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MANUFACTURING GUIDE FOR ELASTOMERIC SEALS

Frank B. Testroet

Rock Island Arsenal
Rock Island, Illinois 61299-5000

27 December 1989

Final technical report for MMT Project 6828030,
"Manufacturing Guide for Elastomeric Seals."

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT Available for public release; distribution is unlimited.	
b. DECLASSIFICATION/DOWNGRADING SCHEDULE		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
c. PERFORMING ORGANIZATION REPORT NUMBER(S) SE-90-04			
a. NAME OF PERFORMING ORGANIZATION Science & Engineering Directorate Rock Island Arsenal	6b. OFFICE SYMBOL (If applicable) SMCRI-SEM-T	7a. NAME OF MONITORING ORGANIZATION	
c. ADDRESS (City, State, and ZIP Code) Rock Island, IL 61299-5000		7b. ADDRESS (City, State, and ZIP Code)	
a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. PAA3297	PROJECT NO. 6828030
		TASK NO.	WORK UNIT ACCESSION NO.

1. TITLE (Include Security Classification)

Manufacturing Guide for Elastomeric Seals

2. PERSONAL AUTHOR(S)

Testroet, Frank B.

3a. TYPE OF REPORT

Final

13b. TIME COVERED

FROM _____ TO _____

14. DATE OF REPORT (Year, Month, Day)

89 Dec 27

15. PAGE COUNT

42

6. SUPPLEMENTARY NOTATION

The citation of specific products or the use of trade names or manufacturer's names does not constitute an endorsement or approval by the Department of Army

7. COSATI CODES

FIELD	GROUP	SUB-GROUP
11	10	
11	09	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Elastomers Injection Molding
Seal Rubber
Back-up Ring

9. ABSTRACT (Continue on reverse if necessary and identify by block number)

Elastomeric seals used in gun mounts have a hard to achieve combination of properties, so acceptable seals are difficult to procure and few sources are available. Therefore, two rubber formulations were developed, each for a different hydraulic oil, with the intention of providing the manufacturing data to U.S. Government activities and potential vendors.

As in-house Army fabrication capability is needed for the seal kit for the M140 gun mount, polytetrafluoroethylene (PTFE) tubes and cloth-filled phenolic sheet were procured for back-up rings in the kit. Subsequent gymnastication demonstrated Rock Island Arsenal has the capability of fabricating all the seals in the kit according to the technical data.

(continued)

10. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
2a. NAME OF RESPONSIBLE INDIVIDUAL Richard Kalkan, Jr.		22b. TELEPHONE (Include Area Code) (309) 782-7873	22c. OFFICE SYMBOL SMCRI-SEM-T

D Form 1473, JUN 86

Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

19. ABSTRACT (continued)

For improved producibility and storage and lower cost, nylon-filled phenolic and polyester thermoplastic back-up rings were fabricated to replace the phenolic and PTFE, respectively. The results to date are inconclusive.

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MANUFACTURING GUIDE FOR ELASTOMERIC SEALS

INTRODUCTION:

One of the objectives of this effort was to increase competition for purchasing elastomeric seals for Army weapons systems where acceptable seals were available from only one or a few vendors and were difficult to fabricate. Manufacturing data from tested formulations would be provided for vendors or U.S. Government activities. This work was also directed toward establishing Army in-house capability of manufacturing seal kits for the M140 Gun Mount. These kits consist of six elastomeric seals, four polytetrafluorethylene (PTFE) back-up rings and one cloth-filled phenolic ring. Such an in-house capability would assure a ready source of supply for seal kits to be installed in M140 and other gun mounts manufactured at Rock Island Arsenal.

ELASTOMERIC SEALS:

Elastomeric seal drawings were surveyed to determine the most needed seal materials for Army weapon systems. Drawing 8689822 was found to provide a suitable material call-out for use in many weapon systems where MIL-H-6083 hydraulic oil is used, especially for the M178 Gun Mount. The requirements of that drawing, with the exception of substituting MIL-H-46170 hydraulic oil for MIL-H-6083, were required for the seals for the M140 Gun Mount.

Drawing 8689822 cites Material: Rubber, Synthetic, Grade SB715A₁E₂F₂Z₁Z₂Z₃Z₄Z₅Z₆, Specification MIL-R-3065 and MIL-STD-417. The Z suffix requirements are defined as follows:

- Z₁: Original Elongation - 150 percent minimum;
- Z₂: 0 - 15 percent volume change after 70 hours immersion in MIL-H-6083 at 275 deg. F.;
- Z₃: No evidence of corrosion or adhesion against steel when tested per MIL-P-5576;
- Z₄: TR10 value of -51 deg. F., or colder when tested at 50 percent elongation per ASTM W1329. Material shall meet TR10 value of -51 deg. F. or colder after 70 hours heat soak in hydraulic fluid conforming to MIL-H-6083 at 70 deg. C. (158 deg. F.);
- Z₅: Modulus at 100 percent elongation of 700 psi minimum, when tested per ASTM D412;
- Z₆: Compression set after 70 hours at 212 deg. F. per ASTM D395, Method B performed on buttons - 23 percent maximum. The complete set of requirements for Grade SB715A₁E₂F₂Z₁Z₂Z₃Z₄Z₅Z₆ are presented in Table 1.

Examination reveals this combination of requirements, e.g., high modulus, low compression set, resistance to embrittlement at low temperature, good low temperature retraction before and after being soaked in hot hydraulic oil, resistance to petroleum oil at 275 deg. F. and corrosion resistance to steel is severe and difficult to achieve by using 'off-the-shelf' nitrile seal compound. Individually, any of the requirements is not too difficult to meet, even though it approaches the best attainable. However, when compounding to reach a best attainable property for any one requirement, other properties are sacrificed, so judicial compromises must be made to attain the desired combination.

