Defense Ammunition Packaging Council Project J7

Research Gasket Shapes and Materials for Sealed Ammunition Containers

AFMC LSO/LOPD
AIR FORCE PACKAGING TECHNOLOGY AND ENGINEERING FACILITY
WRIGHT-PATTERSON AFB, OH 45433-5540
AUGUST 1996
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AFPTEF PROJECT NO. 93-P-125
TITLE: Research Gasket Shapes and Materials for Sealed Ammunition Containers

ABSTRACT

The Air Force Packaging Engineering and Technology Facility (AFPTEF) was task with Defense Ammunition Packaging Council (DAPC) project J7, the Research of Gasket Shapes and Materials for Sealed Ammunition Containers in October of 1993.

The objective of this project was to investigate new materials and shapes available for use as gaskets in sealed containers. The properties of the new materials had to be evaluated/tested to assure they met or exceeded the properties of current gasket materials. The project also looked at the manufacturing processes of extruding vs. molding. Which process was most economical, better for the specific material and shape, and creates the better product. We also investigated the joint bonding process of using a chemical adhesive and the technique required to achieve a good bond as well as vulcanizing and heat welding. Another aspect of the project was to evaluate the required cross sectional area and hence the compression required to create a sealed container repeatedly with the minimum amount of force.

Accomplishments of the project are the development of a new gasket using a solid polyurethane. The development of a very effective and economical way of bonding corners/joints of silicone gaskets. The leak and compression testing of various shaped cross sectional sized gaskets. The recommended gasket from the test results will enhance container sealing and extend the gasket's life cycle.

Total AFPTEF man-hours associated with this project to date is approximately 694.

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AFPTEF

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INTRODUCTION:

BACKGROUND:
The Office of the Secretary of Defense (OSD) established the Defense Ammunition Packaging Council (DAPC) to investigate ammunition packaging requirements and perform some basic research and development in an effort to solve some of the problems identified for ammunition. PM-AMMOLOG, Picatinny Arsenal NJ is handling the overall program management for OSD. All DOD services are participating. A work package proposal for the research and development of a new gasket(s) for sealed ammunition containers was submitted to the DAPC in September of 1992 for consideration. The work package proposal was accepted and approved as a joint service project, DAPC J7, with the Air Force Packaging Engineering and Technology Facility (AFPTEF) as the lead service organization in October 0f 1993. The project is coordinated with the US Army Packaging Division, Picatinny Arsenal NJ, the Packaging, Handling, Storage and Transportability Center, Naval Weapons Station Earle NJ, and the US Marine Corps Naval Surface Warfare Center, Crane IN.

REQUIREMENTS:
AFPTEF feels there is a need to improve and/or replace existing container gaskets. Problems we are seeking to eliminate are gasket degradation due to heat caused adhesion, degradation due to ultra violet exposure, degradation due to packaged items leaking fluids that react with the gasket, poor joint bonding, and questionable reseal ability after repeated use. We will also design and test different shaped and sized gaskets to test for the best compression percentage to create a reliable seal.

TECHNICAL APPROACH:

MATERIAL:
Industry and Military gasket material studies were read and evaluated. AFPTEF's plan of approach was to find a new material, not necessarily one to replace the present materials but an alternative one. The new material had to meet or exceed the properties of the current most widely used silicone and neoprene. It had to be temperature resistant, (-40°F to +140°F), UV resistant, adhesion resistant, tear resistant, have a low compression set, chemical resistant, readily available, easy to extrude or mold into shapes, and economical in price. The new material(s) will be tested to see how well it performs and bonds.

SHAPES:
The limited shapes of gaskets available, problems with the ones currently used, and the present gasket fabrication technology led to the conclusion that container seal ability, gasket fit, compression, and corner seal problems could be enhanced/solved with gaskets of various shapes. Gaskets can be fabricated to fit any extrusion shape. AFPTEF designed various cross sectional
shaped gaskets, had them fabricated, and tested them to see if
gasket shape can enhance sealing.

FABRICATION:
Gasket fabrication techniques were investigated to see which
process, extruding or molding, was more economical, best for
particular materials, best for specific durometers, and best for
certain shapes. Gaskets fabricated by extruding and molding was
tested and economically evaluated.

BONDING:
The quality and performance of gasket joint bonds is determined
by the gasket material, type of adhesive, and bonding techniques
or method used. Methods of bonding investigated and/or tested
were chemical adhesion, chemical adhesion with heat, and heat
welding.

SEALING:
The old rule of thumb concerning ideal compression of 30% was
tested by acquiring gaskets with varying cross sectional areas.
We feel this is necessary to verify the 30% compression theory
confusion of height compression vs. area compression.

RESULTS:

MATERIAL:
The study results reinforced the good to excellent properties of
materials the military presently uses. The most commonly used
materials for sealed container gaskets are silicone and neoprene.
The new material chosen for evaluation, fabrication, and testing
was a solid polyurethane. The 60 durometer polyurethane gasket
failed a pressure leak test drastically on the corners of the
container. The harder durometer did not allow the gasket to be
compressed enough to compensate for the imperfections of the
sealing surface. The molded polyurethane gasket compressed
beyond use, was sticky, and was easily damaged. In addition it
was very difficult to spec out the polyurethane material. Each
manufacture patens their processes of plasticizer additive
mixtures used in the material manufacturing. Also the
properties, such as compression set, aging, heat resistance, are
far different than those of your typical gasket materials. See
Appendix A for detailed information on the polyurethane material
and material specifications.

SHAPES:
The most commonly used gaskets in the military are either round
or flat in cross sectional shape. Container designs typically
provide a groove for round gaskets to lie in and sometimes are
provided for flat gaskets. This groove provides gasket side
restraint eliminating any tendency for the gasket to roll and in
turn creates a good sealing surface area. However, the container
corners, due to fabrication requirements, do not provide a groove
and therefore, do not provide any side restraint. This lack of
side restraint allows the gasket to roll creating a vulnerable area for sealing and sealing repeatability. Flat gaskets, ones that are rectangular or square in cross sectional shape, typically get bonded into place. Flat gaskets are prone to receiving damage do to their physical shape and location and typically don't provide sufficient compression/seal ability for larger containers. AFPTEF has found that by combining features of the flat and round gasket designs, a gasket that is more reliable in seal repeatability and functionality can be obtained. It has been determined that designing/fabricating a gasket with 90° corners, creates a sufficient sealing surface for the corners for a repeatedly sealed container. AFPTEF designed two shapes for polyurethane material fabrication, one for extruding and one for molding and eight different shapes for silicone material extruding. See Appendix B for shape drawings and Appendix C for test results.

