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MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR PLASTIC HOUSING--ETC(U)  
SEP 76 D V GORDON

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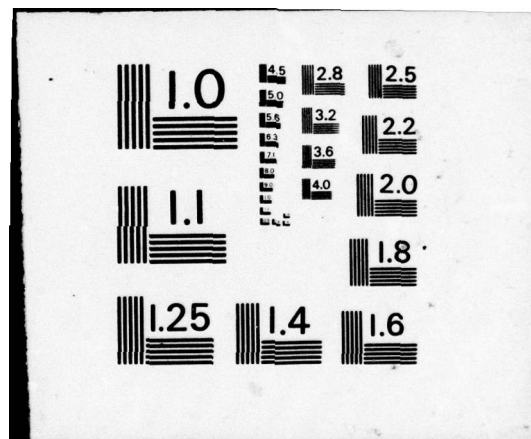
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FINAL REPORT

Manufacturing Methods and Technology Measure

For Plastic Housings For

C-2328-B-GRA-39 and C-2329-B-GRA-39 Radio

AMC Contract # DAAB05-73-C-2081

Placed By

U. S. Army Electronics Command  
Production Division, Procurement and Production Directorate  
DRSEL-PP-I-PI-1  
Ft. Monmouth, New Jersey 07703

Prepared By

Eagle-Picher Industries, Inc.  
Electronics Division  
Couples Department  
Joplin, Missouri  
64801

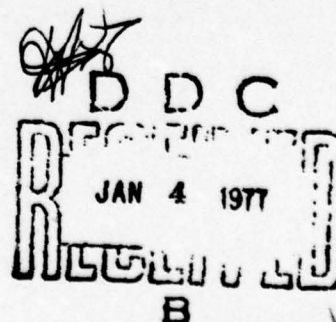
Dale V. Gordon - Project Engineer 417-623-8000

Robert D. Brown - Contract Administrator 417-623-8000

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**MANUFACTURING METHODS AND TECHNOLOGY MEASURE  
FOR PLASTIC HOUSINGS FOR C-2328-B-GRA-39 and C-2329-B-GRA-39**

**RADIO**

**FINAL REPORT**

**September, 1976**

**Object of study; Establish a pilot production  
capability for producing plastic cases  
for Army Radio Sets - AN-GRA-39B**

**AMC Contract # DAAB05-73-C-2081**

**Placed By**

**U. S. Army Electronics Command  
Production Division, Procurement and Production Directorate  
DRSEL-PP-I-PI-1  
Ft. Monmouth, New Jersey 07703**

**Prepared By**

**Dale V. Gordon for  
Eagle-Picher Industries, Inc.  
Electronics Division  
Couples Department  
Joplin, Missouri  
64801**

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# ABSTRACT

This report describes the work done to prove feasibility of mass production of a non-metallic housing for the C-2328-B-GRA-39 and C-2329-B-GRA-39 Radio Set. Selection of materials, manufacturing methods, redesign of the housings and design tools are described. Cross comparisons are made and production techniques are described in detail. Quality Control procedures are included.

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DATE	10-1-54
BY	W. J. B. / J. B. B.
FOR	W. J. B. / J. B. B.
REVISION NO.	2
DATE	10-1-54
BY	W. J. B. / J. B. B.
FOR	W. J. B. / J. B. B.
REVISION NO.	3
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## GLOSSARY

<u>TERM</u>	<u>REFERENCE</u>	<u>DESCRIPTION</u>
Pre-Preg	Page 4	A term given to fiberglass cloth in which the resin is introduced into the cloth at manufacture rather than added in separate step during the lay-up operation.
Lexan 101	Page 5	A trade name given to polycarbonate by the General Electric Company.
Back Pressure	Page 46	A term used in the injection mold industry to specify a pressure in the cylinder to insure an accurate temperature control of the molten resin. No pressure would result in large temperature gradients.
Pile-Ups	Page 46	A term used to describe an overflow or clogging effect when the molded part is ejected.
Plastication	Page 55	A term used in the injection mold industry to describe specified varying temperatures of the molten resin within the molding machine cylinder.
Short Shots	Page 56	A term used by the injection mold industry to describe incomplete filling of the mold cavity during the molding cycle.

### PURPOSE

The primary objective of this project is to perform the production engineering required to permit the replacement of aluminum housings with molded plastic housings for the AN/GRA-39B Radio Telephone. Major accomplishments which will result from the project are as follows:

1. To provide the engineering effort required to establish a capability for pilot line production of the following AN/GRA-39B Radio Housing parts.
  - A. Panel (SM-D-450185)
  - B. Panel (SM-D-450179)
  - C. Case (SM-D-450170)
  - D. Cover (SM-D-456214)
2. Determination, design and fabrication of special tooling, special test equipment, and prototype machines for the pilot line.
3. To prepare and revise as necessary a Management Evaluation Program.
4. Application of Quality Control Procedures including Quality Control Checks of pertinent points of manufacture.
5. To design, fabricate and test engineering samples for design approval.
6. To fabricate and test First Article Samples using pilot line equipment and tooling referred to in 2 above.
7. To perform a Pilot Production Run of 25 parts each to demonstrate the capability of producing 20 radio housings per 8 hour day.

8. To prepare test reports for engineering samples, First Article samples and Pilot Production units including reworked and rejected items.
9. To submit Monthly Letter Reports, Formal Quarterly Reports and a Final Report covering the entire period of the project. Also a step by step procedure of manufacturing instructions, specifications, information and other data will be provided.
10. To prepare a General Report on Step II in accordance with paragraph 3.5.3 of Electronics Command Industrial Preparedness Procurement Requirements No. 15, Revised 3 August 1971.

## I. HISTORY

### A. Introduction and Summary

This Manufacturing Methods and Technology Measure has been conducted over the past three (3) years. Eagle-Picher has been involved in similar programs, the most notable being Contract DAAB05-70-C-3110. This program involved the design and development of several standard non-metallic battery cases for USAECOM. Therefore, this program was not the first of its kind for Eagle-Picher. Other similar contracts which have been done for USAECOM are: DA-28-043-AMC-02512(E), a Development and Manufacture of Advanced Engineering Models for the BB-607/U Nickel-Cadmium Battery Assembly. A similar battery container and parts were developed on Contract DA-28-043-AMC-01508(E) for the BB-610/U Nickel-Cadmium Battery Assembly. The standard sealed battery case has evolved from USAECOM Contracts DA-28-043-AMC-02361(E) and DAAB07-69-C-0406 for battery assemblies which utilize cylindrical type sealed nickel-cadmium battery cells. These programs have included for example, the BB-630/U and the BB-655/U. The metal-air standard case and transit cover have evolved from work on USAECOM development contracts for metal-air batteries BA-524/U through BA-528/U.

All of these batteries, and therefore standard cases will interface with equipment designed in accordance with the new standard line configuration, USAECOM Drawing ES-D-202410.

A. Introduction and Summary (Continued)

It can therefore be seen from the above why a manufacturer of batteries is involved in the design and development of a non-metallic housing for a military radio set.

This production engineering measure has been undertaken to establish optimized manufacturing methods for production of large quantities of non-metallic housings for the GRA/39 radio set.

B. Materials and Manufacturing Method Options

Many different manufacturing techniques are available for fabrication of radio cases. Each material and each manufacturing method has specific advantages and disadvantages; therefore, the materials selected for the radio housing case were based on production rates and environmental requirements. For example, the strongest non-metallic material available for manufacturing ruggedized containers is epoxy preimpregnated fiberglass fabric, commonly referred to as "pre-preg", which is manufacturing in a semi-cured state. This material can be procured per MIL-R-9300. After hand lay-up, the material is cured at elevated temperatures, during which time, pressure is applied to develop the ultimate strength of the material. Vacuum bag molding can be used or matched metal molds can be designed and fabricated for this process. Vacuum bag molding has the advantage of low cost tooling. It is especially applicable to low quantities. Its major disadvantage is lack of tolerance control on the vacuum bag surface and the necessity for considerable cutting, trimming and finishing. Also, the ultimate strength of the material is not fully developed because

**B. Materials and Manufacturing Method Options (Continued)**

of the low pressure attained by vacuum. Higher pressure molding is available using matched metal molds of high temperature aluminum or steel. Matched metal tools are more expensive than vacuum bag molding tools but precise dimensional control is attained. Also piece part price is reduced by the use of matched metal molds as less hand operations are required for finishing of the resulting part.

Another type of fiberglass molding method is available to the battery case designer. This technique is commonly referred to as premix molding. In this process, short random strands of fiberglass are interspersed within epoxy material. A pre-weighed amount of the premix is introduced into matched metal molds followed by curing at elevated temperatures and pressures. Epoxy premix molding is an extension of polyester premix molding commonly used in many fiberglass applications (for example, manufacturing of fiberglass boats). Epoxy compounding is more complex than polyester compounding and there are more manufacturing steps to be taken using epoxies in order to attain high quality parts. Polyester molding has not been considered for alkali battery cases because of its lack of resistance to potassium hydroxide solutions. Premix molding is more economical than pre-preg molding as the hand lay-up operation is eliminated. Some strength is sacrificed, however, because of the lack of continuous fibers in the resulting part. However, the material is ideally suited for smaller parts and complex geometries.

B. Materials and Manufacturing Method Options (Continued)

The main problem with the fiberglass material is that, the weight savings are not appreciable and the method of manufacture is time consuming and costly.

Injection molding was selected as the method of manufacture for the radio housings. Injection molded parts are definitely the lowest cost type. Injection molding materials are generally lower strength than epoxy fiberglass materials that have been discussed above. However, test results using the selected material indicate that injected molded parts from polycarbonate Lexan 101-SE (Lexan 101 exceed fiberglass impact strength) material was utilized because of its all around capability. This material is an unfilled polycarbonate, self extinguishing material. This compounding provides sufficient flexibility to give extremely strong parts. Various compounds of polycarbonate are available which provide a wide range of capability. Another thermoplastic which has been considered for the radio cases is PVC (Polyvinylchloride). This material, commonly known for its use in high pressure water lines, has recently been perfected for applications demanding high impact strength. This material has unique strength properties as it retains the strength at high and low temperatures. Some informal testing was conducted on this material, and test results indicated this material comparable to the selected polycarbonate. More extensive testing might have been done had the material been on the market soon enough.

### C. Design Effort

Parts design was accomplished in three (3) different phases of the PEM, original concepts, engineering models and first article testing. Modifications were performed in these phases as the need became apparent as is described in this section.

Hardware was submitted in three (3) different phases for approval. These submissions were 1) Engineering Samples - Two (2) models of each component with physical characteristics as close to the final product as possible were submitted for approval. The purpose of these samples was to assure that there was no basic design conflict for their intended use, 2) The first article test samples were tested per SCS-458. Upon successful completion, three (3) samples were submitted to verify successful completion of the first article tests. Modifications required in order to pass the first article testing are presented later in this section, 3) The purpose of the pilot production run was to demonstrate the capability of producing the required number of parts at the specified rate. Also of importance was investigating and eliminating problems which arise when starting up a production line. The pilot production line articles (25) were submitted for approval.

#### 1. Radio Case (SM-D-435951)

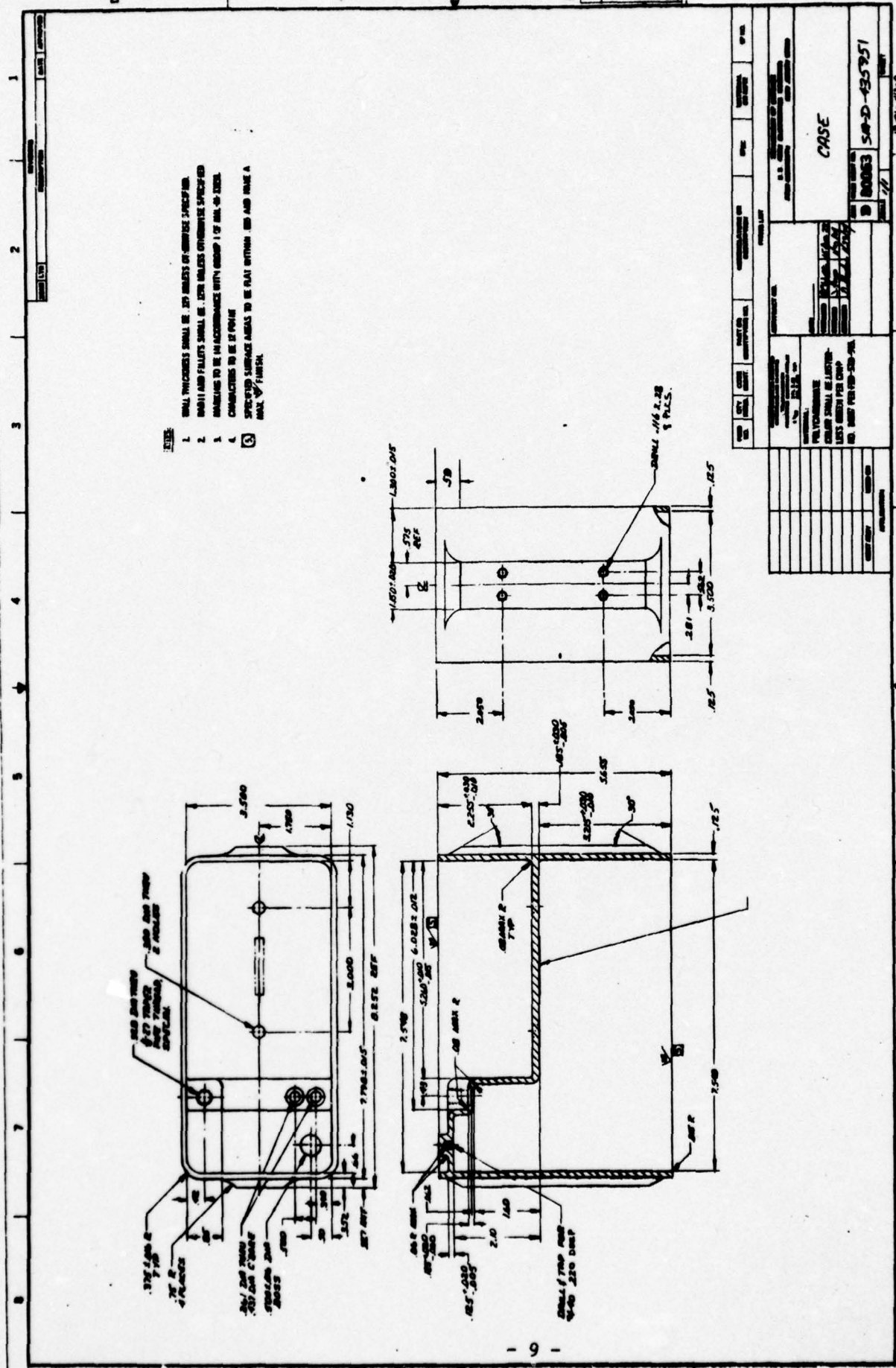
The radio case changed very little during the progress of the manufacturing methods contract. All internal dimensions and tolerances remain unchanged in order to accommodate the

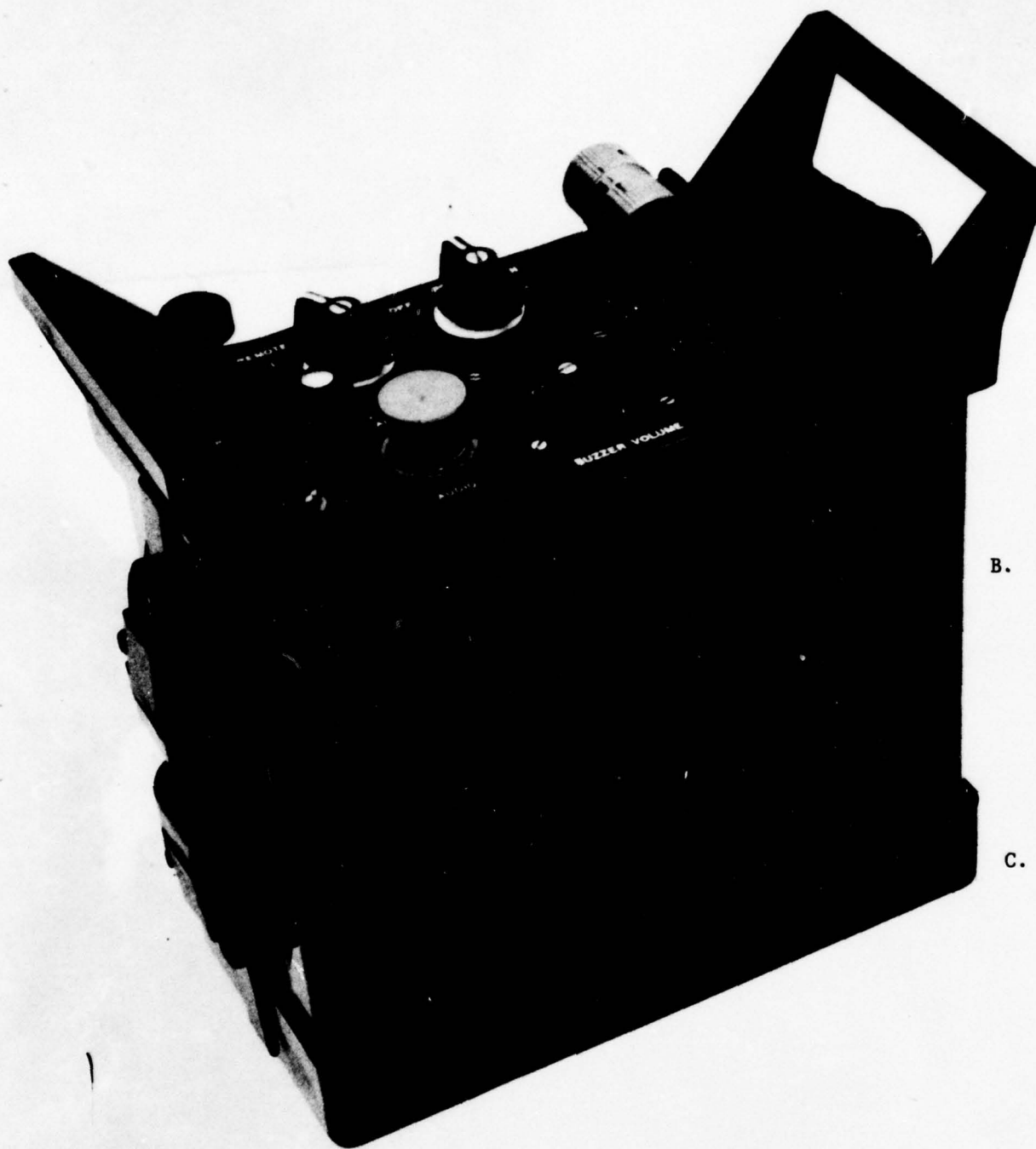
1. Radio Case (SM-D-435951) (Continued)

existing radio set. The wall thickness was increased to .125 in order to assure environmental requirements were maintained. Figure 1 represents the final design of the radio case. The case as in the original design is common to both the local and the remote radio set. The case is open on both the top and bottom and interfaces with the radio panel assembly and the bottom cover assembly (see Photo No. 1). The only other modification that was required was due to the increased thickness of the mounting lip on the open ends of the case. The sealing gasket for both the top panel and the bottom cover required a material of lower durometer to adequately seal the increased cross sectional area.

The material selected for the part was unfilled polycarbonate (Lexan 101). This material offers exceptional impact strength as well as good dimensional stability through the temperature ranges of -65°F to 160°F. No failures were experienced on the radio case when subjected to the extremely severe testing required by SCS-458. Item B of Photo No. 1 represents the radio case.

The manufacturing method used on the case was the injection molding process. This process is utilized where high volume with rigid dimensional accuracy and inexpensive parts are required.