TABLE 1

PHYSICAL PROPERTY REQUIREMENTS OF
GRADE SB715A₁E₃F₂Z₁Z₂Z₃Z₄Z₅Z₆ PER DRAWING 8689822*

<u>PROPERTY</u>	<u>REQUIREMENTS</u>
As received sample: (ASTM D 412 Method A) Tensile strength, psi.	1500 min.
(A1) After 70 hrs. @ 212 deg. F. in air, ASTM D 573. Tensile change, %.	-20 max.
Elongation change, %.	-40 max.
Hardness change, Shore A points.	+15 max.
(E3) After 70 hrs. @ 212 deg. F. in ASTM #3 oil, ASTM D 471. Tensile change, %.	-45 max.
Elongation change, %.	-45 max.
Hardness change, Shore A points.	-10 to
Volume change, %.	0 to + 25
(F2) Brittleness, deg. F., ASTM D 746, para 1.1, Note 1. ASTM D 2137, para 3.2.1, Method A.	-67 No failure
(Z1) Elongation, %.	150 min.
Hardness, Shore A, ASTM D 2240.	70 $\pm$ 5
Temperature retraction, (TR10), deg. F. ASTM D 1320.	-51 or below
(Z2) After 70 hrs. @ 275 deg. F. in MIL-H-6083 oil*. ASTM D 471. Volume change, %.	0 to + 15
(Z3) Corrosion on steel, MIL-P-5516C.	No indication permitted
(Z4) After 70 hrs. @ 158 deg. F. in MIL-H-6083 oil*. Temperature retraction (TR10), deg. F.	-51 or below
(Z5) Modulus @ 100% Elongation, psi.	700 min.
(Z6) After 70 hrs. @ 212 deg. F. in air, ASTM D 395 Method B. Compression set, %.	23 max.

* Other systems, e.g., the M140 Gun Mount, require substitution of MIL-H-46170 hydraulic oil.

Two nitrile rubber based compounds were developed to meet the call-out; one compound, N221, is intended for use with MIL-H-6083 hydraulic oil and the other, N220-1, for use with MIL-H-46170 (Table 2).

These compounds were mixed on a 2-roll laboratory mill measuring 6 X 12 inches. The same compounds were then mixed on a 30 X 12 inch mill used for production purposes to determine if there were any substantial differences in properties, especially stress-strain properties, between laboratory and shop mixed batches. Difference in the size of the rolls affects the mixing of the compounding ingredients into the rubber, mainly because larger rolls produce a different shearing action in the mix of rubber than do rolls of smaller diameter.

The following mixing procedure was followed in both the laboratory and shop:

1. Pass rubber through tight rolls without banding, three times. Do each rubber of the blend separately.
2. Then band both base rubbers in the formula on the slow roll of a tight cold mill. Make two 3/4 cuts from each side after 1 minute to blend the rubbers. Continue to run the banded rubber for 2 more minutes.
3. Add stearic acid, zinc oxide and Maglite D together evenly across the mill. Then add Vanax A, Methyl Ethyl Tuads, Durax and Age Rites. Make additions slowly without cutting the rubber until all the ingredients are incorporated. Then make three 3/4 cuts from each side.
4. Add half of the carbon black and half of the plasticizer evenly across the mill without cutting. When this portion of black and plasticizer is completely mixed into the rubber, open the mill to maintain a small nip. Make three 3/4 cuts from each end. Add remaining black and plasticizer evenly across the mill. When all black and plasticizer is added, make three 3/4 cuts from end to end. Cut from mill and roll the rubber.
5. Pass the rolled rubber endwise through the rolls six times.
6. Weigh and record weight of batch.
7. Sheet out and cool on bench top.

Only fresh elastomers and curatives stored less than 6 months after receipt were used.

Standard 6 X 6 X 0.080 inch test pads were cured 30 minutes at 307 deg. F. in a steam heated press, and 0.500 inch thick compression set buttons were cured 45 minutes at 307 deg. F. in an electrically heated press.

Table 3 presents data for comparison of properties of both compounds N221 and N220-1 between those mixed and cured in the laboratory and those mixed and cured in the production rubber shop. These data show that both compounds, whether mixed in the laboratory or in the production facility, meet the physical property requirements of the specified grade. However, the modulus was measured to be lower with both compounds when mixed in the shop. Compound N221 also displayed somewhat lower tensile strength in the shop mixed batch as compared with the laboratory mix.

TABLE 2
COMPOUND FORMULATIONS

<u>COMPOUNDING INGREDIENTS</u>	<u>PARTS BY WEIGHT</u>	
	<u>N221</u>	<u>N220-1</u>
Chemigum N917 (rubber)	93	95
Paracril B (rubber)	7	-
Natsyn 2200	-	5
Zinc Oxide	5	5
Stearic Acid	1	1
Age Rite Resin D	1.5	1.5
Age Rite Superflex	1.5	1.5
Philblack N550 (carbon black)	45	45
Philblack N774 (carbon black)	70	70
Maglite D	5	5
Vanax A	1.1	1.1
Methyl Ethyl Tuada	2.3	2.3
Durax	1.75	1.75
Plasticizer TP90B	30	-
Plasticizer DOS	-	15
Plasticizer TP95	-	15
TOTAL	264.15	264.15

TABLE 3

COMPARISON OF PHYSICAL PROPERTIES OF COMPOUNDS MIXED IN LABORATORY VS. RUBBER SHOP

Property Measured	Laboratory Mix N221	Rubber Shop Mix N221	Laboratory Mix N220-1	Rubber Shop Mix N220-1	Requirement
Tensile strength, psi	2,130	1,640	1,810	1,950	1,500 min.
Modulus @ 100%, psi	1,000	775	1,030	840	700 min.
Elongation, %	200	190	175	200	150 min.
Hardness, Shore A	74	75	73	71	70 ± 5
Compression Set, 70 hrs./212 Deg. F., %	14	18	17	16	23 max.
Temperature Retraction, Unaged, TRI0, Deg. F.	-56	-55	-59	-63	-51 or below
Temperature Retraction after aging 70 hrs/ 158 Deg. F. TRI0 Deg. F.	-52*	-52*	-53**	-56**	-51 or below
70 hrs./212 Deg. F./ ASTM #3 oil					
Tensile change, %	+3	+21	+3	+4	-45 max.
Elongation change, %	-10	-3	+2	0	-45 max.
Hardness change/points	-4	-5	-6	-6	10 to +5
Volume change, %	+10	+6	+13	+14	0 to +25
70 Hrs./275 deg. F. Volume change, %	+12*	+12*	+5**	+4**	0 to +15
Brittleness at -67 deg. F.	no failure	no failure	no failure	no failure	no failure
70 Hrs./212 deg. F./Air					
Tensile change, %	+10	+21	+1	+3	-20 Max
Elongation change, %	-20	-22	-8	-7	-40 Max
Hardness change, %	+12	+10	+3	+5	+15 Max
corrosion on steel	none	none	none	none	none

* MIL-H-6083 hydraulic oil

** MIL-H-46170 hydraulic oil

M140 SEAL KIT:

Figure 1 shows a cut away of the M140 gun mount with the rubber seals and rings and plastic seals that make up the kit.

