

# CASE FILE COPY

CIRCUIT BREAKER CASES  
N.A.S.A. CONTRACT NAS 9-11755

Final Report

Submitted By:

*Robert L. Holmes*  
Robert L. Holmes, Director  
Rubber Research & Development  
RAYBESTOS-MANHATTAN, INC.  
RLH:cm

OFFICE OF PRIME RESPONSIBILITY

JM 7

**OPEN**

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## I INTRODUCTION

Contract No. NAS 9-11755, Control No. 0-279-016.

A firm fixed-price Research & Development contract in the amount of \$3,914.00 was awarded Raybestos-Manhattan on April 27, 1971. The contract called for the development of Molded Circuit Breaker Cases meeting MSC-PA-D-67-13 Material Standards. Twenty-five completed cases were to be furnished. The Government furnished one Circuit Breaker Case, P/N ME-454-011, that was used to establish physical dimensions. The delivery date of August 27 on the twenty-five cases, and September 27 on the Final Report was not met.

The cases were shipped to N.A.S.A., MSC, Houston, on November 19, 1971, our Register No. 4569. The Technical Monitor, Dan E. Supkis, verbally signified the parts to be satisfactory as received.

## II SUMMARY

A flammable plastic part was submitted to Raybestos-Manhattan to enable them to duplicate it dimensionally using a non-flammable material in place of the flammable plastic. The contract stated the part should weigh less and should meet the requirements of MSC-PA-D-67-13. The material used was L-3203-6 with a 16 hour post cure at 400°F.

Initial efforts were made to determine shrinkage tolerances required to produce a mold which would produce a finished, workable part. The initial mold produced collapsed and a new mold was furnished. This delay caused contract slippage.

The final twenty-five Circuit Breaker Cases were shipped on November 19, 1971, from Charleston. These cases were approved by the monitoring officer, Mr. Dan E. Supkis, as to dimensions. The metal inserts when installed, produced a workable breaker. Initial submissions of cases were rejected as lacking sufficient rigidity though they met all other requirements. The plastic cases weighed 16.5 grams, whereas the REFSET® cases weighed 17 grams, therefore not meeting the less-weight requirement.

The data on shrinkage determinations, mold and part dimensions are shown. The method of manufacture is also reported in the body of this report. Quantity production should result in costs being materially reduced. The high cost per case is a result of costs involved in the product development and the labor requirements due to a single cavity mold. Material costs of less than one dollar per case are indicated. Labor and mold costs depend on quantity requirements.

### III TEST PROCEDURES AND RESULTS

#### A. Compound Selection and Cure Systems

Exhibit A, prepared by N.A.S.A., MSC, shown in the Appendix to this report, is part of Contract NAS-9-11755, and is shown as Exhibit B. The material used must meet Specification MSC-PA-D-67-13. The non-metallic molded case should be of sufficient rigidity, but not brittle, to be operable with the insertion of the electronic parts. It should be of the proper dimensions to house the electronic parts.

L-3203-6 had been tested to MSC-PA-D-67-13 and had been approved by N.A.S.A., MSC to be non-flammable in 100% oxygen. With special post curing, a rigid non-brittle material that was acceptable to N.A.S.A., MSC, was produced from L-3203-6.

Selected Fluorel type 2140 was used in compounding L-3203-6. The compound used is proprietary to Raybestos-Manhattan, Inc.

#### B. Details Of Manufacture

Several plastic flammable Circuit Breaker Cases were submitted to Raybestos-Manhattan by the contractor for dimensional determinations. Raybestos-Manhattan drew various views of the submitted plastic parts, (see Figure I). This drawing, MRD-25698) was submitted to N.A.S.A., MSC for approval. N.A.S.A., MSC sketched in Detail C and returned the approved drawing to Raybestos-Manhattan.

L-3203-6 exhibits shrinkage on cure and continues to shrink on post curing. The mold to produce the desired part required fairly accurate estimates of shrinkage values. Listed in Table I are shrinkage values obtained on molding and post curing L-3203-6. Based on these values the mold maker, Delaware Valley, was requested to produce a mold to the N.A.S.A. approved Sketch, Figure I. Figures II and III are Delaware Valley mold sketches. The circled figures are those obtained on parts cured for 45 minutes at 280°F. in the Delaware

B. Details of Manufacture(Continued)

Valley mold and then post cured in a hot air oven starting at 250°F. with a 30° rise per hour to 450°F. and then post cured 16 hours at 450°F. The parts cured in this manner were assembled with the electronic parts and were submitted to N.A.S.C., MSC for approval. Mr. Supkis, the Project Monitor, advised us of the need for a harder cured part.

To obtain the desired rigidity, sample moldings that had been post cured, were steam cured for six hours at 320°F. plus an additional post cure of six hours at 400°F. Shore D measurements were as follows:

1. Initial Mold cure 45 Min./280°F. 38-40 Shore D
2. Post cured with 30°F. rise/hour to 450°F. plus 16 Hrs. at 450°F. 62 Shore D
3. Post cured (2) plus steam and additional 400°F. cure 70-72 Shore D

Samples cured as in (3) produced acceptable rigidity and though fitting tightly, the electronic parts could be inserted.

Four Molded Circuit Breaker Case halves were then produced post cured with the 30°F. rise to 450°F. plus 16 hours at 450°F. and were measured in 43 key areas. Table II and Figures II and III show the measurements obtained and required. After the additional steam and oven cure, the mating Breaker Case surfaces were ground to produce a tight fitting case surrounding the electronic components. Twenty-five cases, or fifty parts, were shipped to N.A.S.A. for approval.

Verbal approval of the twenty-five cases was received from Mr. Supkis. These cases were shipped from Raybestos-Manhattan on November 23, 1971, on our Register number 9232.

Exhibit "A"

Statement of Work

Development of a Nonflammable  
Circuit Breaker Case

## 1.0 Purpose

The circuit breakers currently used in the Apollo Program are housed in a case which is flammable in 100% oxygen. To comply with Apollo flammability requirements, the circuit breakers are currently coated with a nonflammable material. It is necessary that a new material be developed for use as a circuit breaker case for use in advanced programs.

## 2.0 Objective

The objective of this contract is to secure the development of a nonflammable circuit breaker case. The contractor will develop the required material and fabricate twenty-five (25) circuit breaker cases using the best available material developed for a breaker case. The goal, therefore, is a circuit breaker case which weighs less and exhibits more desirable flammability characteristics than the coated circuit breaker cases now in use.

