE CONVEYOR SPEED FT/MIN	VISUAL RESULTS
A	Alpha 563	Kester 1571	500-525°F	2.6	Complete Flow
B	Alpha 563	Kester 1571	500-525°F	3.5	Complete Flow
C	Alpha 563	Kester 1571	500-525°F	4.0	Complete Flow
D	Alpha 563	Kester 196	500-525°F	4.0	Incomplete Flow
E	Alpha 563	Kester 196	500-525°F	4.0	Incomplete Flow
F	Alpha 563	Kester 196	500-525°F	3.0	Incomplete Flow
H1	Alpha 563	Kester 1571	Hand Soldering		Touch Up Required
H2	Alpha 563	No Flux	Hand Soldering		Incomplete

MCDONNELL

DATE _____

ST. LOUIS, MISSOURI

PAGE 4

REVISED _____

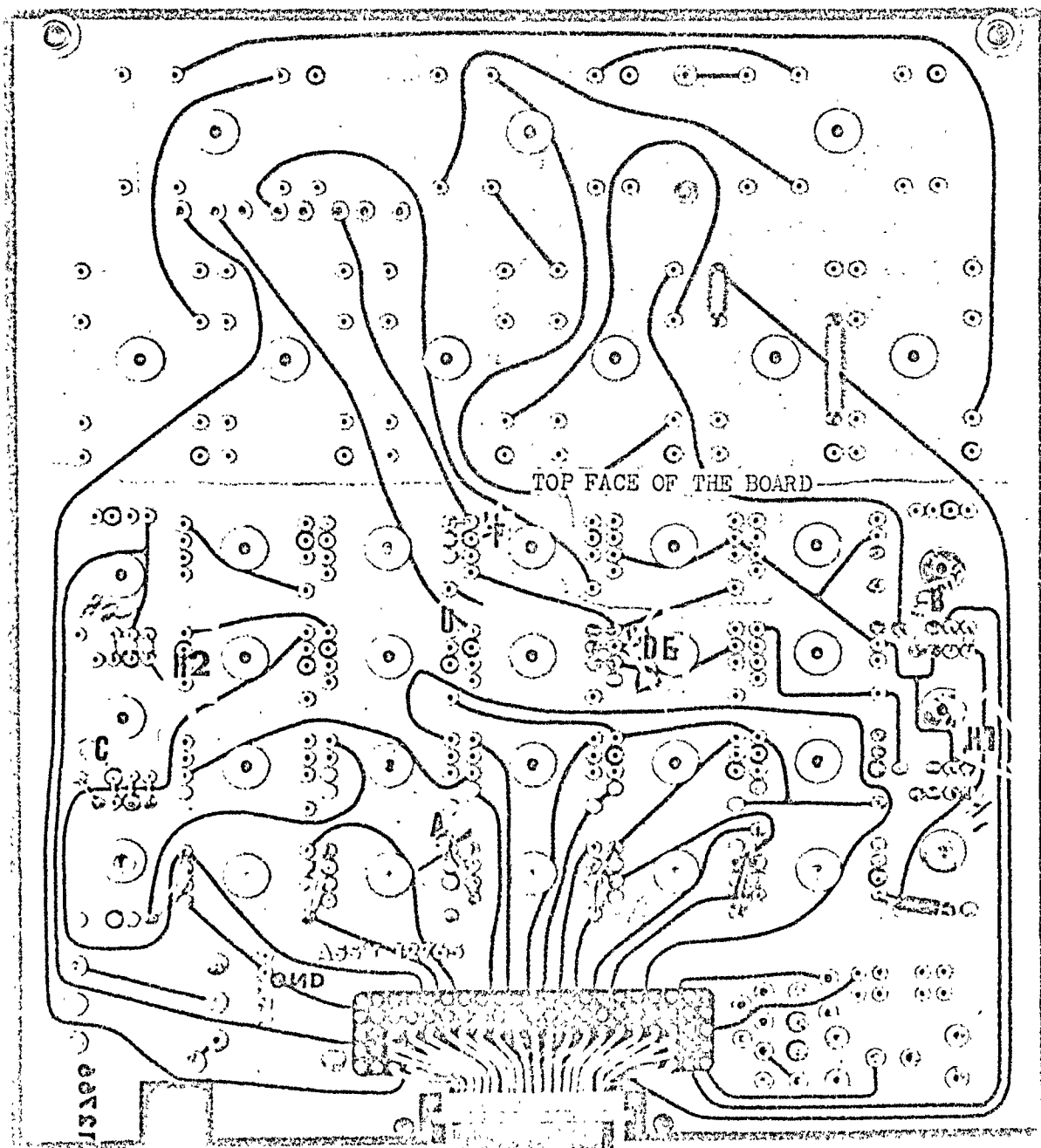
REPORT 061-015-76

PHOTO D4E512422

MODEL Airlock

FIGURE 1

AS-RECEIVED CIRCUIT BOARD (THE CONNECTIONS TO BE SECTIONED ARE MARKED WITH ARROWS)



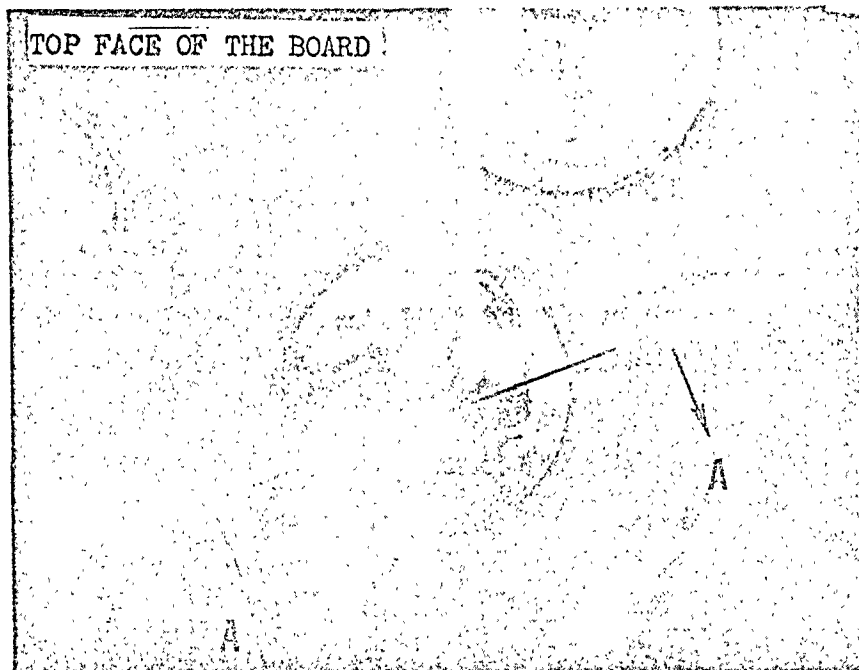
DATE _____

REVISED _____

MCD

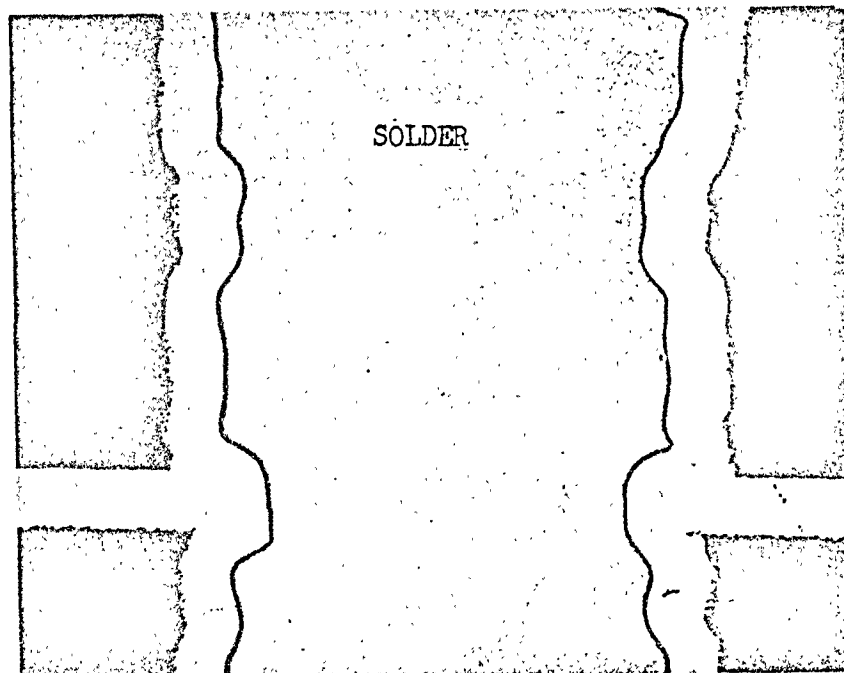
ST. L.