Elastomeric Seals:

Six single cavity steel mold was fabricated for compression molding the six seals required for the M140 gun mounts. Pertinent drawings for these seals are 8728296, 7044081, 7044083, 8448920, 8448921 and 8449265. These seal drawings are shown in Figures 2 through 7, respectively.

M140 Polytetrafluorethylene (PTFE) Back-up Rings:

The seal kit for the M140 gun mount also requires four different sizes of PTFE back-up rings (8448919, 8449266, 8448922 and 8448915) for the elastomeric seals. Figure 8 shows the role of the back-up rings (white) with the matching elastomeric seal (black). Figure 9 shows all the matching combinations; one back-up ring is used for three different seals. These pictured back-up rings are proposed replacements for the PTFE and are discussed later. The PTFE back-up rings are manufactured by machining them from PTFE tube stock, carbon filled (amorphous) 20-25 percent by weight, graphite filled (amorphous) 0-5 percent by weight. Appropriate sizes of tube stock of this PTFE material were procured and processes were developed to turn outside and inside diameter simultaneously, cut off and debur. A cutting fixture was fabricated to slit the rings, as appropriate, at a 15 degree angle scarf.

Back-up rings machined from the PTFE tube stock were measured by SMCRI-QA and were found to meet the dimensional requirements and were considered acceptable for use.

M140 Reinforced Phenolic Back-up Rings:

One cloth reinforced phenolic back-up ring (7044082) is also required for the M140 Gun Mount Kit. A blanking die was fabricated to blank out the outside and inside diameters simultaneously, and a matching die was made to separate the ring as required. The cloth reinforced phenolic sheet stock was conditioned for 24 hours at 50 ± 4 percent relative humidity at 73 ± 2 deg. F. prior to being cut. These back-up rings were found dimensionally acceptable.

Past experience has revealed that the hydroscopic nature of the cloth-filled phenolic rings presents a problem as the rings change dimensions depending on the relative humidity where these back-up rings are stored or handled during assembly. Installation of the water swollen rings becomes difficult or impossible. Therefore, nylon reinforced phenolic sheets, which are less hydroscopic, were procured for testing to ascertain the feasibility of using it as a replacement for the cloth-filled phenolic. It was intended to use the same blanking die that was previously made to cut back-up rings from the nylon filled phenolic material.

Acceptable back-up rings could not be die cut from the nylon reinforced phenolic sheet as excessing layers of nylon produced too rigid of a sheet. Edges were frayed during the blanking process, and parts meeting the dimensional requirements could not be produced.

FIGURE 1

M140 GUN MOUNT



M140 GUN MOUNT

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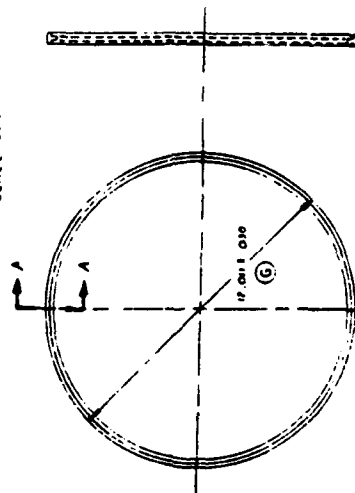
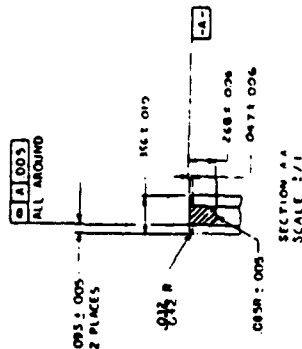
KEYS TO FIGURE 1

Part No. 1	8728296	Rubber Ring	<u>Qty</u> 1
Part No. 2	8448921	Rubber Face Seal	1
	8448922	Plastic Ring	1
Part No. 3	7044083	Rubber Ring	1
	8448915	Plastic Ring	2
Part No. 4	8448920	Rubber Face Seal	1
	8448919	Plastic Ring	1
Part No. 5	7044081	Rubber Ring	1
Part No. 6	8449265	Rubber Seal	1
	8449266	Plastic Ring	1

NOTES:

1. MATERIAL SPECIFICATIONS MUST CONFORM TO DRAWING 86669922, EXCEPT FOR THE SUBSTITUTION OF MIL-H-6817D FOR MIL-H-6083.
2. IDENTIFICATION OF THE SUGGESTED SOURCES OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THIS ITEM.

- 3-.005R MAX ON ALL UNMARKED CORNERS.
- 4- ALL SURFACES OF SEAL MUST CONFORM TO RUBBER MANUFACTURES ASSOCIATION HANDBOOK F-2 FINISH STANDARD



SUGGESTED SOURCES OF SUPPLY		
VENDOR	FSCN	VENDOR ITEM NO.
GREENE TWEED & COMPANY 340 ELM AVE NORTH WALES, PA 19454	72902	
PARKER SEAL COMPANY 2360 PALMBO DRIVE LEXINGTON, KY 40505	02697	

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOU-STD-100.

