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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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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.

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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 $SB715A_1E_3F_2Z_1Z_2Z_3Z_4Z_5Z_6$, Specification MIL-R-3065 and MIL-STD-417. The Z suffix requirements are defined as follows:

Z_1: Original Elongation - 150 percent minimum;
Z_2: 0 - 15 percent volume change after 70 hours immersion in MIL-H-6083 at 275 deg. F.;
Z_3: No evidence of corrosion or adhesion against steel when tested per MIL-P-5576;
Z_4: 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.);
Z_5: Modulus at 100 percent elongation of 700 psi minimum, when tested per ASTM D412;
Z_6: 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 $SB715A_1E_3F_2Z_1Z_2Z_3Z_4Z_5Z_6$ 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 SB715$A_1E_3F_2Z_1Z_2Z_3Z_4Z_5Z_6$ PER DRAWING 8689822*

PROPERTY	REQUIREMENTS
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.	-67
ASTM D 2137, para 3.2.1, Method A.	No failure
(Z1) Elongation, %.	150 min.
Hardness, Shore A, ASTM D 2240.	70 $\pm$ 5
Temperature retraction, (TR10), deg. F. ASTM D 1329.	-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

COMPOUNDING INGREDIENTS	PARTS BY WEIGHT	
	N221	N220-1
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 Tuads	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%E, 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, TR10, Deg. F.	-56	-55	-59	-63	-51 or below
Temperature Retraction after aging 70 hrs/ 158 Deg. F. TR10 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 Polytetrafluorthylene (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:

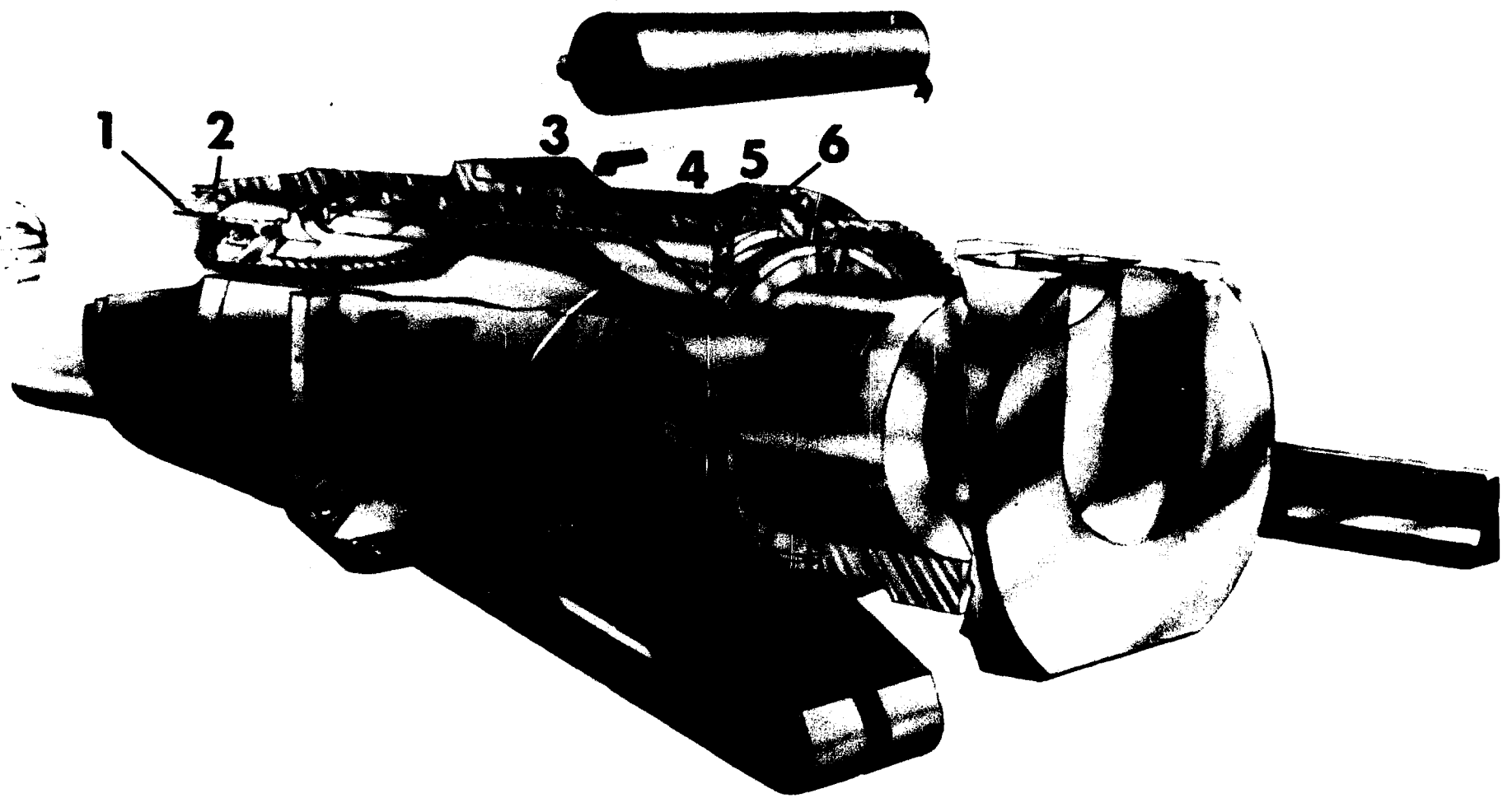
One cloth reinforced phenolic back-up ring (7044082) is also required for the M140 Gun Mount Kit. A blanking die was fabricated to blank out the outside and inside diameters simultaneously, and a matching die was made to separate the ring as required. The cloth reinforced phenolic sheet stock was conditioned for 24 hours at 50 $\pm$ 4 percent relative humidity at 73 $\pm$ 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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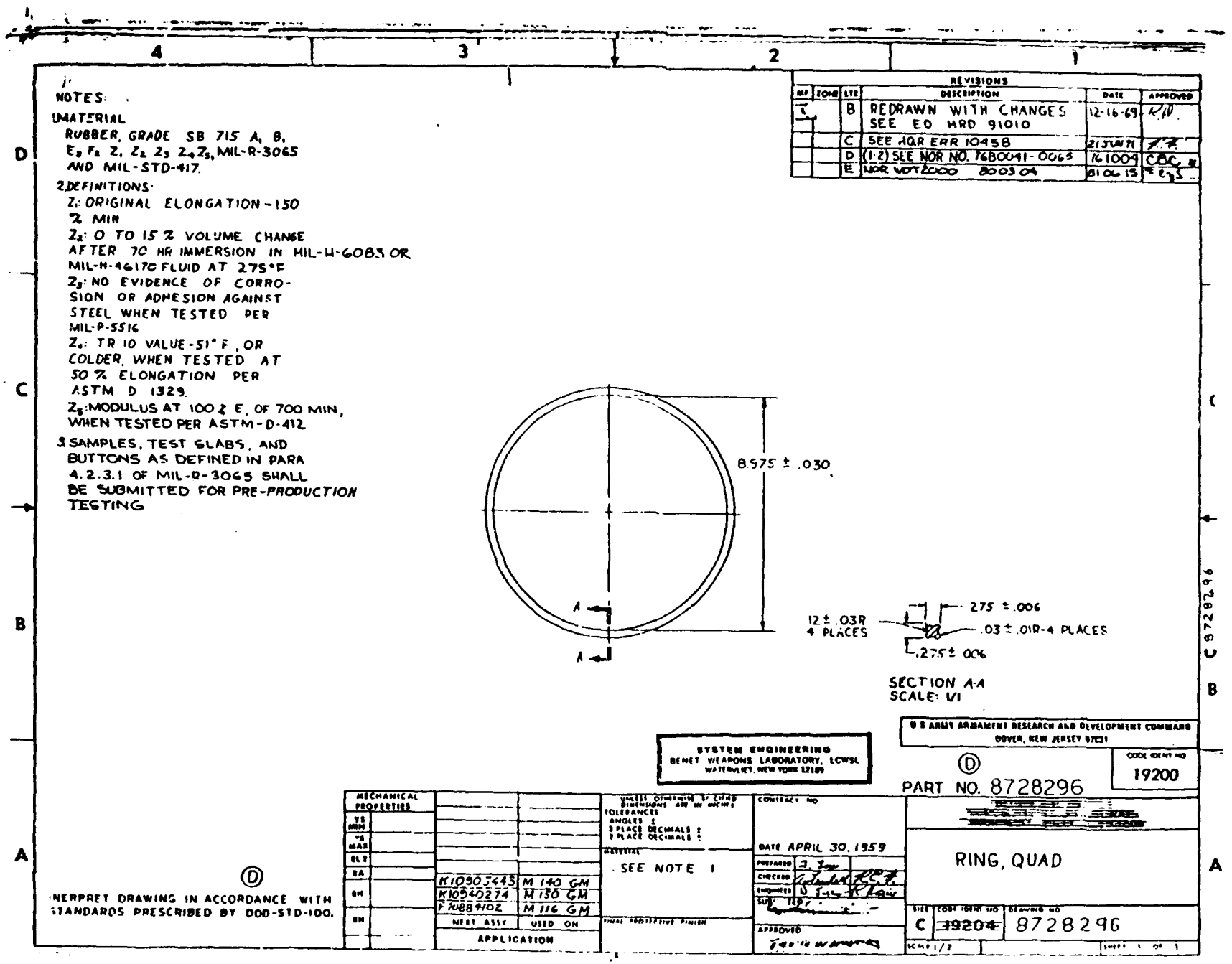
KEYS TO FIGURE 1