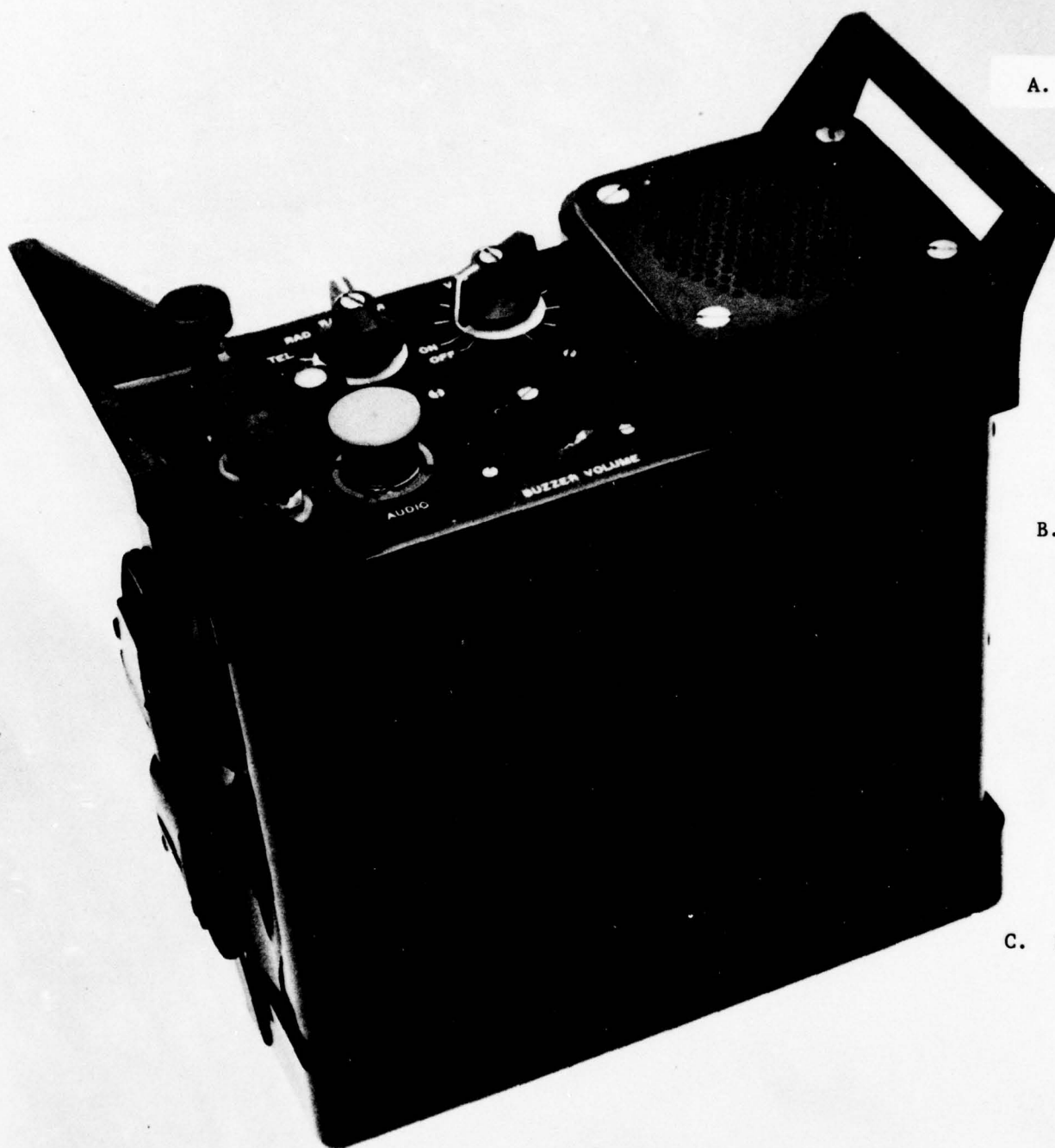


A. TOP PANEL

B. CASE

C. BOTTOM COVER

PHOTO NO. 1  
GRA/39 RADIO - REMOTE  
INSTALLED IN PLASTIC HOUSINGS  
- 10 -



A. TOP PANEL

B. CASE

C. BOTTOM COVER

PHOTO NO. 2  
GRA/39 RADIO - LOCAL  
INSTALLED IN PLASTIC HOUSINGS  
- 11 -

## 2. Bottom Cover

The bottom cover (Figure 2) (Item C of Photo No. 1).

The bottom cover, also is an injection molded part. The material used was polycarbonate (Lexan 101) for reasons mentioned earlier in this report.

In order to retain required rigidity, a reinforcing rib was molded around the outside parameter of the cover. This rib was incorporated to check any bowing of the cover when clamped to the radio case. The increased height required to incorporate the rib was offset by reducing the height of the top panels; The assembled set is only slightly taller (less than 1/8 inch) than the original radio set and still is accommodated by the existing carrying case (cotton duck bag).

A problem was experienced during testing in regard to loosening of the strikes on the cover during the high temperature/high humidity drop test of SCS-458. The problem will be discussed in detail in sub-heading "F" of this section.

## 3. Top Panel (Remote) (Figure 3)

The top panels were by far the most complex parts in regard to redesign. The injection molds for these parts were difficult and time consuming to produce, however once perfected, little trouble was experienced in regard to molding or piece parts production.

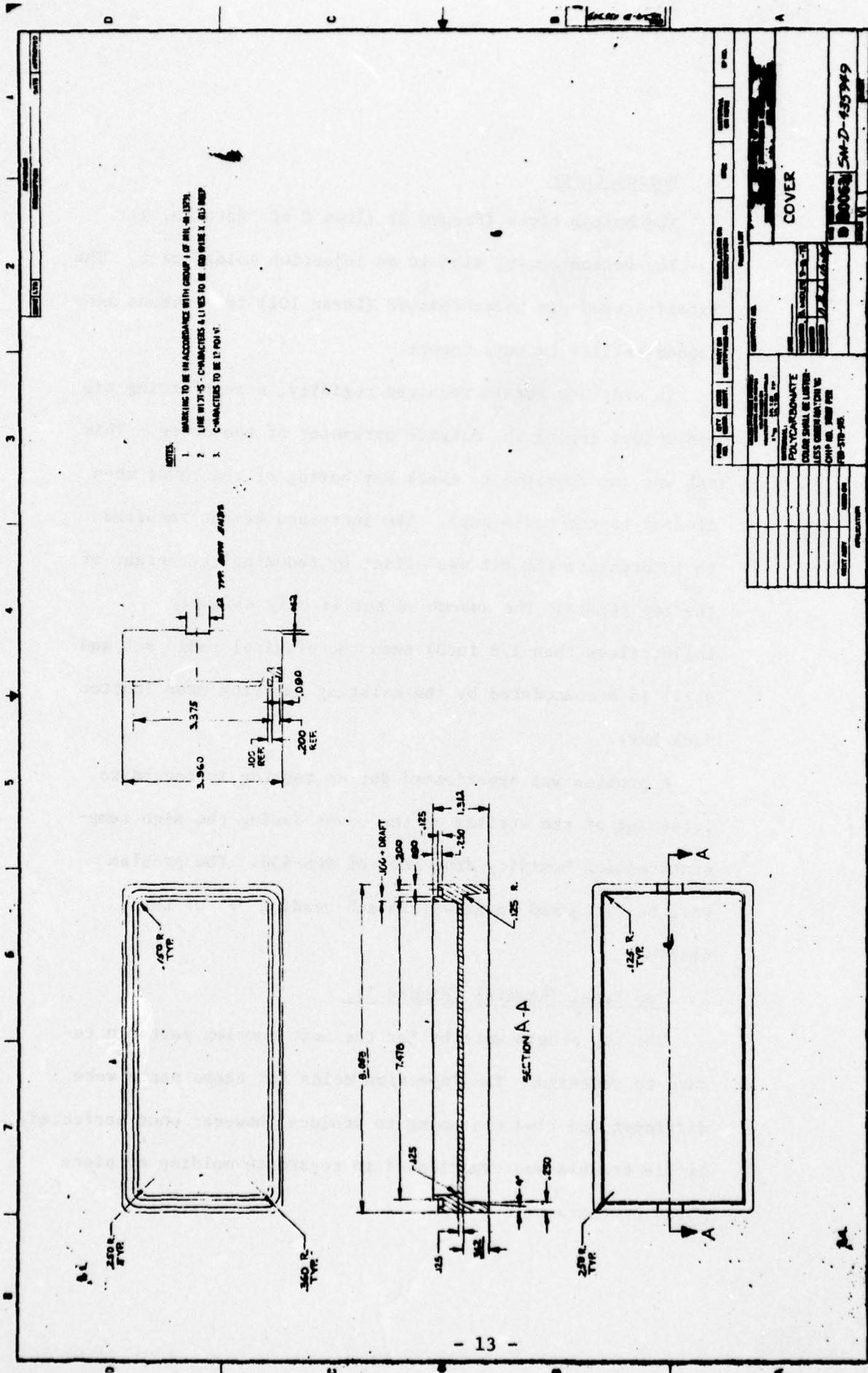


FIGURE NO. 2

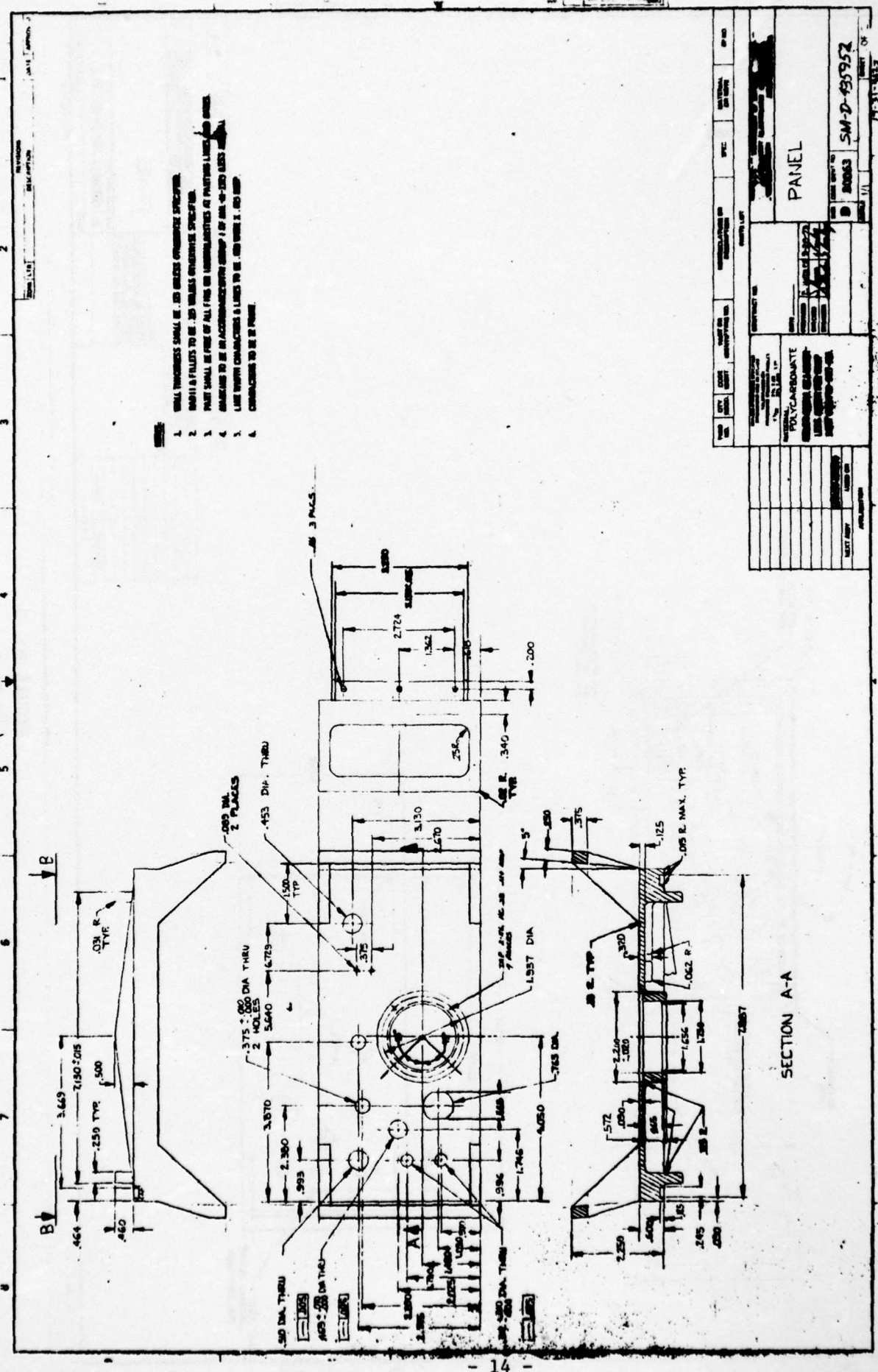


FIGURE NO. 3  
Sheet 1



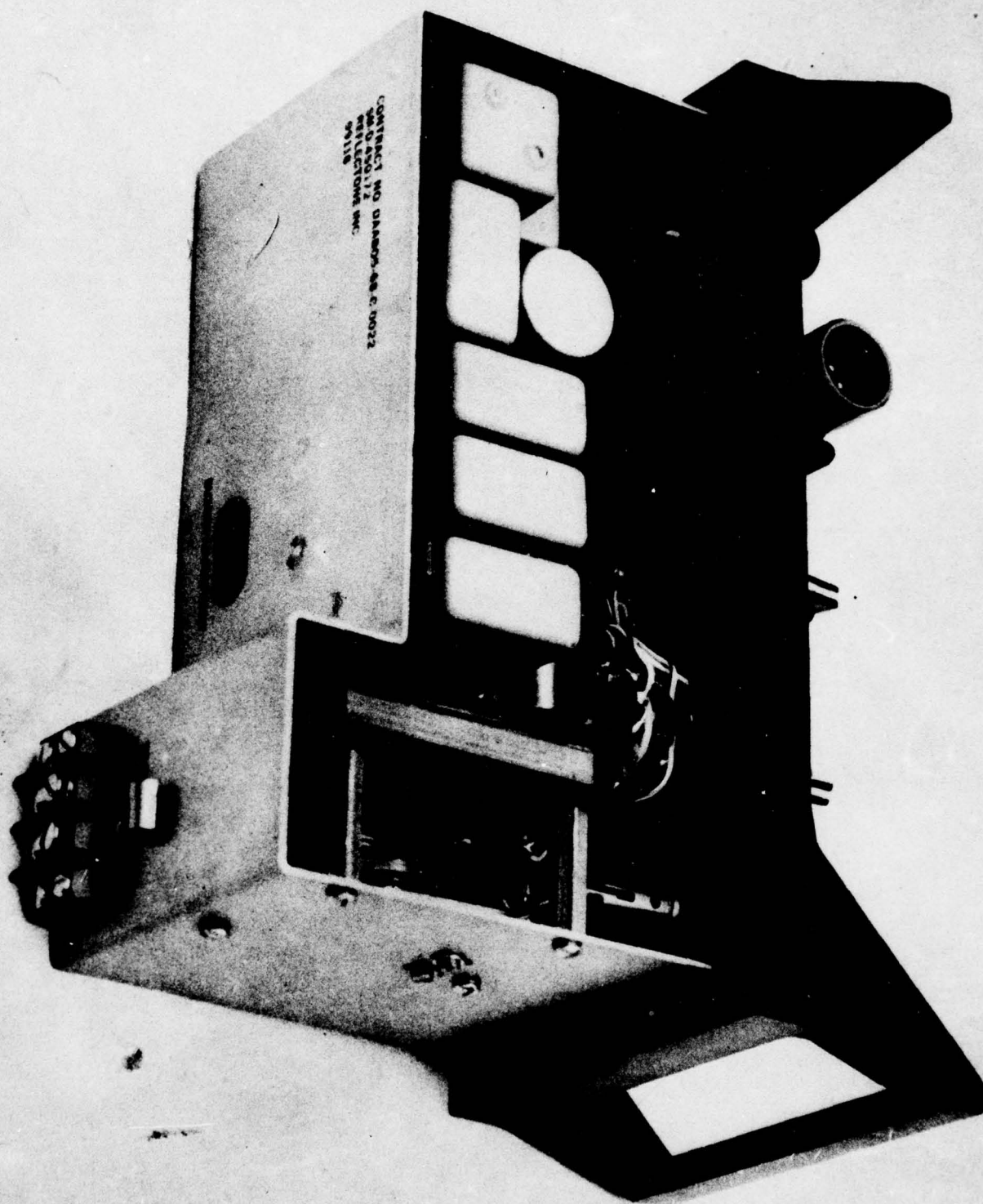


PHOTO NO. 3  
TOP PANEL (REMOTE)  
RADIO CHASSIS INSTALLED  
- 16 -

### 3. Top Panel (Remote) (Continued)

The most obvious redesign factor of the top panels (see Photo No. 2, Item A) was that the carrying handles were molded into the panel instead of being attached by screws as was done in the original design (metal housings). This feature is probably the most significant design improvement made in the redesign. The redesigned panels offer improved ruggedness, less manufacturing or assembly operations and therefore, lower cost than the existing metal housing. Additionally, the weight savings on this panel alone was cut in half.

Some problems were experienced in the high heat/high humidity drop test of SCS-458, again in regard to the loosening of hardware. This problem, as on the bottom cover, will be discussed in detail in sub-paragraph "F" of this section.

The material used for this panel was the same grade of polycarbonate as mentioned earlier in this section for the cover and case.

### 4. Top Panel (Local) (Figure 4)

The top panel of the local unit is very similar to the remote unit and therefore, the same manufacturing, assembly and test problems existed. Further discussion of this part would offer only a repeat of the above. See Item "A" of Photo No. 2.