CONNECTION A SHOW



CONNECTION A

16X

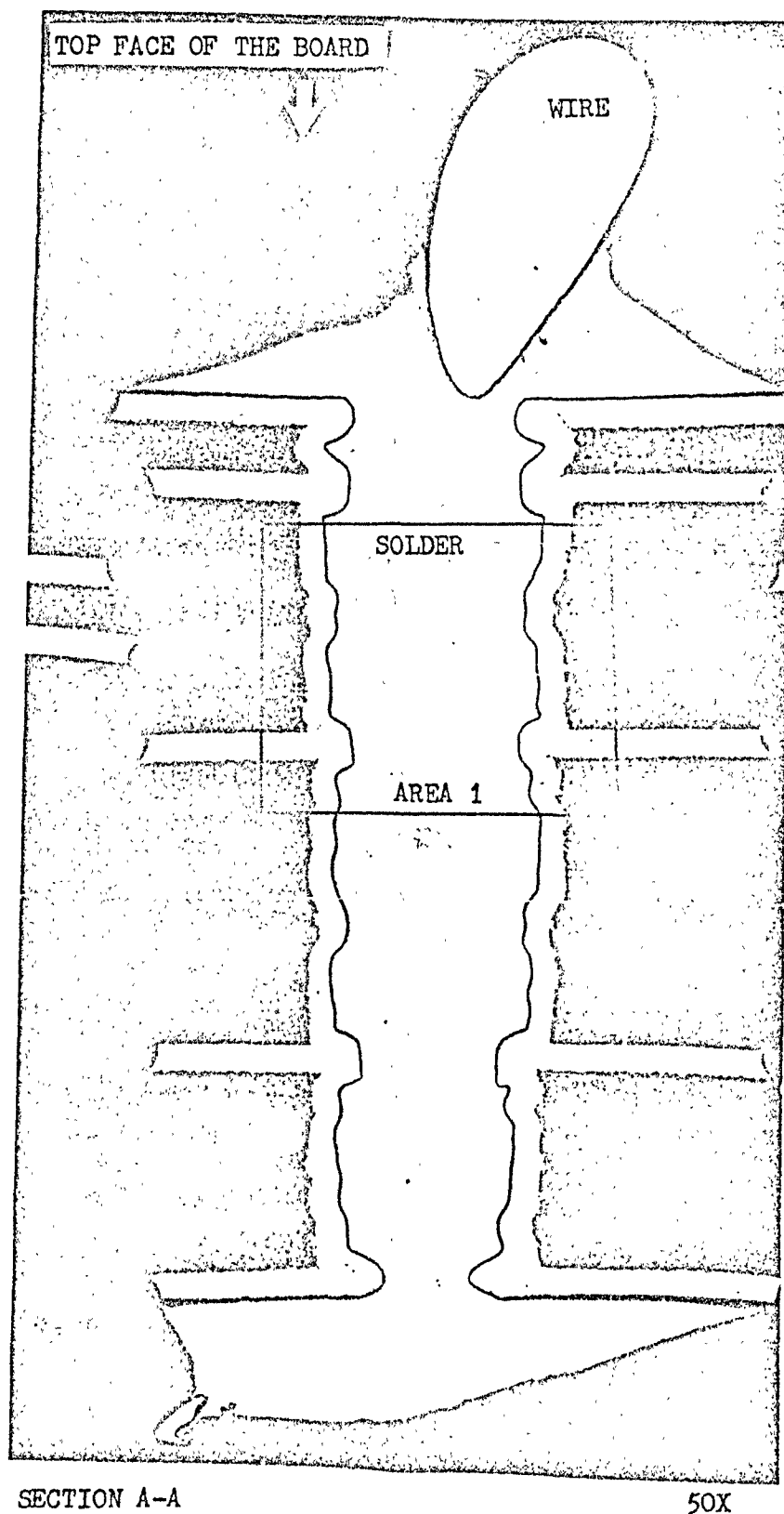


AREA 1 (SECTION A-A)