			Qty
Part No. 1	8728296	Rubber Ring	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


4
3
2
1
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
B
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12-16-69
C
SEE AQR ERR 10458
21 JUN 71
D
(1-2) SEE NOR NO. 76B0041-0063
76 1009
E
LDR NOT 2000 8003 04
81 06 15
NOTES:
1. MATERIAL
RUBBER, GRADE SB 715 A, B, E2 F2 Z1 Z2 Z3 Z4 Z5, MIL-R-3065 AND MIL-STD-417.
2. DEFINITIONS
Z1: ORIGINAL ELONGATION - 150 % MIN
Z2: 0 TO 15 % VOLUME CHANGE AFTER 70 HR IMMERSION IN MIL-H-6083 OR MIL-H-46170 FLUID AT 275°F
Z3: NO EVIDENCE OF CORROSION OR ADHESION AGAINST STEEL WHEN TESTED PER MIL-P-5516
Z4: TR 10 VALUE -51° F, OR COLDER, WHEN TESTED AT 50 % ELONGATION PER ASTM D 1329.
Z5: MODULUS AT 100 % E. OF 700 MIN, WHEN TESTED PER ASTM-D-412
3. SAMPLES, TEST SLABS, AND BUTTONS AS DEFINED IN PARA 4.2.3.1 OF MIL-R-3065 SHALL BE SUBMITTED FOR PRE-PRODUCTION TESTING
8.575 ± .030
A
A
.12 ± .03R 4 PLACES
.275 ± .006
.03 ± .01R-4 PLACES
.275 ± .006
SECTION A-A
SCALE: 1/1
SYSTEM ENGINEERING
BENET WEAPONS LABORATORY, LCWSL
WATERVLIET, NEW YORK 12189
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801
CODE IDENT NO 19200
PART NO. 8728296
MECHANICAL PROPERTIES
YS MIN
YS MAX
EL %
HA
HM
HM
K1090-445
K1090-274
F488402
M 140 GM
M 150 GM
M 116 GM
NEXT ASSY
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
ANGLES ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
MATERIAL
SEE NOTE 1
FINISH
CONTRACT NO
DATE APRIL 30, 1959
PREPARED
CHECKED
ENGINEER
SUP
APPROVED
RING, QUAD
SIZE C
CODE IDENT NO 19204
DRAWING NO 8728296
SCALE 1/1
SHEET 1 OF 1
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100.
8728296
10