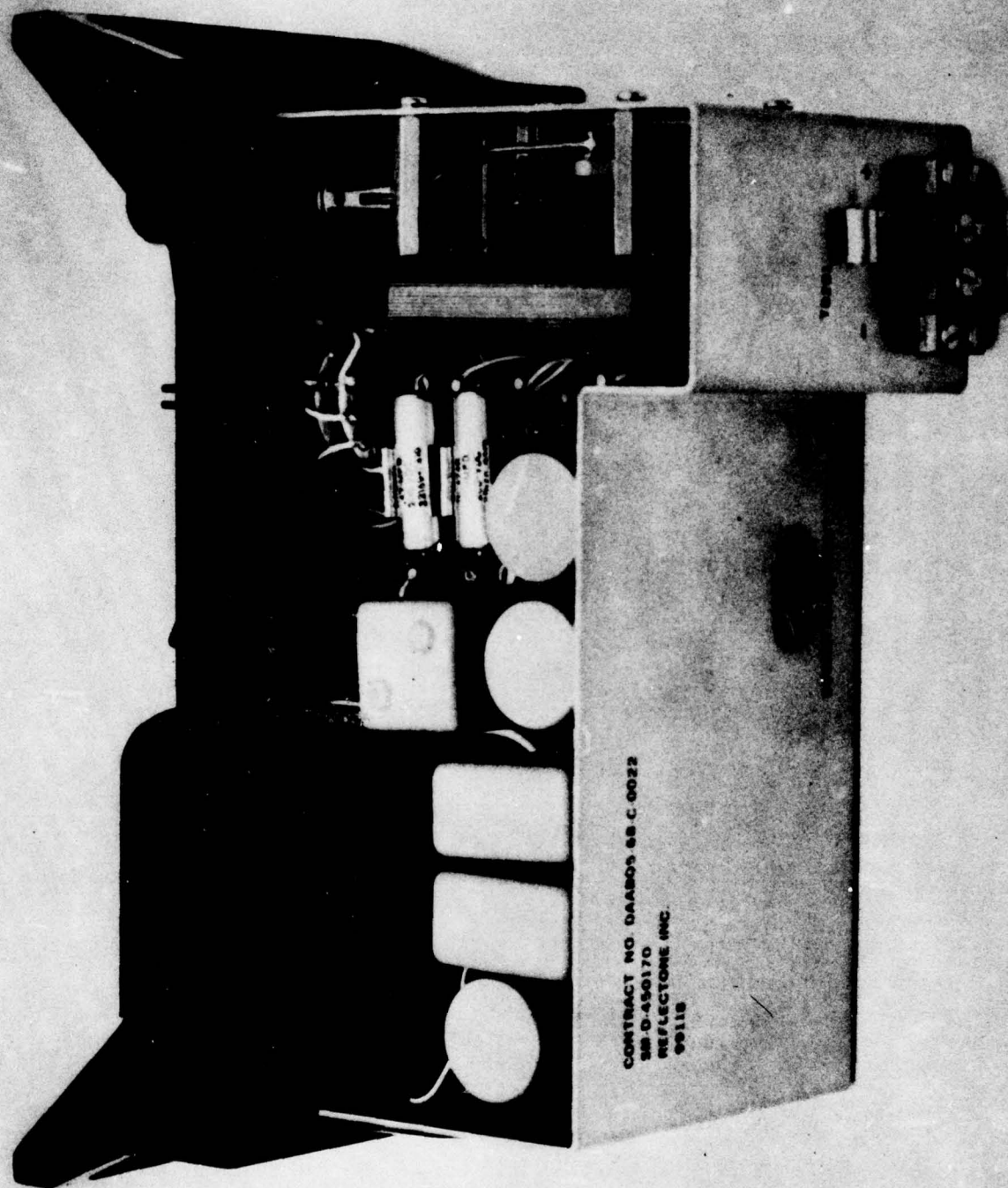


PHOTO NO. 4  
TOP PANEL (LOCAL)  
RADIO CHASSIS INSTALLED  
- 18 -

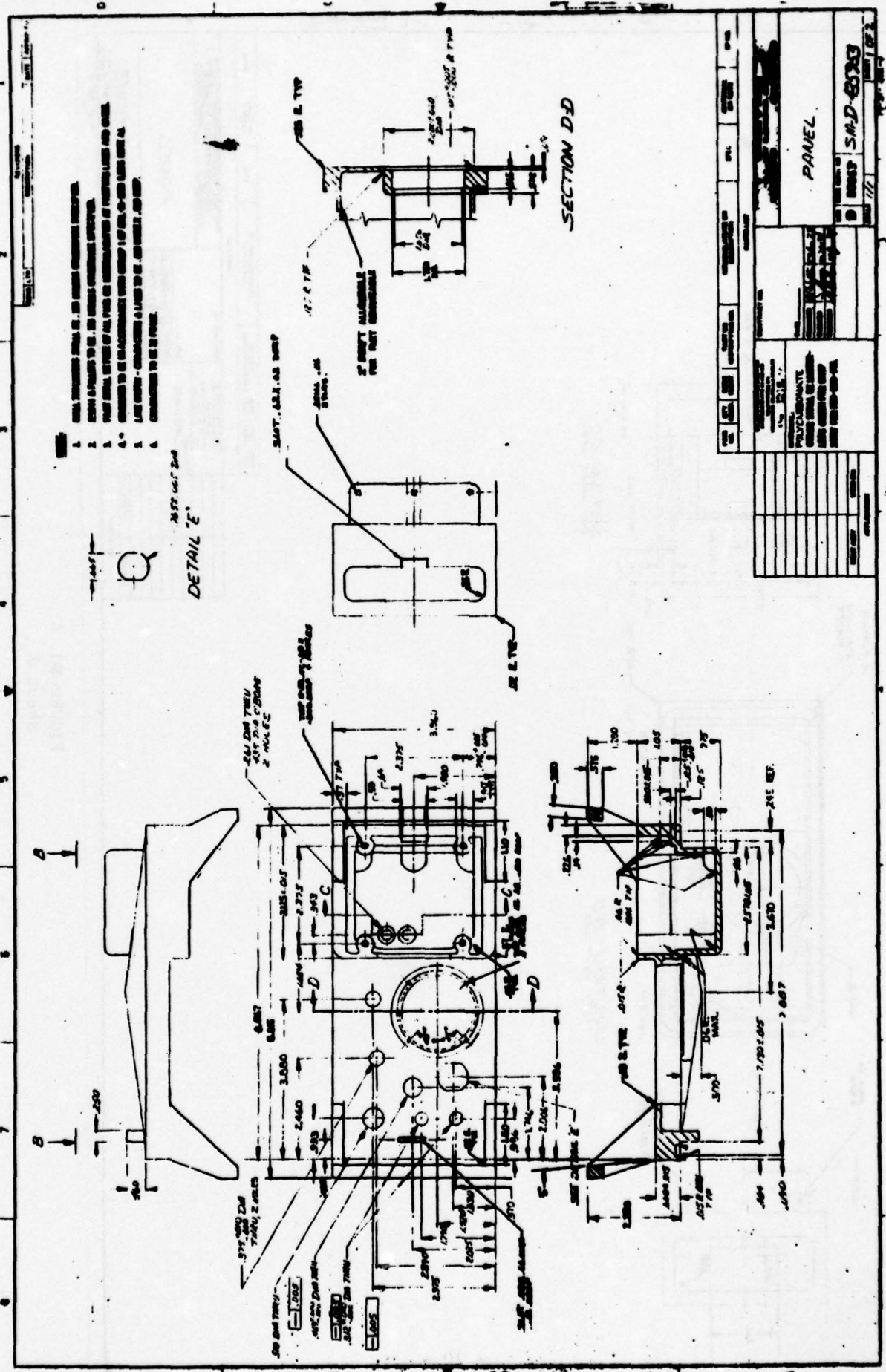
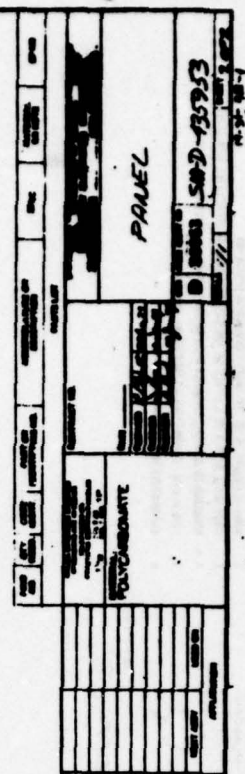


FIGURE NO. 4  
Sheet 1



**FIGURE NO. 4**  
**Sheet 2**

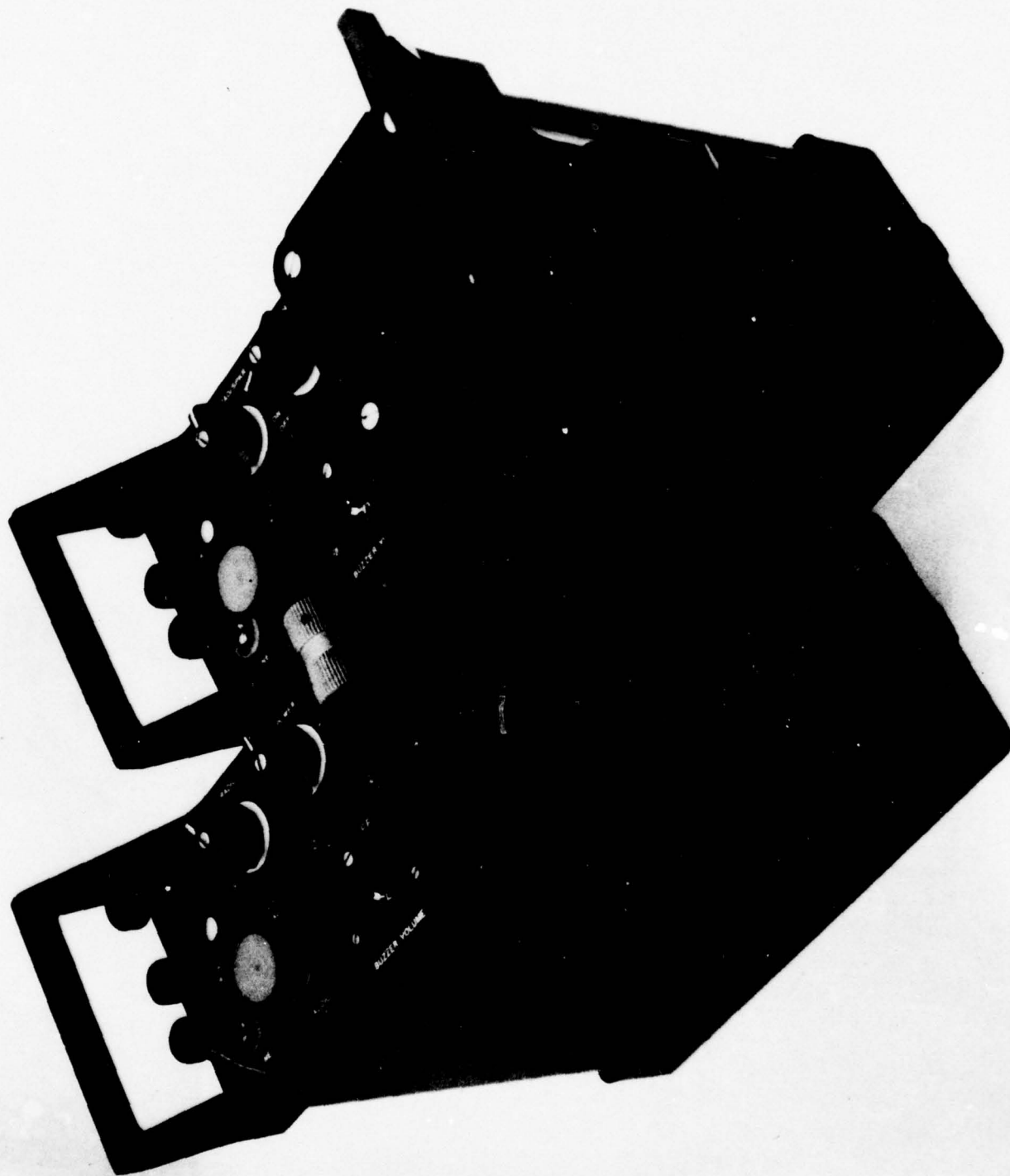


PHOTO NO. 5  
GRA-39 RADIO SET  
INSTALLED IN PLASTIC HOUSING  
- 21 -

#### D. Quality Assurance

##### 1. Introduction

Quality Assurance Measures were performed as parts were received by Eagle-Picher's Quality Control Plan. In addition to this initial inspection plan, the battery cases and their parts were qualified by First Article Testing and by visual sampling.

First Article Tests were conducted on the cases and components per Paragraph 4.4 of SCS-458.

The following are the test paragraphs from the Acceptance Test Report indicating applicable testing for each article.

- a. External and internal dimensions of case, covers and insertable assemblies, when such dimensions affect insertion of items.
- b. Dimensions of cavities, when such dimensions affect insertion of items.
- c. Location of matches or fasteners on separate parts of assemblies which must mate, such as cases, covers and mountings.
- d. Location of components, fasteners and mountings.

##### 2. Standard Test Conditions

Unless otherwise specified herein, all measurement and tests shall be made at a temperature between 68°F and 95°F, ambient atmospheric pressure and relative humidity.

### 3. Test Equipment and Inspection Facilities

Test equipment and inspection facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required inspection. The contractor shall establish calibration of test equipment to the satisfaction of the Government inspector.

### 4. Applicable Documents

- a. SCS-458
- b. MIL-R-55154B
- c. MIL-STD-810B

#### 6.1 Temperature Cycling

##### 6.1.1 Test Equipment

- a) Temperature Chamber (2), Messimer sufficient size and range to accommodate the test.

##### 6.1.2 Test Procedure

The temperature cycling was conducted in accordance with Method 503, Procedure 1 of MIL-STD-810.

##### 6.1.3 Test Results

At the conclusion of the test, the test samples were examined. No apparent damage was noted.

#### 6.2 Mechanical Shock

##### 6.2.1 Test Equipment

- a) Quick Release Drop Hook (Electronically Activated)
- b) Cradling Net
- c) Attaching Hook

#### 6.2.2 Test Procedure

The test samples were tested in accordance with Method 516.1, Procedure II of MIL-STD-810. The test samples were dropped from a height of 48 inches for a total of 26 drops.

#### 6.2.3 Test Results

No apparent damage resulted from the drop test. Only minor scuffing and scraping of the housings was evident.

#### 6.3 Bounce Test

##### 6.3.1 Test Equipment

a) Package Tester, Type 1000-SC as made by L.A.B. Corporation, Skaneateles, New York.

##### 6.3.2 Test Procedure

The test samples were subjected to the test of Method 514, Procedure XI of MIL-STD-810.

##### 6.3.3 Test Results

No operation damage occurred to the radio housings during the bounce test.

#### 6.4 Vibration

##### 6.4.1 Test Equipment

a) Shaker, Ling, 275A  
b) Power Supply, Ling, PP-60/80

##### 6.4.2 Test Procedure

The test samples were subjected to the tests of Method 514, Procedure IX, Part 1, of MIL-STD-810.

6.4.3 Test Results

No operational or physical damage occurred from the vibration testing.

6.5 Immersion

6.5.1 Test Equipment

a) Immersion Tank to accommodate 36 inches of water over the upper most part of the radio housing.

6.5.2 Test Procedure

The test samples were tested in accordance with Method 512, Procedure I of MIL-STD-810.

6.5.3 Test Results

No leakage was present at conclusion of the test.

6.6 Air Seal

6.6.1 Test Equipment

- a) Vacuum Pump
- b) Shut-Off Valve
- c) Mercury Manometer, Meriam, Model 31EC10

6.6.2 Test Procedure

The test was conducted in accordance with Paragraph 4.9 of MIL-R-55154B.

6.6.3 Test Results

The radios passed the requirements of 4.9 of MIL-R-55154B.

6.7 Humidity

6.7.1 Test Equipment

- a) Humidity Chamber, ATO - Model HB4127.

#### 6.7.2 Test Procedure

The test samples were subjected to the testing required by Method 507, Procedure II of MIL-STD-810B.

#### 6.7.3 Test Results

The radio cases passed the Humidity Test. Hardware remained secure with no loosening.

#### 6.8 High Temperature - High Humidity Drop

##### 6.8.1 Test Equipment

- a) Humidity Chamber, ATL - Model HB4127
- b) Quick Release Hook
- c) Cradling Net

##### 6.8.2 Test Procedure

The samples were tested in accordance with Paragraph 4.4.8 of Specification SCS-458.

##### 6.8.3 Test Results

No failures were experienced during the drop testing of Para. 4.4.8 of SCS-458.

#### 6.9 Low Temperature Drop

##### 6.9.1 Test Equipment

- a) Temperature Chamber
- b) Quick-Release Hook
- c) Cradling Net

##### 6.9.2 Test Procedure

The test samples were subjected to the testing of Paragraph 4.4.9 of SCS-458.

### 6.9.3 Test Results

The test samples did not sustain any damage which would impair the function of the housings during the drop test.

### 6.10 Altitude

#### 6.10.1 Test Equipment

a) Altitude Chamber

#### 6.10.2 Test Procedure

The test was performed in accordance with Method 500, Procedure I of MIL-STD-810B.

#### 6.10.3 Test Results

The radio housings sustained no damage as a result of the altitude test.

### 6.11 Fungus Test

Fungus testing was not performed due to contract modification.

### 6.12 Salt Fog

#### 6.12.1 Test Equipment

a) Salt Fog Chamber - Industrial Filter and Mfg. Co., Model 411.1 ABC.

#### 6.12.2 Test Procedure

The test samples were tested in accordance with Method 509, Procedure I of MIL-STD-810B.

#### 6.12.3 Test Results

The housings sustained no damage or deterioration due to the salt fog test.

6.13 Rain

6.13.1 Test Equipment

a) Humidity Chamber (Modified), ATL, Model HB4127.

6.13.2 Test Procedure

The testing was performed in accordance with Method 506, Procedure I of MIL-STD-810.

6.13.3 Test Results

The housings showed no signs of leakage after the rain test.

6.14 Sand and Dust

6.14.1 Test Equipment

a) Sand and Dust Chamber, Standard Model 1195.

6.14.2 Test Procedure

The test was performed in accordance with Method 510, Procedure I of MIL-STD-810.

6.14.3 Test Results

The housings passed the sand and dust test. No sand or dust penetrated the housings. All controls remained operable.

6.15 Low Temperature - Non-Operating

6.15.1 Test Equipment

a) Temperature Chamber - Conrad

6.15.2 Test Procedure

The test samples were tested in accordance with MIL-STD-810, Method 502, Procedure I.

6.15.3 Test Results

No apparent damage resulted from the test.

6.16 High Temperature - Non-Operating

6.16.1 Test Equipment

a) Temperature Chamber - Messimer

6.16.2 Test Procedure

The test samples were subjected to the testing of MIL-STD-810, Procedure II, Method 501.

6.16.3 Test Results

No damage to the housings resulted from the high temperature - non-operating test.

6.17 Sunshine

6.17.1 Test Equipment

a) Incandescent Spot Lamp - G. E.

6.17.2 Test Procedure

The samples were subjected to simulated sunshine in accordance with MIL-STD-810, Method 505, Procedure I.

6.17.3 Test Results

No fading, cracking or other deterioration was apparent as a result of the test.

6.18 Flammability

6.18.1 Test Equipment

a) Propane Torch

6.18.2 Test Procedure

The test was performed on a representative housing in accordance with Paragraph 4.4.18 of SCS-458.

6.18.3 Test Results

The housing after being subjected to an open flame for a minimum of 15.0 seconds, extinguished immediately upon the removal of the flame.

6.19 Electromagnetic Testing

Deleted from specification for this program.

6.20 Weight

6.20.1 Test Equipment

a) Scales - Toledo, Model 3710, Accuracy  $\pm$  1.0 gram.

6.20.2 Test Procedure

The test samples were inspected per Para. 3.1.2 of SCS-458.

6.20.3 Test Results

S/N 11979

Remote 6.47 Lbs.

Local 5.51 Lbs.

S/N 11980

Remote 6.48 Lbs.

Local 5.55 Lbs.

S/N 8417

Remote 6.45 Lbs.

Local 5.54 Lbs.

#### E. Production Run

Records were made during the PEM Program to analyze costs of piece part items and equipment. Yield rates were also maintained for each of the four (4) parts manufactured. Table I summarizes materials selection, material physical properties and manufacturing methods.

Table II summarizes cost comparisons between the new plastic housings and the original metal housings.

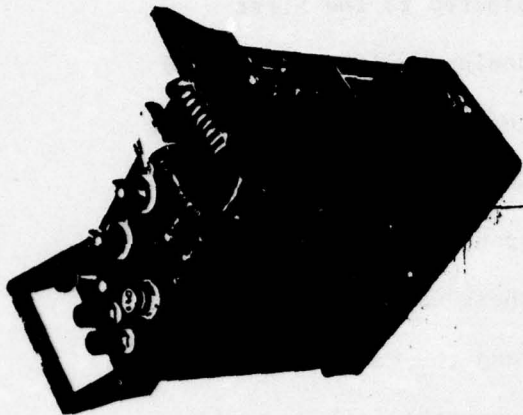
TABLE I  
MATERIAL SELECTION AND PROPERTIES

PART	E-P DWG.	USAECONO.	SELECTED MATERIAL	MFG. METHOD.	REASON FOR SELECTION	SOURCE OF MATERIAL	WEIGHT	
							ORIG.	NEW
Case	19-31-412-0	SM-D-435951	Lexan 101-SE	Injection Mold	Lightweight Ruggedness Producibility High Prod. Rates Low Cost	General Electric	2.90	1.05
Cover, Bottom	19-31-412-3	SM-D-435949	Lexan 101-SE	Injection Mold	Same as Above	General Electric	1.38	.50
Panel (Local)	19-31-412-1	SM-D-435953	Lexan 101-SE	Injection Mold	Same as Above	General Electric	1.82	.66
Panel (Remote)	19-31-412-2	SM-D-435952	Lexan 101-SE	Injection Mold	Same as Above	General Electric	1.57	.57

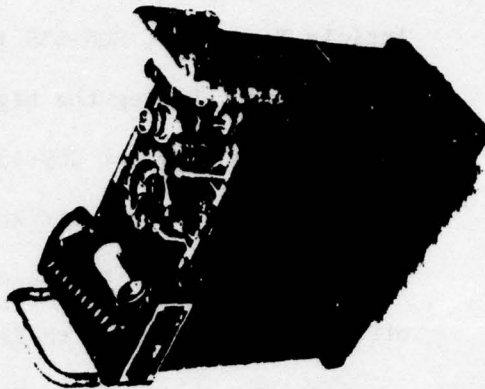
TABLE II  
COST ANALYSIS AND PRODUCTION RATES  
BEFORE AND AFTER PEM

PART DESCRIPTION	PART NO.	BEFORE COST OF EQUIP.	AFTER COST OF EQUIP.	BEFORE COST PER PART	PROD. RATE BEFORE	PROD. RATE AFTER	MFG. METHOD BEFORE	MFG. METHOD AFTER	SUPPLIER
Case	SM-D-435951	\$5,000*	\$12,000	\$20 *	6 Per Hr.*	50 Per Hr.	Die Cast	Injection Mold	Western Controls, Wichita, Ks.
Cover	SM-D-435949	\$2,000*	\$5,000	\$10*	6 Per Hr.*	50 Per Hr.	Die Cast	Injection Mold	Same as above.
Panel, Remote	SM-D-435952	\$2,500*	\$12,000	\$20*	6 Per Hr.*	50 Per Hr.	Die Cast	Injection Mold	Same as above.
Panel, Local	SM-D-435953	\$2,500*	\$12,000	\$20*	6 Per Hr.*	50 Per Hr.	Die Cast	Injection Mold	Same as above.