FABRICATION:
Gasket fabrication techniques were investigated by speaking to and visiting gasket manufacturers. Most materials used to make gaskets can either be extruded or molded, however the processes may effect the properties of the materials differently. The molding process limits the shapes the gasket can be designed to, due to mold restrictions. The extrusion process is generally much more economical than the molding process and the molding process can only be used for gaskets of smaller size. The technology and costs of the molding process just don't afford larger gaskets. The new polyurethane gasket was extruded and molded. We had the polyurethane gasket extruded first, because it allowed us to place an orifice in the center and do to the fact that it comes in a continuous roll, we could make any size gasket we needed for testing purposes. However, the extruded polyurethane gasket had to be limited to a 60 or higher durometer, the molding process allowed the preferred 30 to 40 durometer but required a shape design change of eliminating the center orifice.

BONDING:
The quality and performance of gasket joint bonds is determined by the gasket material, type of adhesive, and bonding techniques or method used. Chemical adhesives are typically used to bond gasket joints in small production runs and prototype and testing situations. A welding or molding process is typically used in larger production runs. A good bond depends on whether the adhesive was properly matched to work with the specific gasket material and whether it was applied correctly. Heat welding or molding requires expensive equipment and therefore is only economical if used in large production runs. Vulcanization, an economical form of heat and adhesive fusion, turned out to be an excellent way to bond joints. The equipment is very inexpensive, easy to operate, and the process takes only minutes form start to finish. Molds can be fabricated to join any cross sectional shaped gasket. It was also found that a small quantity of the raw gasket material, tested only on silicone material, works well
as a bonding agent when using the vulcanization method. We had a very difficult time bonding the polyurethane gasket joints. In speaking with gasket manufacturers it was determined that bonding could be achieved using heat welding or a chemical adhesive. The heat welding process could not be tested since we did not have the equipment. To use a chemical adhesive the elastomer agent used in the manufacturing process of the gasket has to be known to match the correct chemical makeup. Bonding quality was checked by performing pressure leak tests.

SEALING:
The old rule of thumb concerning ideal compression of 30% was tested by acquiring gaskets with varying cross sectional areas. The areas ranged from 0% interference at the sealing surface, meaning all of the gasket area can be compressed into either the gasket itself or the gasket groove on the base of the container. To 30% interference which means that 30% of the gasket area will interfere between the base and cover sealing surfaces after full compression. We feel this testing is necessary to verify the 30% compression theory confusion and to see if the gasket is damaged due to the pinching and so forth created with the interference aspect. Pressurized leak tests were performed in accordance with FED-STD-101, Method 5009.3 on each gasket configuration. Keeping track of pressure loss rate and amount of compression required, in inch-pounds, concluded how shape and cross sectional area (% of compression) effected the container seal. For complete results see Appendix C, Test Report.

CONCLUSIONS: Using polyurethane as a gasket material, whether extruded or molded, can be considered a viable option. Especially when chemical degradation of the gasket is possible. However, it's properties and uncertainties in material specifications do not warrant use over the present gasket materials of silicone and neoprene. The fabrication processes of extruding and molding have to be evaluated for each type of material, shape, durometer, and usage. Vulcanization of silicone gaskets using a small amount of the raw silicone material is a very effective, reliable, and economical process for gasket joint bonding. Polyurethane gaskets lend themselves to chemical bonding. However, choice of bonding agent is solely dependent on the plasticizer used in the material manufacturing. While all gaskets sealed the container, it was determined that the gasket that performed the best repeatedly was gasket 3, Dwg. No. X9489272 with an area compression of 10% and a latch force of 20 inch-pounds. Detailed conclusions on how shape and area effect sealing can be seen in Appendix C, Test Report.

RECOMMENDATION: AFPTEF will begin using gasket number 3, drawing number X9489272 with a measured the latch force of 20 inch pounds.
APPENDIX A

1. MOLDED POLYURETHANE GASKET MATERIAL PROPERTIES
2. EXTRUDED POLYURETHANE GASKET MATERIAL PROPERTIES
3. PROPOSED MOLDED POLYURETHANE GASKET ACQUISITION SPECIFICATION
QSC200
QUASI MDI-POLYESTER PREPOLYMER
PRELIMINARY DATA SHEET

FORMULATION

POLYESTER POLYOL BLEND, PPH
1,4 BDO, PPH
TOTAL CURATIVE, PPH 416
CATALYST LEVEL, DROPS

PROCESSING CONDITIONS

POT LIFE, MINUTES 6
DEMOLD TIME, MINUTES 90

ELASTOMER PROPERTIES

HARDNESS (A) 45
MODULUS (PSI)
10% ELONGATION 40
100% ELONGATION 120
200% ELONGATION 170
300% ELONGATION 200
TENSILE STRENGTH (PSI) 1860
ELONGATION (%) 900
TEAR RESISTANCE (PLI)
DIE C 150
NICK 30
COMPRESSION SET (%) 6
REBOUND (%) 45
ABRASION LOSS (MM3) 32
COLD HARDNESS (SHORE A @ -5°C) 47
HOT HARDNESS (SHORE A @ +80°C) 45
SPECIFIC GRAVITY @ 20°C 1.19
FROM: JEFF BELL, TECHNICAL DIRECTOR

SUBJECT: C60A-10Wn (TPU)

Jan.28, 1993

HARDNESS, DUROMETER  60 ± 5
TENSILE STRENGTH, P.S.I. MIN.  2600
ELONGATION, % MIN.  750
GRAVE TEAR (DIE C) P.P.I. MIN.  250

COMPRESSION SET:

22 HRS. @ 158 °F  40
22 HRS. @ R.T.  20

OIL IMMERION: ASTM # 3 OIL
CONDITIONED 20 HRS. @ 212 °F
7 DAYS @ 176 °F

HARDNESS CHANGE, PTS.  + 6
TENSILE CHANGE, %  + 23
ELONGATION CHANGE, %  - 6
WEIGHT CHANGE, %  - 24

FUEL IMMERION: FUEL A
CONDITIONED 20 HRS. @ 212 °F
7 DAYS @ R.T.