FIGURE 2

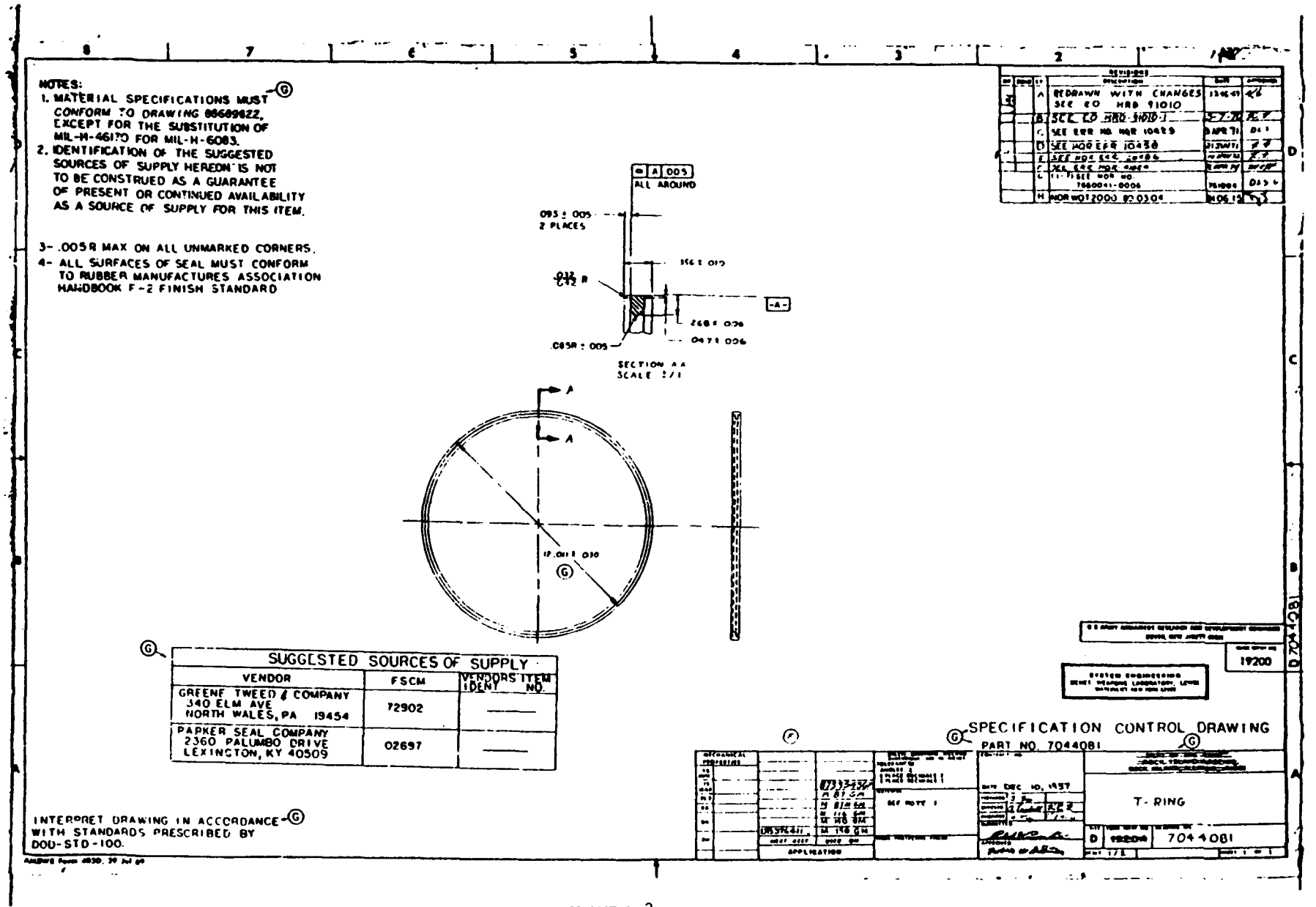
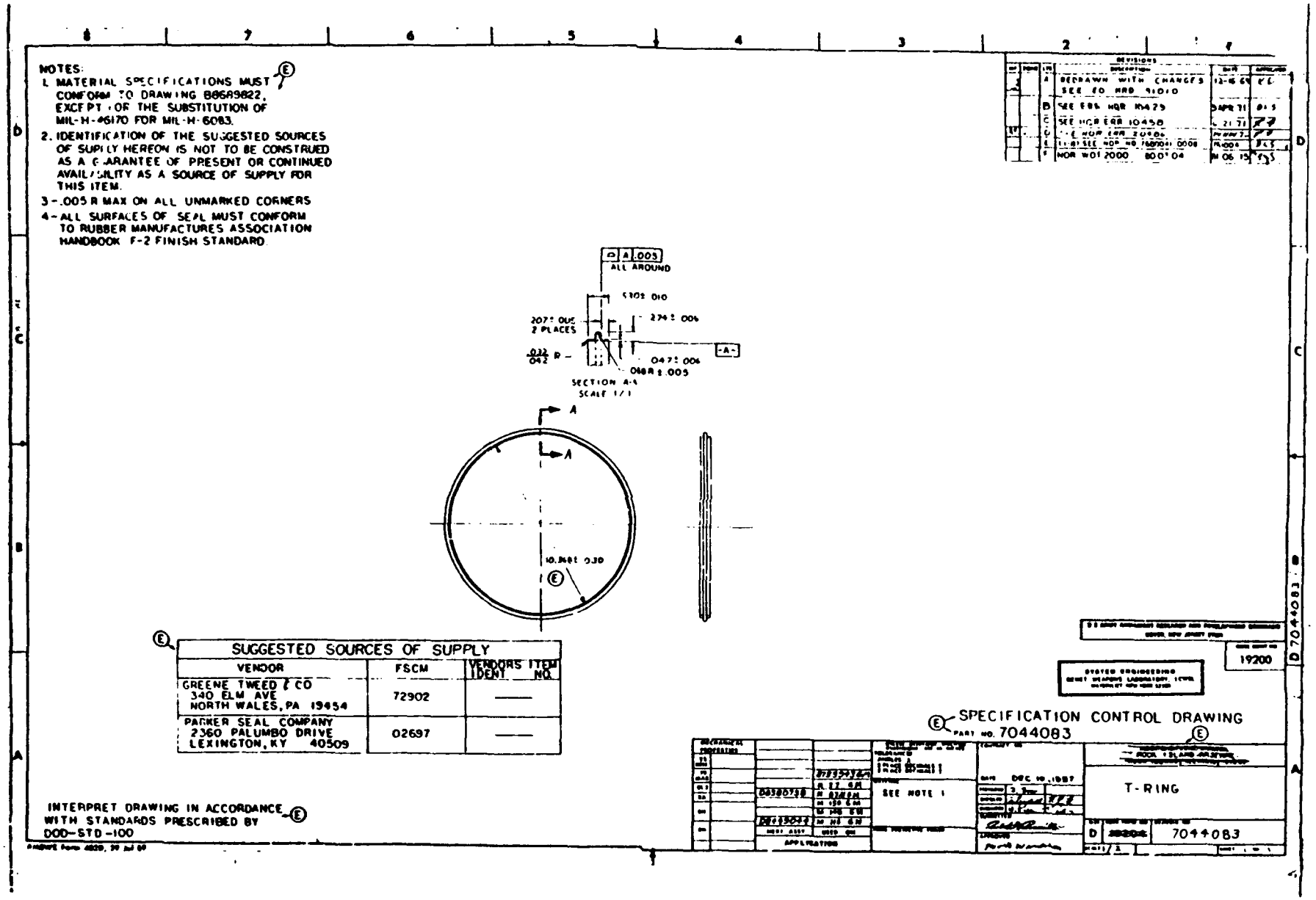