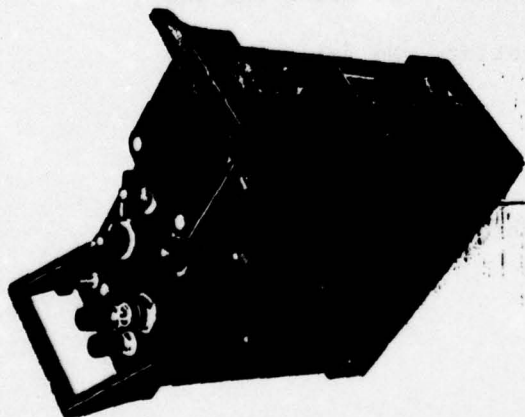
\* Estimate by Eagle-Picher



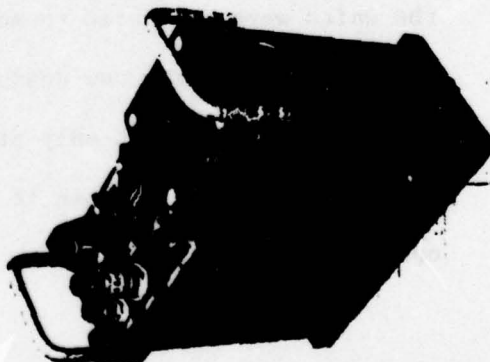
LOCAL UNIT - PLASTIC HOUSINGS



LOCAL UNIT - METAL HOUSINGS



REMOTE UNIT - PLASTIC HOUSINGS



REMOTE UNIT - METAL HOUSINGS

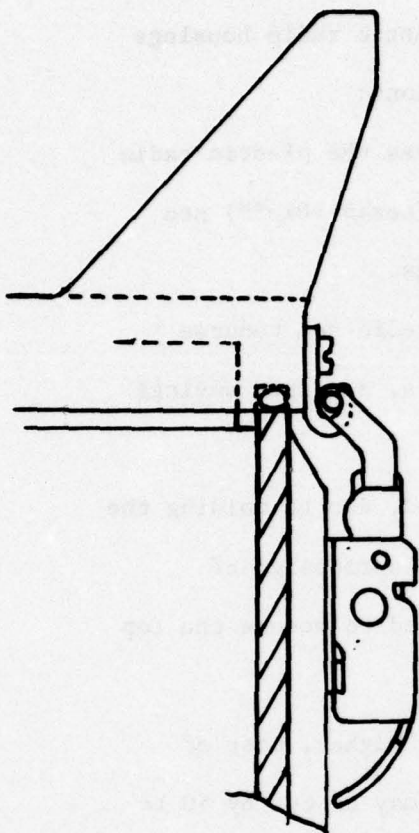
F. Design Modifications

The plastic housings after being subjected to the First Article Testing of SCS-458 indicated a design modification would be required. During the high temperature/high humidity drop test of Paragraph 4.4.8 of SCS-458, the housing failed. The attaching screws which held the strike on the top panels and the bottom cover were loosened to the extent that there was no longer an effective seal between those components and the case assembly.

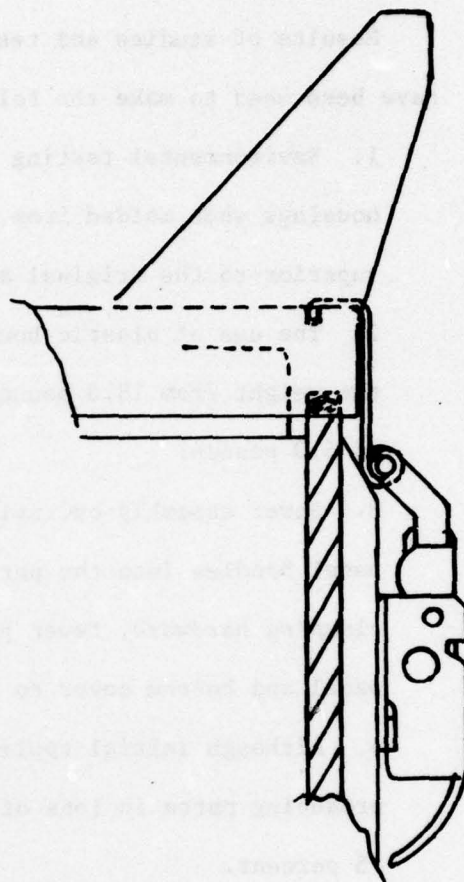
A meeting was held at USAECOM to discuss the failure problem. It was agreed during the meeting to delete the strikes from the panel and cover and instead incorporate an indentation in each component to accommodate a clamping device which would be part of the latch assembly. (See Figure 5 for details of this modification.)

The modification was made and one (1) radio set was retested per Paragraph 4.4.8 of SCS-458 with no further failures experienced. The new design endured the test with no visible degradation. This design was therefore incorporated on the pilot production run and the units were subjected to Acceptance Testing. No failures were encountered with the new design.

The new design not only proved much more reliable, but also was less expensive because it reduces machining and assembly operations.



OLD METHOD



NEW METHOD

FIGURE NO. 5

## G. Conclusions

Results of studies and testing of the plastic radio housings have been used to make the following conclusions:

1. Environmental testing of SCS-458 proves the plastic radio housings when molded from polycarbonate (Lexan 101-SE) are superior to the original aluminum housings.
2. The use of plastic housings for the radio set reduces the weight from 18.0 pounds to 12.0 pounds, a weight savings of 6.0 pounds.
3. Fewer assembly operations are required, due to molding the panel handles into the part. Also due to a redesign of clamping hardware, fewer parts are required to secure the top panel and bottom cover to the radio case.
4. Although initial tooling costs may be higher, cost of producing parts in lots of 2,500 or more may be cut by 50 to 75 percent.
5. Production rates can be improved significantly using the injection mold method of manufacture.
6. Part finish work is reduced to minimum, since the raw stock material is bought to the required color, eliminating the paint operation.

### Discussion:

In view of the above presented data, it appears that there should be no question in regard to the superiority of the plastic housings over the existing aluminum housings.

## II. PROCESS SPECIFICATIONS

### A. Case (SM-D-435951)

#### 1. Manpower and Space Required

<u>OPERATION</u>	<u>DESCRIPTION</u>	<u>MAN MINUTES REQUIRED PER LOT</u>	<u>PER PART</u>
Set-Up Time	Time Required to Get Equipment Ready for Molding	480	
Molding Time	Actual Time Needed to Mold the Part		1.3
Drilling Operations	Drill Holes for Hardware		5
Assembly	Install Latches and Labels		10
TOTAL		480	16.3

MOLDER: Western Controls  
2533 Southwest Street  
P. O. Box 1202  
Wichita, Kansas 67201

Floor Space Available: Approximately 50,000 sq. ft.

Floor Space Needed: 5,000 sq. ft.

#### 2. Equipment, Tools, Jigs and Fixtures Required

- (a) Mold - 19-31-412-0
- (b) Molding Machine - Reed, Model 300, Reciprocating Screw,  
30 oz., 350 ton maximum for preparing resin for  
injection into mold.
- (c) Oven - Size and temperature range to meet production  
requirements. Used to dry the resin previous to  
molding.
- (d) Scales - For weighing moisture content of material.  
Type and capacity to meet application.
- (e) Drill Press - Type and size dependent on production  
rate. (Used to drill holes as required.)
- (f) Drill Jigs - For positioning holes for mounting hardware.

### 3. Material Required (ABS)

- (a) Polycarbonate (Unfilled)
- (b) Lexan, 101-SE (GSM)
- (c) Form - Pelletized Custom Color 3015 Dk. Green

The advantages of this material are that it is one of the easier plastics to mold and possesses excellent impact strength. The material will withstand severe impacts which may occur in shipment or in field use.

### 4. Molding Operations

- (a) Drying - Place stock material in oven or in hopper dryer. Adjust temperature to 170 - 190°F. Dry stock material until there is less than .05 of 1% moisture by weight.
- (b) Fill hopper (if stock material was dried in an oven) with resin.
- (c) Preheat mold to 150°F.
- (d) Stabilize stock material from 435 to 475°F depending on existing conditions (plastication). This is done by the heater band elements located within the mold cylinder. Slight readjustment may be necessary as cycling of mold progresses.
- (e) Regulate nozzle temperatures not to exceed temperatures of the stock material.

4. Molding Operations (Continued)

- (f) Meter stock into cylinder and regulate temperature of stock as follows.

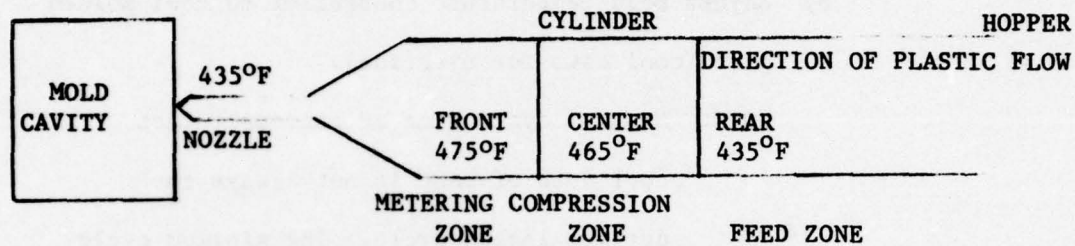


FIGURE NO. 6

- (g) Fill mold cavity and make following adjustments during cycling.

- 1) Injection Pressure 10,000 - 20,000 psi.
- 2) Shot Weight should be 476 grams.
- 3) Regulate fill speed at 5 3/4 inches.
- 4) Adjust screw speed to 9.9 (yellow).

NOTE: The above is a general setting. Ultimate choice of fill speed should be one that completely fills and will consistently mold satisfactory parts. Faster fill speeds can cause short shots, burning of the plastic material or weld lines.

#### 4. Molding Operations (Continued)

- 5) During cycling of machine and once normal screw rpm and heater band adjustments have reached optimum operating efficiency; adjust "back pressure" to approximately 100 psi to maintain a close control over stock temperature.
- 6) Adjust mold temperature controller to cool molded part (cool down for ejection).

NOTE: Minimum cycle time or extremely fast cool down of part is not always the optimum length cycle. The minimum cycle is often too sensitive to changes in ambient temperature. Increasing cycle times of only one or two seconds can increase reject rates considerably.

- 7) Check part ejection system as cycling commences to insure against "pile ups".
- (h) Consult Figure No. 7 for complete molding specifications.

NOTE: The above is general information based on experience; however, "values can change with varying conditions, materials, part design, etc." The molder must make any adjustments or alterations as the molded sampling indicates necessary. Table III is provided to aid in troubleshooting molding problems.



5. Machining Operations

- (a) Using drill jib 19-31-412-0, locate and drill eight hardware mounting holes per Drawing 19-31-412-0.
- (b) Tap to holes inside case cavity per Drawing 19-31-412-0.

6. Assembly of Hardware

- (a) Install four (4) latches with eight (8) screws per Drawing \_\_\_\_\_ in the Appendix of this report.
- (b) Install battery positioning, and identification label as required.

7. Mold Maintenance

- (a) Use dry air to blow out cooling channels.
- (b) Core and cavity areas are sprayed with commercial rust preventative.
- (c) Close mold and place in an assigned position in mold storage rack. Mold storages are located in an air conditioned area.

B. Cover, Bottom (SM-D-435949)

1. Manpower and Space Required

<u>OPERATION</u>	<u>DESCRIPTION</u>	<u>MAN MINUTES REQUIRED PER LOT</u>	<u>PER PART</u>
Set-Up Time	Time Required to Get Equipment Ready for Molding	480	
Molding Time	Actual Time Needed to Mold the Part		1.16
Drilling Operations	Drill Holes for Hardware		None
Machining Operation			None
Assembly	Gasket (Assemble Lower Case)	_____	<u>3</u>
	TOTAL	480	4.16

1. Manpower and Space Required (Continued)

MOLDER: Western Controls  
2533 Southwest Street  
P. O. Box 1202  
Wichita, Kansas 67201

Floor Space Available: Approximately 50,000 sq. ft.

Floor Space Needed: 5,000 sq. ft.

2. Equipment, Tools, Jigs and Fixtures Required

- (a) Mold - 19-31-412-3
- (b) Molding Machine - Reed, Model 200, Reciprocating Screw,  
18 oz., 350 ton maximum for preparing resin for  
injection into mold.
- (c) Oven - Size and temperature range to meet production  
requirements. Use to dry the resin previous to  
molding.
- (d) Scales - For weighing moisture content of material.  
Type and capacity to meet application.

3. Material Required

- (a) Polycarbonate (unfilled).
- (b) Lexan 101-SE
- (c) Form - Pelletized Custom Color 3015, Dk. Green

4. Molding Operations

- (a) Drying - Place stock material in oven or in hopper  
dryer. Adjust temperature to 170-190°F. Dry stock  
material until there is less than .05 of 1% moisture  
by weight.
- (b) Fill hopper (if stock material was dried in an oven)  
with resin.

4. Molding Operations (Continued)

- (c) Mold Temperature (chiller)
- (d) Stabilize stock material from 450 to 475°F depending on existing conditions (plastication). This is done by the heater band elements located within the mold cylinder. Slight readjustment may be necessary as cycling of mold progresses.
- (e) Regulate nozzle temperature not to exceed temperatures of the stock material.
- (f) Meter stock into cylinder and regulate temperature of stock as follows.

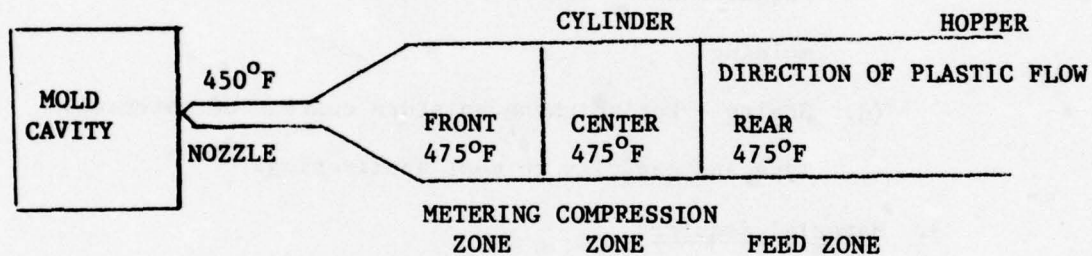


FIGURE NO. 8

- (g) Fill mold cavity and make following adjustments during cycling.
  - 1) Injection Pressure 10,000 - 20,000 psi
  - 2) Shot Weight should be 225 grams.
  - 3) Regulate fill speed at 2 7/8 inches.

#### 4. Molding Operations (Continued)

- 4) Adjust screw speed to medium range (2.0 yellow).

NOTE: The above is a general setting. Ultimate choice of fill speed should be one that completely fills and will consistently mold satisfactory parts. Faster fill speeds can cause short shots, burning of the plastic material or weld lines.

- 5) During cycling of machine and once normal screw rpm and heater band adjustments have reached optimum operating efficiency; adjust "back pressure" to approximately 100 psi to maintain a close control over stock temperature.
- 6) Adjust mold temperature controller to cool molded part (cool down for ejection).

NOTE: Minimum cycle time or extremely fast cool down of part is not always the optimum length cycle. The minimum cycle is often too sensitive to changes in ambient temperature. Increasing cycle times of only one or two seconds can increase reject rates considerably.

- 7) Check part ejection system as cycling commences to insure against "pile ups".

4. Molding Operations (Continued)

- (h) Consult Figure No. 9 for complete molding specifications.

NOTE: The above is general information based on experience; however, "values can change with varying conditions, materials, part design, etc." The molder must make any adjustments or alterations as the molded sampling indicates necessary. Table III is provided to aid in troubleshooting molding problems.

5. Assembly Operations - Install Cover Gasket

- (a) SM-A-435969 to the cover using RTV-108 as supplied by the General Electric Company.
- (b) Install identification label as required.

6. Mold Maintenance

- (a) Use dry air to blow out cooling channels.
- (b) Core and cavity areas are sprayed with commercial rust preventative.
- (c) Close mold and place in an assigned position in mold storage rack. Mold storages are located in an air conditioned area.

PLASTIC DEPT. INTERSHOP ORDER

**SECRET**

23

412-5

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NO. 1

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C. Panel, Remote (SM-D-435952)

1. Manpower and Space Required

<u>OPERATION</u>	<u>DESCRIPTION</u>	<u>MAN MINUTES REQUIRED PER LOT</u>	<u>REQUIRED PER PART</u>
Set-Up Time	Time Required to Get Equipment Ready for Molding	480	
Molding Time	Actual Time Needed to Mold the Part		1.25
Drill & Tap Holes	For Hardware Installation		10
Assembly	Install Gasket, Brackets and Fill Lettering		15
	TOTAL	480	26.25

MOLDER: Western Controls  
2533 Southwest Street  
P. O. Box 1202  
Wichita, Kansas 67201

Floor Space Available: Approximately 50,000 sq. ft.

Floor Space Needed: 5,000 sq. ft.

2. Equipment, Tools, Jigs and Fixtures Required

- (a) Mold - 19-31-412-2
- (b) Molding Machine - Reed, Model 300, Reciprocating Screw,  
30 oz., 350 ton maximum for preparing resin for injection  
into mold.
- (c) Oven - Size and temperature range to meet production  
requirements. Used to dry the resin previous to  
molding.
- (d) Scales - For weighting moisture content of material.  
Type and capacity to meet application.
- (e) Drill Press - Type and size dependent on production  
rate. (Used to drill and tap holes as required).
- (f) Drill Jig - For positioning holes (19-31-412-2).

### 3. Material Required

- (a) Polycarbonate (unfilled)
- (b) Lexan 101-SE
- (c) Form - Pelletized, Custom Color 3015, Dk. Green.

### 4. Molding Operations

- (a) Drying - Place stock material in oven or in hopper dryer. Adjust temperature to 170-190°F. Dry stock material until there is less than .05 of 1% moisture by weight.
- (b) Fill hopper (if stock material was dried in an oven) with resin.
- (c) Preheat mold to 125°F.
- (d) Stabilize stock material from 460 to 510°F depending on existing conditions (plastication). This is done by the heater band elements located within the mold cylinder. Slight readjustment may be necessary as cycling of mold progresses.
- (e) Regulate nozzle temperatures at 510°F.
- (f) Meter stock into cylinder and regulate temperature of stock as follows:

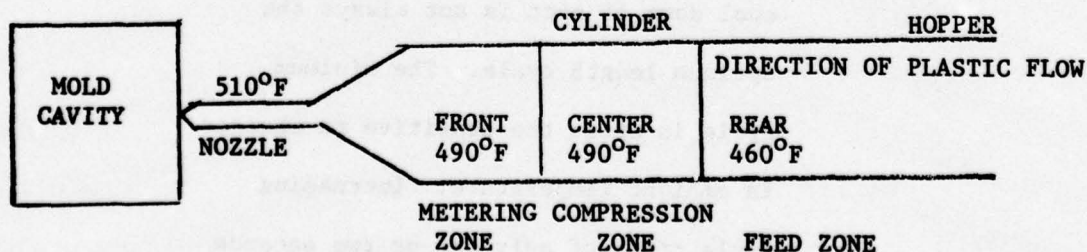


FIGURE NO. 10

#### 4. Molding Operations (Continued)

(g) Fill mold cavity and make following adjustments during cycling.