HARDNESS CHANGE, PTS.  + 15
TENSILE CHANGE, %  + 14
ELONGATION CHANGE, %  + 5
WEIGHT CHANGE, %  - 27

Jeff Bell
TECHNICAL DIRECTOR
**AGED PROPERTIES**

C90A-100% IMMERSED IN FUEL "A"

<table>
<thead>
<tr>
<th></th>
<th>Originals</th>
<th>1 Day</th>
<th>3 Day</th>
<th>7 Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness &quot;A&quot;, pts</td>
<td>69</td>
<td>70</td>
<td>72</td>
<td>74</td>
</tr>
<tr>
<td>Ultimate Tensile, psi</td>
<td>2839</td>
<td>3154</td>
<td>3239</td>
<td>3284</td>
</tr>
<tr>
<td>300% Modulus, psi</td>
<td>696</td>
<td>724</td>
<td>729</td>
<td>718</td>
</tr>
<tr>
<td>100% Modulus, psi</td>
<td>351</td>
<td>360</td>
<td>357</td>
<td>370</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
<td>630</td>
<td>666</td>
<td>681</td>
<td>682</td>
</tr>
<tr>
<td>Weight Change, %</td>
<td></td>
<td>-10</td>
<td>-19</td>
<td>-27</td>
</tr>
</tbody>
</table>

- All test plaques conditioned for 20 hrs. @ 100°C prior to testing
- All materials were molded & tested in Wyandotte:
  *Effects of Liquids: ASTM D-471
- ASTM Fuel "A" = 100% iso Octane @ R.T.
## AGED PROPERTIES

**CSOA-1DWN**

*Oil Immersion*

<table>
<thead>
<tr>
<th>Property</th>
<th>Originals</th>
<th>ASTM Oil #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness 'A', pts</td>
<td>64</td>
<td>CSOA-1DWN</td>
</tr>
<tr>
<td>Ultimate Tensile, psi</td>
<td>4495</td>
<td>% Change</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
<td>89</td>
<td>+8</td>
</tr>
</tbody>
</table>

### ASTM Oil #3

<table>
<thead>
<tr>
<th>Property</th>
<th>CSOA-1DWN</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness 'A', pts</td>
<td>70</td>
<td>+8</td>
</tr>
<tr>
<td>Ultimate Tensile, psi</td>
<td>6510</td>
<td>+23</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
<td>840</td>
<td>-9</td>
</tr>
<tr>
<td>Weight Change, %</td>
<td></td>
<td>-24</td>
</tr>
</tbody>
</table>

- All plaques conditioned for 20 hrs. @ 100°C prior to testing
- Test conditions were 7 day immersion @ 80°C
- All tests were performed in Germany
C60A-10WN
HYDROLYTIC STABILITY
(In Water @ 80 C)
C60A-10WN
HYDROLYTIC STABILITY
(Above Water @ 80 C)
Specification
Gasket, Polyurethane-Ester, Molded, Shape

1. Scope. This specification is to set forth the minimum requirements for special shaped, molded lengths, of polyurethane-ester, gaskets. There shall be two separate formulations to create both 30A durometer and 40A durometer gaskets. The 30A gasket formulation shall be from now on referred to as gasket "A" and the 40A gasket formulation as "B". All requirements of this specification shall apply to both formulations with the exception of paragraphs 3.5.1 and 3.5.2 and they clearly make the distinction.

2. Applicable Documents

2.1 Government Documents.
AF Drawing No. X9198590

2.2 Non-Government Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted.

ASTM D395 - Rubber Property-Compression Set
ASTM D412 - Rubber Properties in Tension
ASTM D471 - Rubber Property-Effect of Liquids
ASTM D573 - Rubber-Deterioration in an Air Oven
ASTM D624 - Rubber Property-Tear Resistance
ASTM D792 - Standard Test Methods for Density & Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D2137 - Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics
ASTM D2240 - Rubber Property-Durometer Hardness
ASTM D1044 - Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1137).

3. Requirements

3.1 Material. The material shall be polyurethane-ester elastomer formulated and processed to meet the requirements of this specification (see 4.1.1).

3.2 Form. The gaskets shall be in the form of the molded shape per Figure 1 (Dwg No X9198590) (see 4.2.1).

3.3 Dimensions and Tolerances. Dimensions shall be accordance with drawing number X9198590, (Figure 1). Tolerances shall be in accordance with Table 1 (see 4.2.1).
3.4 Gasket Length. The gaskets shall be molded in lengths of six (6) feet (see 4.2.1).

3.5 Physical and Mechanical Properties.

3.5.1 Hardness. Measured by Shore-A-Durometer, shall be 30 ±5 for gasket "A" and 40 ±5 for gasket "B" (see 4.2.2, ASTM D224).

3.5.2 Hardness after Aging. Maximum change in hardness to both gaskets "A" and "B" shall be ±10%. Oven aging process shall be 20 hours at 100°C (212°F) (see 4.2.2, ASTM D224).

3.5.3 Compression Set. The maximum percent of compression set for the aged gaskets shall be 25%. Oven aging process shall be 20 hours at 65°C (150°F) (see 4.2.2, ASTM D395).

3.5.4 Tensile Strength. Minimum tensile strength for unaged gasket material shall be 4.8MPa (700psi). Maximum allowable tensile strength change for aged gasket material shall be -20%. Oven aging process shall be 20 hours at 100°C (212°F) (see 4.2.2, ASTM D412).

3.5.5 Elongation. Minimum percent of elongation is 240%. Maximum percent of change allowable after aging is -40% elongation. Oven aging process shall be 20 hours at 100°C (212°F) (see 4.2.2, ASTM D412).

3.5.6 Tear Resistance. Minimum tear resistance for gasket material shall be 25.0KNm (150ppi) (see 4.2.2, ASTM D624).

3.5.7 Abrasion Resistance. Maximum material loss due to abrasion shall be 10mg (.0001 oz) (see 4.2.2, ASTM D1044).

3.5.8 Brittle Point. Low temperature brittle point minimum is -70°C (-100°F). The specimen shall not fail after single-impact blow, at the temperature specified (see 4.2.2, ASTM D2137).

3.5.9 Volume Change after Water Immersion. Maximum percent of volume change after 70 hours of water immersion at 80°C (176°F) is +5% (see 4.2.2, ASTM D471).

3.5.10 Specific Gravity. Specific gravity after molding shall be equal to the pre-production value ±0.03 (see 4.2.2, ASTM D792).

3.5.11 Color. The color of the gasket shall match the natural color of the compound furnished (see 4.2.1).

3.6 Bonding. The gasket lengths shall have the capability of being bonded together with an adhesive, the adhesive shall be provided, to create corner joints. The bonded joint shall withstand/pass a gasket pull test, perpendicular to bond plane, of 20 pounds without signs of separation. The bonding process
shall be chemical in nature (i.e. one or two part epoxy/glue) requiring no mechanical process (i.e. heat welding) (see 4.2.1).