Approved Form 8830, 79 Jul 80

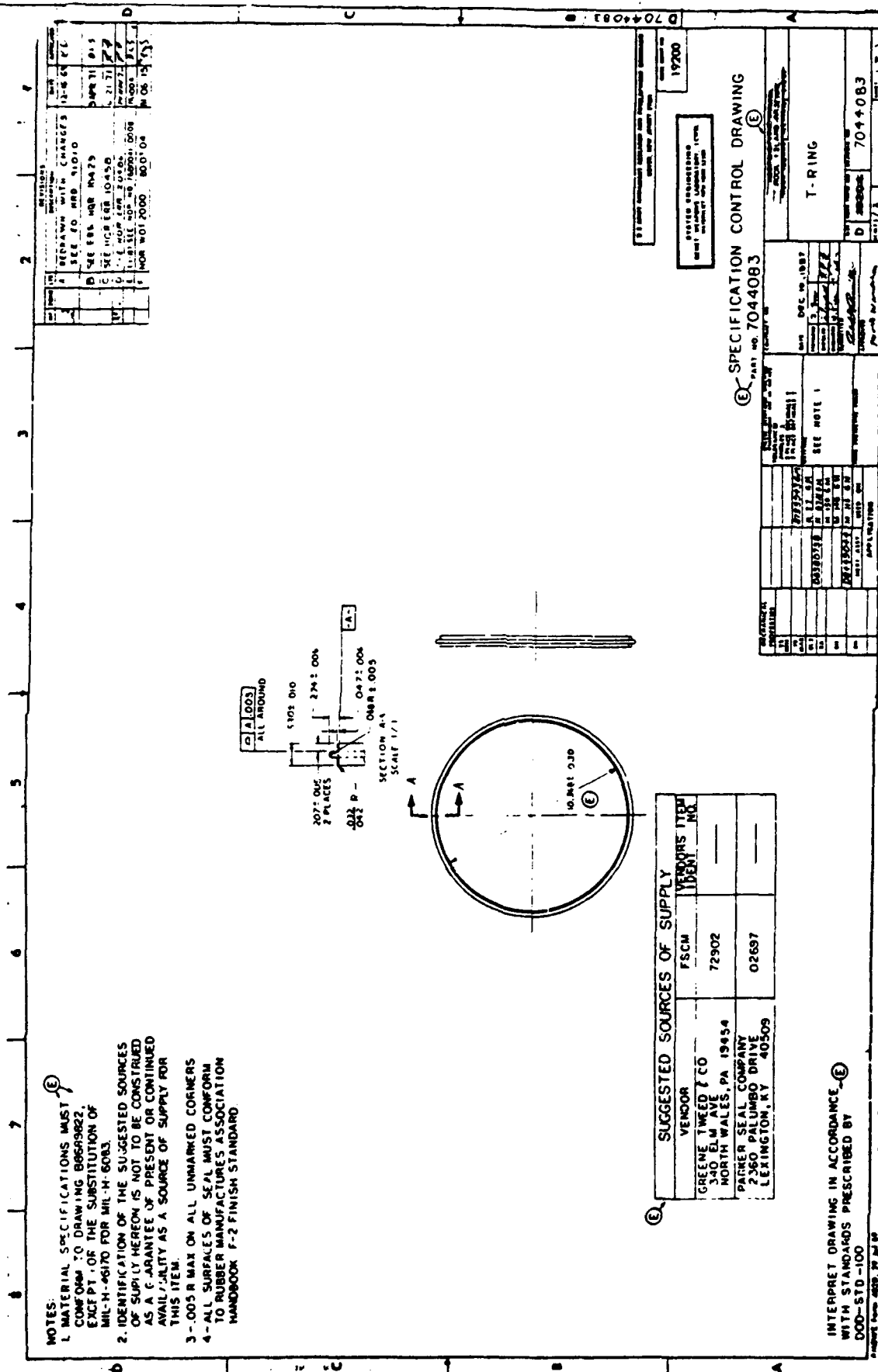
REV	DESCRIPTION	DATE
A	REDRAWN WITH CHANGES	11/14/61
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C	SEE TO HAD 11010	5/7/62
D	SEE TO HAD 11010	5/7/62
E	SEE TO HAD 11010	5/7/62
F	SEE TO HAD 11010	5/7/62
G	SEE TO HAD 11010	5/7/62
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V	SEE TO HAD 11010	5/7/62
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X	SEE TO HAD 11010	5/7/62
Y	SEE TO HAD 11010	5/7/62
Z	SEE TO HAD 11010	5/7/62

19700

SPECIFICATION CONTROL DRAWING
PART NO. 7044081

REV	DESCRIPTION	DATE
A	SEE TO HAD 11010	5/7/62
B	SEE TO HAD 11010	5/7/62
C	SEE TO HAD 11010	5/7/62
D	SEE TO HAD 11010	5/7/62
E	SEE TO HAD 11010	5/7/62
F	SEE TO HAD 11010	5/7/62
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U	SEE TO HAD 11010	5/7/62
V	SEE TO HAD 11010	5/7/62
W	SEE TO HAD 11010	5/7/62
X	SEE TO HAD 11010	5/7/62
Y	SEE TO HAD 11010	5/7/62
Z	SEE TO HAD 11010	5/7/62