- 1) Injection Pressure 10,000 - 20,000 psi
- 2) Shot Weight should be 260 grams
- 3) Regulate fill speed at 2 3/4 inches
- 4) Adjust screw speed to medium (Blue 9.0)

NOTE: The above is a general setting. Ultimate choice of fill speed should be one that completely fills and will consistently mold satisfactory parts. Faster fill speeds can cause short shots, burning of the plastic material or weld lines.

- 5) During cycling of machine and once normal screw rpm and heater band adjustments have reached optimum operating efficiency; adjust "back pressure" to approximately 100 psi to maintain a close control over stock temperature.
- 6) Adjust mold temperature controller to cool molded part (cool down for ejection).

NOTE: Minimum cycle time or extremely fast cool down of part is not always the optimum length cycle. The minimum cycle is often too sensitive to changes in ambient temperature. Increasing cycle times of only one or two seconds can increase reject rates considerably.

#### 4. Molding Operations (Continued)

- 7) Check part ejection system as cycling commences to insure against "pile ups".

(h) Consult Figure No. 11 for complete molding specifications.

NOTE: The above is general information based on experience; however, "values can change with varying conditions, materials, part design, etc." The molder must make any adjustments or alterations as the molded sampling indicates necessary. Table III is provided to aid in troubleshooting molding problems.

#### 5. Machining Operations

Drill and tap required holes per Drawing SM-D-453952.

#### 6. Assembly Operations

- (a) Install gasket SM-A-435954 to the panel using RTV-108 as supplied by General Electric.
- (b) Install two (2) support brackets to underside of panel (slip fit only brackets will be secured at radio installation). Bracket P/N's are SM-A-435967 and SM-A-435968.
- (c) Fill instrument identification lettering using florescent white paint on top side of panel.

#### 7. Mold Maintenance

- (a) Use dry air to blow out cooling channels.
- (b) Core and cavity areas are sprayed with commercial rust preventative.
- (c) Close mold and place in an assigned position in mold storage rack. Mold storages are located in an air conditioned area.



D. Panel, Local (SM-D-435953)

1. Manpower and Space Required

<u>OPERATION</u>	<u>DESCRIPTION</u>	<u>MAN MINUTES REQUIRED PER LOT</u>	<u>REQUIRED PER PART</u>
Set-Up Time	Time Required to Get Equipment Ready for Molding	480	
Molding Time	Actual Time Needed to Mold the Part		1.25
Drilling and Tapping Operation	Drill and Tap Holes for Hardware		10
Assembly	Install Gasket and Bracket Fill Lettering		15
TOTAL		480	26.25

MOLDER: Western Controls  
2533 Southwest Street  
P. O. Box 1202  
Wichita, Kansas 67201

Floor Space Available: Approximately 50,000 sq. ft.

Floor Space Needed: 5,000 sq. ft.

2. Equipment, Tools, Jigs and Fixtures Required

- (a) Mold - 19-31-412-1
- (b) Molding Machine - Reed, Model 300, Reciprocating Screw,  
30 oz., 350 ton maximum for preparing resin for injection  
into mold.
- (c) Oven - Size and temperature range to meet production  
requirements. Used to dry the resin previous to  
molding.
- (d) Scales - For weighing moisture content of material.  
Type and capacity to meet application.
- (e) Drill Press - Type and size dependent on production  
rate. (Used to drill holes as required)
- (f) Drill Jig - For positioning holes (19-31-412-1).

### 3. Material Required

- (a) Polycarbonate (unfilled)
- (b) Lexan 101-SE
- (c) Form - Pelletized (Custom Color 3015, Dk. Green)

### 4. Molding Operations

- (a) Drying - Place stock material in oven or in hopper dryer. Adjust temperature to 170-190°F. Dry stock material until there is less than .05 of 1% moisture by weight.
- (b) Fill hopper (if stock material was dried in an oven) with resin.
- (c) Preheat mold to 160°F.
- (d) Stabilize stock material from 470 to 520°F depending on existing conditions (plastication). This is done by the heater band elements located within the mold cylinder. Slight readjustment may be necessary as cycling of mold progresses.
- (e) Regulate nozzle temperatures at 520°F.
- (f) Meter stock into cylinder and regulate temperature of stock as follows.

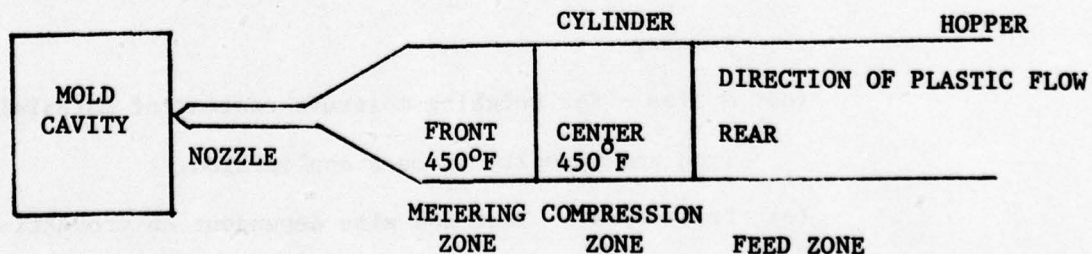


FIGURE NO. 12

#### 4. Molding Operations (Continued)

(g) Fill mold cavity and make following adjustments during cycling.

- 1) Injection Pressure 10,000 - 20,000 psi
- 2) Shot Weight should be 300 grams
- 3) Regulate fill speed at 3 3/4 inches.
- 4) Adjust screw speed at low range - B-7.

NOTE: The above is a general setting. Ultimate choice of fill speed should be one that completely fills and will consistently mold satisfactory parts. Faster fill speeds can cause short shots, burning of the plastic material or weld lines.

- 5) During cycling of machine and once normal screw rpm and heater band adjustments have reached optimum operating efficiency; adjust "back pressure" to approximately 100 psi to maintain a close control over stock temperature.
- 6) Adjust mold temperature controller to cool molded part (cool down for ejection).

NOTE: Minimum cycle time or extremely fast cool down of part is not always the optimum length cycle. The minimum cycle is often too sensitive to changes in ambient temperature. Increasing cycle times of only one or two seconds can increase reject rates considerably.

4. Molding Operations (Continued)

- 7) Check part ejection system as cycling commences to insure against "pile ups".

(h) Consult Figure No. 13 for complete molding specifications.

NOTE: The above is general information based on experience; however, "values can change with varying conditions, materials, part design, etc." The molder must make any adjustments or alternations as the molded sampling indicates necessary. Table III is provided to aid in troubleshooting molding problems.

5. Machining Operations

Drill and tap required holes per Drawing SM-D-453952.

6. Assembly Operations

- (a) Install cover gasket SM-A-435954 to the panel using RTV-108 as supplied by General Electric.
- (b) Install one (1) support bracket to underside of panel. (Slip fit only. Brackets will be secured at radio installation). Bracket part number is SM-A-435968.
- (c) Fill instrument identification lettering on top side of panel with florescent white paint.

7. Mold Maintenance

- (a) Use dry air to blow out cooling channels.
- (b) Core and cavity areas are sprayed with commercial rust preventative.
- (c) Close mold and place in an assigned position in mold storage rack. Mold storages are located in an air conditioned area.

2-28-75  
 19-31-412-1  
 Bagle Picher (Joplin) Panel

PLASTIC DEPT. INTERSHOP ORDER  
 MATERIAL CODE NUMBER 060-1205-60  
 MATERIAL DESCRIPTION  
 Lexan 101;3015 Dk. Green.

PART NUMBER 19-31-412-1  
 PRINT REVISION  
 DATE DUE  
 COLOR  
 CUSTOMER P.O. NUMBER  
 HOURS REQD. TO PRODUCE ORDER

HEAT ZONES		MOLDING MACHINE		MOLDING MACHINE		MOLDING MACHINE	
NOZZLE CODE NO.	C-6 275	TIME SETTINGS	C-6 275	NET WEIGHT PER PART	300.0	QUOTED MACHINE	300 Reed
NOZZLE	520	PLUNGER FORWARD	16	NET WEIGHT	300.0	QUOTED CYCLE	75
FRONT	470	DIES CLOSED	30	NO. CAVITIES IN MOLD	1	QUOTED SET-UP TIME	53740 (30 oz. cylinder)
CENTER	480	DELAY UNLOAD	7	MOLD NUMBER			
REAR	470	DIES OPEN					
MANIFOLD		DECOMPRESS					
MOLD TEMP. STATIONARY	Chiller	STUFFING					
MOLD TEMP. MOVING	Chiller	PLUNGER ADVANCE					
MOLD TEMP. SLIDES		CYCLE SECONDS	55				
CYL. WATER TEMP.		RATE PARTS/HR					
			01666				

OPER. NO.		TOOLS REQUIRED	TOOL LOC.	DESCRIPTION OF OPERATIONS	INSP.	SET-UP TIME	
						PREL.	DATE & INITIAL
1		Mold		Injection mold (1) part per cycle. Box for shipment.			
2							
PACKAGING INSTRUCTIONS							

PACKAGING INSTRUCTIONS		START		DATE & INITIAL		STOP		DATE & INITIAL		TOTAL HOURS		FINISH DATE	
GROSS	BOX NO.												
TARE	QTY. PER BOX												
NET													

FIGURE NO. 13

TABLE NUMBER VII

## TROUBLE SHOOTING

As an example of how to use the trouble shooting chart, assume the problem in question is poor surface finish on the molded part. Under the column titled "poor surface finish" read downward until you find remedy #1. This will indicate the easiest possible solution to the problem. If predrying does not correct the situation, use remedy #2 in the same column. Afterwards, if the problem still remains, subsequent remedies are prescribed until the condition is corrected. The same procedure is followed to trouble-shoot other abnormal conditions listed.

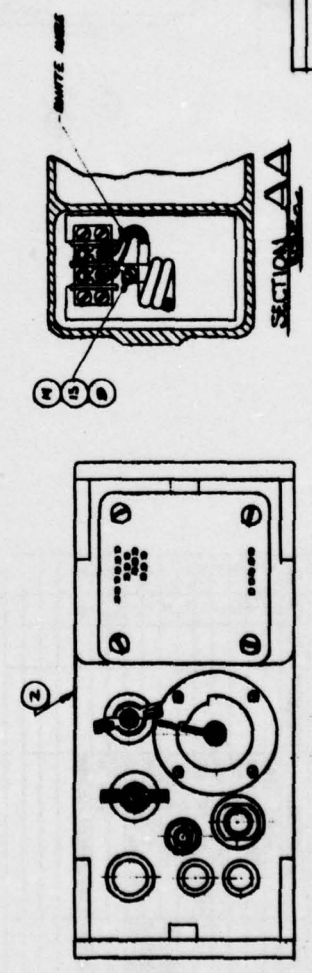
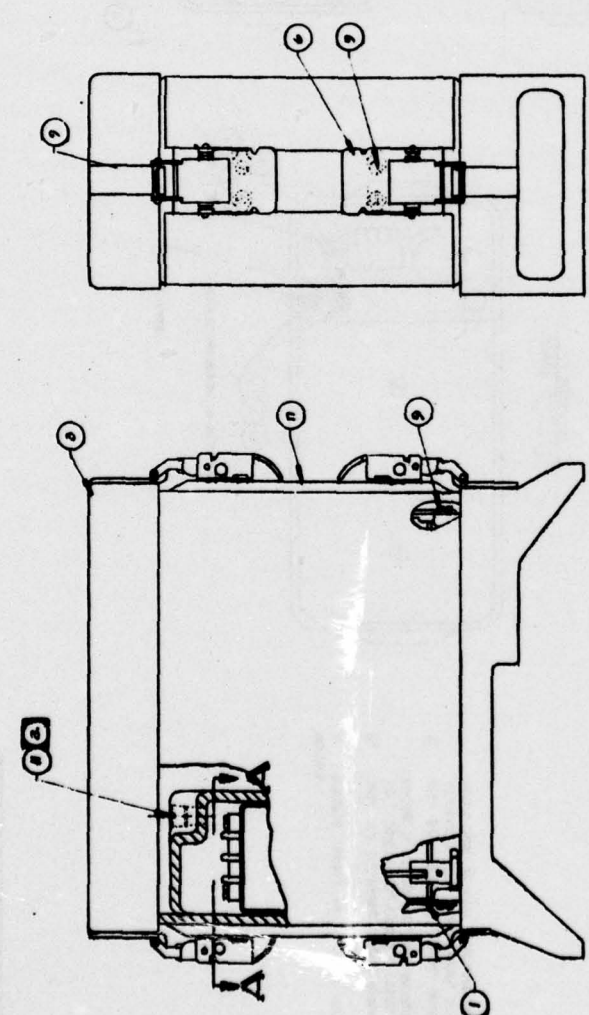
Color streaking Short shots Sink marks Flash Weak weld Brittleness Poor surface finish Blush at gate Jetting Weld burns Lamination Warpage Wave marks Poor dimensional stability Drag marks Sticking in cavity Sprue sticking															SUGGESTED REMEDIES	
	2	2		4	5	2	3			5	2					Increase injection pressure
4			2			6		5	3	3	2	3				Decrease injection pressure
	7	6							8	7	7					Increase cycle time
	6	5				8	6		4	6	5		5			Increase injection hold-time
			3					4					3	4	1	Decrease injection hold-time
10	8	7		7	7	14	9	7	8		11		7			Increase sprue, runner or gate size
	10			6	6	13	8		6		10		6			Decrease gate land area
	9	9		5		12	7	5	5		8					Use larger opening in nozzle
	2	1	1							1	1	1				Adjust feed
			5							5						Increase clamp pressure
	5			3	3	5			3	2	2					Increase stock temperature
	1		3	1		4	3	4	2	1	7	3		2		Decrease stock temperature
	6	3			1	2	4	2	3	3	2		4		2	Increase mold temperature
		4								6	4			1		Decrease mold temperature
		9			18					11	8	12				Change location of water channels
			6													Re-match mold parting line
					15	12		7								Add more gas vents
	3				1	1	1	1	1							Pre-dry material
	11	11	8		8		17	11	8			9				Change location of gate
						10						1	8			Polish surface of mold
						16	10	6		7						Increase depth or dia. of cold slug well
	4			2												Increase injection speed
	5		4			7	5	4	2	4	9		6			Decrease injection speed
															3	Re-seat nozzle
	8							6								Check nozzle heating band
					11											Polish sprue, runners & gates
	7				9	8	9			9						Check material for contamination
										10						Use clamping or shrink fixtures
															5	Polish sprue bushing
															4	Check sprue puller for defects & correct



MOD COL					DATA LIST		DEPARTMENT OF DEFENSE U.S. ARMY ELECTRONICS COMMAND FORT MONMOUTH, NEW JERSEY 07703			REVISION			
					LIST TITLE			CODE IDENT	SHEET 1 OF 2 SHEETS		LTR	DATE	APVD
					Radio Set C-2328A/GRA-39 C-2329A/GRA-39			80063					
					P II NO.			AUTH	REVD	DATE			
									24 June 1971				
8	4	3	2	1	CODE IDENT	DWG SIZE	DOCUMENT NUMBER	NO. SH	REV	LTR	NOMENCLATURE OR DESCRIPTION		
				*	80063	D	SM-D-435949				Cover		
				*		C	SM-C-435950				Lettering Detail		
				*		C	SM-C-435951				Lettering Detail		
				*		D	SM-D-435952				Panel		
				*		D	SM-D-435953				Panel		
				*		A	SM-A-435954				Gasket, Panel		
				*		D	SM-D-435955	2			Case Assembly		
				*		D	SM-D-435956	2			Panel Assembly		
				*		D	SM-D-435957				Panel Assembly		
				*		D	SM-D-435958				Control Radio Assembly (C-2328A)		
				*		D	SM-D-435959				Control Radio Assembly (C-2329A)		
				*		D	SM-D-435960				Cover Assembly		
				*		B	SM-B-435961				Label, Battery Installation		
				*		B	SM-B-435962				Buckle		
				*		B	SM-B-435963				Buckle		
				*		B	SM-B-435964				Buckle		
				*		B	SM-B-435965				Pad		
				*		B	SM-B-435966				Label, Identification		
				*		A	SM-A-435967				Support Bracket		
				*		A	SM-A-435968				Support Bracket		
				*		A	SM-A-435969				Gasket, Cover		

MCO COL					DATA LIST		DEPARTMENT OF DEFENSE U.S. ARMY ELECTRONICS COMMAND FORT MONMOUTH, NEW JERSEY 07703				REVISION		
					LIST TITLE				CODE IDENT		SHEET 2 OF 2 SHEETS		
					P II NO.				AUTH		REVD		
					DATE								
5	4	3	2	1	CODE IDENT	DWG SIZE	DOCUMENT NUMBER	NO. SH	REV	LTR	NOMENCLATURE OR DESCRIPTION		
				*	96906		MS-9021-016 MS-35233-28 MS-35233-27 MS-35233-25 MS-35233-13					Packing Preformed Screw, Machine-Pan Head Screw, Machine-Pan Head Screw, Machine-Pan Head Screw, Machine-Pan Head	
				*			MS-35237-328 MS-51021-10					Screw, Machine-Pan Head Set Screw Hexagon, Socket	
				*			FF-S-92 FF-S-107 FF-S-200 FF-W-84 FF-W-92					Screw, Machine Slotted or Cross-Recessed Screw Tapping & Drive Set Screw Washer, Lock Washer, Flat	
				*	81349		MIL-P-5516 MIL-A-8623 MIL-A-46106					Packing Anodic Coatings Adhesive Sealant, Silicone	

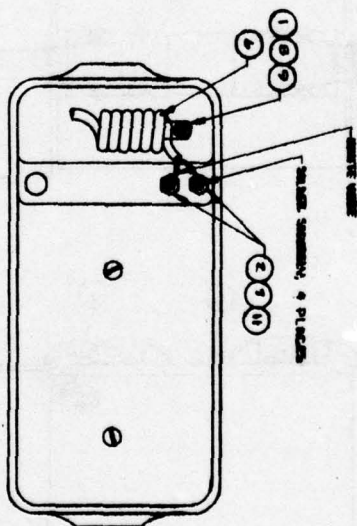




- NOTES:
1. THE SUBMITTER DRAWING SEE 144-3-400716
  2. SHALL BE AS SUPPLIED BY AMERICAN MANUFACTURING CO., HARTFORD, CT. THE PART IN CASE A, CLAMP CO. OF EQUAL.
  3. NO SET INSTALL CARD IN II AND 3 UNTIL AFTER VACUUM TEST.
  4. COOL IN 20007 PER FEB 57D-575
  5. APPLY ALIGHT COATING OF MOUNTING COMPOUND NCA TO COILS ASSEMBLY AND LABEL ASSEMBLY CARBETS FEB 57D-575 300-7964

ITEM	QTY	DESCRIPTION	UNIT	REMARKS
17	1	CLAMP	ASSEMBLY	
18	1	SILICONES	AND	17-5-52
19	1	WASHER	AND	17-5-52
20	1	WASHER	AND	17-5-52
21	1	WASHER	AND	17-5-52
22	1	WASHER	AND	17-5-52
23	1	WASHER	AND	17-5-52
24	1	WASHER	AND	17-5-52
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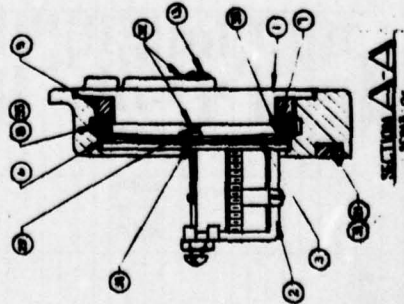
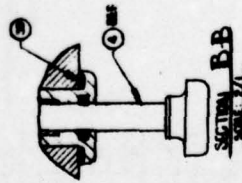
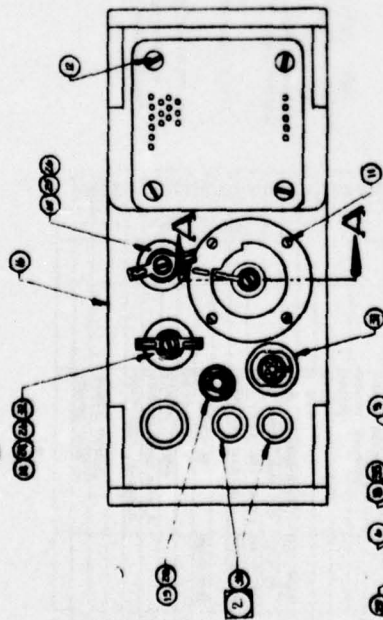
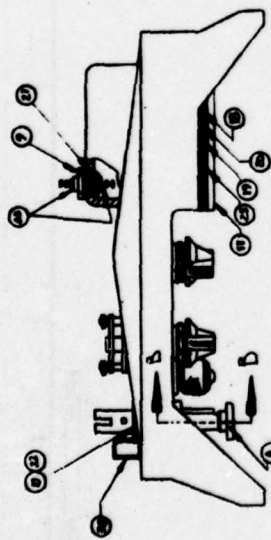
CONTROL ASSEMBLY  
RADIO SET  
C-732BA / 68A-39  
80063  
54-D-43578



VIEW   
SCALE: ~

1. NOTES: STAKE SHALL BE FOR USE OF THE OFFICE
2. AND BE OBTAINED FROM AMERICAN SEALANTS  
CO. MEMPHIS COOK THESE PARTY IN  
GRADE A CLASS ED OR SUPERIOR SKILL
3. AND BE OBTAINED FROM CONSTRUCTION  
PRODUCTS CO. MEMPHIS TN. THESE  
PARTY IN A 21 OR SUPERIOR SKILL

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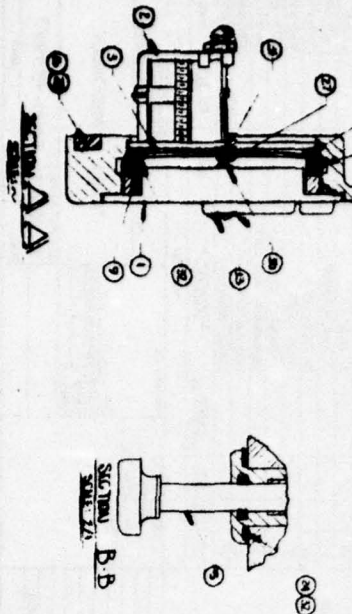


- NOTES:
1. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  2. INSTALL PERMANENTLY TO BOTTOM OF PANEL. SLATS ARE PERMANENTLY TO BOTTOM OF PANEL.
  3. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  4. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  5. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  6. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  7. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  8. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.
  9. MAY BE OBTAINED FROM MANUFACTURING / 446 CO, THIS PART IS SC-14, OR APPROVED EQUIVALENT.