3.6.1 **Adhesive.** The adhesive shall be provided in small quantity/ single use packaging, one (1) ounce tubes or packets, and shall have a shelf life of two (2) years minimum.

3.7 **Packing.** Gaskets "A" and "B" shall come packed separately and marked as indicated in 3.7.1. The package shall allow for the gasket lengths to lay straight without being folded or bent. The packing should be weather resistant to guard against moisture absorption.

3.7.1 **Marking.** Marking on external package shall identify the durometer, the suppliers name, address, and suppliers part number.

4.0 **Quality Assurance Provisions**

4.1 **Responsibility for Inspection** The contractor is responsible for the performance of all inspection requirements (examinations and tests) to ensure the gaskets meet all requirements specified herein. The contractor may use his own or any other facility suitable for the performance of the quality inspection. The Government reserves the right to perform any inspections deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 **Responsibility for Compliance** All items shall meet all requirements of section 3. The inspections shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirement in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submissions of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 **Quality Conformance Inspection** Quality conformance inspection shall be applied to each item prior to being offered for acceptance under the contract. The gasket shall be examined/tested to determine compliance with all requirements of this specification.

4.2.1 **Examination of the End Item** The gaskets shall be examined for defects in appearance and workmanship, and defects in dimension.

4.2.2 **Testing of the Material.** The end item will be tested in accordance with the methods specified in Table II and therefore
shall be the test methods for ensuring the gaskets will meet the requirements herein.

4.3 **Acceptance.** The gaskets will be accepted if all requirements are met. Requirement verification shall be determined by inspection and testing. The acceptance criteria shall be the tolerances stated in each of the applicable requirements paragraphs (section 3.0) for each appropriate test.
Table I. Dimensional Tolerances.

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Fixed dimension Tolerance (mm)</th>
<th>Closure Dimension Tolerance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above</td>
<td>Incl.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>9.99</td>
<td>±0.20</td>
</tr>
<tr>
<td>10</td>
<td>15.99</td>
<td>0.25</td>
</tr>
<tr>
<td>16</td>
<td>24.99</td>
<td>0.32</td>
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<tr>
<td>25</td>
<td>39.99</td>
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<tr>
<td>40</td>
<td>62.99</td>
<td>0.50</td>
</tr>
<tr>
<td>63</td>
<td>99.99</td>
<td>0.63</td>
</tr>
<tr>
<td>100</td>
<td>159.99</td>
<td>0.80</td>
</tr>
</tbody>
</table>

160 and over - Multiply by 0.5%

1/ Fixed dimension tolerances apply individually to each fixed dimension by its own size.
2/ Closure dimension tolerances are determined by the largest closure dimension and this single tolerance is used for all other closure dimensions. (Closure dimension refers to any dimension in a place parallel to the plane traced when the mold closes).

Table II. Test Methods for Physical Properties.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>D224</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>D412</td>
</tr>
<tr>
<td>Elongation</td>
<td>D412</td>
</tr>
<tr>
<td>Volume Change</td>
<td>D471</td>
</tr>
<tr>
<td>Compression Set</td>
<td>D395</td>
</tr>
<tr>
<td>Tear Resistance</td>
<td>D624</td>
</tr>
<tr>
<td>Brittle Point</td>
<td>D2137</td>
</tr>
<tr>
<td>Oven Aging</td>
<td>D573</td>
</tr>
<tr>
<td>Water Immersion</td>
<td>D471</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>D1044</td>
</tr>
<tr>
<td>Specify Gravity</td>
<td>D792</td>
</tr>
</tbody>
</table>
APPENDIX B

GASKET DRAWINGS

POLYURETHANE:
1. 9198585
2. 9198590

SILICONE:
1. 9198575
2. 9489270
3. 9489271
4. 9489272
5. 9489273
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW RSA STANDARD, CLASS A-DWG DESIGNATION A (HIGH PRECISION) FOR GROUP 1 COMPOUNDS.
4. IDENTIFICATION OF THE KNOWN SOURCE(S) OF SUPPLY HERETIN IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT FOR THE ITEM DESCRIBED ON THE DRAWING.

KNOWN SOURCE OF SUPPLY

<table>
<thead>
<tr>
<th>SOURCE</th>
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<tbody>
<tr>
<td>JAMACK FABRICATION INC.</td>
<td>2833</td>
</tr>
<tr>
<td>1401 N. BOWIE DR.</td>
<td></td>
</tr>
<tr>
<td>WEATHERFORD, TX 76086</td>
<td></td>
</tr>
<tr>
<td>(817) 594-8771</td>
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</tr>
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SCALE 5/1

PARTS LIST

<table>
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<tr>
<th>SYM</th>
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METRIC

U.S. AIR FORCE

P-GASKET

B 0B275 9198585

PC - COMPUTER GENERATED
NOTES:

1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH
   UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW TABLE I.
4. DIMENSIONAL TOLERANCES, OF ATTACHED
   SPECIFICATION.

Identification of the known source(s) of
supply herein is not to be construed as a
Guarantee of present or continued availability
as a source of supply or quality of product
for the item described on the drawing.

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

PARTS LIST

METRIC

U.S. AIR FORCE

X-GASKET

AREA 94.6 mm²

COMPUTER GENERATED, (AUTOCAD, VERSION 12, HQ AFMC/LGPD) ENGINEERING DRAWING LAYOUT B
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW RMS STANDARD, CLASS 2.
4. IDENTIFICATION OF THE KNOWN SOURCE(S) OF SUPPLY HEREIN IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT FOR THE ITEM DESCRIBED ON THE DRAWING.

KNOWN SOURCE OF SUPPLY
SOURCE
JAMACK FABRICATION INC
1401 N. BOWIE DR.
WEATHERFORD, TX 76086
(817) 594-8771
DIE NO.
2833

U.S. AIR FORCE
GASKET
MATERIAL:
SILICONE RUBBER
PER ZZ-R-765
CLASS 2B
GRADE 40

PARTS LIST
SYM NOMENCLATURE CASE CODE IDENTIFYING NO. MATERIAL/SPECIFICATION UNIT WT ZONE FIND NO.

PC - COMPUTER GENERATED
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW MIL-STD-100.
4. IDENTIFICATION OF THE KNOWN SOURCE(S) OF SUPPLY HEREIN IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT FOR THE ITEM DESCRIBED ON THE DRAWING.