## 3.0 Contractor Effort

3.1 The contractor shall provide all the necessary personnel, services, raw materials and facilities for research, development, design, and fabrication. The contractor shall use the technical requirements of section 4.0 as design goals in the case fabrication and development effort. It is understood that the contractor shall perform the effort on a best efforts basis.

3.2 All samples shall be tested for flammability and further qualifications at NASA-MSC, Houston, to prevent an expensive duplication of equipment.



3.3 The Contractor shall supply twenty five of the circuit breaker cases developed to NASA MSC for test and evaluation. In establishing the physical dimensions of the circuit breaker cases, the contractor shall use a circuit breaker or breaker case to be provided as Government furnished property. NASA MSC shall be responsible for integrating the appropriate electronics in the newly developed circuit breaker cases.

#### 4.0 Technical Requirements

4.1 The circuit breaker case material shall meet the following requirements. The document entitled, "Nonmetallic Materials Requirements," MSC-PA-D-67-13 Enclosure I shall be used to obtain the data and satisfy the technical requirements as indicated.

4.1.1 The developed circuit breaker case shall be self-extinguishing when ignited at the bottom at the following conditions: (MSC-PA-D-67-13 takes precedence over all other documents on flammability.)

- a. For use in a command module, the required atmospheric conditions at 16.5 psia, 100% oxygen.
- b. For use in a lunar module, the required atmospheric conditions are 6.2 psia, 100% oxygen.

4.1.2 Flash and fire point (MSC-PS-D-67-13)

4.1.2.1 Material that evolves vapors which produce a visible flash at temperature of less than 400°F will be considered unacceptable.

4.1.2.2 A material that shows evidence of charring, self-sustaining combustion, degradation or other signs of pyrolysis at a temperature of less than 450°F shall be considered unacceptable.

4.1.3 The material must have a total score of 2.5 or less for the sum of ten odor evaluations of any sample material by panel members, signifying the material has passed the odor test. A total score of above 2.5 at any dilution signifies that the material failed the odor test and is rejected (MSC-PA-D-67-13).

4.1.4 The maximum allowable level of offgassing of a material for total organics for use in the spacecraft shall not exceed 100 micrograms per gram of sample.

4.1.5 The maximum allowable level of carbon monoxide offgassing for a material for use in the spacecraft shall not exceed 25 micrograms per gram of sample (MSC-PA-D-67-13).

- 4.2 "Circuit breakers shall be supplied as engineering models with electrical and electromechanical requirements in accordance with North American Procurement Specification MC 454-0010 and ME454-011, Enclosures 2 and 3 revised, for Type II circuit breakers."

Functional acceptance testing only shall be performed on each breaker in accordance with MC 454-0010 and limits in the applicable source control drawings.

#### 5.0 Reports and Deviations

- 5.1 The contractor shall submit monthly letter reports stating information pertaining to technical achievements, work status, budget status, difficulties experienced, proposed solutions to problems, progress during the reported period, and anticipated progress for the next report period.
- 5.2 At the conclusion of the effort the contractor shall submit a Final Report. The reports should describe the materials used in manufacture of final product, chemical composition, details of manufacture, a summary of the development program which includes charts, curves, and photographs, and all test results showing the products qualifications to meet the technical qualifications.
- 5.3 One copy of the final report shall be in a form suitable for reproduction without further editing or retyping.

5.4 A draft of the final report shall be jointly reviewed by the contractor and technical monitor prior to issue of the final report in its complete form.

5.5 Deviations: Any deviations to the requirement of this statement of work shall be brought to the attention of the Contracting Officer as they occur during the development/testing program and shall be noted in the monthly progress reports, MSC/Contractor resolution of all deviations, including rationale used in the resolution, shall be contained in the final report.

## EXHIBIT "B"

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                        |                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------|
| <b>NATIONAL AERONAUTICS AND SPACE ADMINISTRATION</b><br><b>NEGOTIATED CONTRACT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                        | <b>Contract No.</b><br>NAS 9-11755 |
| <b>ISSUING OFFICE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                                    |
| <b>Name</b> NASA Manned Spacecraft Center<br>R&T Procurement Branch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Address</b><br>Houston, Texas 77058                                                 |                                    |
| <b>CONTRACTOR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                        |                                    |
| <b>Name</b> Raybestos Manhattan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Address</b> 1875 E. 22nd Street<br>P. O. Box 54820, T. A.,<br>Los Angeles, CA 90054 |                                    |
| <b>Contract for</b> Circuit Breaker Cases                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Amount</b> \$3,914.00                                                               |                                    |
| <b>Appropriation and other administrative data</b><br><br><u>Control number:</u> 0-279-016 (Complete)<br><br><u>Type of contract:</u> Firm Fixed-Price Research and Development<br><br><u>Administration by:</u> NASA Manned Spacecraft Center<br>R&T Procurement Branch<br>Houston, TX 77058<br><u>Appropriation and allotment chargeable:</u> 320-01-10-02-EC-2511<br>,80X0108<br><u>Priority Rating:</u> DO-A2 Certified for national defense use under DMS Reg. I.<br><u>Contract Negotiator:</u> V. E. Mason, Mail Code BC721(7), telephone: A/C 713, 483-5441<br><u>Technical Monitor:</u> Dan Supkis, Mail Code EC7, telephone: A/C 713, 483-4336                                                                                                                                                     |                                                                                        |                                    |
| This negotiated contract is entered into pursuant to the provisions of 10 U.S.C. 2304 (a)(11) and any required findings and determination have been made.<br><br>THIS CONTRACT is entered into as of _____ by and between the United States of America, hereinafter called the Government, represented by the Contracting Officer executing this contract, and <u>Raybestos Manhattan</u><br>(i) a corporation organized and existing under the laws of the State of <u>New Jersey</u><br>(ii) a partnership consisting of _____<br>(iii) an individual trading as _____<br><br>hereinafter called the Contractor. The parties hereto agree that the Contractor shall furnish and deliver all supplies and perform all the services set forth in the attached Schedule, for the consideration stated herein. |                                                                                        |                                    |

## CONTRACT SCHEDULE

### ARTICLE I - SCOPE OF WORK

The Contractor shall provide the material, personnel, and facilities required to develop a nonflammable circuit breaker case in accordance with the attached Exhibit "A," Statement of Work. After developing an optimum material, the Contractor will fabricate twenty-five (25) circuit breaker cases using the material developed. The end items will be delivered to NASA Manned Spacecraft Center for testing.