ITEM	QTY	DESCRIPTION	UNIT	REMARKS
1	1	TOP COVER	EA	
2	1	SCREW	EA	
3	1	SCREW	EA	
4	1	SCREW	EA	
5	1	SCREW	EA	
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7	1	SCREW	EA	
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9	1	SCREW	EA	
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NAME: ASSEMBLY

DATE: 03/05/57



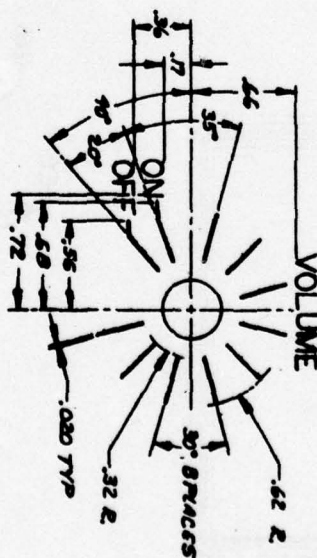
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[illegible]

## POWER ASSEMBLY

SM-D-435956





NOTES:

1. MARKING TO BE IN ACCORDANCE WITH GROUP I OF MIL-N-13251.
2. LINE WIDTH: CHARACTERS & LINES TO BE .020 WIDE X .015 DEEP.
3. CHARACTERS TO BE 12 POINT.

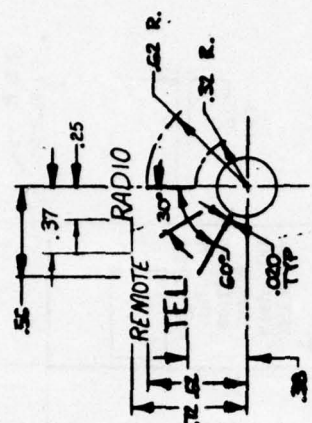
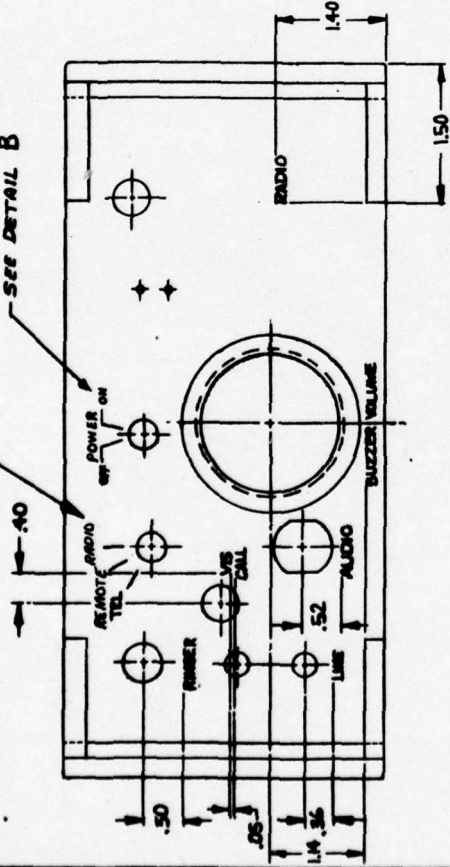


(HW) **SAC-43595**

REVISIONS	DATE	APPROVED
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DESCRIPTION		

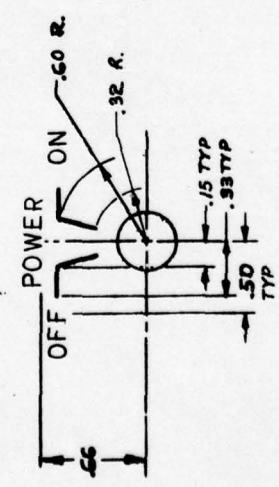
SEE DETAIL A

SEE DETAIL B



DETAIL A  
SCALE 2/1

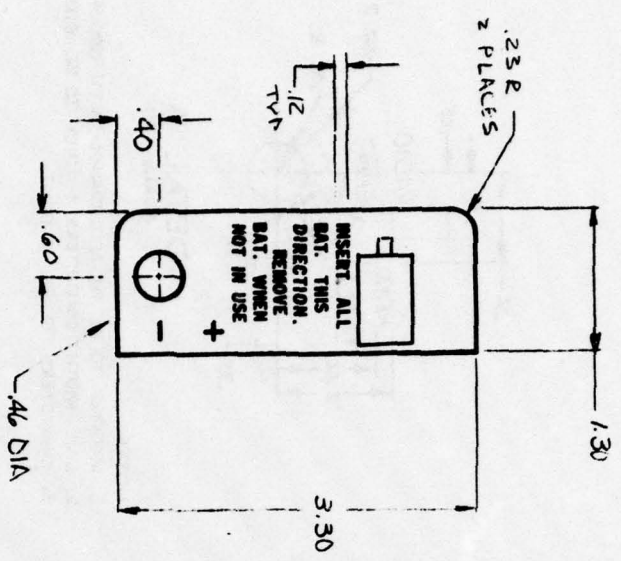
- NOTES:
1. MARKING TO BE IN ACCORDANCE WITH GROUP I OF MIL-M-13231.
  2. LINE WIDTH: CHARACTERS & LINES TO BE .020 WIDE x .015 DEEP.
  3. CHARACTERS TO BE 12 POINT.



DETAIL B  
SCALE 2/1

PARTS LIST				CONTRACT NO.		DEPARTMENT OF DEFENSE U.S. ARMY ELECTRONICS COMMAND FORT MONMOUTH NEW JERSEY 07703	
FIND NO.	QTY REQD.	CODI IDENT	PART OR IDENTIFYING NO.	MANUFACTURE OR DESCRIPTION	SPEC	MATERIAL OR NOTE	EP NO.
				DATE		LETTERING DETAIL	
				PREPARED BY: WINNER 7-12-77		CODE IDENT NO. C 80063	
				CHECKED BY: J. J. J. J.		SM-C-435950	
				ENGINEER: J. J. J. J.		SCALE 1/1	
						SHEET 1 OF 1	

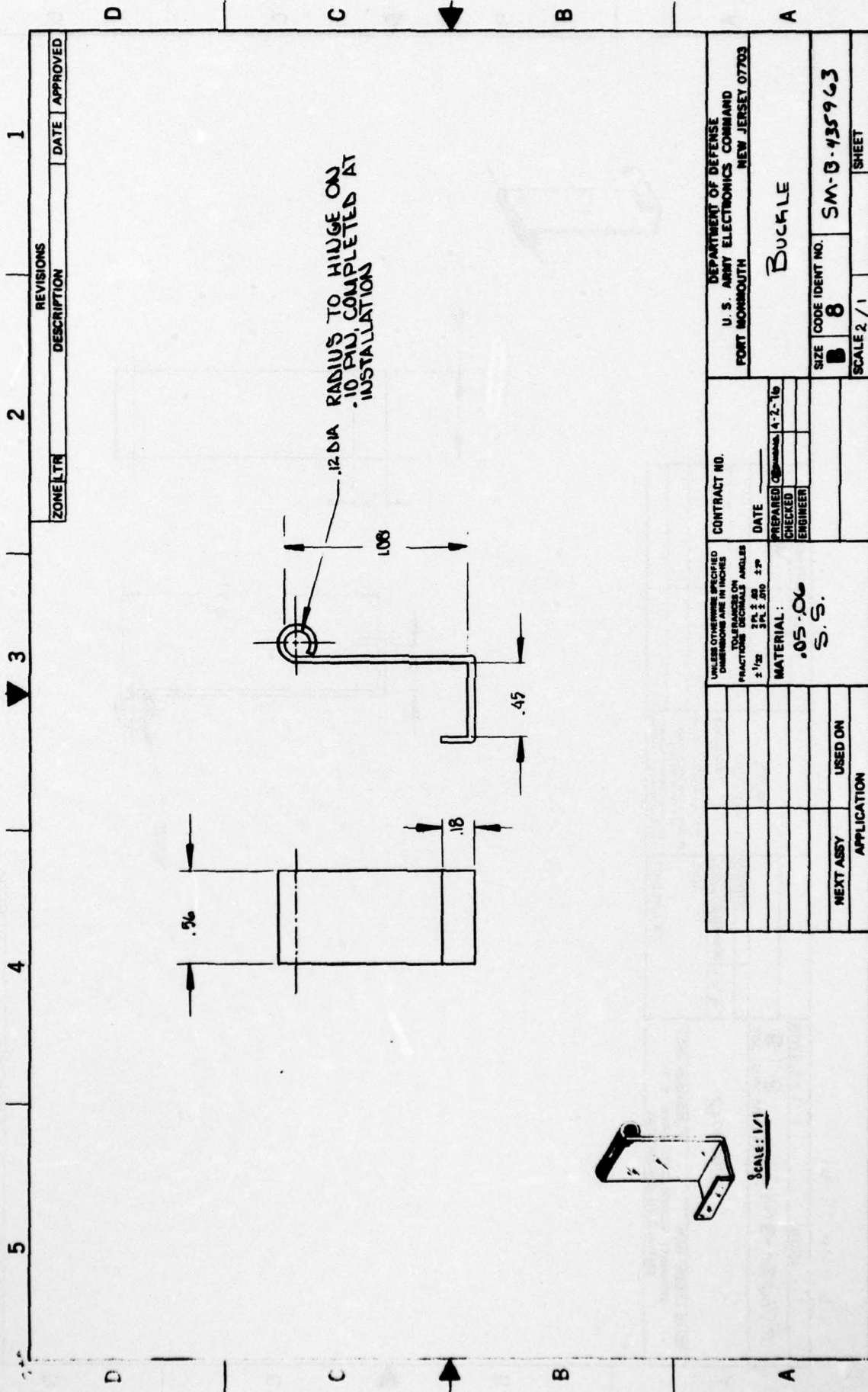
REVISIONS		1
ZONE LTR	DESCRIPTION	DATE APPROVED



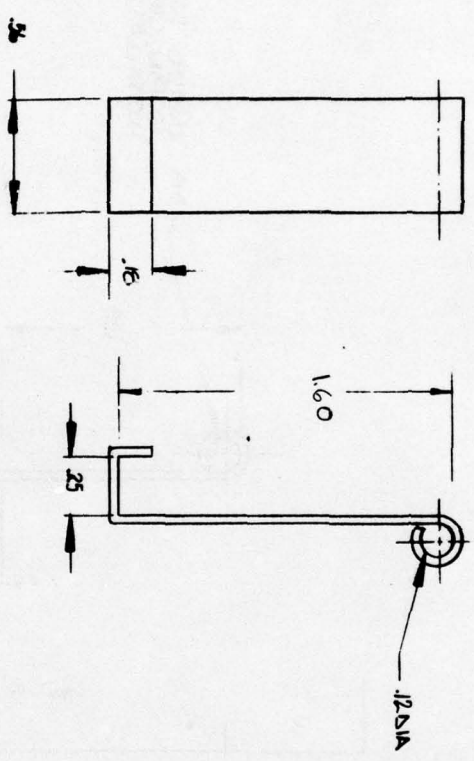
CONTRACT NO.		U.S. ARMY ELECTRONICS COMMAND FORT MONMOUTH NEW JERSEY 07703	
DATE		U.S. ARMY ELECTRONICS COMMAND FORT MONMOUTH NEW JERSEY 07703	
MATERIAL: MYLAR		BATTERY INSTALLATION	
ADHESIVE BACK		CODE IDENT NO. 80063	
NEXT ASSY USED ON		SN-B-4357861	
APPLICATION		SCALE 1/1	

A B C D

A B C D



REVISIONS		1
ZONE LTR	DESCRIPTION	DATE APPROVED



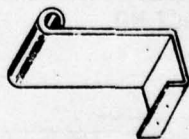
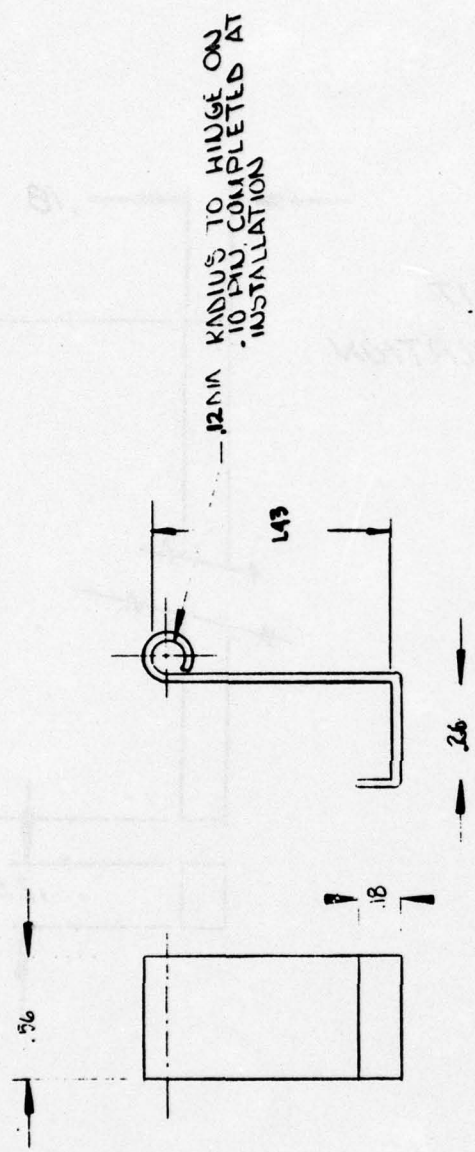
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± 1/32 3/16 .001 .002		DATE		PREPARED BY 4-2-76	
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APPLICATION		USED ON		SM-B-435964	
				SCALE 2/1	
				SHEET	

19-31-412-8

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D C B A

ZONE LTR	REVISIONS	DATE	APPROVED
	DESCRIPTION		



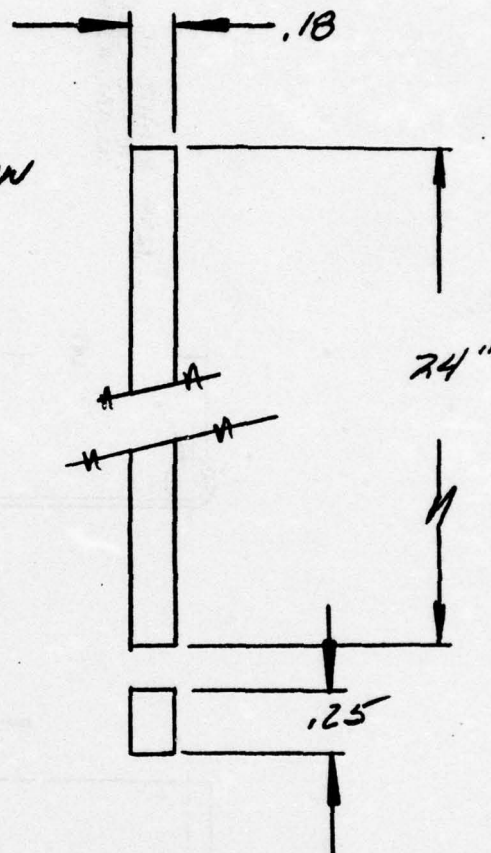
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2 1/32	2 PL ± .03	DATE	PREPARED	BUCKLE	
3 PL ± .010	2 PL ± .010	CHECKED	ENGINEER		
MATERIAL: .05 .06 S. S.					
NEXT ASSY	USED ON	SIZE CODE IDENT NO B 80063 SM-B-435962			
APPLICATION		SCALE 2 SHEET			

19-31-412-7

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
SM-D-435949	GRA/39 B				

NOTES:

- GASKET SHALL BE CUT TO LENGTH AT INSTALLATION



UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES: FRACTIONS  $\pm$   
ANGLES  $\pm$   
3 PLACE DECIMALS  $\pm$ .010  
2 PLACE DECIMALS  $\pm$ .03

CONTRACT NO.

DATE

DEPARTMENT OF DEFENSE  
U. S. ARMY ELECTRONICS COMMAND  
FORT MONMOUTH NEW JERSEY 07703

GASKET, COVER

MATERIAL  
R 431 N  
SCE-43-BLACK

PREPARED *B. Brown* 24 FEB 75  
CHECKED  
ENGINEER

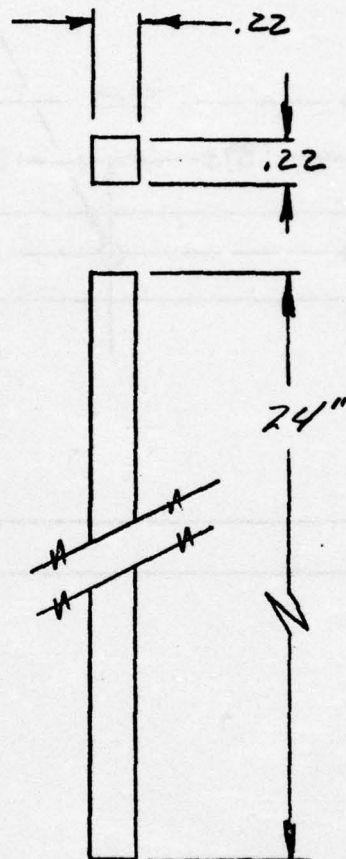
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SCALE *1/2* SHEET

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SM-D-435956	GRA/39B			
SM-D-435957				

# NOTES:

- GASKET SHALL BE CUT TO LENGTH AT INSTALLATION



UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES: FRACTIONS  $\pm$   
ANGLES  $\pm$   
3 PLACE DECIMALS  $\pm$ .010  
2 PLACE DECIMALS  $\pm$ .03

CONTRACT NO.