100X

COMPLETE SOLDER FLOW

FIGURE 2



SECTION A-A

50X

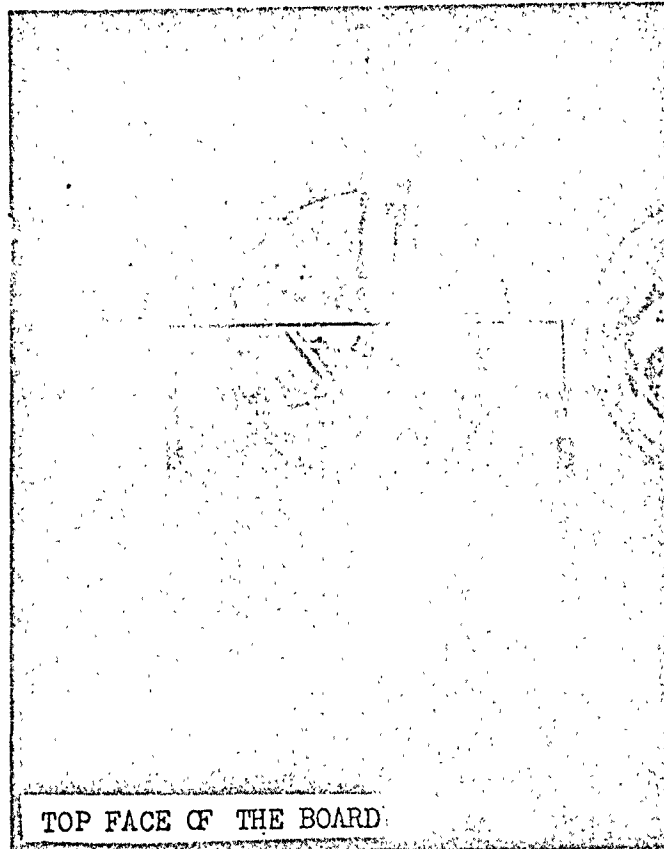
DATE _____

REVISED _____

MCD

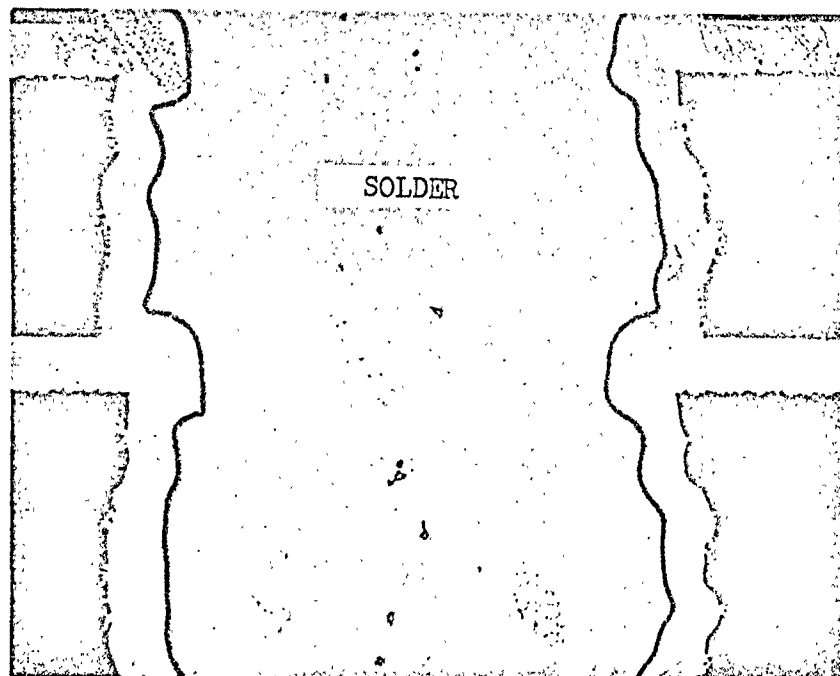
ST. L

CONNECTION B SHOW



CONNECTION B

16X

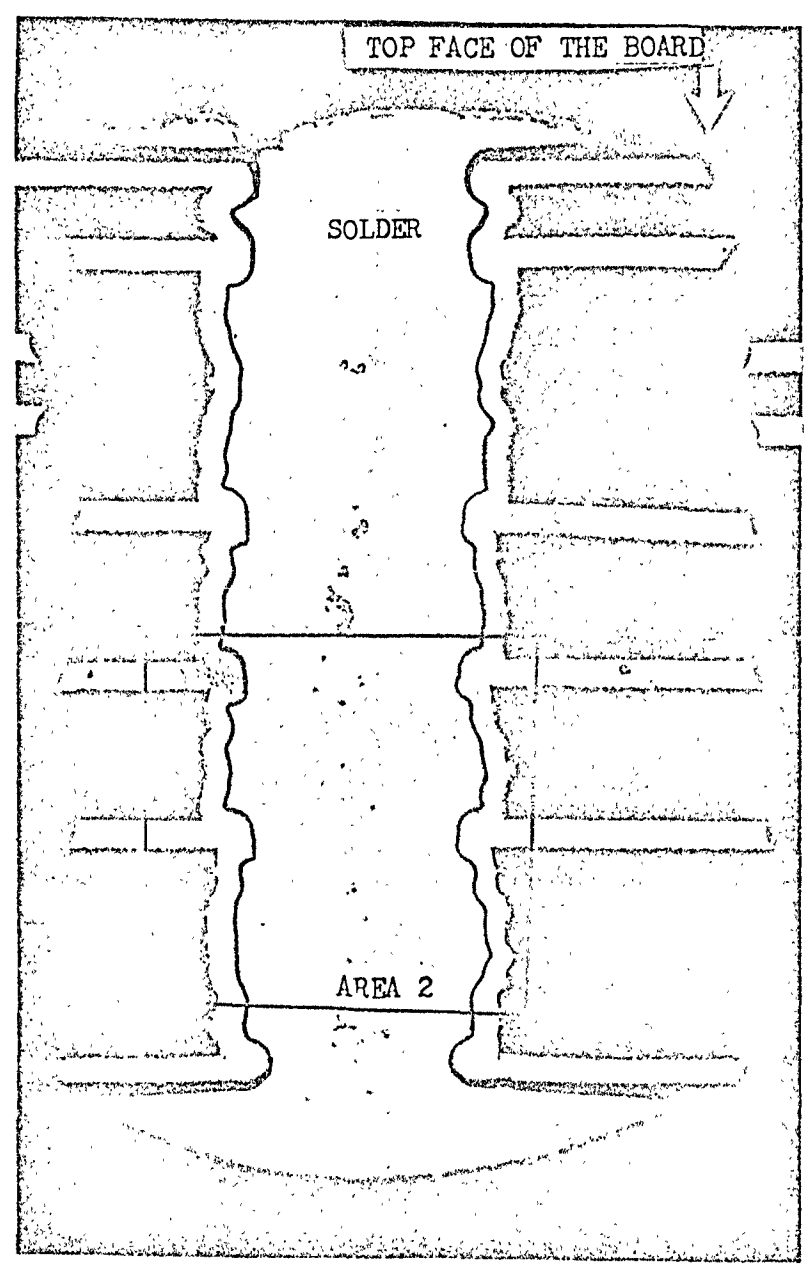


AREA 2 (SECTION B-B)

100X

ING COMPLETE SOLDER FLOW

FIGURE 3



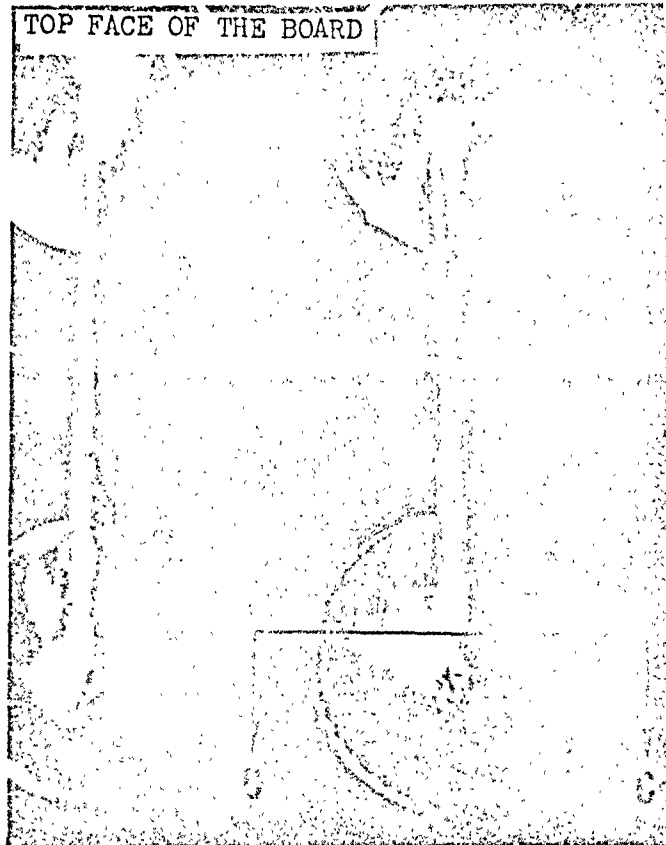
DATE _____

REVISED _____

MCD

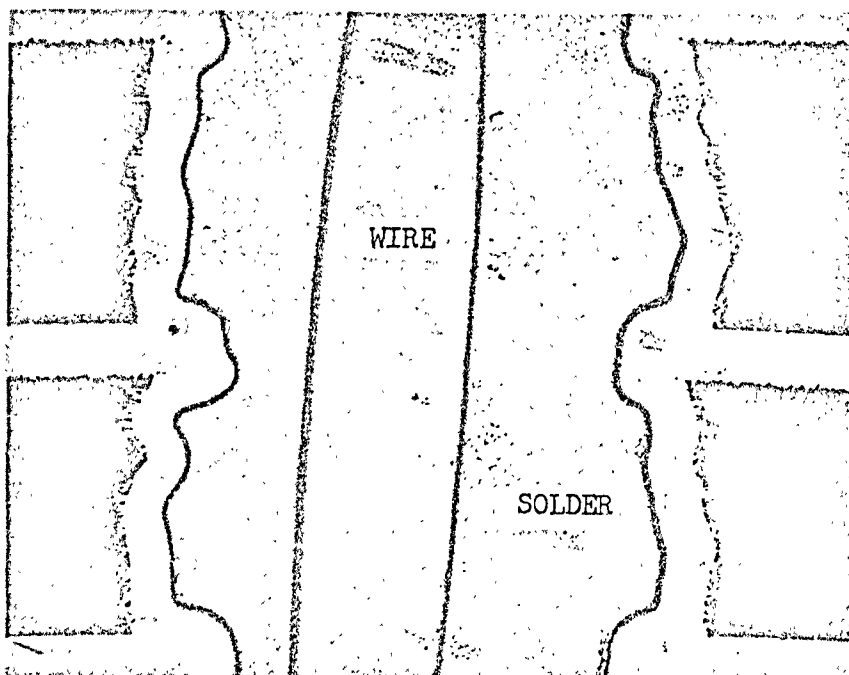
ST. LO

CONNECTION C SHOWING



CONNECTION C

16X

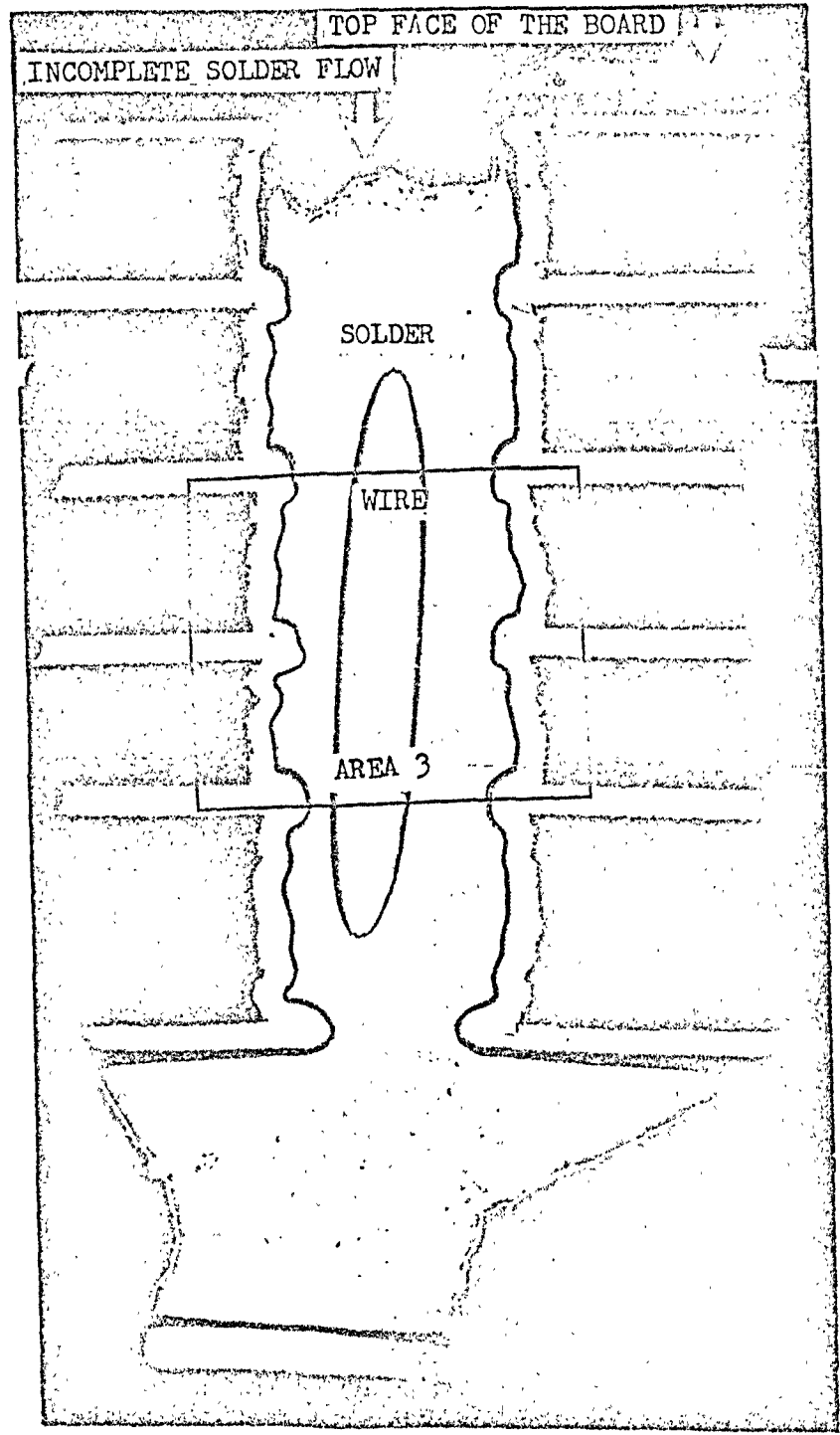


AREA 3 (SECTION C-C)