NOTES:
1. MATERIAL SPECIFICATIONS MUST CONFORM TO DRAWING 86609822, EXCEPT FOR THE SUBSTITUTION OF MIL-H-4617D FOR MIL-H-6083.
2. IDENTIFICATION OF THE SUGGESTED SOURCES OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THIS ITEM.
3- .005R MAX ON ALL UNMARKED CORNERS.
4- ALL SURFACES OF SEAL MUST CONFORM TO RUBBER MANUFACTURES ASSOCIATION HANDBOOK F-2 FINISH STANDARD
.005 A ALL AROUND
.093 ± .005 2 PLACES
SECTION A-A SCALE 2/1
SUGGESTED SOURCES OF SUPPLY
VENDOR
FSCM
VENDORS ITEM IDENT NO.
GREENE TWEED & COMPANY 340 ELM AVE NORTH WALES, PA 19454
72902
PARKER SEAL COMPANY 2360 PALUMBO DRIVE LEXINGTON, KY 40509
02697
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100.
SPECIFICATION CONTROL DRAWING
PART NO. 7044081
T-RING
19200
7044081

FIGURE 3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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. .005 R 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
FSCM
VENDORS ITEM IDENT NO.
GREENE TWEED & CO 340 ELM AVE NORTH WALES, PA 19454
72902
PARKER SEAL COMPANY 2360 PALUMBO DRIVE LEXINGTON, KY 40509
02697
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100
SECTION A-A
SCALE 1/1
SPECIFICATION CONTROL DRAWING
PART NO. 7044083
T-RING
7044083
19200

FIGURE 4

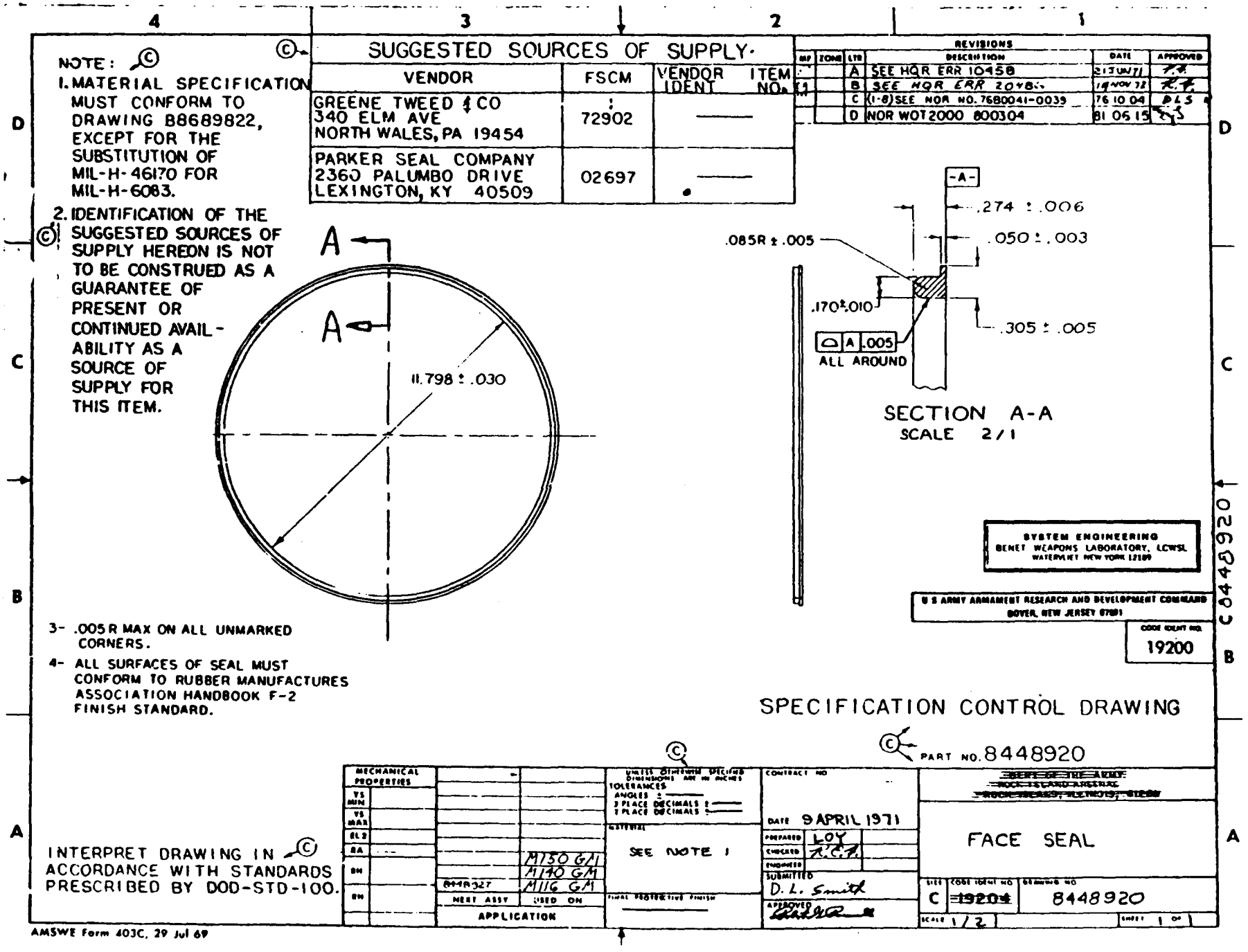
NOTE: ©
1. MATERIAL SPECIFICATION MUST CONFORM TO DRAWING B8689822, EXCEPT FOR THE SUBSTITUTION OF MIL-H-46170 FOR MIL-H-6083.
2. IDENTIFICATION OF THE SUGGESTED SOURCES OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THIS ITEM.
SUGGESTED SOURCES OF SUPPLY
VENDOR | FSCM | VENDOR ITEM IDENT NO.
GREENE TWEED & CO 340 ELM AVE NORTH WALES, PA 19454 | 72902 | —
PARKER SEAL COMPANY 2360 PALUMBO DRIVE LEXINGTON, KY 40509 | 02697 | —
REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A SEE HQR ERR 10458
B SEE HQR ERR 20488
C (1-8) SEE NOR NO. 76B0041-0039 76 10 04
D NOR WOT 2000 800304 81 06 15
A
11.798 ± .030
-A-
.274 ± .006
.050 ± .003
.085R ± .005
.170 ± .010
.305 ± .005
⌀ A .005 ALL AROUND
SECTION A-A
SCALE 2/1
3- .005 R MAX ON ALL UNMARKED CORNERS.
4- ALL SURFACES OF SEAL MUST CONFORM TO RUBBER MANUFACTURES ASSOCIATION HANDBOOK F-2 FINISH STANDARD.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100.
SYSTEM ENGINEERING
BENET WEAPONS LABORATORY, LCWSL
WATERVLIET NEW YORK 12189
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801
CODE IDENT NO. 19200
SPECIFICATION CONTROL DRAWING
PART NO. 8448920
MECHANICAL PROPERTIES
M150 GAI
M140 GM
M116 GM
SEE NOTE 1
DATE 9 APRIL 1971
PREPARED LOY
CHECKED R.C.F.
SUBMITTED D. L. Smith
FACE SEAL
SIZE C
CODE IDENT NO 19200
DRAWING NO 8448920
SCALE 1/2
SHEET 1 OF 1
AMSWE Form 403C, 29 Jul 69
C8448920