### ARTICLE II - DELIVERY SCHEDULE

The items and reports required to be furnished under this contract shall be delivered as follows:

| ITEM                                         | QUANTITY                               | NUMBER OF MONTHS FROM DATE OF<br>CONTRACTOR'S RECEIPT OF A<br>SIGNED COPY OF THIS CONTRACT |
|----------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------------------|
| 1. Progress Reports                          | Ten (10) copies<br>plus a reproducible | Monthly                                                                                    |
| 2. Nonflammable<br>Circuit Breakers<br>Cases | Twenty-five (25)                       | Four (4)                                                                                   |
| 3. Final Report                              | Ten (10) copies<br>plus a reproducible | Five (5)                                                                                   |

### ARTICLE III - F.O.B. POINT

Delivery of all items shall be F.O.B. destination and shall be shipped at Contractor's expense to the destination specified in Article IV.

### ARTICLE IV - SHIPPING INSTRUCTIONS

All documentation shall be shipped to the addresses cited in Article XII.

Shipment of all other items shall be as follows:

#### 1. Parcel Post Shipments

Ship to:           Transportation Officer  
                  Bldg. 420  
                  NASA Manned Spacecraft Center  
                  Houston, Texas 77058

Mark For: Accountable Property Officer 807402  
Mark with: Purchase Request No. 0-278-016  
Contract Number NAS 9-11755  
For reissue to: Dan Supkis EC7 7A  
(name) (mail code) (Bldg.)

## 2. Freight Shipments

Ship to:            Transportation Officer  
                      Bldg. 420  
                      NASA Manned Spacecraft Center, Texas

Mark For: Accountable Property Officer 807402  
Mark with: Purchase Request No. 0-278-016  
Contract Number NAS 9-11755  
For reissue to: Dan Supkis EC7 7A  
(name) (mail code) (Bldg.)

The Contractor shall prepare DD Form 250 for each shipment made under the terms of this contract.

Block 19 "Unit Price" and Block 20 "Amount" of the DD Form 250, must be completed. When the form is not used as an invoice for payment purposes, the amounts entered may be the Contractor's best estimate.

Contractor shall distribute DD Form 250 on the day of shipment as follows: Government Plant Inspection Representative, if any, 2 copies; Contracting Officer, 2 copies; MSC Transportation Officer, 1 copy; MSC Technical Monitor, 1 copy; MSC Accountable Property Officer, Mail Code BF9, 1 copy; and MSC Cost and Property Accounting Branch, Mail Code BR8, 1 copy. Two copies shall be included in the data package (if applicable) and four copies attached to box number 1 of the shipment.

## ARTICLE V - PACKAGING

Preservation, packaging, and packing for shipment shall be in accordance with commercial practice and adequate for acceptance by common carrier and safe transportation at the most economical rates.

## ARTICLE VI - INSPECTION AND ACCEPTANCE

Final inspection and acceptance shall be accomplished by the Contracting Officer or his duly authorized representative at NASA Manned Spacecraft Center. Unless otherwise specified elsewhere in this contract, the Technical Monitor is the only authorized representative of the Contracting Officer for the purpose of this Article.

## ARTICLE VII - SUBMISSION OF INVOICES

Invoices shall be prepared and submitted in quadruplicate unless otherwise specified. Invoices shall contain the following information: Contract and order number (if any), item numbers, description of supplies or services, sizes, quantities, unit prices, and extended totals. Invoices shall be submitted to NASA Manned Spacecraft Center, Financial Management Division, Houston, TX 77058, Attention: BR34.

## ARTICLE VIII - CONSIDERATION AND PAYMENT

The total fixed price of this contract is \$3,914.00.

## ARTICLE IX - CONTRACTING OFFICER REPRESENTATIVES

Wherever in this contract a Contracting Officer's representative has been specifically designated by office or by name, or in any other manner, the Government reserves the right for the Contracting Officer unilaterally to withdraw such designation and (1) designate another person to act in the named representative's place; or (2) make any future designations extra-contractually; or (3) perform the related function himself, provided that notification of any such withdrawal and subsequent designation(s) will be given to the Contractor in writing.

## ARTICLE X - TECHNICAL MONITOR

Dan Supkis, Mail Code EC7, is hereby designated a representative to act as Technical Monitor under this contract. He will represent the Contracting Officer in the technical phases of the work.

The Technical Monitor is not authorized to change any of the terms and conditions of the contract. Such changes, if any, shall be made only by the Contracting Officer.

## ARTICLE XI - DESIGNATION OF NEW TECHNOLOGY REPRESENTATIVE AND PATENT REPRESENTATIVE (August 1969)

A. For purposes of facilitating administration of the clause of this contract entitled "New Technology" or "Property Rights in Inventions," whichever is included, the following named representatives are hereby designated by the Contracting Officer to administer the clause:

| <u>Name</u>     | <u>Title</u>                     | <u>Mail<br/>Code</u> | <u>Address</u>                                                              |
|-----------------|----------------------------------|----------------------|-----------------------------------------------------------------------------|
| John T. Wheeler | New Technology<br>Representative | JM7                  | NASA, Manned Spacecraft Center<br>Bldg. 45, Rm. 242<br>Houston, Texas 77058 |



C. For contracts containing the New Technology clause, the requirement to identify the Contracting Officer in subcontracts set forth in paragraph (d)(1) of the clause may be satisfied by the inclusion of this entire provision..

The following reports shall be prepared in accordance with the requirements contained in Clause 74:

The final report shall be submitted in ten (10) copies, plus a reproducible.

### Delivery Addressees

1. One (1) copy of each report prepaid to:

NASA Manned Spacecraft Center  
R&D Procurement Branch  
Houston, TX 77058  
Attn: V. E. Mason, Mail Code BC721(7)  
Mark For: Contract NAS 9-11755

2. Four (4) copies of the final report prepaid to:

NASA Manned Spacecraft Center  
Technical Library Branch  
Houston, TX 77058  
Attn: Retha Shirkey, Mail Code JM6  
Mark For: Contract NAS 9-11755

3. One (1) copy of the final report prepaid to:

NASA Manned Spacecraft Center  
 Management Services Division  
 Houston, TX 77058  
 Attn: John T. Wheeler, Mail Code JM7  
 Mark For: Contract NAS 9-11755

4. Nine (9) copies of the monthly report and four (4) copies of the final report, plus a reproducible of each, prepaid to:

NASA Manned Spacecraft Center  
Crew Systems Division  
 Houston, TX 77058  
 Attn: Dan Supkis  
 Mark For: Contract NAS 9-11755

ARTICLE XIII - GOVERNMENT-FURNISHED PROPERTY (Reference Clause 132 of General Provisions)

The Government shall furnish, for performance of the work required herein, the following items:

One (1) Circuit Breaker Case, P/N ME 454-0011, to be used in establishing physical dimensions of end items.