100X

INCOMPLETE SOLDER FLOW

FIGURE 4



SECTION C-C

50X

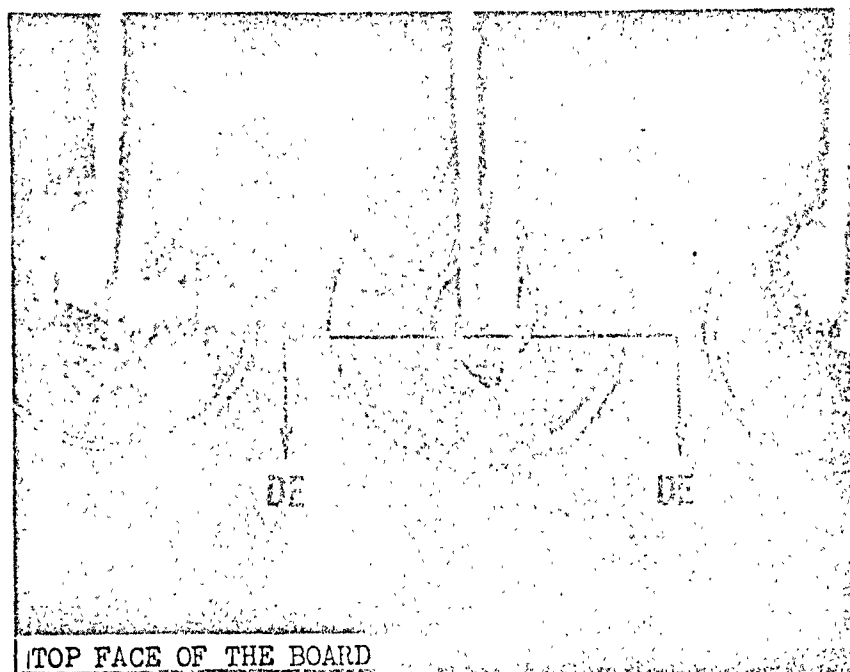
DATE _____

REVISED _____

MCD

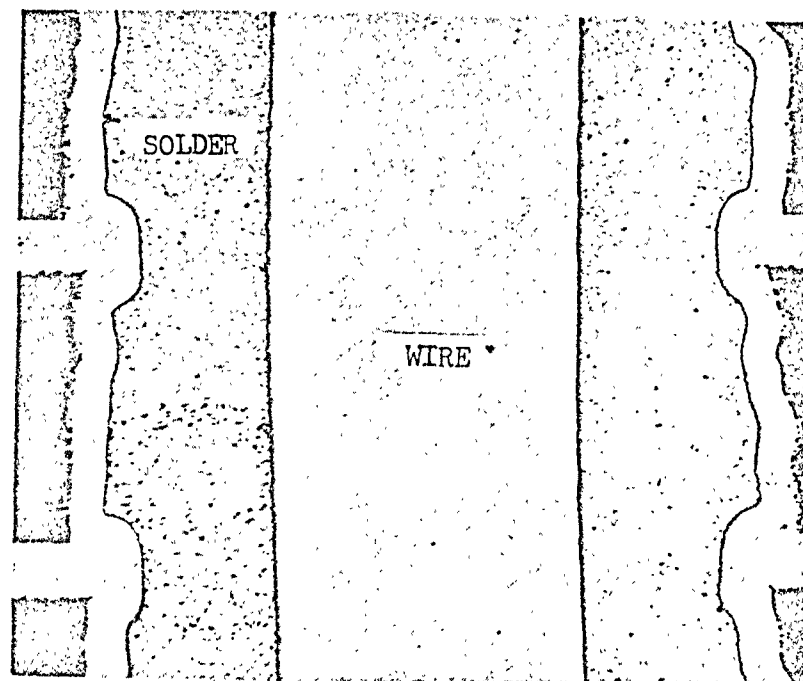
ST. LO

CONNECTION DE SHOWING



CONNECTION DE

16X

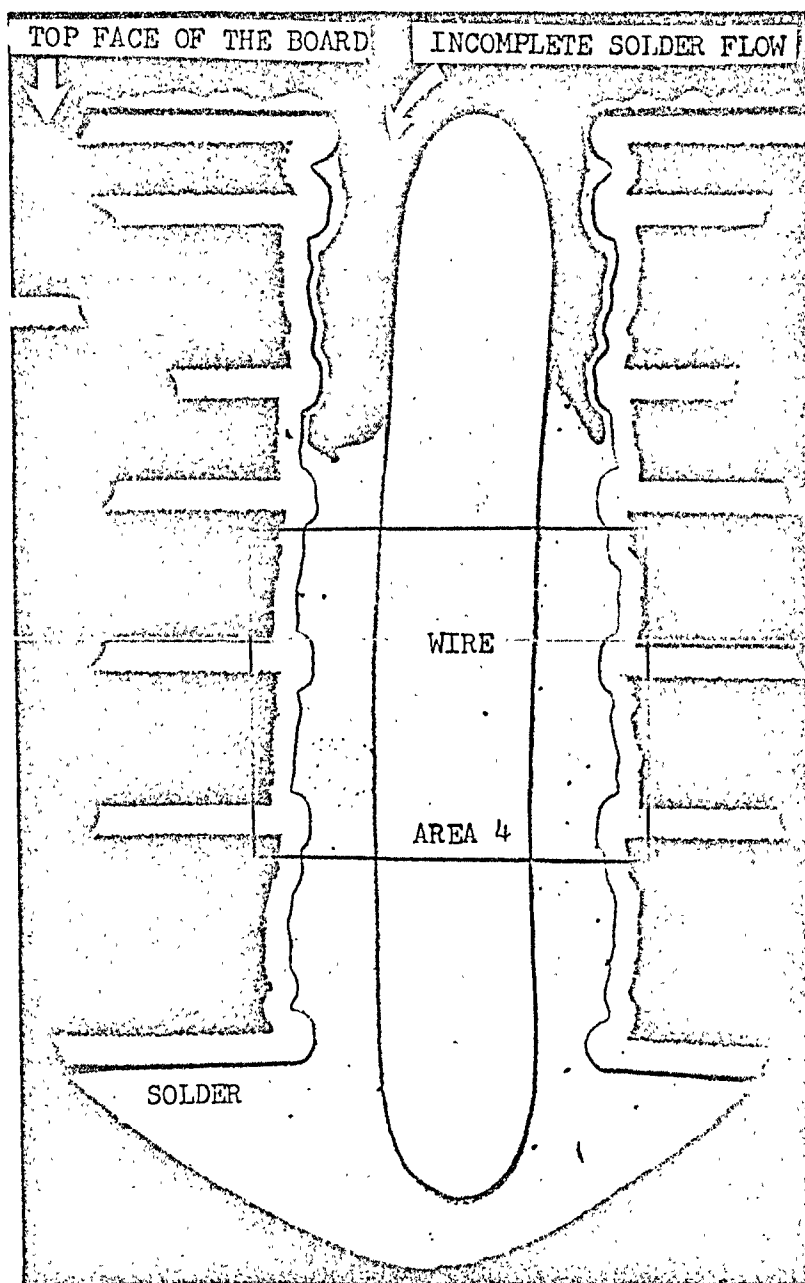


AREA 4 (SECTION DE-DE)