DATE

PREPARED *J. Roman 24 Feb 75*  
CHECKED  
ENGINEER

DEPARTMENT OF DEFENSE  
U. S. ARMY ELECTRONICS COMMAND  
FORT MONMOUTH NEW JERSEY 07703

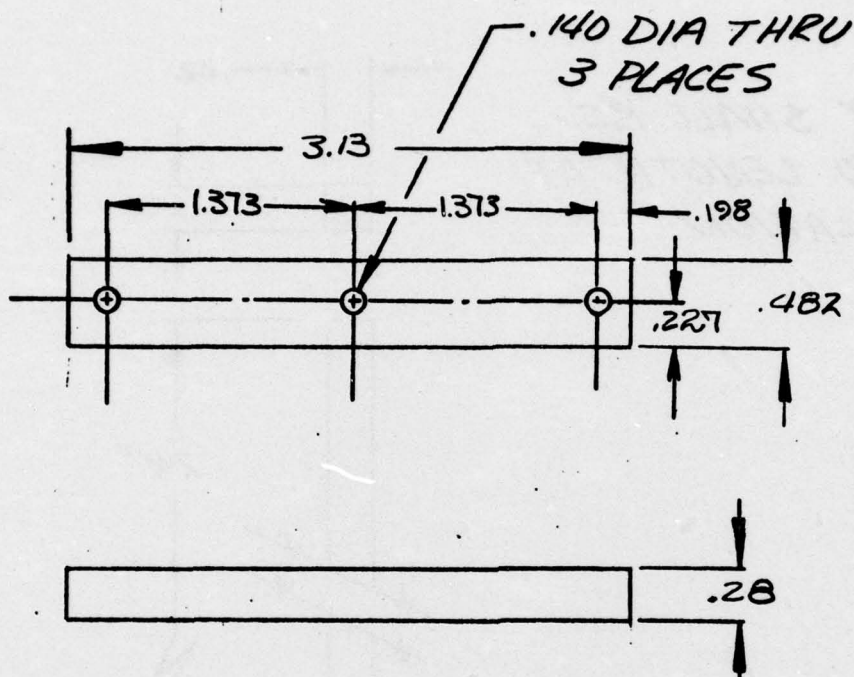
GASKET, PANEL

MATERIAL  
R 431 N  
SCE-43-BLACK

SIZE **A** CODE IDENT NO. 80063 DRAWING NO. SM-A-435954

SCALE *~* SHEET

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
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SM-D-435952					



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TOLERANCES: FRACTIONS  $\pm$   
ANGLES  $\pm$   
3 PLACE DECIMALS  $\pm .010$   
2 PLACE DECIMALS  $\pm .03$

CONTRACT NO.

DATE

PREPARED *R. J. J. J.* 24 FEB 75  
CHECKED  
ENGINEER *St. J. J.* 4 MAR 75

DEPARTMENT OF DEFENSE  
U. S. ARMY ELECTRONICS COMMAND  
FORT MONMOUTH NEW JERSEY 07703

SUPPORT BRACKET

MATERIAL:  
S.S.

SIZE

A

CODE IDENT NO.

80063

DRAWING NO.

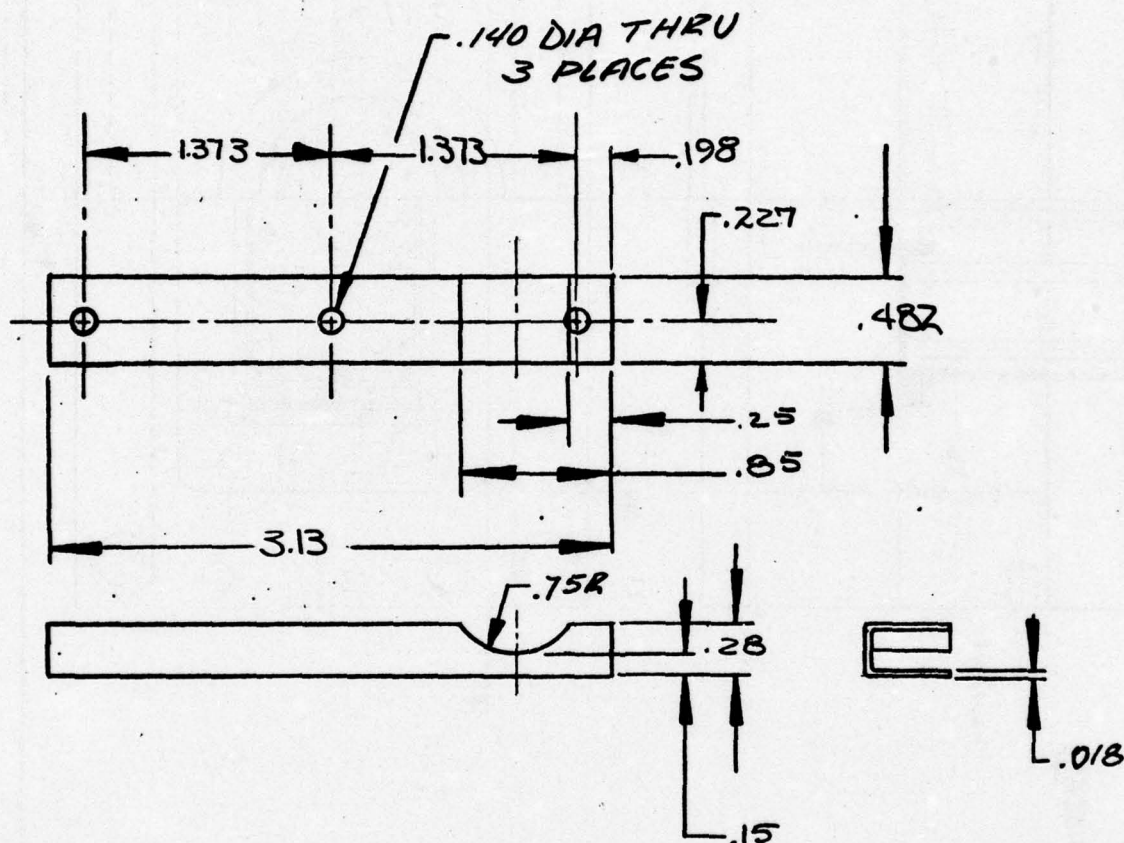
SM-A-435968

SCALE 1/1

SHEET

35952

APPLICATION		REVISIONS			
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ANGLES  $\pm$   
3 PLACE DECIMALS  $\pm$ .010  
2 PLACE DECIMALS  $\pm$ .03

CONTRACT NO.

DATE

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CHECKED  
ENGINEER *Bouman* 4 MAR 75

DEPARTMENT OF DEFENSE  
U. S. ARMY ELECTRONICS COMMAND  
FORT MONMOUTH NEW JERSEY 07703

SUPPORT BRACKET

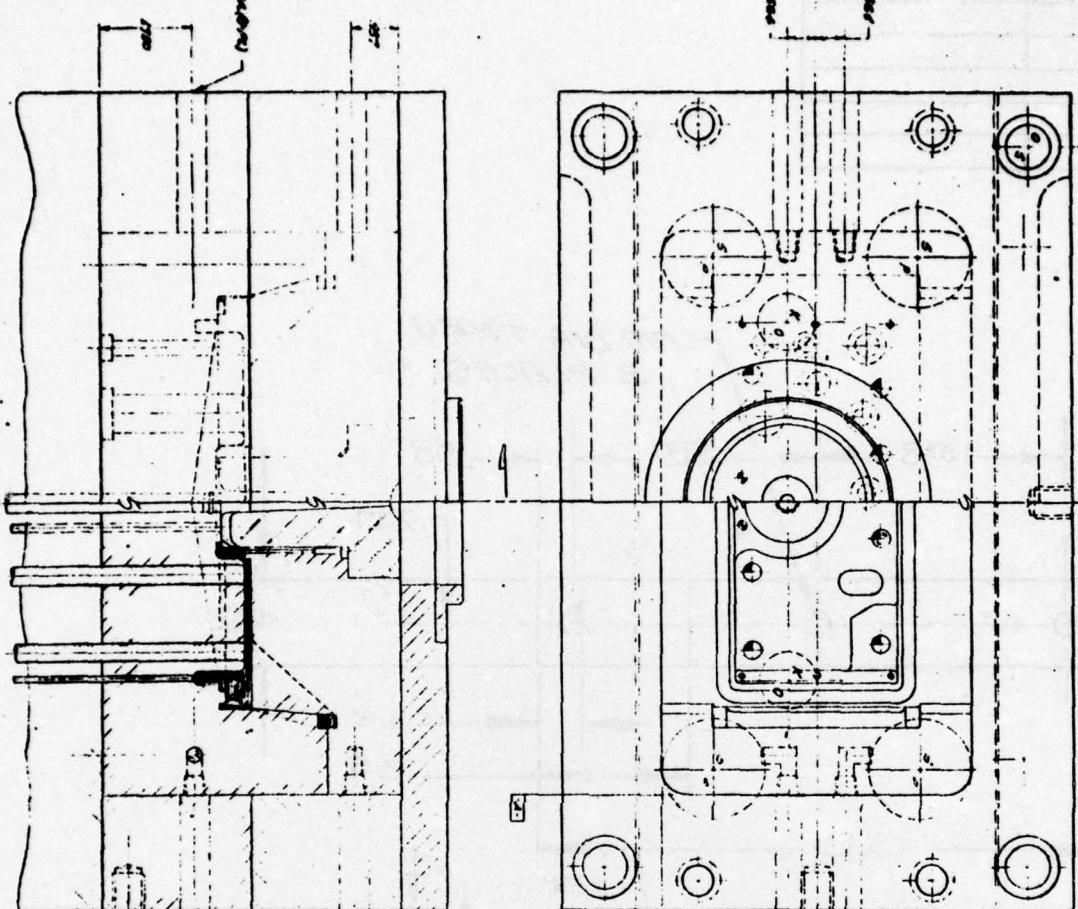
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SCALE 1/1 SHEET

435960

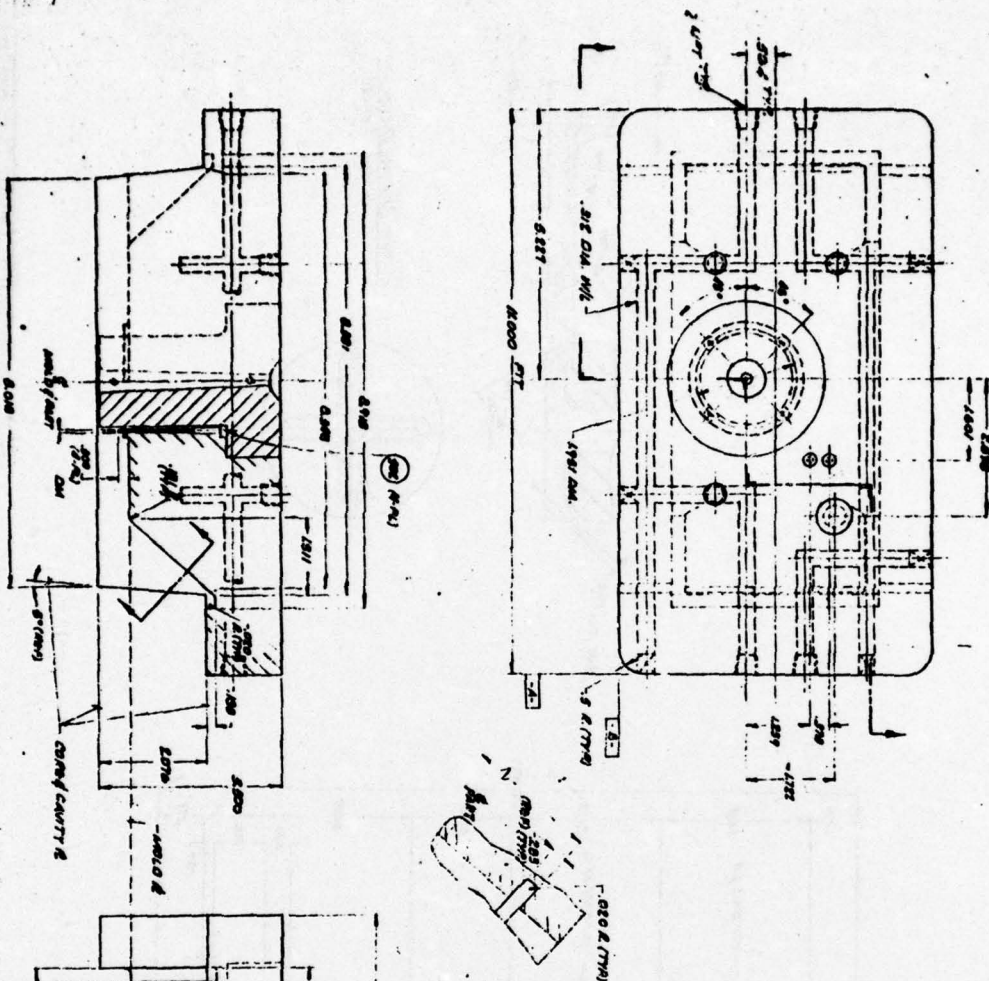
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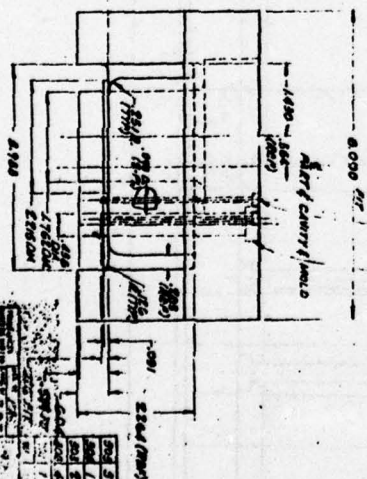
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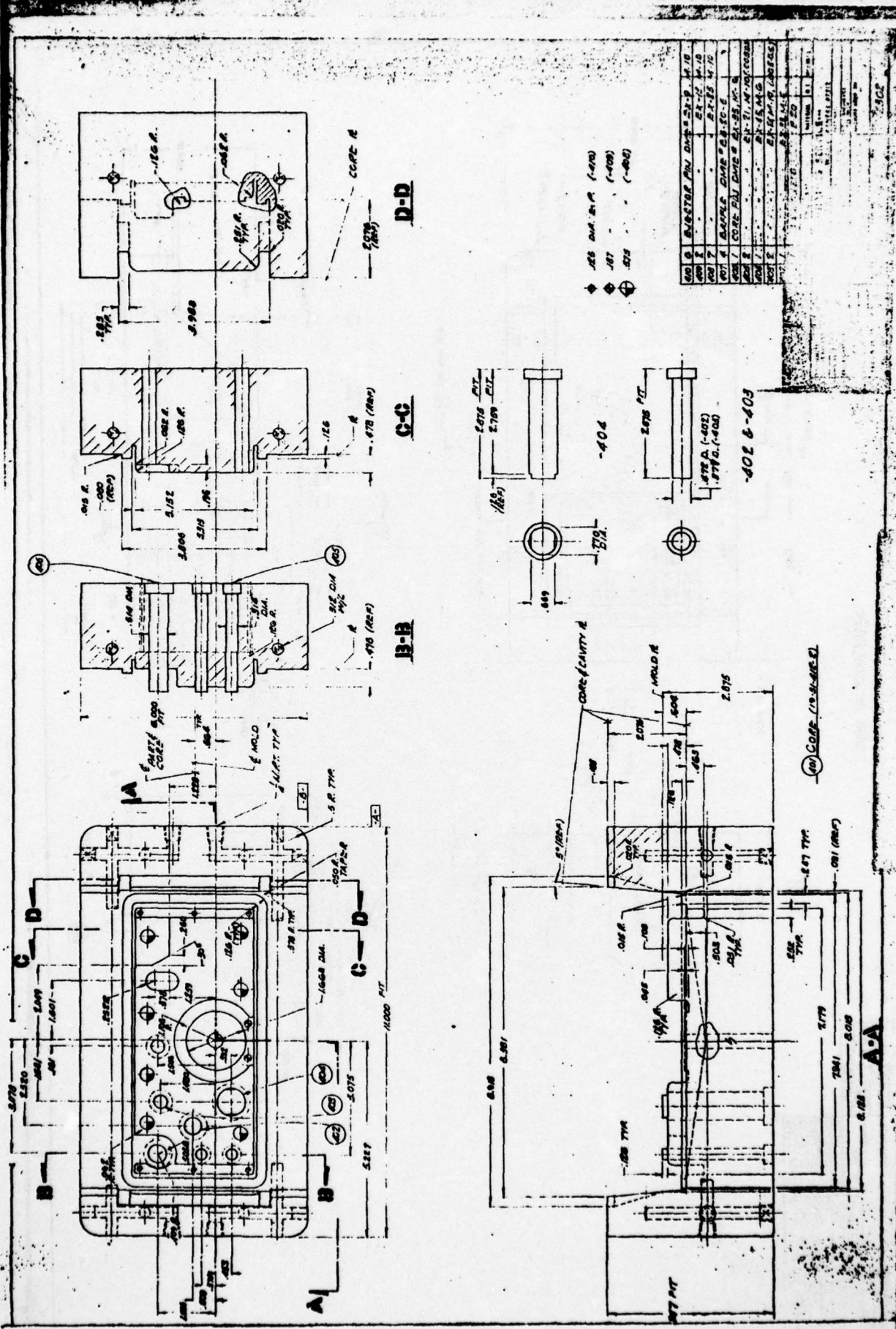