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DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

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<tr>
<td>GASKET1</td>
</tr>
<tr>
<td>MATERIAL: SILICONE RUBBER</td>
</tr>
<tr>
<td>CLASS 2B</td>
</tr>
<tr>
<td>GRADE 40</td>
</tr>
<tr>
<td>APPLICATION</td>
</tr>
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COMPUTER GENERATED, (AUTOCAD, VERSION 12, HQ AFMC/LGTPD) ENGINEERING DRAWING LAYOUT B
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW RMA STANDARD, CLASS 2.
4. IDENTIFICATION OF THE KNOWN SOURCE(S) OF SUPPLY HEREIN IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT FOR THE ITEM DESCRIBED ON THE DRAWING.

KNOWN SOURCE OF SUPPLY

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DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

PARTS LIST

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<tbody>
<tr>
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<tr>
<td>GASKET2</td>
</tr>
<tr>
<td>METRIC</td>
</tr>
<tr>
<td>MATERIAL: SILICONE RUBBER PER ZZ-R-765 CLASS 2B GRADE 40</td>
</tr>
<tr>
<td>R.D. MILLER</td>
</tr>
<tr>
<td>R.D. MILLER</td>
</tr>
<tr>
<td>APPLICATION</td>
</tr>
<tr>
<td>AREA = 103.0 mm²</td>
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COMPUTER GENERATED, (AUTOCAD, VERSION 12, HQ AFMC/LGTPD) ENGINEERING DRAWING LAYOUT B
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH
   UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW RMA STANDARD,
   CLASS 2.
4. IDENTIFICATION OF THE KNOWN SOURCE(s) OF
   SUPPLY HEREIN IS NOT TO BE CONSTRUED AS A
   GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY
   AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT
   FOR THE ITEM DESCRIBED ON THE DRAWING.

KNOWN SOURCE OF SUPPLY

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<tbody>
<tr>
<td>JAM-PACK FABRICATION INC.</td>
<td>42-85041</td>
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<tr>
<td>1401 N. BOWIE DR.</td>
<td></td>
</tr>
<tr>
<td>WEATHERFORD, TX 76086</td>
<td></td>
</tr>
<tr>
<td>(817) 594-8771</td>
<td></td>
</tr>
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SCALE 5/1

DISTRIBUTION STATEMENT A.  APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

<table>
<thead>
<tr>
<th>PARTS LIST</th>
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<tbody>
<tr>
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</table>

METRIC

U.S. AIR FORCE

GASKET 272

MATERIAL:
SILICONE RUBBER
PER ASTM D2000
MBGE405 OR
MBGE406

AREA: 99.3 mm²

COMPUTER GENERATED, (AUTOCAD, VERSION 12, HD AFMC/LGTPID)
NOTES:
1. INTERPRET DRAWING IAW MIL-STD-100.
2. ALL CONVERSIONS FROM METRIC TO ENGLISH UNITS SHALL BE IAW ASTM E380.
3. ALL TOLERANCES SHALL BE IAW RMA STANDARD, CLASS 2.
4. IDENTIFICATION OF THE KNOWN SOURCE(S) OF SUPPLY HEREIN IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY OR QUALITY OF PRODUCT FOR THE ITEM DESCRIBED ON THE DRAWING.

KNOWN SOURCE OF SUPPLY

SOURCE

DIE NO.

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

PARTS LIST

U.S. AIR FORCE

GASKET4

METRIC

UNITED STATES SPECIFIED

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED

UNIT: INCHES

MATERIAL:

SILOX RUBBER

PER ZZ-R-765

CLASS 28

GRADE 40

MORT. MILLER

MORT. MILLER

APPLICATION

AREA: 99.3 mm²

COMPUTER GENERATED, (AUTOCAD, VERSION 12, HQ AFMC/LGTD)

ENGINEERING DRAWING LAYOUT B
APPENDIX C

Test Results
SUSAN J. MISRA
Materials Engineer
DSN: 787-4519
Commercial: (513) 257-4519

DEFENSE AMMUNITION PACKAGING COUNCIL
(DAPC) J7 GASKET TESTING

AFMC LSO/LOP
5215 THURLOW ST
WRIGHT-PATTERSON AFB OH 45433-5540
SEP 1995
INTRODUCTION

The objective of this test series was to compare the performance of various gaskets during pneumatic pressure/vacuum retention leaks tests. The outcome of this testing is recommendations for the most reliable gasket(s).

CONTAINER DESCRIPTION

The gasket container is a small-sized, sealed aluminum container (Figures 1 and 2). The container consists of a cover and base. Maximum outer container dimensions are 27.56 inches in length, 27.56 inches in width, and 20.30 inches in depth. The lid is secured by the use of two latches on each side, for a total of four latches. An optional latch on each end is provided to help seal the container, if necessary.

The container was designed and furnished by the requesting branch.

GASKET DESCRIPTIONS

Reference Main Appendix B.

The gaskets were designed and furnished by the requesting branch.

TEST PROCEDURE

The gaskets were tested in accordance with the Air Force Packaging Technology and Engineering Facility (AFPTEF) Container Test Plan, dated 15 Jun 95, (Test Report Appendix B) which referenced FED-STD-101C.

The test methods constitute both the procedure for performing the tests and performance criteria for evaluation of the gaskets. The tests are commonly applied to special shipping containers. The tests were performed at AFMC LSO/LOPM, 5215 Thurlow St, Wright-Patterson AFB, OH 45433-5540.
TEST SEQUENCES


The following equipment and instrumentation was utilized:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Ser#</th>
<th>Cal Exp</th>
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<tr>
<td>Digital Manometer</td>
<td>Yokogawa</td>
<td>2655-22</td>
<td>85DJ6001</td>
<td>Jun 96</td>
</tr>
<tr>
<td>Vacuum/Pressure Pump</td>
<td>Gast Mfg</td>
<td>MOA-</td>
<td>0485</td>
<td>N/A</td>
</tr>
<tr>
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<td></td>
<td>P109-A</td>
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<td></td>
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The container pressure relief valve was removed and the relief valve hole used for attachment of the digital manometer and vacuum/pressure pump lines. The empty container was closed and sealed with each gasket. The leak tests were conducted in accordance with FED-STD-101C, Method 5009.3, at ambient and pressure and vacuum.

The pneumatic pressure leak technique (Figure 3) was utilized and the container pressurized to 1.50 pounds per square inch (psig). The maximum allowable leak rate was 0.025 psi/hr (reference Test Report Appendix B, Test Plan).