ARTICLE XIV - LIMITATION ON PRINTING AND REPRODUCTION (Reference Clause 27 of the General Provisions)

The standards contemplated by the above referenced clause are listed in the attached Table XX entitled, "Reports and Data Duplication."

ARTICLE XV - CONTENTS OF CONTRACT

This Contract NAS 9-11755 consists of the following:

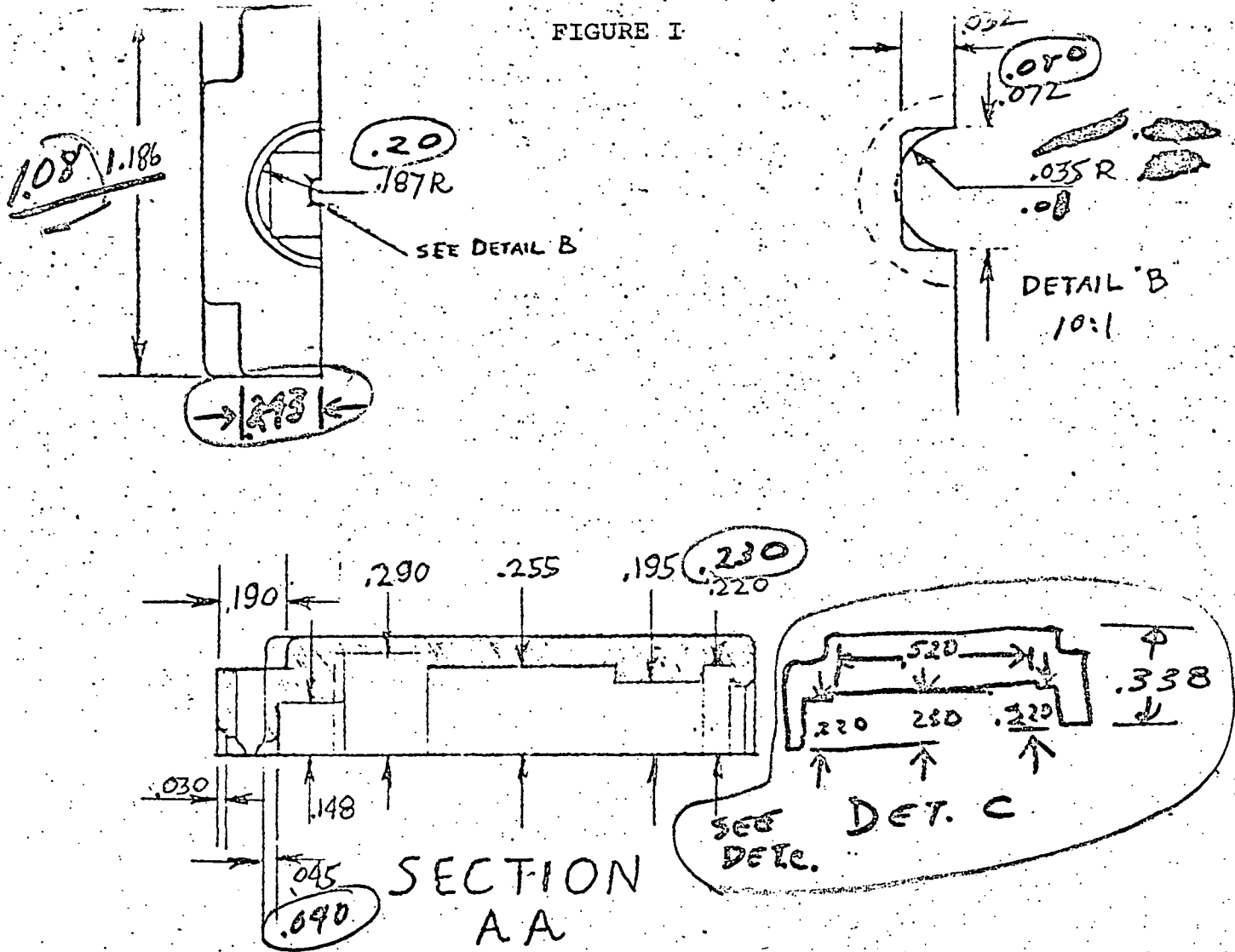
Cover Page (NASA Form 437)  
 Schedule Articles I thru XV  
 Exhibit "A," Pages 1 thru 5  
 Table XX

General Provisions, as follows, incorporated herein by reference:

- (a) All clauses in the attached MSC Form 1320A (Rev. Sept. 70).
- (b) The following clauses in the attached MSC Form 1320B (Rev. Sept. 70):  
 27, 69, 108, and 132.

Signature Page (NASA Form 437-1)

