SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-P-5315

Issued MAR 1998

Submitted for recognition as an American National Standard

PACKING, PREFORMED, HYDROCARBON FUEL RESISTANT

NOTICE

This document has been taken directly from U.S. Military Specification MIL-P-5315B, Amendment 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-P-5315B, Amendment 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Any material relating to qualified product lists has not been adopted by SAE. This material was part of the original military specification and is reprinted here for historic reference only.

1. SCOPE:

1.1 This specification covers hydrocarbon fuel resistant O-ring preformed packings of the sizes shown on MS29512 and MS29513 and of one grade only.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7154 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

QQ-A-250/4	Aluminum Alloy, Plate and Sheet 2024
QQ-A-620	Aluminum Bronze, Plate, Bar, Sheet, and Strip
QQ-B-613	Brass, Leaded and Non-Leaded; Flat Products (Plate, Bar, Sheet, and Strip)
QQ-B-750	Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections
QQ-M-44	Magnesium Alloy Plate and Sheet (AZ31)
TT-S-735	Standard Test Fluids, Hydrocarbon
MIL-P-4861	Packing, Preformed, Rubber, Packing, Packaging of
MIL-S-5059	Steel, Corrosion-Resistant (18-8), Plate, Sheet and Strip
MIL-G-5572	Gasoline, Aviation: Grades 80/87, 91/96, 100/130, 115/145
MIL-J-5624	Jet Fuel, Grades JP-4 and JP-5
MIL-H-6083	Hydraulic Fluid, Petroleum Base, Preservative
MIL-P-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT, General Requirements for
MIL-S-7720	Steel, Corrosion-Resistant (18-8) Bars, and Forging Stock (for Aircraft Applications)
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-S-18729	Steel Plate, Sheet, and Strip, Alloy, 4130, Aircraft Quality

FED. TEST METHOD STD. NO. 601 Rubber: Sampling and Testing

MIL-STD-10	Surface Roughness, Waviness, and Lay
MIL-STD-413	Visual Inspection Guide for Rubber O-Rings
MIL-STD-831	Test Reports, Preparation of
MS20995	Wire, Lock
MS29512	Packing, Preformed, Hydrocarbon Fuel Resistant, Tube Fitting, O-Ring
MS29513	Packing, Preformed, Hydrocarbon Fuel Resistant, O-Ring

AIR FORCE-NAVY AERONAUTICAL AN385 Pin, Tapered Plain
AIR FORCE-NAVY AERONAUTICAL BULLETIN No. 438 Age Controls for Synthetic Rubber Parts

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 1329-60 Evaluating Low-Temperature Characteristics of Rubber and Rubber-Like Materials by Temperature-Retraction Procedure (TR Test)

3. REQUIREMENTS:

3.1 Qualification:

The packing furnished under this specification shall be a product which has been subjected to and which has passed the qualification tests specified herein, and which has been listed on or approved for listing on the applicable Qualified Products List.

3.2 Data:

Unless otherwise specified in the contract or order, no data (other than reports and drawings accompanying qualification samples) are required by this specification or any of the documents referenced in section 2 herein (see 6.2).

3.3 Materials:

The materials used shall be suitable for use in aircraft and engine fuel systems in which fuels conforming to MIL-G-5572 and MIL-J-5624 are used. The materials shall contain no substances that, when in contact with the fuel, will adversely affect the properties of the fuel or packing as indicated by the tests described herein. The material shall have no corrosive or deleterious affect on metals under conditions normally encountered in service or as indicated by the tests described in section 4.

3.3.1 Homogeneity: The material shall be homogeneous to insure consistent swell, strength and hardness characteristics throughout the entire batch.

3.3.2 Physical properties at manufacture: The physical properties of the material at time of manufacture shall be suitable for the purpose intended. Table 1 and section 4 outline required physical tests and methods of performing these tests. The term "as determined", as used in table I, denotes that the value shall be determined but irrespective of what the value may be, it will not be cause for rejection.

Table I. Physical properties at manufacture

Item	Property	Requirements
1	Tensile stress at 100 percent elongation, psi.	As determined.
2	Tensile strength, psi.....	1,000 min.
3	Ultimate elongation, percent.....	200 min.
4	Specific gravity, points.....	As determined.
5	Volume increase after fluid aging, type I test fluid, percent.	0-10.
6	Volume increase after fluid aging, type III test fluid, percent.	0-50.
7	Hardness, durometer points.....	60-70.
8	Compression set (permanent set) percent.	25 max
9	Temperature retraction (50/10), °F	-50° F or colder.
10	Corrosion and adhesion.....	None.

3.3.3 Change in physical properties: The physical properties of the materials shall not change with accelerated aging in test fluids conforming to TT-S-735, type I or type III, by more than the values shown in table I when tested in accordance with 4.7.4.

3.3.4 Uniformity of physical properties: The physical properties of the production material shall meet the requirements of table I and shall be maintained within the limits specified in table II as compared to the values obtained during the qualification tests of the material.