The vacuum retention leak technique was utilized and the container evacuated to -1.50 psig. The maximum allowable leakage rate was 0.025 psi/hr (reference Test Plan).

Preliminary tests consisted of lubricating one of the gaskets in order to produce a good seal in the gasket area. The container was left overnight and maintained a pressure of 1.5 psig and a leak rate of 0.02 psi/hr. The vacuum retention test maintained a pressure of -1.5 psig and a leak rate of 0.02 psi/hr.

Gasket performance was not affected by the use of the end latches; therefore, only the side latches were used. The side latches were torqued at several levels, in inch-pounds (in.-lb.), in order to determine what the best level was for each gasket, i.e., most gaskets worked best when the latches were torqued to 20 in.-lb. where another gasket worked best when the latches were torqued to 35 in.-lb. The gaskets were removed and rotated after each test to verify performance at each torque level. Because most of the gaskets sealed well when the latches were torqued to 20 in.-lb., this was the level used to perform the comparison tests; however, results are also given for gaskets whose performance improved when latches were torqued at a different level. Once torque level for each gasket was established, a total of five tests each were conducted to compare gasket performances. As in the preliminary tests, gaskets were removed and rotated 90° after each test. The latches were loosened and re-torqued to the required level before each test.
Gaskets exhibited better and more consistent performance during the vacuum retention tests. The noticeable differences in gasket performance occurred during the pneumatic pressure tests. Leak rates and comments for each gasket are as follows, reference Main Appendix B. Results of each test are shown in order to demonstrate the consistencies and inconsistencies. Recommendations are based on the requirements for typical pneumatic pressure/vacuum retention leak tests which state that pressure shall be maintained at 1.50 psig and the leak rate shall not exceed 0.05 psi/hr.

GASKET, DRAWING NUMBER 9198575

Material: Silicone Rubber, PER ZZ-R-765, Class 2B, Grade 40.
Latches torqued to 20 in.-lb.

PNEUMATIC PRESSURE

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (psi/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5556</td>
<td>1.5526</td>
<td>0.0030</td>
</tr>
<tr>
<td>2</td>
<td>1.5033</td>
<td>1.2960</td>
<td>0.2073</td>
</tr>
<tr>
<td>3</td>
<td>1.5466</td>
<td>1.5423</td>
<td>0.0043</td>
</tr>
<tr>
<td>4</td>
<td>1.5590</td>
<td>1.4679</td>
<td>0.0911</td>
</tr>
<tr>
<td>5</td>
<td>1.5670</td>
<td>1.5561</td>
<td>0.0109</td>
</tr>
</tbody>
</table>

COMMENTS:

This gasket performed rather inconsistently. Results appeared to be highly dependent on the placement of the gasket. The gasket was carefully removed and replaced after each test; however, its performance varied greatly without a noticeable difference in its placement in the container. If it was in a position where it performed well, (i.e., a leak rate of no more than 0.05 psi/hr), the lid could be removed and placed back on the container, the latches re-torqued, and it would maintain its excellent performance. However, since one could not determine if the gasket was properly placed until after testing, there is no guarantee that it would perform well each time. Increasing/decreasing the torque level of the latches did not improve its performance.

CONCLUSION:

Since the performance of this gasket is not reliable, it is not recommended for use, unless it is verified of sealing the container prior to use and not removed from that position in the container.
VACUUM RETENTION

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (Absolute Value) (psi/hr)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>-1.5536</td>
<td>-1.5481</td>
<td>0.0055</td>
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<tr>
<td>2</td>
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<td>5</td>
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<td>-1.5211</td>
<td>0.0065</td>
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</table>

COMMENTS:

The gasket exceeded the requirements of the vacuum retention test with the greatest leak rate being 0.0491 psi/hr.

GASKET 1, DRAWING NUMBER X9489270

Material: Silicone Rubber, PER ZZ-R-765, Class 2B, Grade 40.

Latches torqued to 20 in.-lb.

PNEUMATIC PRESSURE

<table>
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<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (psi/hr)</th>
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<tr>
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<td>1.5448</td>
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<td>0.0339</td>
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<td>5</td>
<td>1.5423</td>
<td>1.4921</td>
<td>0.0502</td>
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COMMENTS:

This gasket performed fairly consistently and usually exceeded pressure test requirements.

VACUUM RETENTION

<table>
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<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (Absolute Value) (psi/hr)</th>
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</thead>
<tbody>
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<td>-1.5527</td>
<td>-1.5392</td>
<td>0.0135</td>
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</table>
COMMENTS:

The gasket exceeded the requirements of the vacuum retention test with the greatest leak rate being 0.0268 psi/hr.

GASKET2, DRAWING NUMBER X9489271

Material: Silicone Rubber, PER ZZ-R-765, Class 2B, Grade 40.

Latches torqued to 35 in.-lb.

PNEUMATIC PRESSURE

<table>
<thead>
<tr>
<th>Test #</th>
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<th>Final psig</th>
<th>Leak Rate (psi/hr)</th>
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</thead>
<tbody>
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<td>1.5512</td>
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<td>5</td>
<td>1.5393</td>
<td>1.5238</td>
<td>0.0155</td>
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COMMENTS:

This gasket performed fairly consistently; however, it would not hold a seal when the latches were torqued at 20 in.-lb. All of the other silicone rubber gaskets sealed extremely well when the latches were torqued at 20 in.-lb. Because the latches needed to be torqued so high (35 in.-lb.) it made securing the lid quite difficult.

CONCLUSION:

This gasket is not recommended as other gaskets had better performance and it is much easier to secure the lid with the latches being torqued at a lower level.

VACUUM RETENTION

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (Absolute Value) (psi/hr)</th>
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<td>-1.5499</td>
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<td>0.0037</td>
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COMMENTS:

The gasket usually met the requirements of the vacuum retention test with the greatest leak rate being 0.0545 psi/hr.

GASKET3, DRAWING NUMBER X9489272

Material: Silicone Rubber, PER ZZ-R-765, Class 2B, Grade 40.
Latches torqued to 20 in.-lb.

PNEUMATIC PRESSURE

<table>
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<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (psi/hr)</th>
</tr>
</thead>
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<tr>
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<td>1.5492</td>
<td>1.5432</td>
<td>0.0060</td>
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COMMENTS:

This gasket had the best performance of all. In fact, it had excellent performance as the greatest leak rate encountered was only 0.0189 psi/hr which is significantly below the normally accepted value. Its performance is extremely consistent and is quite reliable.