FIGURE I

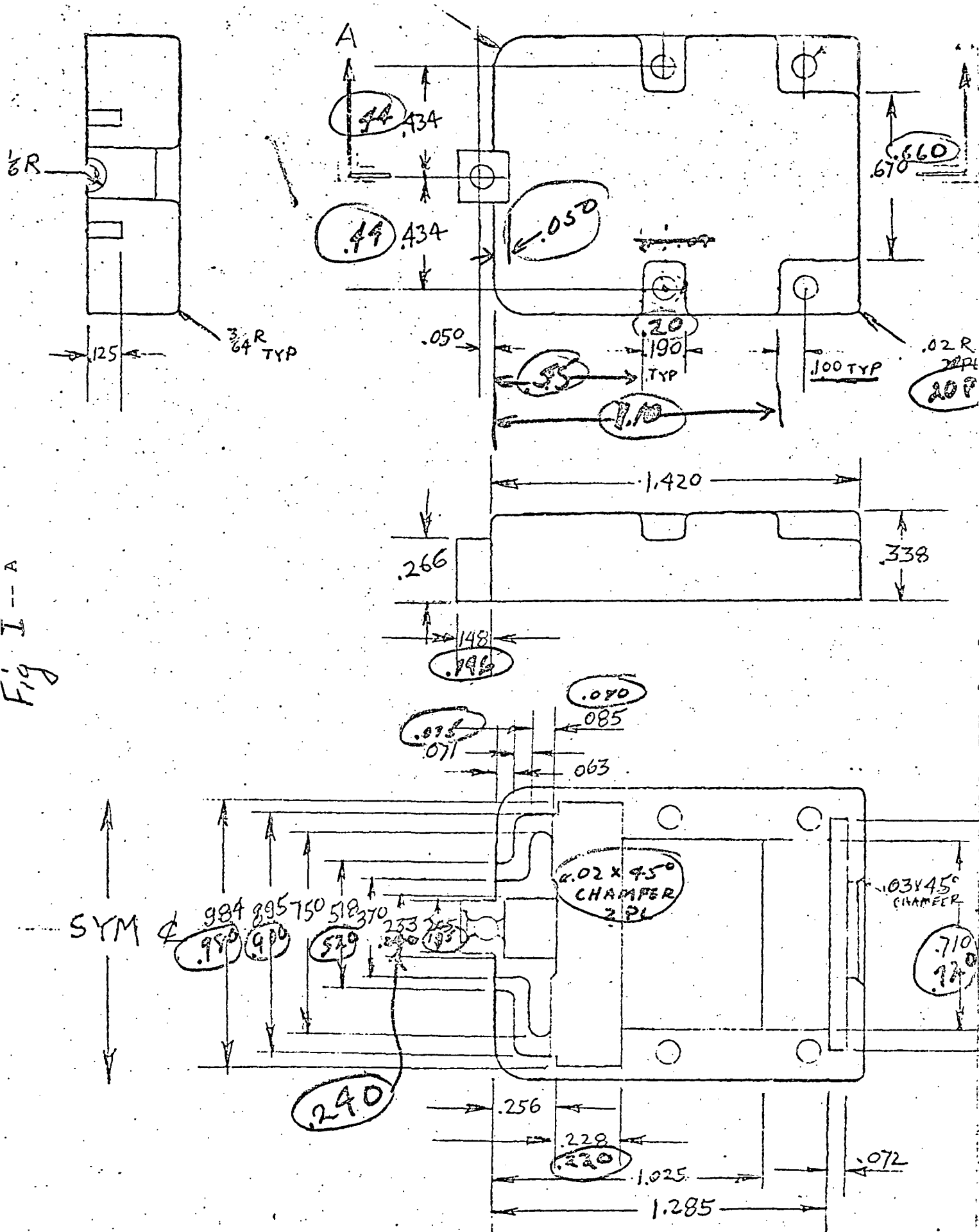


MATERIAL: REFSET

TOLERANCE:  $\pm 5\%$  ON ALL DIMENSIONS

Rec'd. from  
NASA 6/28

|                                      |              |                |
|--------------------------------------|--------------|----------------|
| RAYBESTOS - MANHATTAN, INC.          |              |                |
| NORTH CHARLESTON, S. C.              |              |                |
| SCALE: 2:1                           | APPROVED BY: | DRAWN BY JCM   |
| DATE: 5-14-71                        |              | REVISED        |
| CIRCUIT BREAKER CASE P/N ME-454-0011 |              |                |
| NASA CONTRACT NAS-9-11755            |              |                |
| REF - DEL VAL # 7598                 |              | DRAWING NUMBER |
|                                      |              | MRD 25698      |



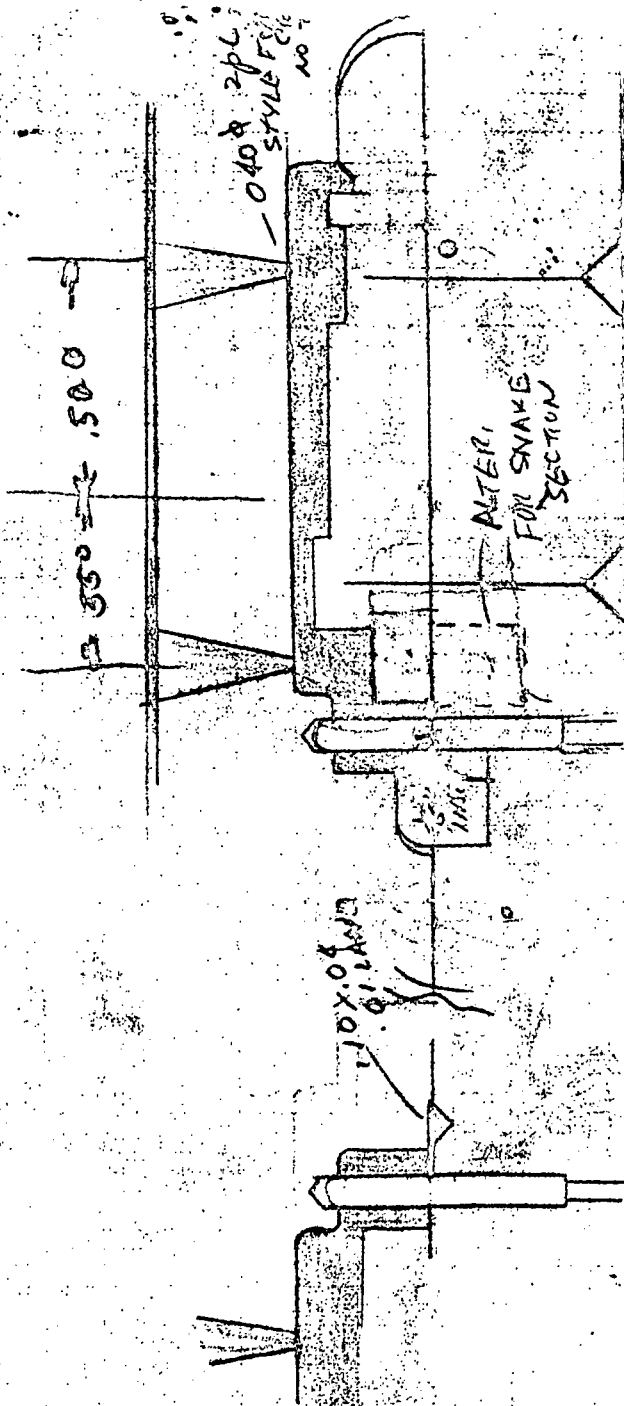
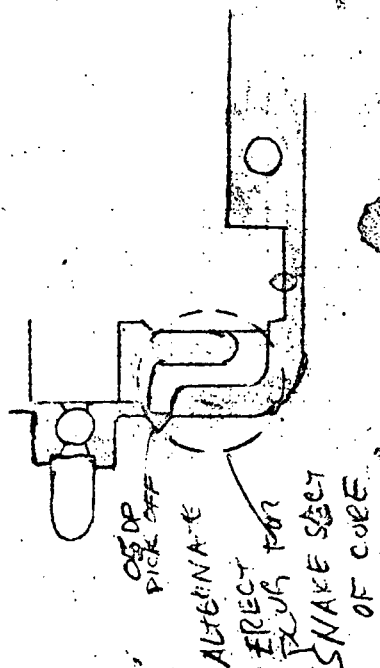