100X

INCOMPLETE SOLDER FLOW

FIGURE 5



SECTION DE-DE

50X

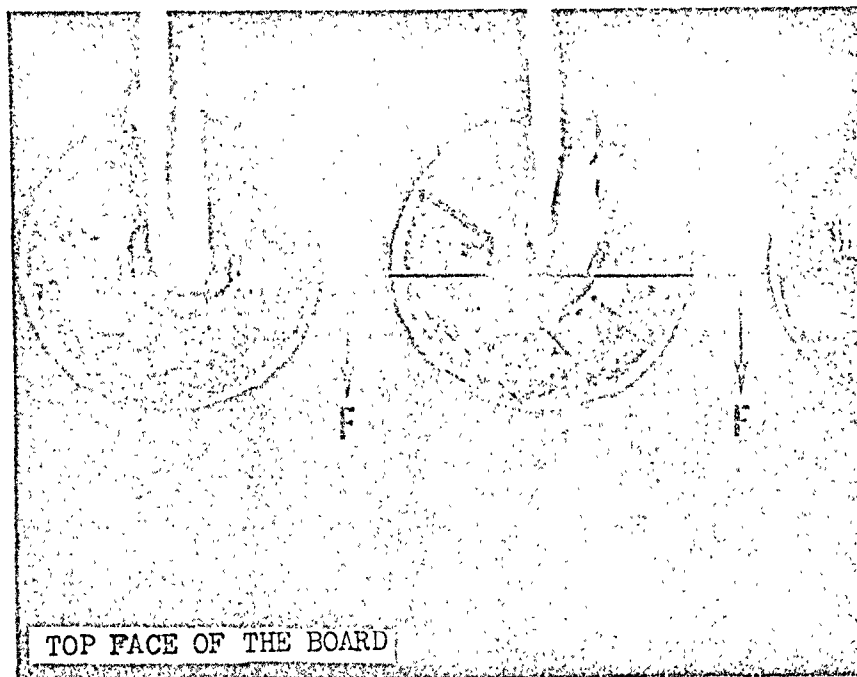
DATE _____

REVISED _____

MCD

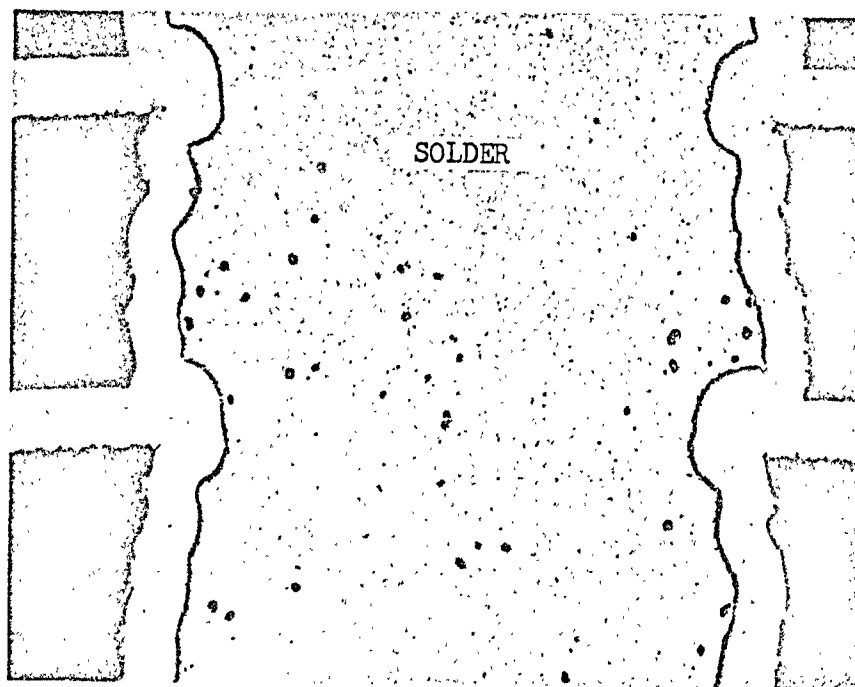
ST. LO

CONNECTION F SHOWING



CONNECTION F

16X

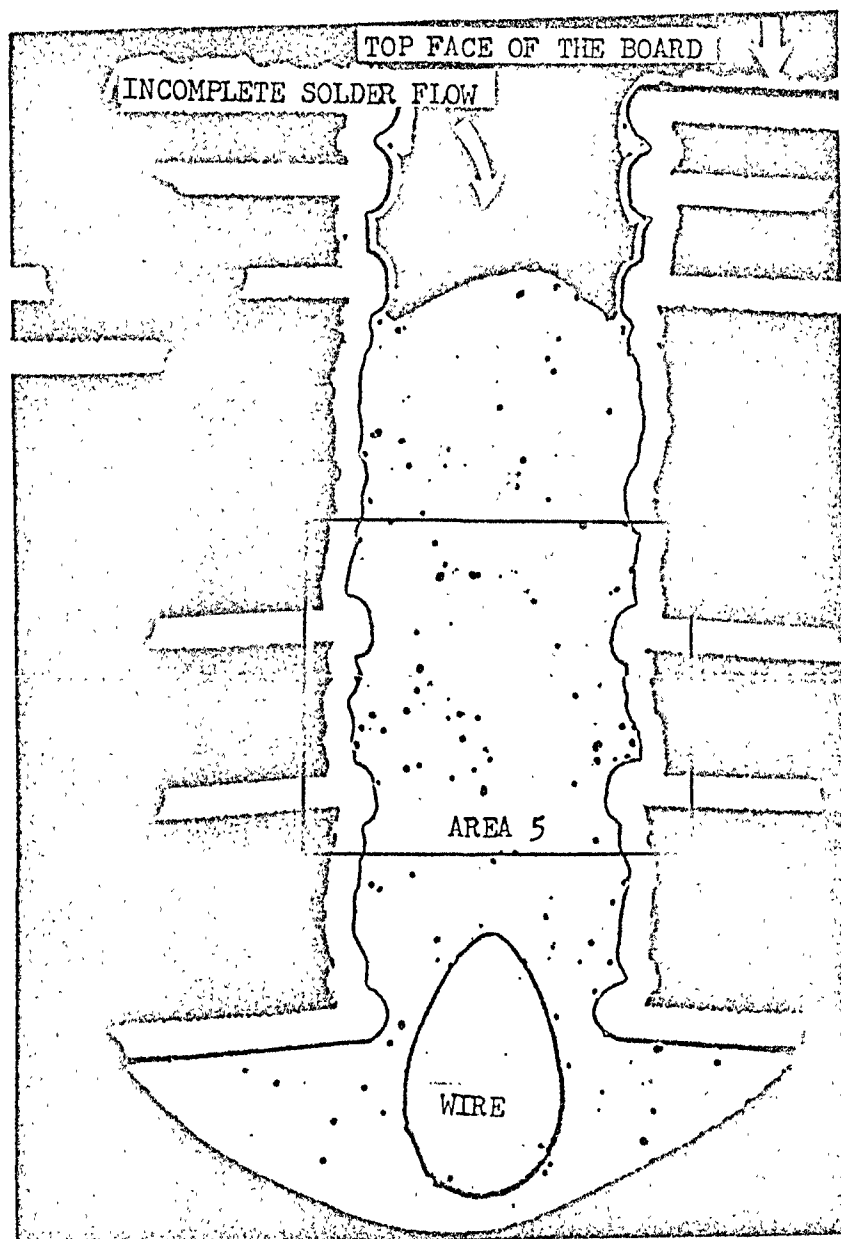


AREA A (SECTION F-F)