FIGURE 5

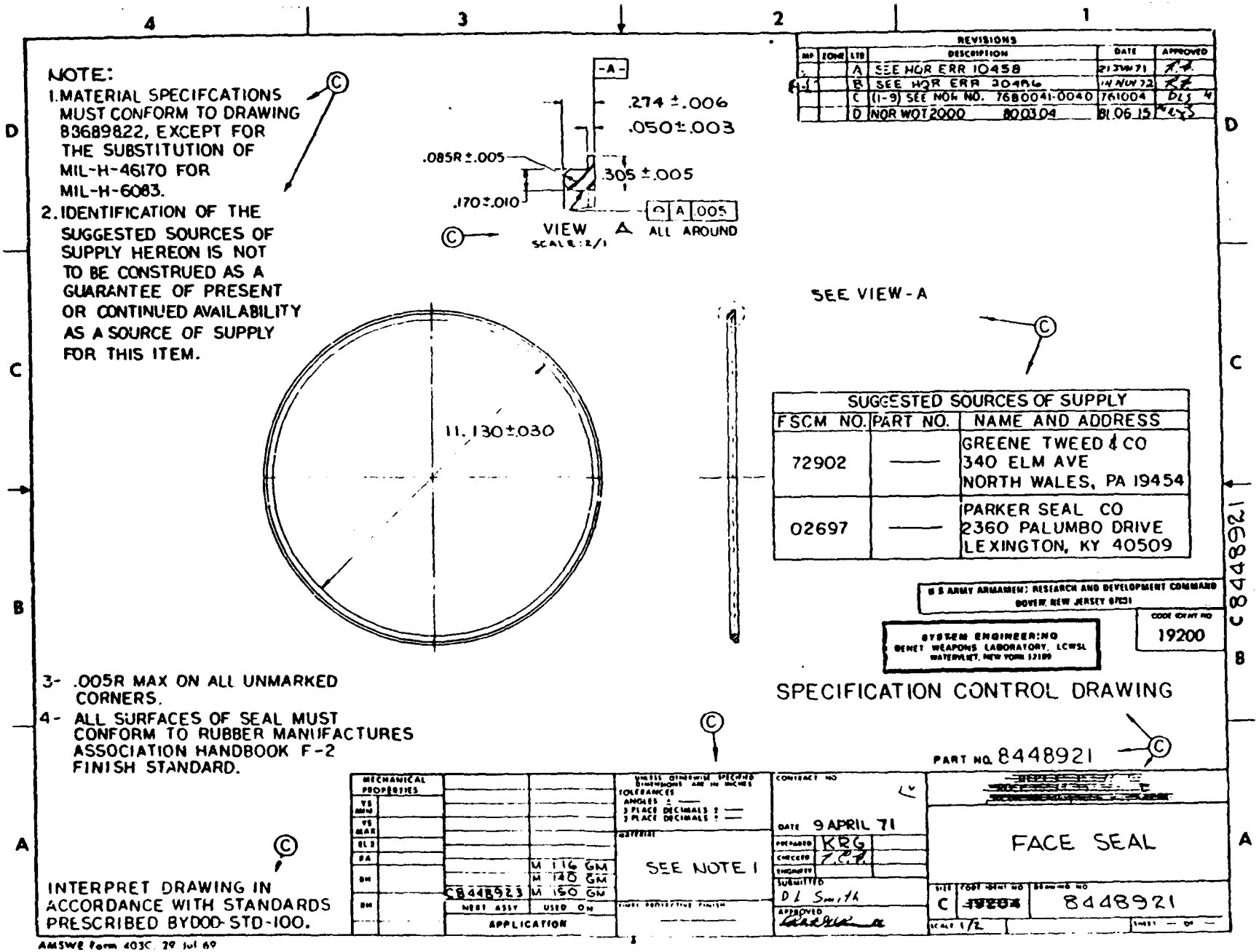
NOTE:
1. MATERIAL SPECIFCATIONS MUST CONFORM TO DRAWING 83689822, EXCEPT FOR THE SUBSTITUTION OF MIL-H-46170 FOR MIL-H-6083.
2. IDENTIFICATION OF THE SUGGESTED SOURCES OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THIS ITEM.
3- .005R MAX ON ALL UNMARKED CORNERS.
4- ALL SURFACES OF SEAL MUST CONFORM TO RUBBER MANUFACTURES ASSOCIATION HANDBOOK F-2 FINISH STANDARD.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BYDOD-STD-100.
REVISIONS
LTR DESCRIPTION DATE APPROVED
A SEE NOR ERR 10458 21 JAN 71
B SEE NOR ERR 20486 14 NOV 72
C (1-9) SEE NOR NO. 7680041-0040 761004
D NOR WOT 2000 800304 810615
.274 ±.006
.050±.003
.085R±.005
.305 ±.005
.170±.010
A 005
VIEW A ALL AROUND
SCALE 2/1
SEE VIEW-A
11.130±.030
SUGGESTED SOURCES OF SUPPLY
FSCM NO. PART NO. NAME AND ADDRESS
72902 — GREENE TWEED & CO 340 ELM AVE NORTH WALES, PA 19454
02697 — PARKER SEAL CO 2360 PALUMBO DRIVE LEXINGTON, KY 40509
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND DOVER, NEW JERSEY 07801
SYSTEM ENGINEERING GENET WEAPONS LABORATORY, LCWSL WATERVLIET, NEW YORK 12189
CODE IDENT NO 19200
SPECIFICATION CONTROL DRAWING
PART NO 8448921
MECHANICAL PROPERTIES
TS AMB
YS AMB
EL 2
RA
BH
BH
M 116 GM
M 140 GM
M 150 GM
8448923
NEXT ASSY USED ON
APPLICATION
SEE NOTE 1
CONTRACT NO
DATE 9 APRIL 71
PREPARED KBG
CHECKED
ENGINEER
SUBMITTED D L Smith
APPROVED
FACE SEAL
SIZE C
CODE IDENT NO 19200
DRAWING NO 8448921
SCALE 1/2
SHEET — OF —
8448921
AMSWE Form 403C 29 Jul 69