TABLE I

## SHRINKAGE VALUES L-3203-6 ON CURING

## I TEST PROCEDURE

1500 Vols.stock weighed to  $\pm 5$  grams. Example: Gravity of compound  $1.5 \times 1500 = 2250$  grams L-3203-6. Specific Gravity  $2.1 \times 1500 = 3150$  grams.

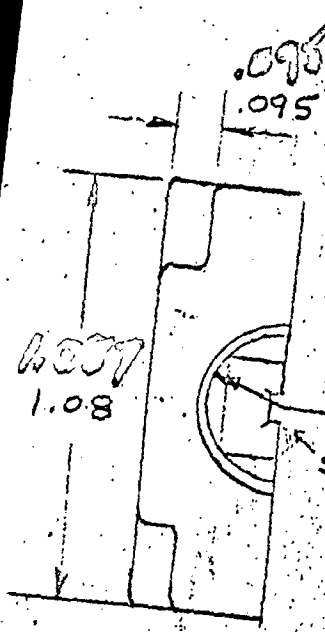
Material placed on 6" x 12" laboratory rubber mill and banded. Thickness adjusted to .285"/.295" gauge on sheet and banded sheet with rolling bank, allowed to mill for three minutes. Mill stopped and sample sheet cut parallel to roll length. Mill started and material removed as sheet of more than twenty inches in length. Sheet allowed to cool to room temperature and strip cut with or against grain -with grain is in direction of sheet length, approximately .250" - .000", + .015" wide by twenty inches length + .000", - .032".

Mold is single cavity, 20.010 inches length by .274 inches wide and .274 inches high. Above cut strip placed in mold and with mold cover in place, mold is inserted into press, heated to 320°F. Mold and cover previously heated to 320°F.  $\pm 5^\circ\text{F}$ . Sample cured for stated cure time, under 2000 pound ram pressure on 24" x 24" platens. Sample removed and excess flash trimmed from sample.

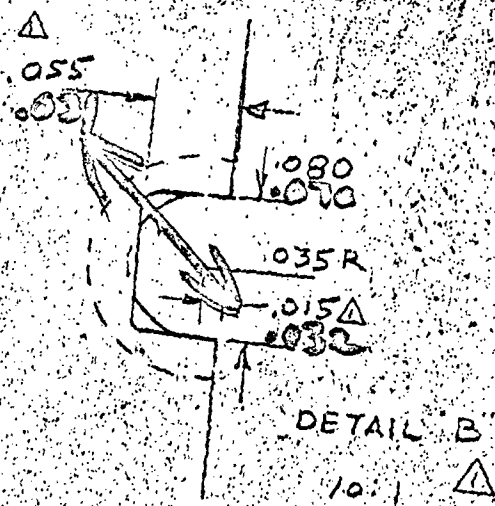
Sample aged overnight or minimum of 16 hours at room temperature 75°F.  $\pm 5^\circ\text{F}$ . and 50% relative humidity  $\pm 10\%$ . Sample measured on length to .001 inches and width to .001 inches. Results recorded and percent shrinkage calculated as loss, divided by mold length and width. Expansion of steel not incorporated into measurements as molds used are normally heated to 320°F. post cured samples are measured in like manner and results recorded.

## II RESULTS (L-3203-6 - AS CURED 30'/320°F.)

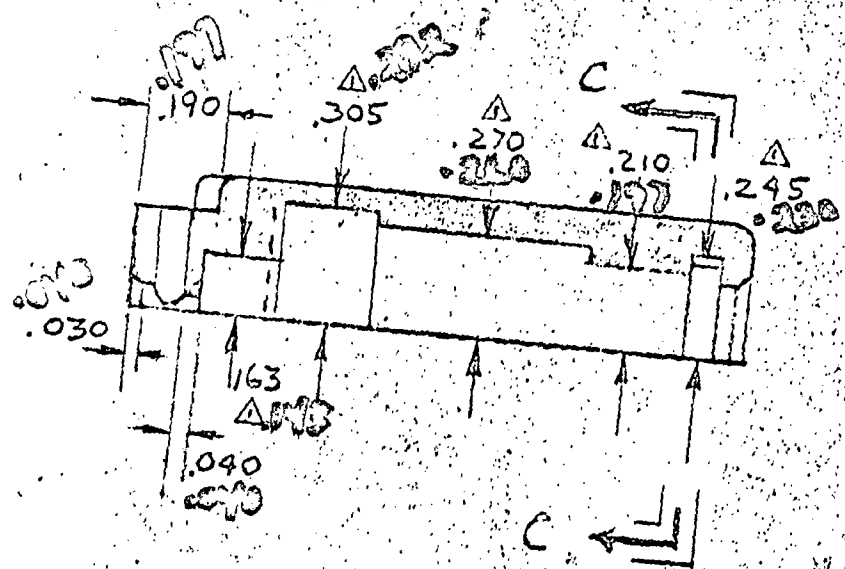
| CONDITION                            | DURO A | WIDTH | SHRINKAGE | LENGTH | SHRINKAGE |
|--------------------------------------|--------|-------|-----------|--------|-----------|
| With Grain                           | 89     | .266  | 2.8       | 19.633 | 2.2       |
| Against Grain                        | 88     | .265  | 3.2       | 19.666 | 1.7       |
| (L-3203-6 POST CURED 16 HRS./350°F.) |        |       |           |        |           |
| With Grain                           | 96     | .265  | 3.2       | 19.073 | 4.6       |
| Against Grain                        | 95     | .263  | 4.0       | 19.166 | 4.1       |
| (L-3203-6 POST CURED 16 HRS/450°F.)  |        |       |           |        |           |
| With Grain                           | 98     | .262  | 4.4       | 19.010 | 4.99      |
| Against Grain                        | 98     | .261  | 4.7       | 19.041 | 4.84      |