3.3.5 Age: The age control of the packing shall be in accordance with ANA Bulletin No. 438.

3.4 Design and construction:

The design and construction of the packing shall be in accordance with MS29512 and MS29513, as applicable.

3.4.1 Finish:

3.4.1.1 Trimming: Mold flashing shall be removed in such a manner that the finished packing shall conform to the requirements specified herein and on the applicable MS standard.

Table II. Permissible production variation in physical properties from the qualification values

Item	Property	Variation
1	Tensile stress at 100 percent elongation, psi.	±15 percent
1/ 2	Tensile strength, psi.	±15 percent
1/ 3	Ultimate elongation, percent.	±20 percent
4	Specific gravity, points.	±0.02 points
1/ 5	Volume change due to type I test fluid aging, percent.	±2 units of percent
1/ 6	Volume change due to type III test fluid aging, percent.	±3 units of percent
1/ 7	Hardness, durometer, points.	±3 points
1/ 8	Compression set (permanent set), percent.	±5 units of percent
1/ 9	Temperature retraction, °F.	±2° F
10	Corrosion and adhesion.	None.

1/ All values obtained shall be within the numerical limits specified in table I.

3.4.1.2 Sealing surface: The sealing surface of the packings shall be free from defects, blemishes, or irregularities, except as specified herein or on the applicable MS standard. The entire surface of the packing is considered a sealing surface.

3.5 Performance:

The packing shall satisfy the following performance requirements as specified in the tests of section 4.

3.5.1 Process control: The physical properties test shall be conducted on unaged packings as specified herein. Variations from the values contained in the qualification approval report shall not exceed those specified in table II.

3.5.2 Low-temperature resilience: The packing shall be subjected to and shall withstand the low-temperature resilience test specified in 4.7.1.

3.5.3 Fuel resistance, aging, and interrupted service: The packing shall be subjected to and shall withstand the fuel resistance, aging, and interrupted services test as specified in 4.7.2.

3.5.4 Cycling endurance: The packing shall be tested to the cycling endurance test as specified in 4.7.3. At the conclusion of this test, no evidence of fluid leakage shall occur.

3.5.5 Physical properties: The physical properties tests shall be conducted on packing rings and compression set plugs as specified herein and recorded on the qualification test report. Variations shall not exceed those specified in table II.

3.5.6 Corrosion and adhesion: The packing shall not adhere nor show any evidence of pitting, erosion, or corrosion when removed from between the spacer plates at the conclusion of the corrosion and adhesion test specified in 4.7.4.7.

3.6 Identification of product:

Each packing shall be sealed in an individual envelope and the packing will lose its identity when removed from the individual envelope. There shall be no color dots or dashes on the packing for identification. Larger size packings may be coiled into loops in order to reduce the size of the envelope.

3.7 Workmanship:

Manufacturing practices shall be such that the physical properties of the finished packings shall be uniform throughout the cross section of the packing, uniform in quality and condition, clean, smooth, and free from foreign materials or defects detrimental to their performance.

3.7.1 Molding: The method of preparing the uncured stock for loading into the mold and the molding process and mold design shall be such that the finished packings will not fail in service due to unbonded sections or weak sections caused by internal mold seams, cold shuts, foreign inclusions, or other detrimental characteristics causing localized failures. If a splicing operation is used in the preparation of the packings, the resultant bond shall be no weaker than the minimum tensile strength as specified in table II.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any other commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests:

The inspection and testing of packings shall be classified as follows:

(a) Qualification tests (4.3)
(b) Quality conformance tests (4.4)

4.3 Qualification tests:

4.3.1 Test samples: Qualification test samples shall consist of those specified below. Samples shall be identified in individual envelopes as specified in 3.6 and any additional information required by the letter of authorization.

3 MS29513-110-Packings
3 MS29513-222-Packings
6 MS29513-325-Packings
5 MS29513-214-Packings
9 MS29513-218-Packings
2 Compression set plugs (0.25 inch thick and 1.00 inch diameter)

4.3.1.1 Test report, test samples, and test data. The following shall be furnished to the activity responsible for qualification:

(a) Test report: Three copies of a test report prepared in accordance with MIL-STD-831. The report shall contain a tabulation of the physical property values obtained during qualification tests. The report shall contain a complete set of photographs showing the packing as mounted for each test and showing details of any failures encountered. Diagrams of test setups shall be provided when not self-explanatory by the photographs.
(b) Test items: The O-rings used in the tests and one unused O-ring of each size used for testing. The metallic plates specified in 4.7.4.7.

4.3.2 Tests: The qualification tests shall consist of the following tests as described under 4.6 and 4.7. Tests shall be conducted in the order specified.

(a) Examination of product	(4.6.1)
(b) Low-temperature resilience	(4.7.1)
(c) Fuel resistance, aging, and interrupted service	(4.7.2)
(d) Cycling endurance	(4.7.3)
(e) Physical properties	(4.7.4 to 4.7.4.7.1 inclusive)

4.4 Quality conformance tests:

Quality conformance tests shall consist of the following tests.