100X

INCOMPLETE SOLDER FLOW

FIGURE 6



SECTION F-F

50X

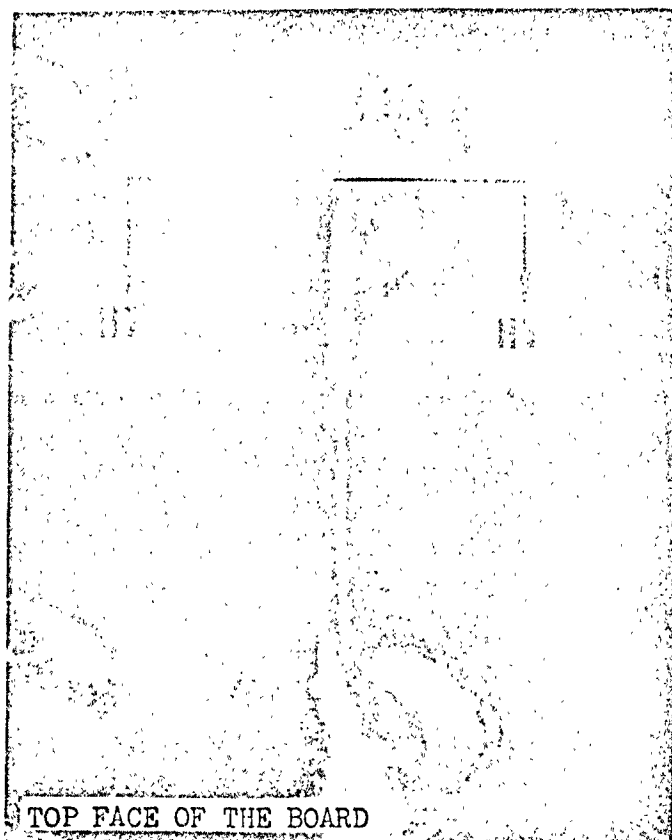
DATE _____

REVISED _____

MCDC

ST. LO

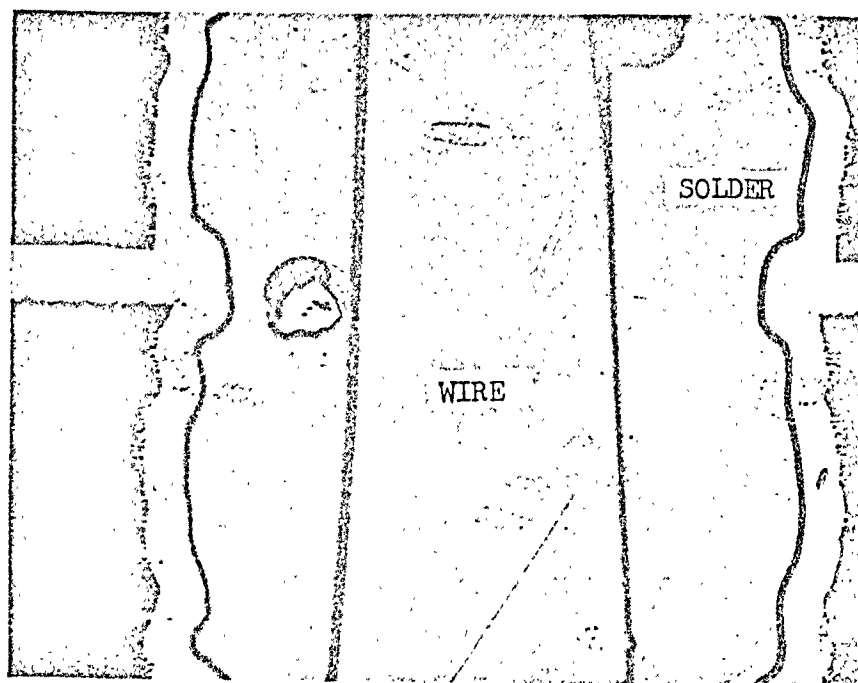
CONNECTION H1 SHOWS
EXCEPT FOR



TOP FACE OF THE BOARD

CONNECTION H1

16X

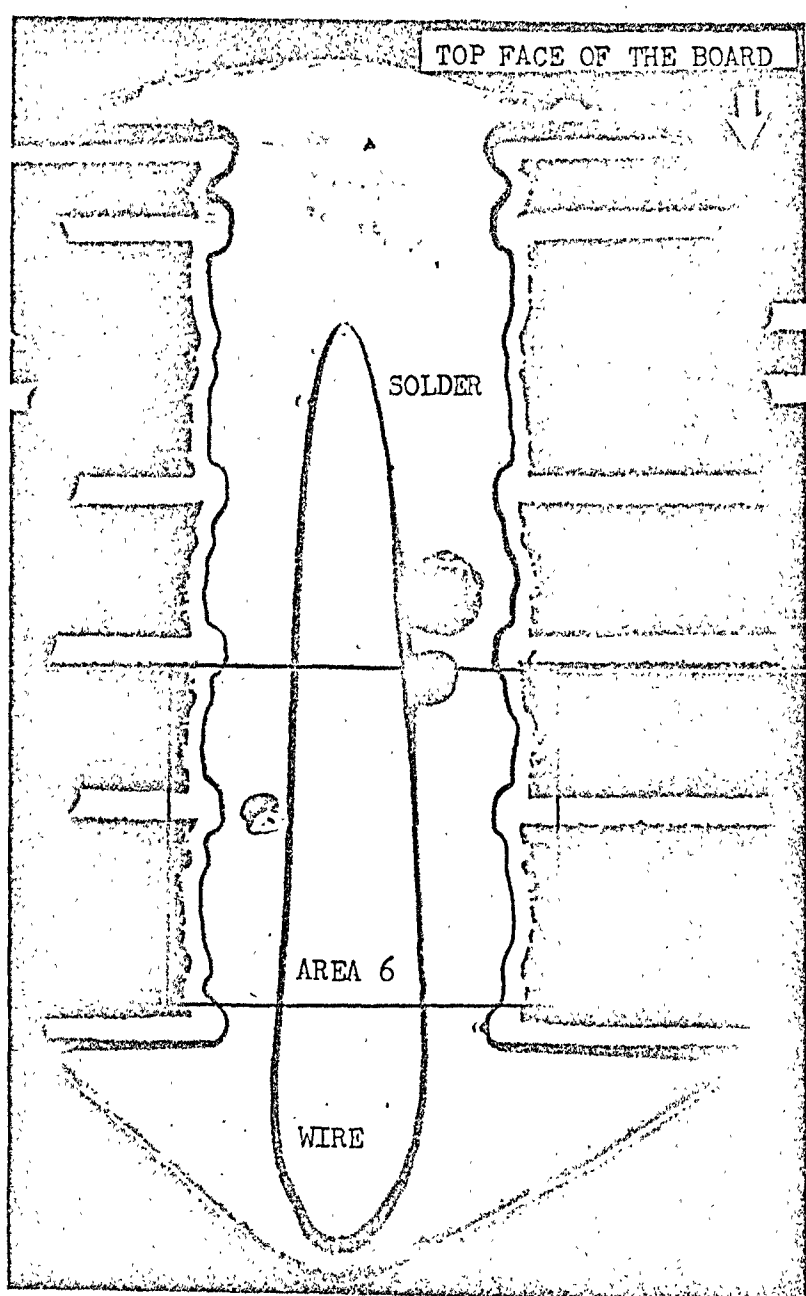


AREA 6 (SECTION H1-H1)