FIGURE 6

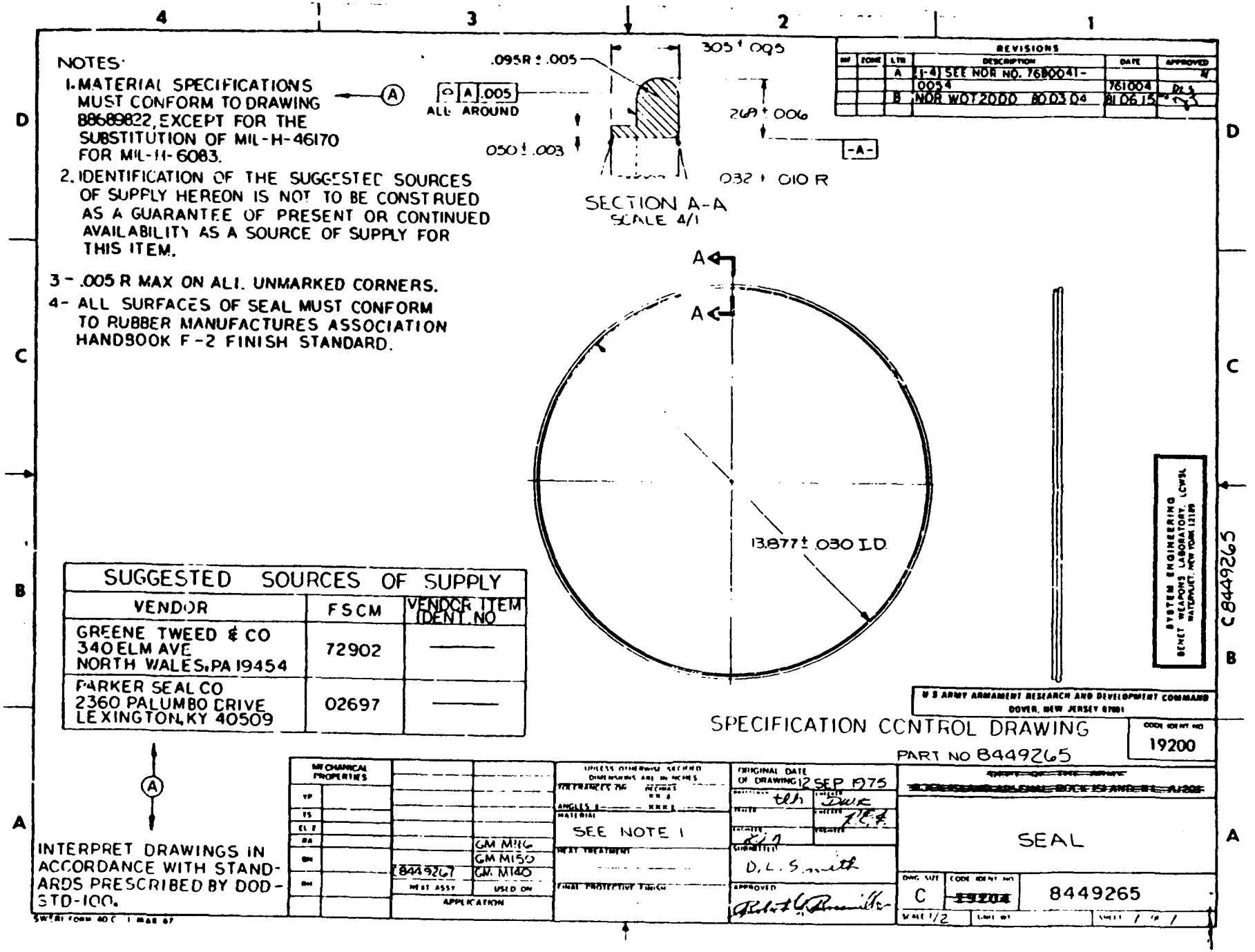
NOTES:
1. MATERIAL SPECIFICATIONS MUST CONFORM TO DRAWING 88689822, EXCEPT FOR THE SUBSTITUTION OF MIL-H-46170 FOR MIL-H-6083.
2. IDENTIFICATION OF THE SUGGESTED SOURCES OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THIS ITEM.
3 - .005 R MAX ON ALL UNMARKED CORNERS.
4 - ALL SURFACES OF SEAL MUST CONFORM TO RUBBER MANUFACTURES ASSOCIATION HANDBOOK F-2 FINISH STANDARD.
.095R ± .005
.005 A
ALL AROUND
.050 ± .003
.305 ± .005
.269 ± .006
-A-
.032 ± .010 R
SECTION A-A
SCALE 4/1
A
A
13.877 ± .030 I.D.
REVISIONS
LTR A: 1-4 SEE NOR NO. 7680041-0054 7610 04
LTR B: NOR WOT 2000 80 03 04 81 06 15
SUGGESTED SOURCES OF SUPPLY
VENDOR: GREENE TWEED & CO, 340 ELM AVE, NORTH WALES, PA 19454 — FSCM 72902 — VENDOR ITEM IDENT NO —
VENDOR: PARKER SEAL CO, 2360 PALUMBO DRIVE, LEXINGTON, KY 40509 — FSCM 02697 — VENDOR ITEM IDENT NO —
INTERPRET DRAWINGS IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100.
MECHANICAL PROPERTIES
GM M116
GM M150
GM M140
8449267
NEXT ASSY
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
ANGLES ±
MATERIAL
SEE NOTE 1
HEAT TREATMENT
FINAL PROTECTIVE FINISH
ORIGINAL DATE OF DRAWING 12 SEP 1975
DRAWN tlh
CHECKED DWK
ENGR APPR
MFG APPR
D.L. Smith
APPROVED
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801
SPECIFICATION CONTROL DRAWING
PART NO 8449265
CODE IDENT NO 19200
SEAL
SIZE C
CODE IDENT NO 19200
8449265
SCALE 1/2
SYSTEM ENGINEERING
BENET WEAPONS LABORATORY, LCWSL
WATERVLIET, NEW YORK 12189
C 8449265 B