VACUUM RETENTION

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (Absolute Value) (psi/hr)</th>
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</thead>
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<td>-1.5476</td>
<td>-1.5315</td>
<td>0.0161</td>
</tr>
</tbody>
</table>

COMMENTS:

The gasket exceeded the requirements of the vacuum retention test with the greatest leak rate being 0.0161 psi/hr.
GASKET4, DRAWING NUMBER X9489273

Material: Silicone Rubber, PER ZZ-R-765, Class 2B, Grade 40.
Latches torqued to 20 in.-lb.

**PNEUMATIC PRESSURE**

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (psi/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5571</td>
<td>1.5543</td>
<td>0.0028</td>
</tr>
<tr>
<td>2</td>
<td>1.5555</td>
<td>1.5254</td>
<td>0.0301</td>
</tr>
<tr>
<td>3</td>
<td>1.5245</td>
<td>1.5005</td>
<td>0.0240</td>
</tr>
<tr>
<td>4</td>
<td>1.5310</td>
<td>1.4990</td>
<td>0.0320</td>
</tr>
<tr>
<td>5</td>
<td>1.5609</td>
<td>1.5355</td>
<td>0.0254</td>
</tr>
</tbody>
</table>

**COMMENTS:**

This gasket had consistent, excellent performance as its greatest leak rate was only 0.0320 psi/hr.

**VACUUM RETENTION**

<table>
<thead>
<tr>
<th>Test #</th>
<th>Initial psig</th>
<th>Final psig</th>
<th>Leak Rate (Absolute Value) (psi/hr)</th>
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<tbody>
<tr>
<td>1</td>
<td>-1.5458</td>
<td>-1.5313</td>
<td>0.0145</td>
</tr>
<tr>
<td>2</td>
<td>-1.5417</td>
<td>-1.5251</td>
<td>0.0166</td>
</tr>
<tr>
<td>3</td>
<td>-1.5275</td>
<td>-1.5161</td>
<td>0.0114</td>
</tr>
<tr>
<td>4</td>
<td>-1.4933</td>
<td>-1.4829</td>
<td>0.0104</td>
</tr>
<tr>
<td>5</td>
<td>-1.5497</td>
<td>-1.5487</td>
<td>0.0010</td>
</tr>
</tbody>
</table>

**COMMENTS:**

The gasket exceeded the requirements of the vacuum retention test with the greatest leak rate being 0.0166 psi/hr.
X-GASKET, DRAWING NUMBER X9489276, DUROMETER 30

Material: Polyurethane.

COMMENTS:

This gasket did not seal during either test. Its performance was not affected by increasing or decreasing the torque of the latches. All tests were terminated when the pressure decreased/increased to 1.36 psig/-1.36 psig. This decrease/increase in pressure occurred, on an average, only ten minutes into the test. During the pneumatic pressure test, the sound of air escaping from the corners of the container was audible from about twenty-four inches away from the leak.

X-GASKET, DRAWING NUMBER X9489276, DUROMETER 40

Material: Polyurethane.

COMMENTS:

This gasket did not seal during either test. Its performance was not affected by increasing or decreasing the torque of the latches. The pressure decreased/increased to about 1.0 psig/-1.0 psig, on an average, less than five minutes into the test. During the pneumatic pressure test, the sound of air escaping from the corners of the container was audible from about twenty-four inches away from the leak.

CONCLUSIONS AND RECOMMENDATIONS

One important factor in the performance of the gaskets was their placement in the container. Preliminary tests concluded that the corners needed to be evenly squared before securing the lid. This usually needed to be accomplished after the gasket was placed within the channel of the container.

The polyurethane gaskets would not seal the container. The material itself tended to stick together in the shipping carton. As each strip of the material was removed from the carton, it generally needed to be peeled away from the other strips, causing gouges in the strips of material. In addition, the corners of the gaskets were not evenly sealed and apparently the standard sealing methods of the other gaskets could not be used.

The overall recommendation is the use of gasket 3, drawing number X9489272, as it performed with the most reliability and the lowest leak rates. Even though comparison tests were conducted with the latches torqued at 20 in.-lb., this gasket still exhibited an average leak rate of only 0.0294 psi/hr when the tension of the latches was torqued at only 17 in.-lb.; therefore, easing the use of the latches.
APPENDIX A

PHOTOGRAPHS
Figure 1. Container Drawing.

Figure 2. Container.
Figure 3. Pneumatic Pressure/Vacuum Retention Leak Test.
APPENDIX B

TEST PLAN
# AIR FORCE PACKAGING TECHNOLOGY & ENGINEERING FACILITY
## (Container Test Plan)

<table>
<thead>
<tr>
<th>CONTAINER SIZE (L x W x D) (MILLIMETERS)</th>
<th>WEIGHT (Kgs)</th>
<th>CUBE (CU. M)</th>
<th>QUANTITY</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERIOR: 610 X 610 X393</td>
<td>45</td>
<td></td>
<td>1</td>
<td>15 Jun 95</td>
</tr>
<tr>
<td>EXTERIOR: 700 X700 X515</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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**ITEM NAME:**
GASKETS SHAPES AND MATERIALS

**CONTAINER NAME:**
DAPC J7 GASKET TEST CONTAINER

**PACK DESCRIPTION:**

**CONDITIONING:**
AMBIENT

<table>
<thead>
<tr>
<th>TEST NO.</th>
<th>REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S</th>
<th>TEST TITLE AND PARAMETERS</th>
<th>CONTAINER ORIENTATION</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>FTMS 101 MTHD 5009.3</td>
<td>Pneumatic Pressure at 1.50 PSIG, allow for temperature/pressure stabilization. Test duration after stabilization shall be 60 minutes. Leak rate shall be measured during the test period. Leak Rate shall not exceed 0.025 PSI in 60 minutes.</td>
<td>Ambient temp.</td>
<td>Digital Manometer (DM)</td>
</tr>
<tr>
<td>b.</td>
<td>FTMS 101 MTHD 5009.3</td>
<td>Vacuum Retention at 1.50 PSIG, allow for temperature/pressure stabilization. Test duration after stabilization shall be 60 minutes. Leak rate shall be measured during the test period. Leak Rate shall not exceed 0.025 PSIG in 60 minutes.</td>
<td>Ambient temp.</td>
<td>Data Acq. Sys (DAS)</td>
</tr>
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</table>