100X

COMPLETE SOLDER FLOW
IDS ALONG WIRE

FIGURE 7



SECTION H1-H1

50X

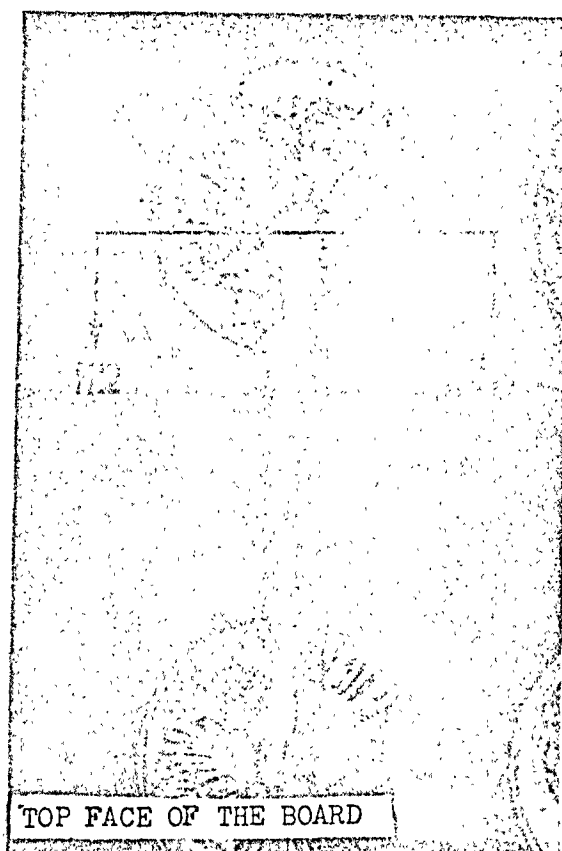
DATE _____

REVISED _____

MCD

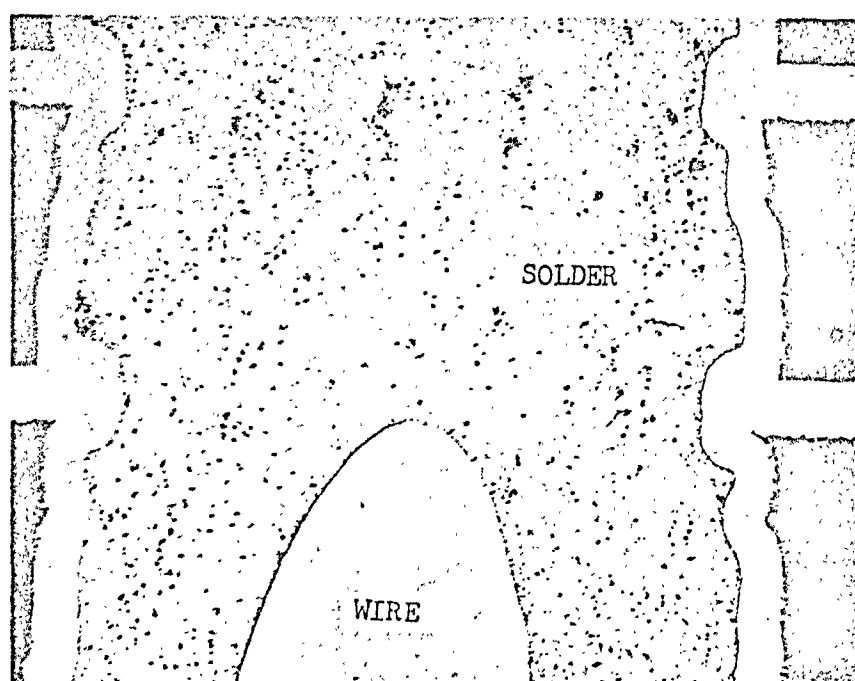
57

CONNECTION H2 SH



CONNECTION H2

16X

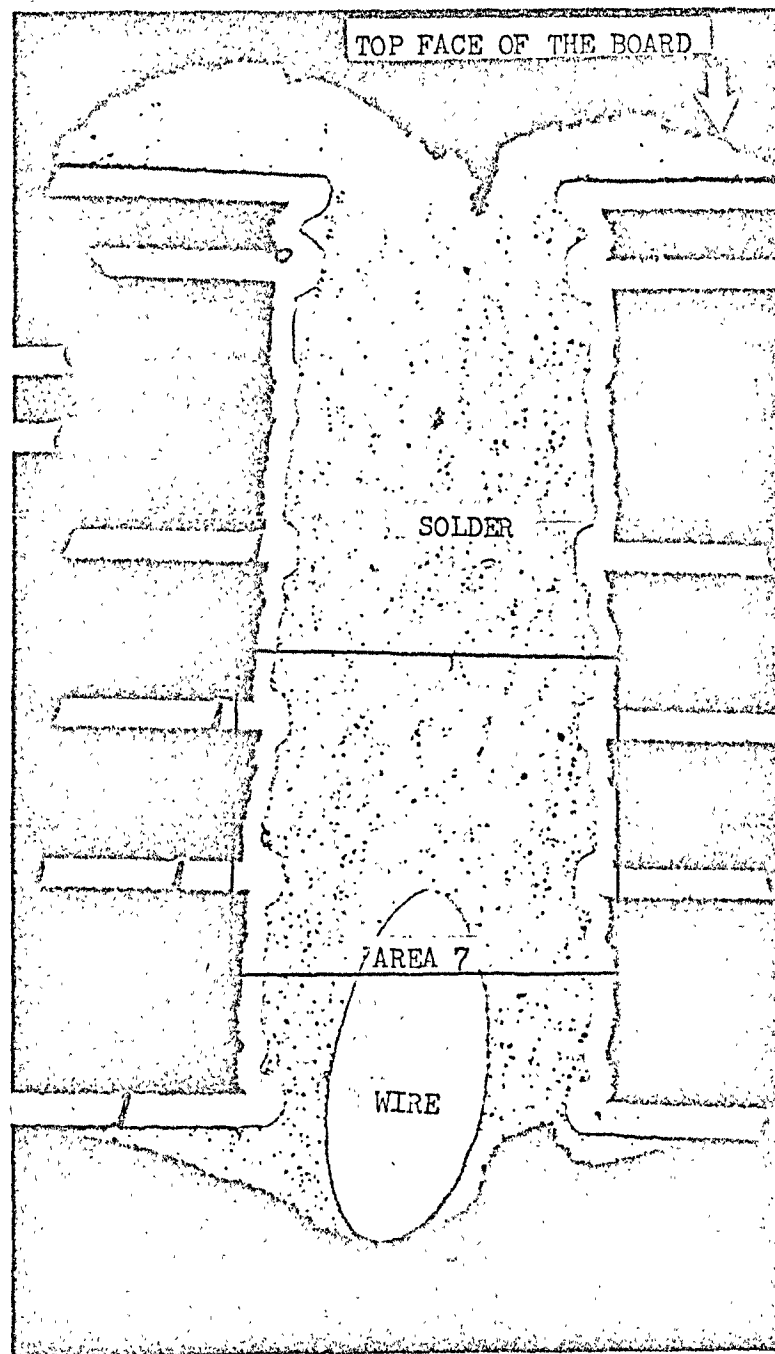


AREA 7 (SECTION H2-H2)

100X

FIGURE 8

NG COMPLETE SOLDER FLOW



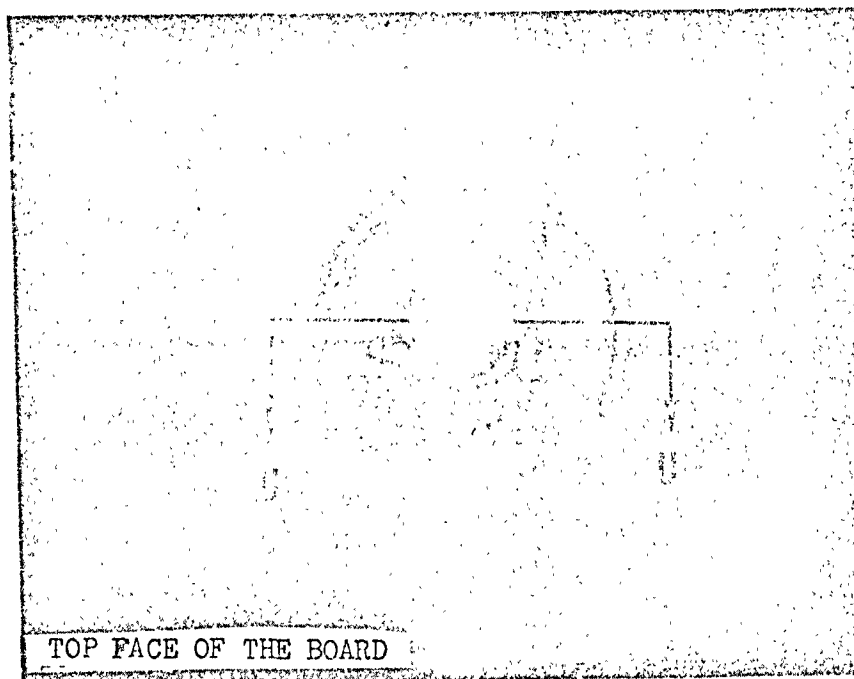
DATE _____

REVISED _____

MCD

ST. L.