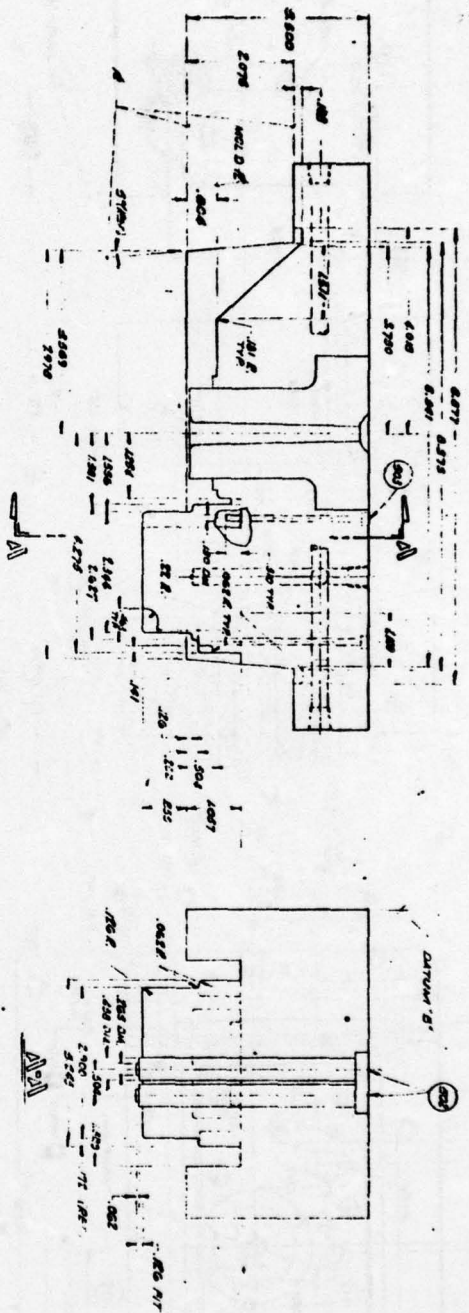


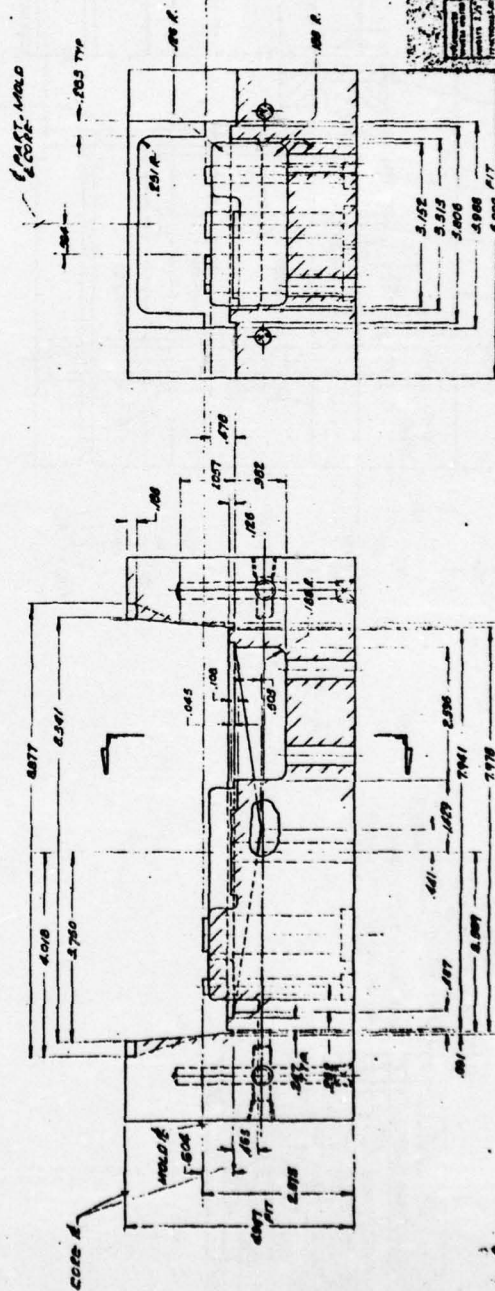
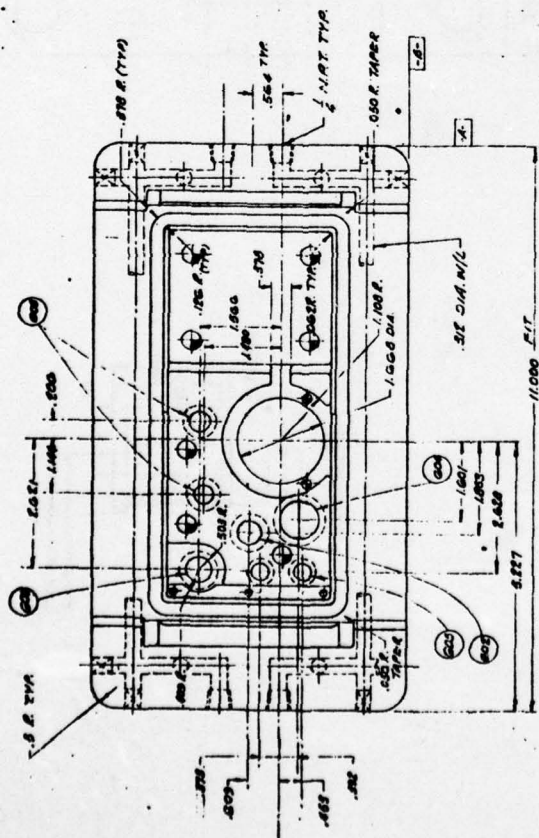
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5	10/1/78	J. J. J.	J. J. J.	REVISION 4
6	10/1/78	J. J. J.	J. J. J.	REVISION 5
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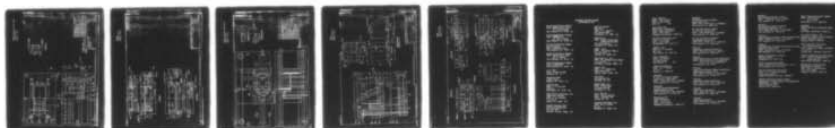
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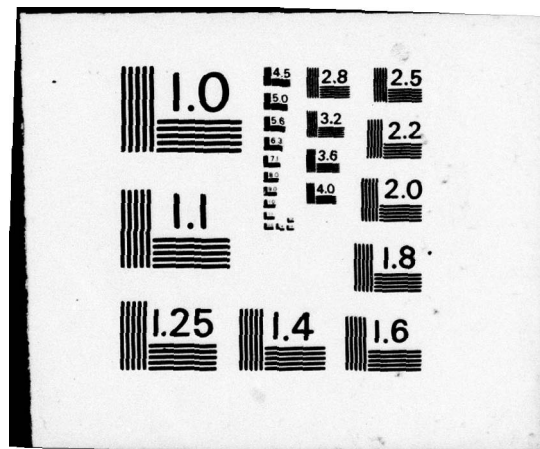
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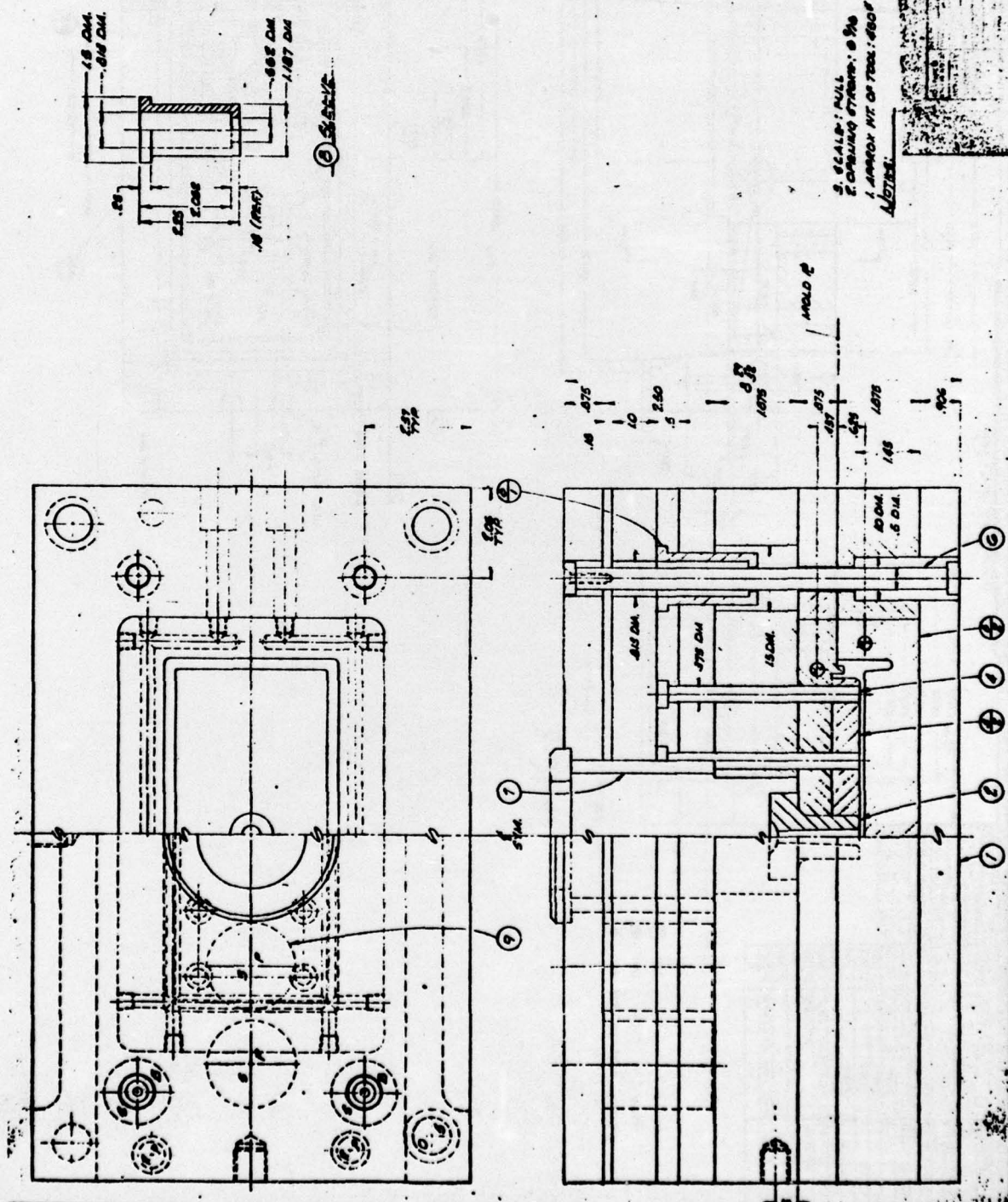
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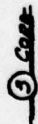
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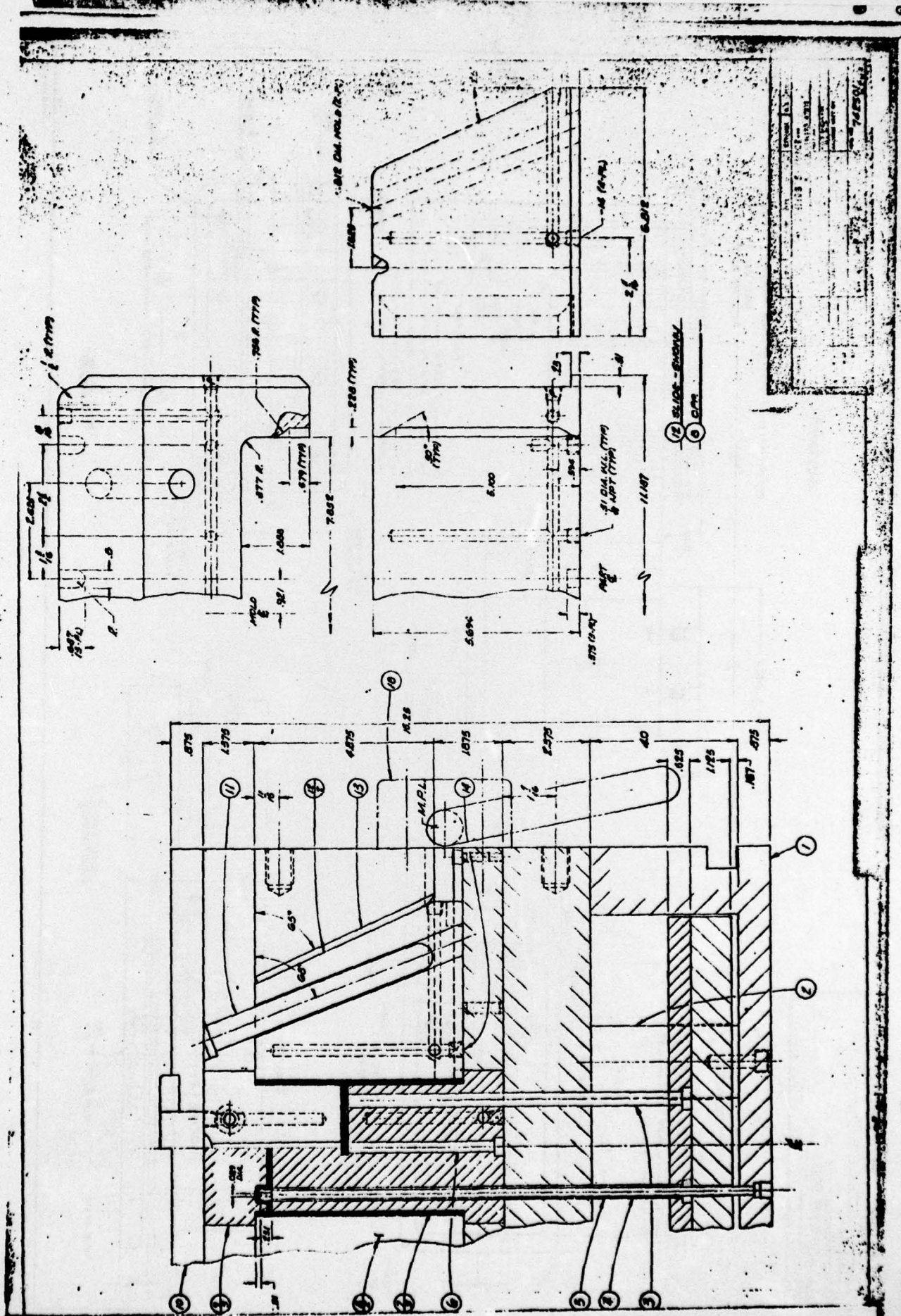
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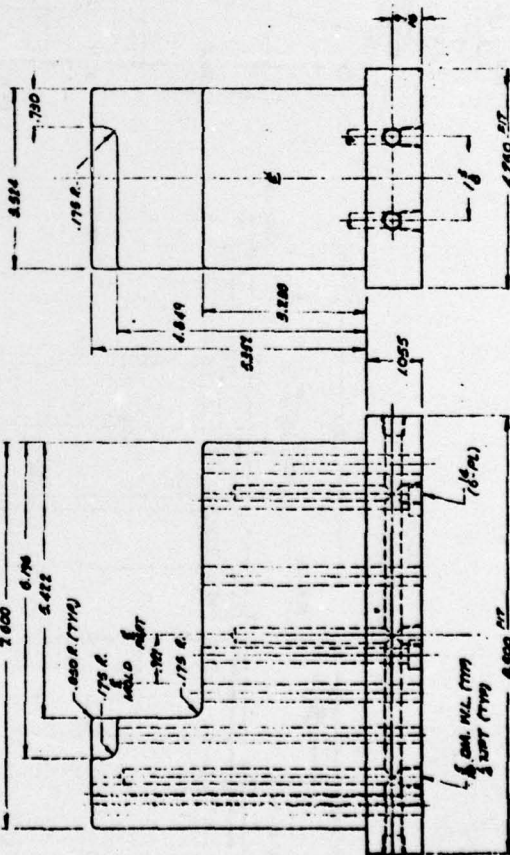
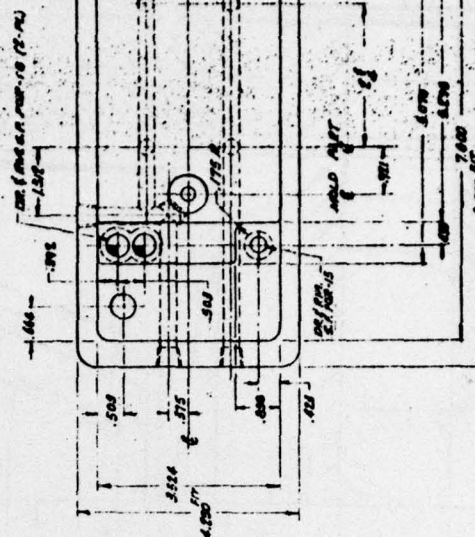
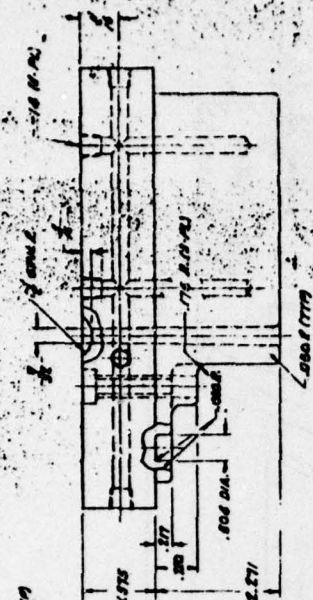
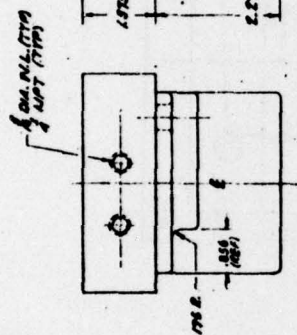
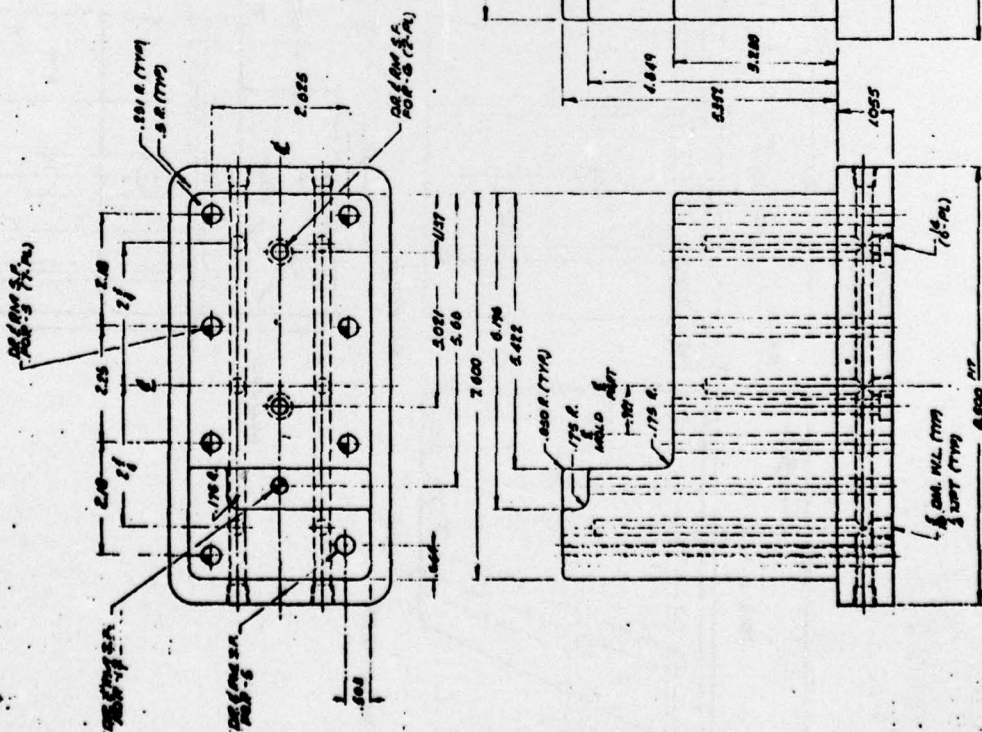
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Sheet 2 of 3



Case  
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Avionics Laboratory  
ATTN: DRSEL-VL-D (Ltc E. Richards)  
Fort Monmouth, NJ 07703 (2)

Director  
R&D Technical Support Activity  
ATTN: DRSEL-GG-D (Mr. E. Fister)  
Fort Monmouth, NJ 07703 (2)

Director  
R&D Technical Support Activity  
Mechanical Engineering Div.  
ATTN: DRSEL-GG-E (Mr. P. Devroates)  
Fort Monmouth, NJ 07703 (2)

Director  
Communications Automatic Data Processing Lab.  
ATTN: DRSEL-NL-D (Col. J. Mitchell)  
Fort Monmouth, NJ 07703 (2)

Director  
Communications Automatic Data Processing Lab.  
Technical Plans & OPS  
ATTN: DRSEL-NL-D-4 (Mr. M. Curtis)  
Fort Monmouth, NJ 07703 (2)

Defense Documentation Center  
Cameron Station  
Alexandria, VA 22314 (12)

US Army Electronics Command  
ATTN: DRSEL-PF-I-PI-1 (William R. Peltz)  
Fort Monmouth, NJ 07703 (2)

Air Force Materials Laboratory  
ATTN: Mr. J. Wittebert (MATE)  
Electronics Branch  
Wright-Patterson AFB, Ohio 45433(1)

Defense Electronics Supply Center  
Directorate of Engineering & Standardization  
(DESG-ECS/N A. Hauck)  
1507 Wilmington Pike  
Dayton, Ohio 45401 (1)

Naval Electronic Systems Command  
ATTN: ELEX-0151431  
Mr. R. Wade  
Washington, D. C. 20360 (1)

Commander  
Naval Electronics Laboratory Center  
Library  
San Diego, California 92152 (1)

Mr. Daniel Becker - PR6  
Reliability Quality & Test Division  
Manned Spacecraft Center  
Houston, Texas 77058 (1)

NASA Scientific & Technical  
Information Facility  
ATTN: Acquisition Branch (S-AK/DL)  
P.O. Box 33  
College Park, Maryland 20740 (1)

US Army Production Equipment Agency  
ATTN: AMXPE-MT Manufacturing  
Technology Div  
Rock Island, Illinois 61201 (1)

Reliability Analysis Center  
ITT Research Institute  
ATTN: Mr. H. Lauffenburger  
10 W. 35th Street  
Chicago, Illinois 60616 (1)