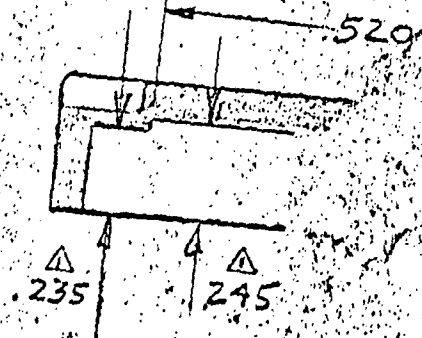
SEE DETAIL B



DETAIL B



SECTION A A

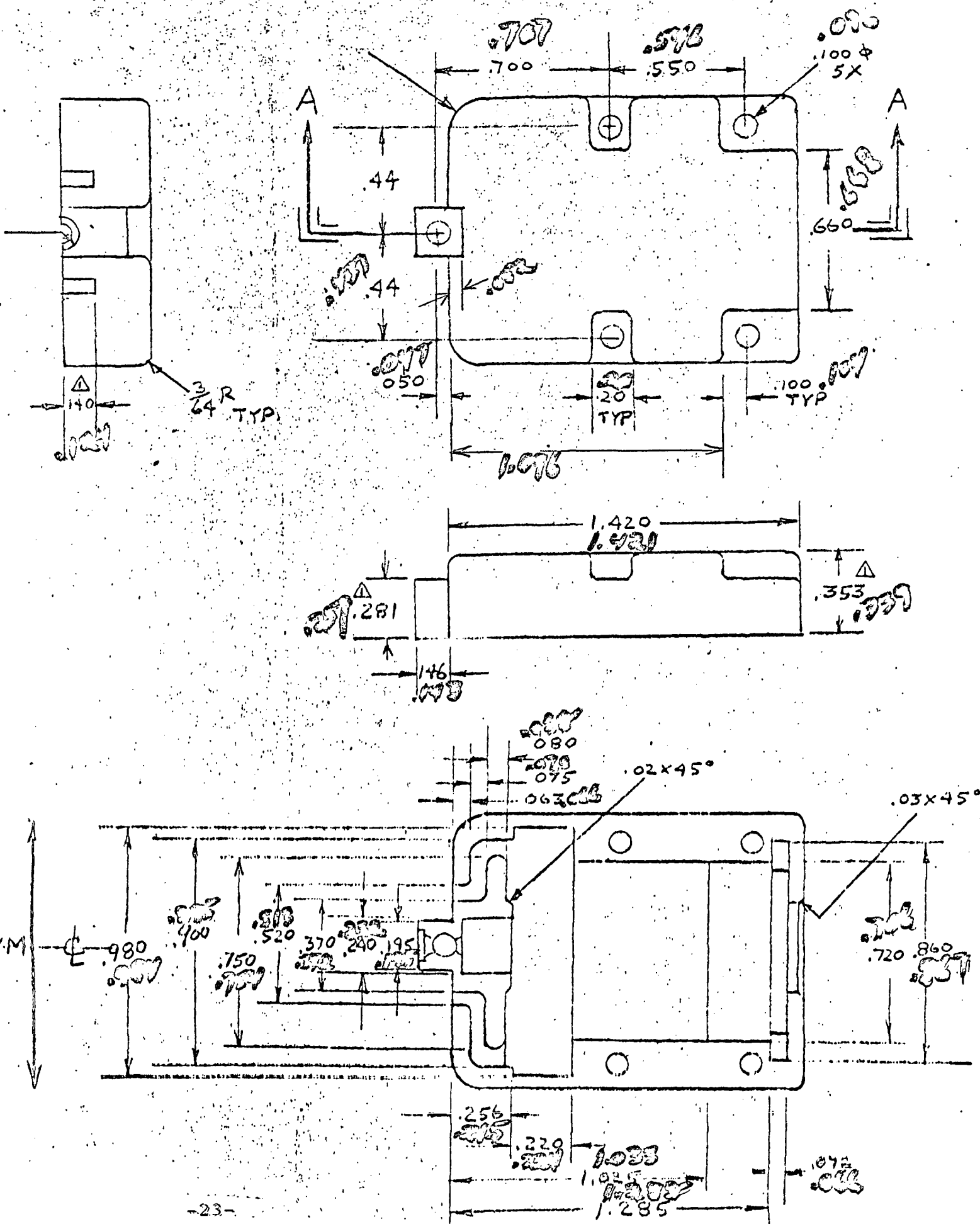


SECTION C C

MATERIAL : REFSET  
TOLERANCE  $\pm 5\%$  ON ALL DIMENSIONS

|                                                               |                     |
|---------------------------------------------------------------|---------------------|
| <p>△ VERTICAL DIMENSIONS INCLUDE .015 MACHINING ALLOWANCE</p> |                     |
| <p>RAYBESTOS MANHATTAN, INC.</p>                              |                     |
| <p>NORTH CHARLESTOWN, S.C.</p>                                |                     |
| <p>SCALE: 2:1</p>                                             | <p>APPROVED BY:</p> |
| <p>DATE: 5-14-71</p>                                          | <p>DRAWN BY JCM</p> |
| <p>REVIEWED 8-12-71</p>                                       |                     |
| <p>CIRCUIT BREAKER CASE ME-454-CON</p>                        |                     |