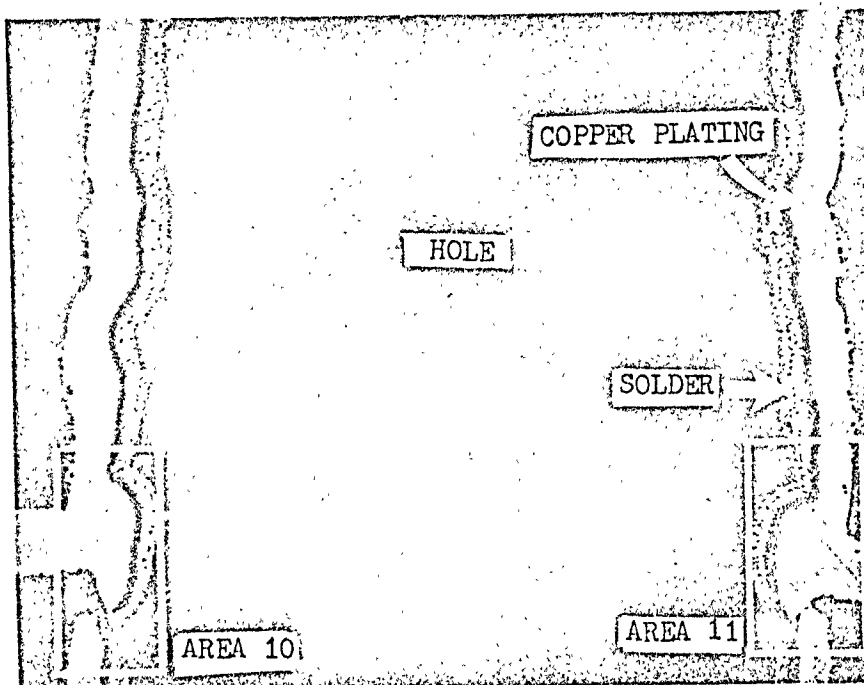
UNSO



TOP FACE OF THE BOARD

UNSOLDERED HOLE

16X

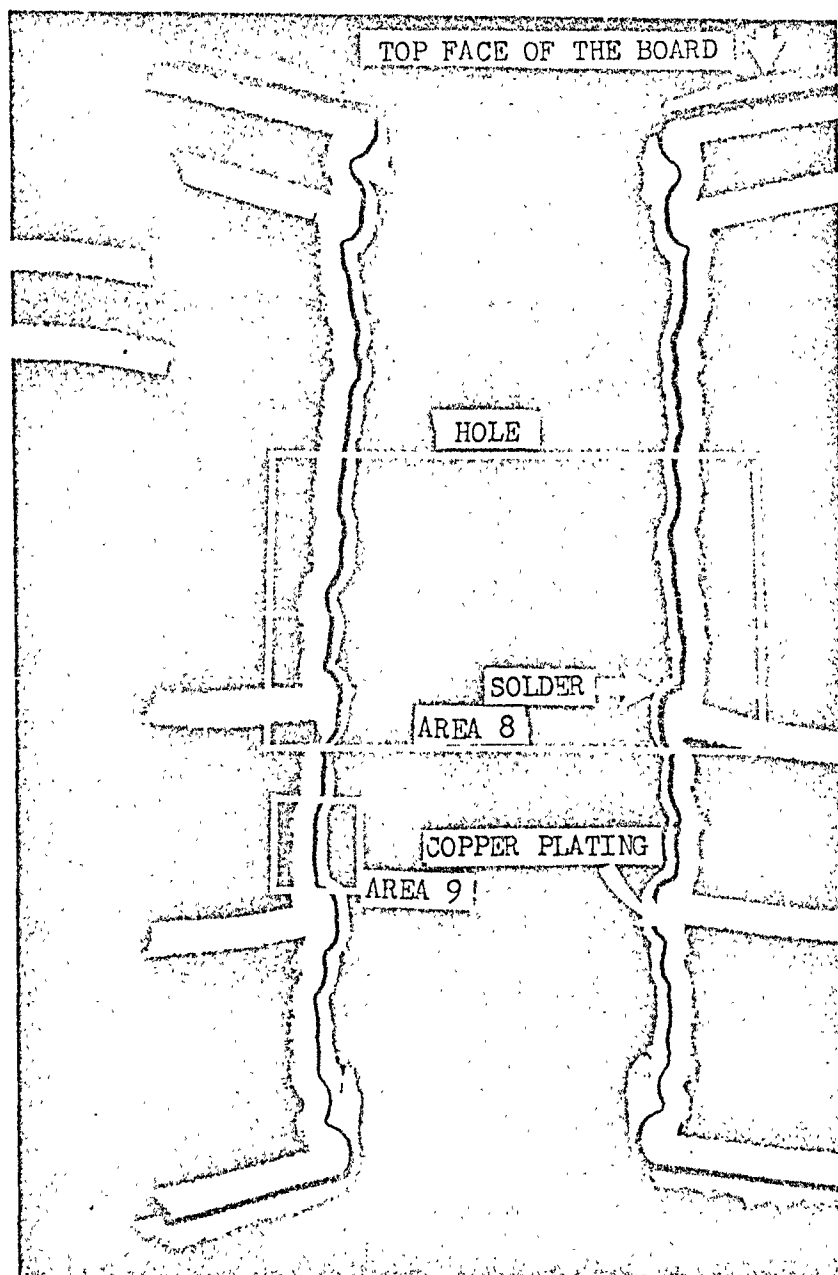


AREA 8 (SECTION U-U)

100X

FIGURE 9

RED HOLE



SECTION U-U

50X

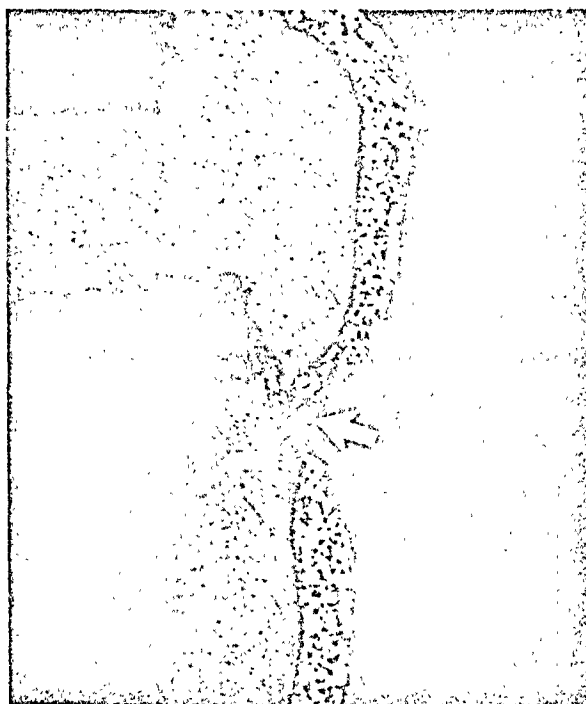
DATE _____

REVISED _____

MCDC

ST. LO

FIGURE 10.-AREAS 10 AND 11 OF SECTION U-U



Area 10, Break in
Copper Plate (arrow)

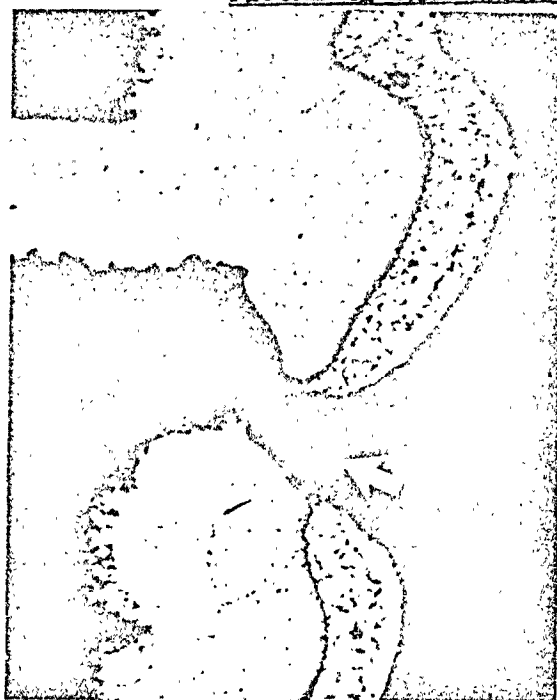
250X



Area 11, Crack in
Copper Plate (arrow)

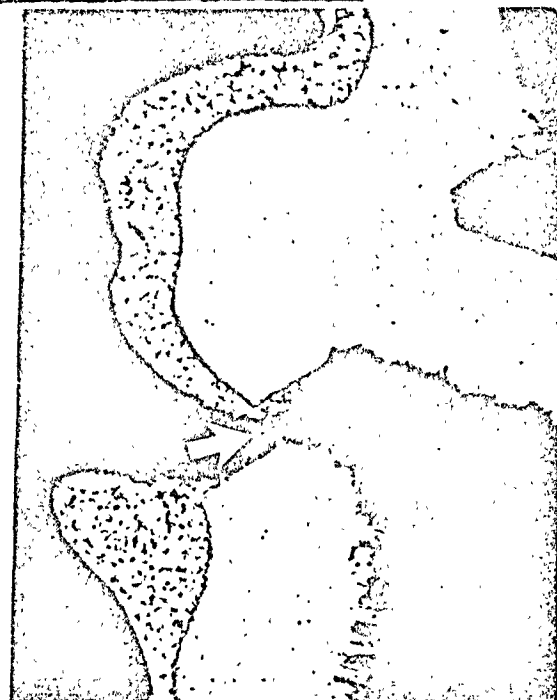
250X

FIGURE 11 SAME AREAS AS FIGURE 10 AFTER REPOLISHING



Area 10, Break in
Copper Plate (arrow)

250X

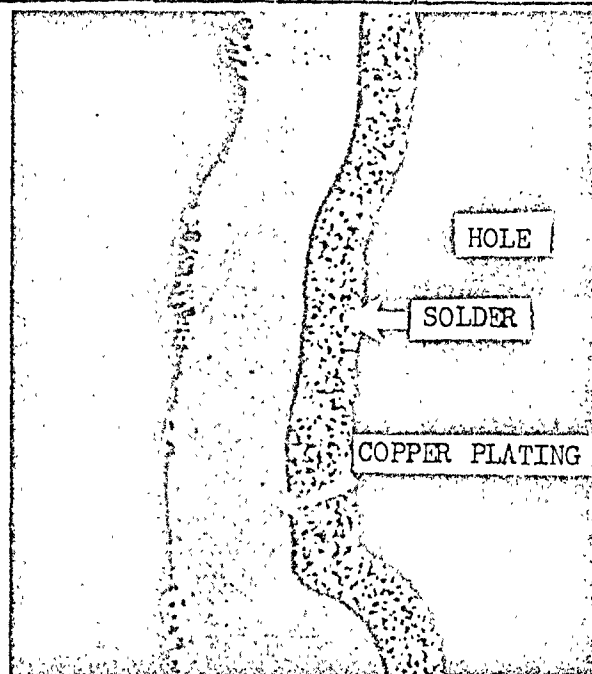


Area 11, Break
In Copper Plate (arrow)

250X

FIGURES 10, 11, 12

FIGURE 12-AREA OF SECTION U-U FROM
WHICH THICKNESS MEASUREMENTS WERE TAKEN



Area 9

250X