FIGURE 3



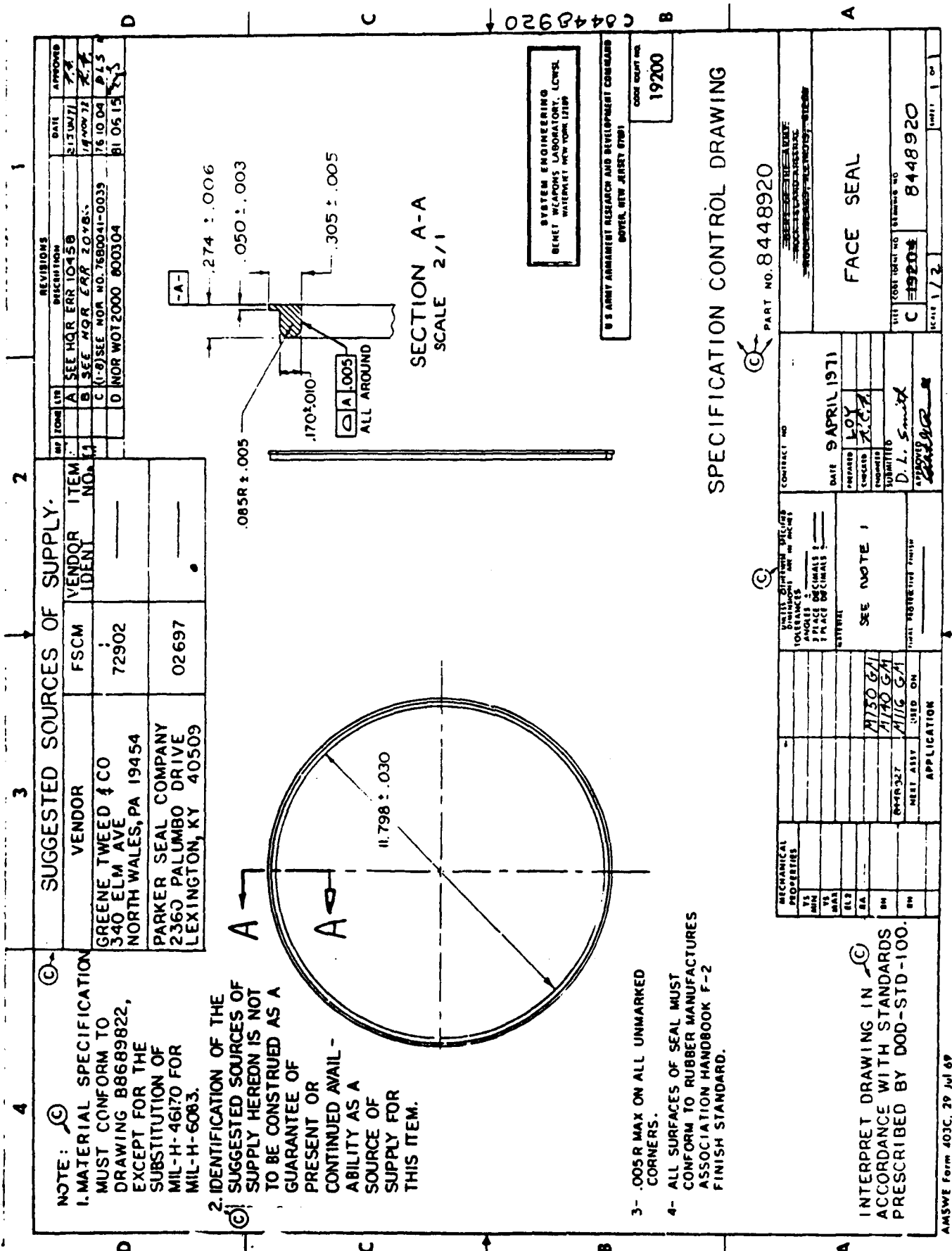


FIGURE 5

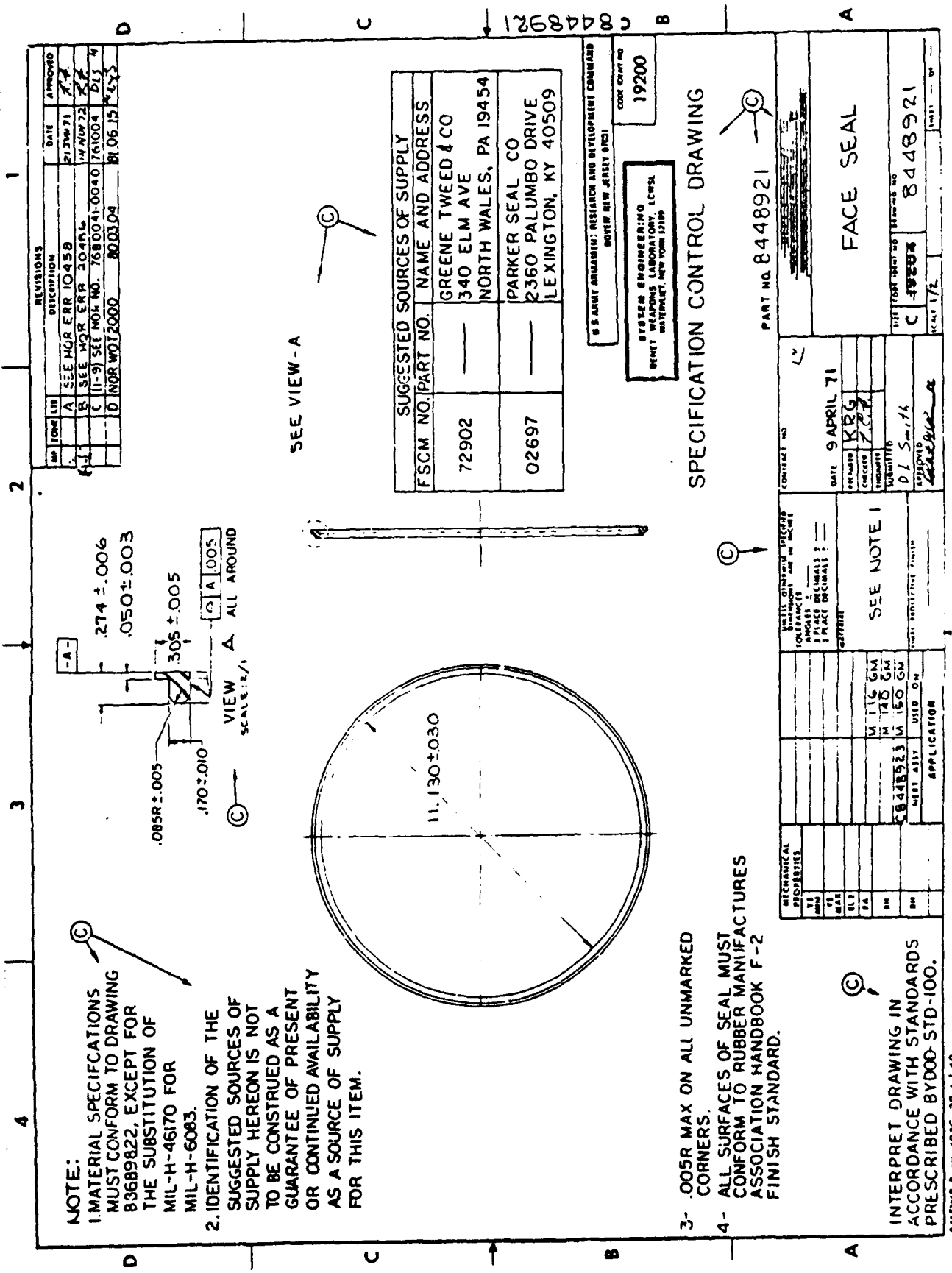


FIGURE 6

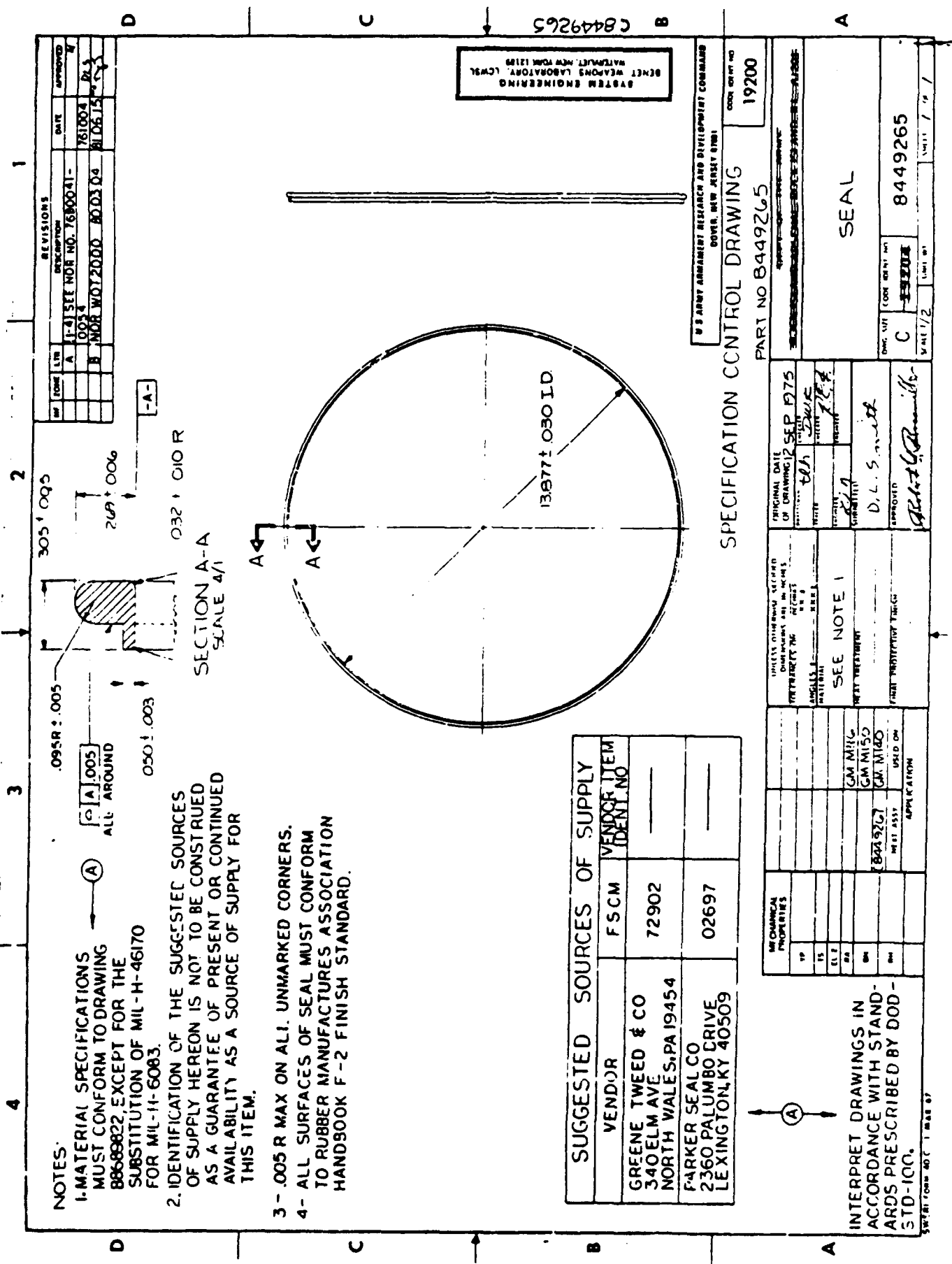


FIGURE 7

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110 BLACK-FLY RIVER
HAS BEEN IN THE
HOLDING

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FIGURE 9

THE FOUR TYPES OF BACK-UP RINGS FOR THE SIX
ELASTOMERIC SEALS OF THE M140 GUN MOUNT

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M140 Gymnastication:

The six rubber seals for the M140 Gun Mount molded from compound N220-1 were installed along with attendant commercial PTFE and cloth-filled phenolic back-up rings in an M140 Gun Mount that was exercised on a powder gymnasticator at RIA. No problems were encountered with installing the elastomeric seals in the M140 Gun Mounts. The seals were mounted in five gun mounts, and the changes in ounces were 11, 11 1/4, 11 3/4, 12 and 12 1/2. Allowable oil leakage was a maximum of 40 drops.

Gun mounts serial numbers 12307 and 12309 exceeded that limit. Disassembly and inspection of the seal systems revealed that the phenolic rings displayed excessive gaps which was attributed to the excessive leakage. The 'Weapon Firing Reports' for these gun mounts are provided in Figures 10 through 14.

Replacement of PTFE for the M140 Back-up Rings:

Current practice to fabricate the PTFE back-up rings by machining them from tube stock is not entirely satisfactory, as at times, difficulties were encountered with procurement of PTFE tube stock that could consistently meet the required physical properties, in particular the compressive strength. Furthermore, the PTFE is quite expensive, and the machining operation produces a large amount of unreclaimable scrap. The machining process is also time consuming and, therefore, costly.

Alternate materials and manufacturing techniques were studied as possible replacement of the machined PTFE. An injection moldable thermoplastic polyester material, Valox 325, was chosen as a potential replacement of the machined PTFE back-up rings. Typical physical properties of the Valox 325 material are listed in Table 4.

A contract was awarded for the fabrication of a single four cavity injection mold to produce the four different sized rings required for the kit. The four back-up rings have been molded by the contractor and are planned to be tested in conjunction with elastomeric seals in an M140 Gun Mount on the gymnasticator.

Back-up rings made by the injection molding process were not totally acceptable to drawing requirements. Surface finish did not meet the 32 RMS requirements, and concave surfaces were noted. However, polishing or other remachining of the mold could eliminate this problem. Some of the dimensions were out of tolerances. Measurement data of the plastic back-up rings is presented in Tables 5 through 8. Nonetheless, these back-up rings are satisfactory to be tested in an experimental basis in an M140 Gun Mount in a gymnasticator.