FIGURE 7

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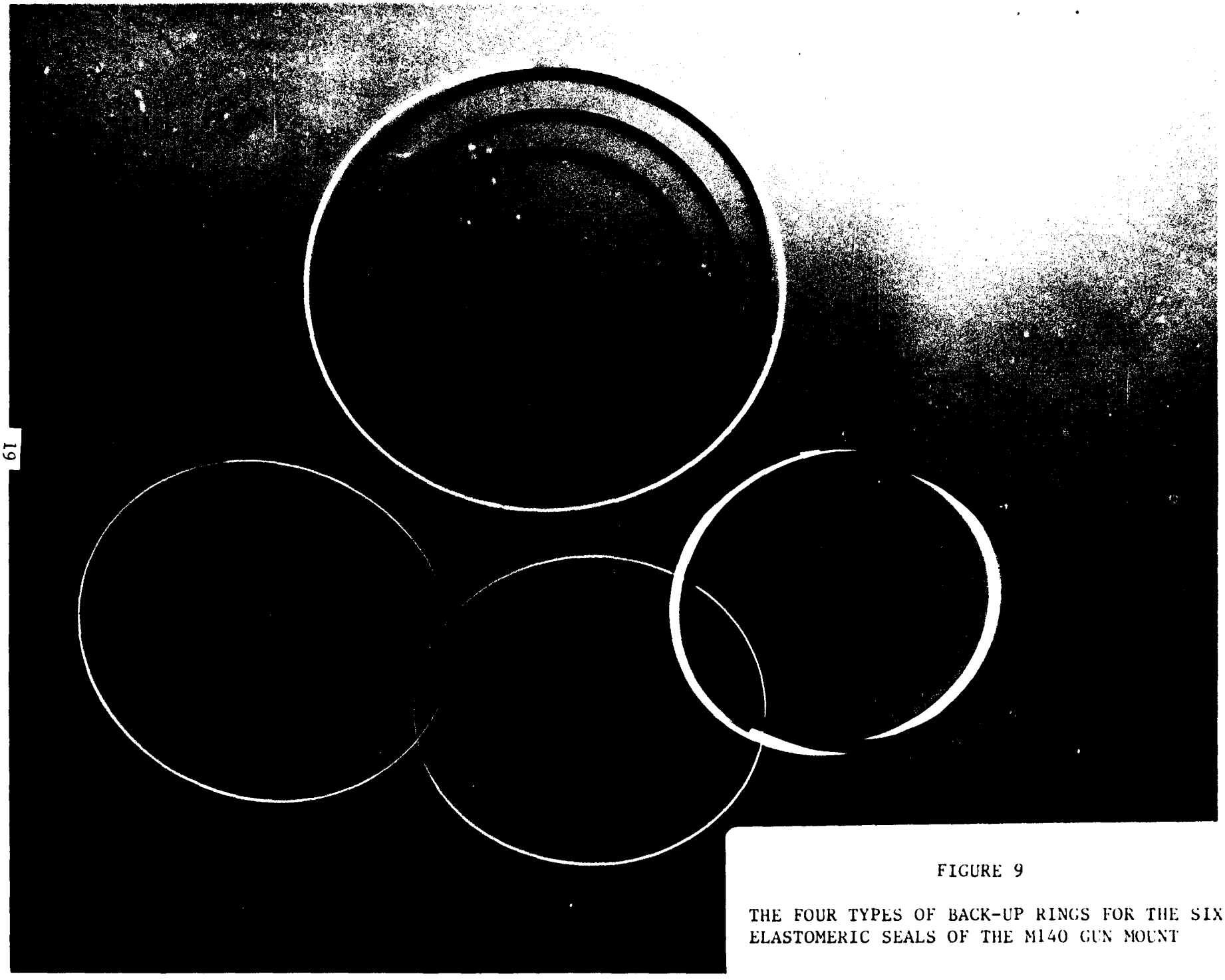

FIGURE 9

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: 25 SEPT 84 | REPORT NO.: 84-20

JOB ORDER NO.: L3402-10000

TEST REQUEST AUTHORITY: SARRI-APA LOI dated 2 Feb 78
M140A1 Recoil Mechanism

PAGE NO.: 1 | NO. OF PAGES: 1

MATERIEL TESTED:

Mount, Gun: M140A1, for M60A1/A3, S/N 12306

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: LS 293-4
Propellant, M1, single perforated, lot: RAD6941 7.
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 8689261, with MIL-H-46170 oil, used in testing the mount. Ambient temperature 48°F.
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): SPECIAL SEALS (TYPE RIA567)

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	.57	3200	11 3/8				
3	11	11 1/2	.57	3050	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 3/8				
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 3/8	0	0	0	0
11									
12									
13									
14									
15									

Chief
Prod Engrg Test Branch

SARRI Form 114, ... MORRIS

FIGURE 10

WEAPON FIRING REPORT

DATE: Sept 26. 1984

REPORT NO.: 84-30

JOB ORDER NO.: 12403-10000

TEST REQUEST AUTHORITY: SARRI-APA LOI dated 2 Feb 78
M140A1 Recoil Mechanism

PAGE NO.: 1

NO. OF PAGES: 1

MATERIEL TESTED:

Mount, Gun: M140A1, for M60A1/A3, S/N 12307

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: LS-293-4.
Propellant, M1, single perforated, lot: RAD 69417.
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 8689261, with MIL-H-46170 oil, used in testing the mount. Ambient temperature 56°F. 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): Special Seals (Type RIA 567)