## Circuit Breaker Case

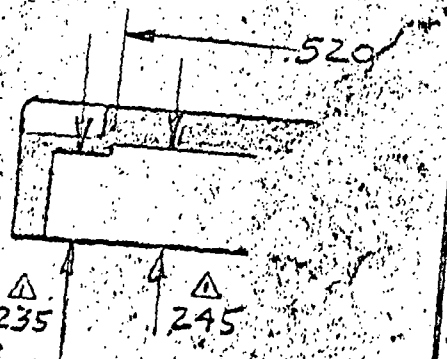
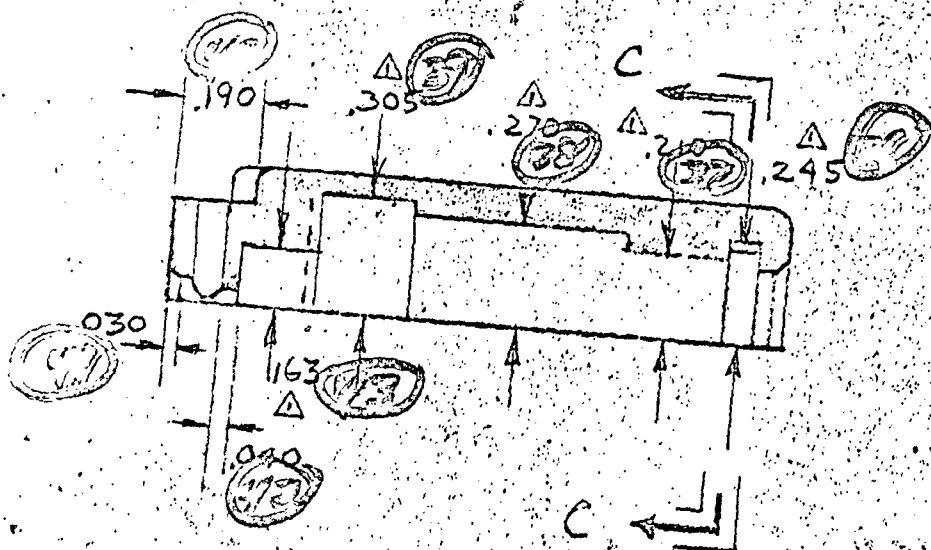
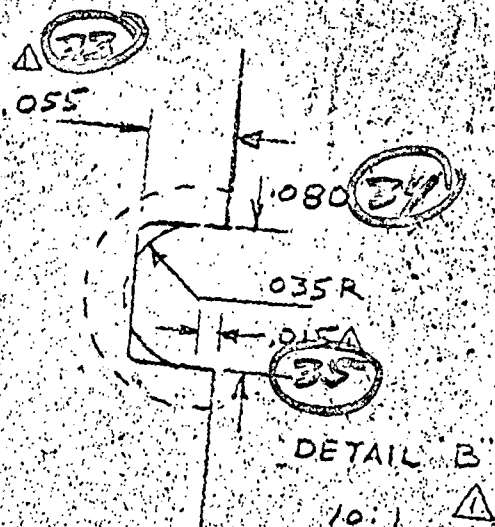
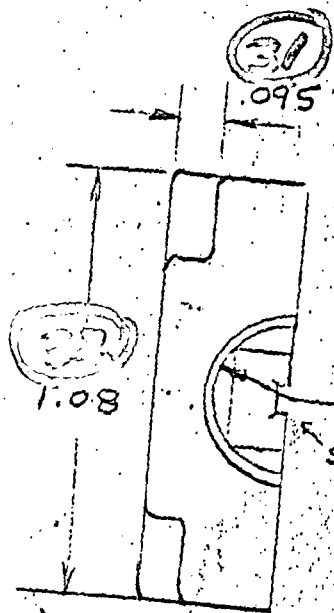
September 21, 1971  
Sheet #1

Refer to Detail Print marked "Key"

| Location  | Case #1 | Case #2 | Case #3 | Case #4 |
|-----------|---------|---------|---------|---------|
| Holes (5) | .096    | .098    | .100    | .100    |
| 1         | .694    | .677    | .690    | .680    |
| 2         | .553    | .551    | .544    | .555    |
| 3         | .660    | .667    | .660    | .668    |
| 4         | .101    | .107    | .101    | .103    |
| 5         | .202    | .200    | .202    | .200    |
| 6         | .047    | .047    | .047    | .047    |
| 7         | .443    | .441    | .441    | .441    |
| 8         | 1.095   | 1.097   | 1.096   | 1.100   |
| 9         | 1.410   | 1.413   | 1.411   | 1.417   |
| 10        | .332    | .332    | .336    | .334    |
| 11        | .142    | .141    | .141    | .145    |
| 12        | *.249   | *.268   | *.256   | *.265   |
| 13        | .119    | .122    | .120    | .123    |
| 14        | .985    | .987    | .990    | .972    |
| 15        | .911    | .911    | .909    | .904    |
| 16        | .750    | .751    | .746    | .742    |
| 17        | .538    | .538    | .527    | .529    |
| 18        | .368    | .371    | .369    | .364    |
| 19        | .243    | .243    | .243    | .239    |
| 20        | .195    | .198    | .196    | .197    |
| 21        | .063    | .063    | .063    | .062    |
| 22        | .074    | .072    | .072    | .075    |

continued -

| Location | Case #1 | Case #2   | Case #3 | Case #4 |
|----------|---------|-----------|---------|---------|
| 23       | .079    | .078      | .079    | .080    |
| 24       | .254    | .260      | .259    | .255    |
| 25       | .216    | .215      | .216    | .219    |
| 26       | 1.025   | 1.024     | 1.024   | 1.028   |
| 27       | 1.261   | 1.278     | 1.272   | 1.269   |
| 28       | .073    | .075/.084 | .075    | .074    |
| 29       | .720    | .730      | .725    | .721    |
| 30       | .865    | .868      | .868    | .868    |
| 31       | .099    | .102      | .100    | .101    |
| 32       | 1.088   | 1.097     | 1.092   | 1.092   |
| 33       | .039    | .043      | .040    | .040    |
| 34       | .085    | .083      | .083    | .085    |
| 35       | -       | -         | -       | -       |
| 36       | *.225   | *.230     | *.220   | *.230   |
| 37       | *.185   | *.186     | *.183   | *.186   |
| 38       | *.246   | *.250     | *.248   | *.248   |
| 39       | *.277   | *.278     | *.284   | *.284   |
| 40       | .198    | .195      | .194    | .197    |
| 41       | .043    | .035      | .044    | .042    |
| 42       | .035    | .037      | .036    | .039    |
| 43       | *.137   | *.139     | *.140   | *.140   |



SECTION A A

SECTION C C

MATERIAL : REFSET

TOLERANCE  $\pm 5\%$  ON ALL DIMENSIONS

|                                                               |                     |
|---------------------------------------------------------------|---------------------|
| <p>△ VERTICAL DIMENSIONS INCLUDE .015 MACHINING ALLOWANCE</p> |                     |
| <p>RAYBESTOS MANHATTAN, INC.<br/>NORTH CHARLESTOWN, S.C.</p>  |                     |
| <p>SCALE: 2:1</p>                                             | <p>APPROVED BY:</p> |
| <p>DATE: 5-14-71</p>                                          | <p>DRAWN BY JCM</p> |
| <p>CIRCUIT BREAKER CASE ME-45A</p>                            |                     |
| <p>REVISED 8-12-71</p>                                        |                     |