WEAPON FIRING REPORT						DATE		REPORT NO.	
JOB ORDER NO.		TEST REQUEST AUTHORITY				PAGE NO.		NO. OF PAGES	
13402-10000		SARRI-APA LOI dated 2 Feb 78 M140A1 Recoil Mechanism				1		1	
MATERIEL TESTED:						Mfg: RIA Chrysler (X)			
Mount, Gun: M140A1, for M60A1/A3, S/N <u>12306</u>									
PURPOSE OF TEST:									
Production Proof Acceptance									
FIXTURE AND OR MATERIEL USED IN TEST:									
Powder gymnasticator, a simulation device, drawing No. 66F417. Elevation simulation equipment, drawing No. AWC 138815.									
AMMUNITION COMPONENTS:									
Case, cartridge, M18 modified, lot: mixed. Primer, percussion, M18A2, lot: <u>LS 293-4</u> Propellant, M1, single perforated, lot: <u>RAD69417</u> Cup, closing, 75mm, RIA manufacture.									
TEST PROCEDURE									
The mount was functioned in accordance with MIL-M-45976(WC), para 3.3.4.2. Replenisher, P/N <u>2689261</u> , with <u>MIL-H-46170</u> oil, used in testing the mount. Ambient temperature <u>48°F</u> . Collar torque per para 3.3.2., Yes (X) No (). Replenisher oil reserve per drwg. 7389741, Yes (X) No (). Erratic operation or HOB, Yes () No (X). Case ejection, Yes (X) No ().									
Remarks (Continue on reverse): <u>SPECIAL SEALS (TYPE RIA 567)</u>									
TEST DATA									
Round No.	Charge Oz.	Recoil Length In.	Cycle Time Sec.	Oil Pressure psi	Head Space In.	Rear Seal Leakage Drops/Minute			
						1st	2nd	3rd	Total
1	11	11 1/2	.65	3280	11 3/8				
2	11	11 1/2	.54	3200	11 3/8				
3	11	11 1/2	.57	3080	11 3/8				
4	11	11 5/8	.57	3260	11 3/8				
5	11	11 5/8	.57	3190	11 3/8				
6	11	11 5/8	.60	3180	11 5/8				
7	11	11 1/2	.58	3210	11 3/8				
8	11	11 1/2	.56	3170	11 3/8				
9	11	11 1/2	.57	3155	11 3/8				
10	11	11 1/2	.56	3140	11 5/8	0	0	0	0
11									
12									
13									
14									
15									

Chief
 Prod Engrg Test Branch

SARRI Form 114, 1-66

MORRIS

FIGURE 10

WEAPON FIRING REPORT						DATE <i>Sept 26. 1984</i>	REF ID <i>84-30</i>																																																																																																																																																																				
JOB ORDER NO. <i>17403-10000</i>	TEST REQUEST AUTHORITY SARRI-APA LOI dated 2 Feb 78 M140A1 Recoil Mechanism				PAGE NO. <i>1</i>	NO. OF PAGES <i>1</i>																																																																																																																																																																					
MATERIAL TESTED: Mount, Gun: M140A1, for M60A1/A3, S/N <i>12307</i>					Mfg: RIA <i>(X)</i> Chrysler <i>()</i>																																																																																																																																																																						
PURPOSE OF TEST: Production Proof Acceptance																																																																																																																																																																											
FIXTURE AND OR MATERIAL USED IN TEST: Powder gymnasticator, a simulation device, drawing No. 66F417. Elevation simulation equipment, drawing No. AWC 138815.																																																																																																																																																																											
AMMUNITION COMPONENTS: Case, cartridge, M18 modified, lot: mixed. Primer, percussion, M1B1A2, lot: <i>LS-293-4</i> Propellant, M1, single perforated, lot: <i>RAD 69417</i> Cup, closing, 75mm, RIA manufacture.																																																																																																																																																																											
TEST PROCEDURE: The mount was functioned in accordance with MIL-M-45976(WC), para 3.3.4.2. Replenisher, P/N <i>8689261</i> , with <i>MIL-H-46170</i> oil, used in testing the mount. Ambient temperature <i>56°F</i> . Collar torque per para 3.3.2., Yes <i>(X)</i> No <i>()</i> . Replenisher oil reserve per drwg. 7389741, Yes <i>(X)</i> No <i>()</i> . Erratic operation or HGB, Yes <i>()</i> No <i>(X)</i> . Case ejection, Yes <i>(X)</i> No <i>()</i> .																																																																																																																																																																											
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David C. H. H. H.
 Chief
 Prod Engrg Test Branch

SARRI Form 114, Rev 74

Burham

WEAPON FIRING REPORT						DATE Sept 26 1984		REPORT NO. 84-20	
JOB ORDER NO. <u>12403-10000</u>		TEST REQUEST AUTHORITY SARRI-APA LOI dated 2 Feb 78 M140A1 Recoil Mechanism				PAGE NO. <u>1</u>		NO. OF PAGES <u>1</u>	
MATERIEL TESTED: Mount, Gun: M140A1, for M60A1/A3, S/N <u>12308</u>						Mfg: RIA {X} Chrysler { }			
PURPOSE OF TEST: Production Proof Acceptance									
FIXTURE AND OR MATERIEL USED IN TEST: Powder gymnasticator, a simulation device, drawing No. 66F417. Elevation simulation equipment, drawing No. AWC 138815.									
AMMUNITION COMPONENTS: Case, cartridge, M18 modified, lot: mixed. Primer, percussion, M1B1A2, lot: <u>LS-293-4</u> . Propellant, M1, single perforated, lot: <u>RAO 69417</u> . Cup, closing, 75mm, RIA manufacture.									
TEST PROCEDURE: The mount was functioned in accordance with MIL-M-45976(WC), para 3.3.4.2. Replenisher, P/N <u>8689261</u> , with <u>MIL-H-46170</u> oil, used in testing the mount. Ambient temperature <u>54 °F</u> . Collar torque per para 3.3.2., Yes () No (). Replenisher oil reserve per drwg. 7389741, Yes () No (). Erratic operation or HOB, Yes () No (X). Case ejection, Yes () No ().									
Remarks (Continue on reverse): <u>SPECIAL SEALS (TYPE RIA567)</u>									
TEST DATA									
Round No.	Charge Oz.	Recoil Length In.	Cycle Time Sec.	Oil Pressure psi	Head Space In.	Rear Seal Leakage Drops/Minute			
						1st	2nd	3rd	Total
1	11 3/4	11 1/2	.58	2870	11 1/4				
2	11 3/4	11 1/2	.58	2140	11 1/4				
3	11 3/4	11 1/2	.54	3050	11 1/4				
4	11 3/4	11 1/2	.56	2800	11 1/4				
5	11 3/4	11 1/2	.55	2850	11 1/4				
6	11 3/4	11 1/2	.54	2870	11 1/4				
7	11 3/4	11 1/2	.55	2880	11 1/4				
8	11 3/4	11 1/2	.56	2870	11 1/4				
9	11 3/4	11 1/2	.55	2990	11 1/4				
10	11 3/4	11 1/2	.54	2900	11 1/4				
11									
12									
13									
14									
15						0	0	0	0