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 1/4	11 1/2	.74	3000	11 3/8				
2	11 1/4	11 1/2	.71	2850	11 3/8				
3	11 1/4	11 1/2	.70	2850	11 3/8				
4	11 1/4	11 3/8	.67	2860	11 3/8				
5	11 1/4	11 3/8	.68	2870	11 3/8				
6	11 1/4	11 1/2	.63	2840	11 3/8				
7	11 1/4	11 3/8	.64	2855	11 3/8				
8	11 1/4	11 1/2	.63	2870	11 3/8				
9	11 1/4	11 1/2	.65	2860	11 3/8				
10	11 1/4	11 1/2	.64	2870	11 3/8				
11									
12									
13									
14									
15						38	24	12	74

Chief
Prod Engrg Test Branch

SARRI Form 114, ... 74

Burcham

FIGURE 11

WEAPON FIRING REPORT

DATE: Sept 26 1984

REPORT NO.: 84-20

JOB ORDER NO.: 12403-10000

TEST REQUEST AUTHORITY: SARRI-APA LOI dated 2 Feb 78
M140A1 Recoil Mechanism

PAGE NO.: 1

NO. OF PAGES: 1

MATERIEL TESTED:

Mount, Gun: M140A1, for M60A1/A3, S/N 12308

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: LS-293-4.
Propellant, M1, single perforated, lot: RAO 69417.
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 8689261, with MIL-H-46170 oil, used in testing the mount. Ambient temperature 54 °F. 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): Special seals (Type RIA547)

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 7/8				
2	11 3/4	11 1/2	.58	3140	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

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Prod Engrg Test Branch

SARRI FORM 114, ... 74

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FIGURE 12

WEAPON FIRING REPORT

DATE: Sept 28 1984

REPORT NO.: 84-20

JOB ORDER NO.: 12403-10000

TEST REQUEST AUTHORITY: SARRI-APA LOI dated 2 Feb 78
M140A1 Recoil Mechanism

PAGE NO.: 1

NO OF PAGES: 1

MATERIEL TESTED:

Mount, Gun: M140A1, for M60A1/A3, S/N 12309

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: LS-393-4.
Propellant, M1, single perforated, lot: RAD 69417.
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 8689261, with MIL-H-46170 oil, used in testing the mount. Ambient temperature 48. 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):

Special seals - (RIA 567)

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	12 1/2	11 1/4	.65	2860	11 3/8				
2	12 1/2	11 1/4	.66	2860	11 3/8				
3	12 1/2	11 1/4	.66	3030	11 1/4				
4	12 1/2	11 3/8	.64	3010	11 1/4				
5	12 1/2	11 3/8	.63	3070	11 1/4				
6	12 1/2	11 3/8	.65	3050	11 1/4				
7	12 1/2	11 1/4	.63	3100	11 1/4				
8	12 1/2	11 1/4	.64	3090	11 1/4				
9	12 1/2	11 1/4	.64	3070	11 1/4				
10	12 1/2	11 1/4	.63	3090	11 1/4				
11									
12									
13									
14									
15						43	24	12	79

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Buchan

FIGURE 13

WEAPON FIRING REPORT

DATE: Sept 27 1984 | REPORT NO.: 54-20

JOB ORDER NO.: 12403-10000

TEST REQUEST AUTHORITY: SARRI-APA LOI dated 2 Feb 78
M140A1 Recoil Mechanism

PAGE NO.: 1 | NO. OF PAGES: 1

MATERIEL TESTED:

Mount, Gun: M140A1, for M60A1/A3, S/N 12310

Mfg: RIA (X)
Chrysler ( )

PURPOSE OF TEST:

Production Proof Acceptance

FIXTURE AND OR MATERIEL USED IN TEST:

Powder gymnasticator, a simulation device, drawing No. 60F417.
Elevation simulation equipment, drawing No. AWC 138815.

AMMUNITION COMPONENTS:

Case, cartridge, M18 modified, lot: mixed.
Primer, percussion, M1B1A2, lot: LS-293-4.
Propellant, M1, single perforated, lot: RAD 69417.
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 8689261, with MIL-H-46170 oil, used in testing the mount. Ambient temperature 48 °F. 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): Special seals - RIA 567

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	12	11 1/2	.65	2800	11 1/8				
2	12	11 1/2	.64	2860	11 1/4				
3	12	11 3/8	.60	2870	11 1/4				
4	12	11 1/4	.62	2890	11 1/4				
5	12	11 1/4	.62	2880	11 1/4				
6	12	11 1/4	.62	2860	11 1/4				
7	12	11 3/8	.63	2830	11 1/4				
8	12	11 3/8	.61	2870	11 1/4				
9	12	11 3/8	.60	2880	11 1/4				
10	12	11 3/8	.59	2860	11 1/4				
11									
12									
13									
14									
15						12	7	3	24

Chief
Prod Engrg Test Branch

SARRI Form 114, [illegible]

Buchan

FIGURE 14

Table 4

Comparison of Valox 325 with PTFE

Property	Valox 325*	Requirements for PTFE Material
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

Piece I.D.	11.813±.005 in. Dimension	.090±.005 in. Wall Thickness	.178±.004 in. Height	32 RMS Max	.005 in. RADIUS Max
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 8448919

Piece I.D.	12.473±.005 in. Dimension	.090±.005 in. Wall Thickness	.178±.004 in. Height	32 RMS Max	.005 in. Radius Max
1	pass	.084-.099	.176-.180	pass	pass
2	pass	.084-.099	.176-.180	pass	pass
3	pass	.084-.099	.176-.180	pass	pass
4	pass	.084-.101	.176-.180	pass	pass
5	pass	.084-.102	.176-.180	pass	pass
6	pass	.084-.099	.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

Piece I.D.	10.878-.002 in. Dimension	.182-.005 in. Wall Thickness	.162-.008 in. Height	32 RMS Max	.005 in. Radius Max
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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MANUFACTURING GUIDE FOR ELASTOMERIC SEALS
F. B. Testroet

Report SE 90-04, 42 p. incl. illus. tables,
(AMS Code 3297.06.8248) Unclassified Report.

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.

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1. Elastomers
2. Seal
3. Back-up Ring
4. Injection Molding
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As in-house Army fabrication capability is needed for the seal kit for the M140 gun mount, polytetrafluorethylene (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.

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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