2. LEAK TEST (For each Gasket Configuration)

<table>
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<tr>
<th>TEST NO.</th>
<th>REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S</th>
<th>TEST TITLE AND PARAMETERS</th>
<th>CONTAINER ORIENTATION</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>FTMS 101 MTHD 5009.3</td>
<td>Pneumatic Pressure at 1.50 PSIG, allow for temperature/pressure stabilization. Test duration after stabilization shall be 60 minutes. Leak rate shall be measured and recorded during the entire test period</td>
<td>Ambient temp.</td>
<td>DM</td>
</tr>
<tr>
<td>b.</td>
<td>FTMS 101 MTHD 5009.3</td>
<td>Vacuum Retention at 1.50 PSIG, allow for temperature/pressure stabilization. Test duration after stabilization shall be 60 minutes. Leak rate shall be measured and recorded during the entire test period</td>
<td>Ambient temp.</td>
<td>DM</td>
</tr>
</tbody>
</table>

**COMMENTS:**
Temperature and Pressure Graphs required.
All latches shall apply even pressure to create a sealed container, lock tight to disallow readjustment.

**PREPARED BY:**
Robbin Miller, Mechanical Engineer

**APPROVED BY:**
Ted Hinds, Chief, Design Group, AFPTEA
APPENDIX D

DISTRIBUTION LIST
<table>
<thead>
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<th>DISTRIBUTION LIST</th>
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<tr>
<td>DTIC/FDAC</td>
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<tr>
<td>CAMERON STATION</td>
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<tr>
<td>ALEXANDRIA VA 22304-6145</td>
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<tr>
<td>HQ AFMC/LG</td>
</tr>
<tr>
<td>4375 CHIDLAW ROAD SUITE 6</td>
</tr>
<tr>
<td>WRIGHT-PATTERSON AFB OH 45433-5006</td>
</tr>
<tr>
<td>HQ AFMC/LGT</td>
</tr>
<tr>
<td>4375 CHIDLAW ROAD SUITE 6</td>
</tr>
<tr>
<td>WRIGHT-PATTERSON AFB OH 45433-5006</td>
</tr>
<tr>
<td>AFMC LSO/LO</td>
</tr>
<tr>
<td>4375 CHIDLAW ROAD SUITE 6</td>
</tr>
<tr>
<td>WRIGHT-PATTERSON AFB OH 45433-5006</td>
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<tr>
<td>AFMC LSO/LOP (LIBRARY)</td>
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<tr>
<td>5215 THURLOW ST</td>
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<tr>
<td>WRIGHT-PATTERSON AFB OH 45433-5540</td>
</tr>
<tr>
<td>HQ USAF/LGTT</td>
</tr>
<tr>
<td>1030 PENTAGON RM 4B322</td>
</tr>
<tr>
<td>WASHINGTON DC 20330-1030</td>
</tr>
<tr>
<td>72 ABW/LGTP</td>
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<tr>
<td>7615 SENTRY BLVD SUITE 201</td>
</tr>
<tr>
<td>TINKER AFB OK 73145-8912</td>
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<tr>
<td>75 ABW/LGTP</td>
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<tr>
<td>7530 11th ST</td>
</tr>
<tr>
<td>HILL AFB UT 84056-5707</td>
</tr>
<tr>
<td>CO-ALC/LIWGB</td>
</tr>
<tr>
<td>ATTN: JOHN LOCHNER</td>
</tr>
<tr>
<td>6034 DOGWOOD AVENUE</td>
</tr>
<tr>
<td>HILL AFB UT 84056-5816</td>
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<tr>
<td>76 LG/LGTP</td>
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<tr>
<td>401 WILSON BLVD</td>
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<tr>
<td>KELLY AFB TX 78241-5340</td>
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<tr>
<td>77 ABW/LGTP</td>
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<tr>
<td>1961 IDZOREK ST</td>
</tr>
<tr>
<td>MCCLELLAN AFB CA 95652-1620</td>
</tr>
<tr>
<td>78 ABW/LGTP BLDG 376</td>
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<tr>
<td>455 BYRON ST SUITE 1150</td>
</tr>
<tr>
<td>ROBINS AFB GA 31098-1860</td>
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DOVER NJ 07801-5001

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ATTN: DLA-MMDO
DEFENSE LOGISTICS AGENCY
CAMERON STATION
ALEXANDRIA VA 22304-6100

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DAVIS MONTAN AFB AZ 85707-4341

HQ PACAF/LGT BLDG 1102
25 E. ST. STE I326
HICKAM AFB HI 96853-5426

HQ USAFE/LGT
UNIT 3050 BOX 105
APO AE 09094-0105

HQ ACC/LGT
130 DOUGLAS ST STE 210
LANGLEY AFB VA 23665-2791

HQ AF SPACECOM/LGT
150 VANDENBURG ST., STE 1105
PETERSON AFB CO 80914-5000

HQ AETC/LGT
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RANDOLPH AFB TX 78150-4440

*HQ AFSA/SEW
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SCOTT AFB IL 62225-5363

HQ AFRES/LGT
155 SECOND ST
ROBINS AFB GA 31098-1635

HQ ANGRC/LGT
3500 FETCHET AVE
ANDREWS AFB MD 20331-5157

HQ USAFA/LGT
8110 INDUSTRIAL DR
USAFA ACADEMY CO 80840-2305

ODUSD/L/MRM
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WASHINGTON DC 20301-8000

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FORT MONMOUTH NJ 07703-5000

DIRECTOR, US ARMY EDGWOOD RESEARCH
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PICATINNY ARSENAL, NJ 07806-5000

US ARMY ARDEC
BLDG. 455
ATTN: SMCAR-AEP PACKAGING DIVISION
EUGENE FARRELL
PICATINNY ARSENAL, NJ 07806-5000

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ROUTE 34 SOUTH CODE 5022
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COLTS NECK, NJ 07722-5000

ASC/YJA
EGLIN AFB FL 32542-5000
ATTN: LEE LIPSCOMB

COMMANDING OFFICER
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361 CODE 4073
ATTN: FRANK NIEHAUS
CRANE, IN 47522
The objective of this project was to investigate new materials and shapes available for use as gaskets in sealed containers. The properties of the new materials had to be evaluated/tested to assure they met or exceeded the properties of current gasket materials. The project also looked at the manufacturing processes of extruding vs. molding. We also investigated the joint bonding process of using chemical adhesive as well as vulcanizing and heat welding. Another aspect of the project was to evaluate the required cross-sectional area and hence the compression required to create a sealed container repeatedly with the minimum amount of force.