Chief
Prod Engrg Test Branch

SARRI FORM 114, 1-77

Burcham

FIGURE 12

WEAPON FIRING REPORT						CASE <i>Sept 27</i> <i>1984</i>	REF NO <i>94-20</i>																																																																																																																																																																				
JOB ORDER NO. <i>12403-10000</i>		TEST REQUEST AUTHORITY SARRI-APA LOI dated 2 Feb 78 M140A1 Recoil Mechanism				PAGE NO. <i>1</i>	NO OF PAGES <i>1</i>																																																																																																																																																																				
MATERIEL TESTED: Mount, Gun: M140A1, for M60A1/A3, S/N <i>12310</i>						Mfg: RIA (X) Chrysler (X)																																																																																																																																																																					
PURPOSE OF TEST Production Proof Acceptance																																																																																																																																																																											
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SARRI Form 114, Rev 1-78

Burcham

FIGURE 14

Table 4

Comparison of Valox 325 with PTFE

<u>Property</u>	<u>Valox 325*</u>	<u>Requirements for PTFE Material</u>
Tensile strength, psi	7,500	2,000 min.
Elongation %	300	**
Flexural strength	12,000	**
Compressive strength @ 10% deflection	13,000	1,700 min.
Shear strength	7,700	3,000 min.
Hardness, Shore D	65	60-70

* Typical value

** No requirement

TABLE 5
INSPECTION OF VALOX 325 BACK-UP RING 8449266

Piece I.D.	14.376-.002 in. Dimension	.178-.004 in. Wall Thickness	.080-.008 in. Height	32 RMS Max	.005in. Radius Max
1	*	.169-.180	.072-.083	pass	pass
2**	*	.160-.176	.070-.082	pass	pass
3**	*	.160-.175	.067-.082	pass	pass
4	*	.169-.175	.070-.082	pass	pass
5	*	.169-.178	.069-.082	pass	pass
6	*	.169-.178	.066-.083	pass	pass

* Not applicable as ring was without scarf

** Reject

General notes: Excess flash on all edges.
The two parallel surfaces are visually concave.

TABLE 6

INSPECTION OF PART 8448922

<u>Piece I.D.</u>	<u>11.813±.005 in. Dimension</u>	<u>.000±.005 in. Wall Thickness</u>	<u>.178±.004 in. Height</u>	<u>32 RMS Max</u>	<u>.005 in. RADIUS Max</u>
1	pass	.083-.101	.177-.181	pass	pass
2	pass	.083-.102	.176-.181	pass	pass
3	pass	.083-.102	.176-.181	pass	pass
4	pass	.083-.101	.176-.181	pass	pass
5	pass	.083-.101	.176-.181	pass	pass
6	pass	.083-.098	.176-.180	pass	pass

General notes: Excess flash on all edges. The two parallel surfaces are visually concave. Scratches on I.D.

TABLE 7

INSPECTION OF PART 8448010

Piece I.D.	12.473 $\pm$.005 in. Dimension	.000 $\pm$.005 in. Wall Thickness	.178 $\pm$.004 in. Height	32 RMS		.005 in. Radius	
				Max	Min	Max	Min
1	pass	.084-.090	.176-.180	pass		pass	
2	pass	.084-.090	.176-.180	pass		pass	
3	pass	.084-.090	.176-.180	pass		pass	
4	pass	.084-.101	.176-.180	pass		pass	
5	pass	.084-.102	.176-.180	pass		pass	
6	pass	.084-.090	.176-.180	pass		pass	

General notes: Excess flash on edges. The two parallel surfaces are visually concave. Scratches on I.D.

TABLE 8

INSPECTION OF PART 8448915

<u>Piece I. D.</u>	<u>10.878-.002 in.</u> <u>Dimension</u>	<u>.182-.005 in.</u> <u>Wall Thickness</u>	<u>.162-.008 in.</u> <u>Height</u>	<u>32 RMS</u> <u>Max</u>	<u>.005 in. Radius</u> <u>Max</u>
1	*	.177-.183	.154-.168	pass	pass
2	*	.178-.183	.153-.166	pass	pass
3	*	.177-.183	.154-.171	pass	pass
4	*	.177-.182	.152-.167	pass	pass
5	*	.178-.183	.151-.167	pass	pass
6	*	.178-.184	.154-.167	pass	pass

* Not applicable as ring was without scarf.

General notes: Step on parallel surfaces. Excess flash on edges.

CONCLUSIONS:

Rubber compounds are available that meet the property requirements of material drawing 8689822 or of drawings differing only by the substitution of MIL-H-46170 hydraulic oil for MIL-H-6083.

RIA has the in-house capability to fabricate elastomeric seals, PTFE and cloth-filled phenolic back-up rings.

RECOMMENDATIONS:

Attempts should be made to formulate a single compound suitable for use in both MIL-H-6083 and MIL-H-46170.

Other materials should be sought for replacement of the cloth-filled phenolic back-up rings.

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As in-house Army fabrication capability is needed for the seal kit for the M140 gun mount, polytetrafluoroethylene (PTFE) tubes and cloth-filled phenolic sheet were procured for back-up rings in the kit. Subsequent gymastication demonstrated Rock Island Arsenal has the capability of fabricating all the seals in the kit according to the technical data.

For improved producibility and storage and lower cost, nylon-filled phenolic and polyester thermoplastic back-up rings were fabricated to replace the phenolic and PTFE, respectively. The results to date are inconclusive.

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