(a) Batch	(4.4.1)
(b) Finished product	(4.4.2)
(c) Process control	(4.4.3)
(d) Examination of product	(4.6.1)

4.4.1 Batch tests: Batch tests shall consist of the following:

(a) Hardness	(4.7.4.4)
(b) Specific gravity	(4.7.4.2)
(c) Tensile stress at 100 percent elongation	(4.7.4.1.1)
(d) Tensile strength	(4.7.4.1.2)
(e) Ultimate elongation	(4.7.4.1.3)

A batch shall consist of the quantity of material compounded at any one time, and ready for molding and curing into the finished product. Acceptance of the batch shall in no case be construed as a guarantee of the acceptance of the finished product.

4.4.1.1 Test specimens: Test specimens shall be molded from each batch and finished with the same state of cure as the finished product. Test specimens shall consist of the following:

(a) One compression set plug (0.25 inch thick and 1.00 inch diameter)
(b) Three MS29513-218 packings

4.4.1.2 Rejection and retest: Failure of any of the batch test specimens to conform to the requirements of this specification shall be cause for rejection of the batch represented.

4.4.2 Finished product tests: The following tests shall be performed on unaged specimens:

(a) Tensile stress at 100 percent elongation	(4.7.4.1.7)
(b) Tensile strength	(4.7.4.1.2)
(c) Ultimate elongation	(4.7.4.1.3)
(d) Specific gravity	(4.7.4.2)

4.4.2.1 Test specimens: Three MS29513-218 O-ring packings and three MS29513-325 O-ring packings shall be selected at random from each day's production or shall be molded and cured concurrently with other production parts, using the same production techniques. In the event of more than one work shift per a 24-hour day, the six samples required shall be comprised of O-rings selected on an equal basis from the production of each work shift. All test specimens shall be furnished by the manufacturer.

4.4.2.2 Rejection and retest: Failure of any of the test specimens to conform to the acceptance requirements of this specification shall require a retest of an additional set of test specimens. In the event of failure of any of the retested specimens, the day's production of the finished product, represented by the specimens, shall be rejected. No further O-rings shall be accepted until the reason for failure has been determined and corrective action taken and verified by reconducting the complete series of finished product tests (4.4.2).

4.4.3 Process control tests: Tests shall be conducted, as follows, at 6-month intervals, on unaged specimens noted in 4.4.3.1:

(a) Volumetric change	(4.7.4.3)
(b) Compression set	(4.7.4.5)
(c) Corrosion and adhesion	(4.7.4.7)
(d) Temperature retraction	(4.7.4.6)

4.4.3.1 Test specimens: Test specimens shall be selected at random from production lots or shall be molded and cured concurrently with other production parts, using the same production techniques. Test specimens shall consist of the following:

6 Each of MS29513-325
2 Compression set plugs (0.25 inch thick and 1.00 inch diameter)
5 Each of MS29513-214
3 Each of MS29513-110
3 Each of MS 29513-222
4 Each of MS29513-218

4.4.3.2 Rejection and retest: Failure of any of the test specimens to conform to the process control requirements of this specification shall require a retest of 2 additional sets of test specimens. In the event of failure of any of the retested specimens, all production items shall be rejected. No further O-rings shall be accepted until the reason for failure has been determined and corrective action taken and verified by reconducting the complete series of process control tests (4.4.3).

4.5 Test conditions:

4.5.1 Material:

4.5.1.1 Test fluid: Test fluid conforming to TT-S-735, type I or type III, as applicable, shall be used in the following tests:

(a) Low-temperature resilience	(4.7.1)
(b) Fuel resistance, aging, and interrupted service	(4.7.2)
(c) Cycling endurance	(4.7.3)

4.5.2 Test equipment:

4.5.2.1 Packing test jig: Three test jigs, in accordance with (a) on figure 1 (except that the axis of the stem groove shall be made eccentric to the axis of the stem by 0.0005 inch) shall be used in each of the following tests:

(a) Low-temperature resilience	(4.7.1)
(b) Fuel resistance, aging, and interrupted service	(4.7.2)
(c) Cycling endurance	(4.7.3)

4.5.2.1.1 Lubrication: Prior to assembly into the test jigs, the packing shall be lubricated with type I test fluid conforming to TT-S-735.

4.5.3 Standard temperature: Unless otherwise specified, tests shall be performed at a temperature of 80° ± 9° F (26.8 ± 5° C).

4.6 Examinations:

4.6.1 Examination of product: Each packing shall be carefully examined in accordance with MIL-STD-413 to determine conformance with the applicable MS standards, finish, and workmanship.

4.6.2 Preservation, packaging, packing, and marking: Preparation for delivery shall be inspected for conformance to section 5.

4.7 Test methods:

4.7.1 Low-temperature resilience: The test jigs shall be connected into a fuel circulating system. This complete system shall then be placed into a cold chamber and the temperature reduced from room temperature to -65° ± 2° F (-54° ± 1° C) in not less than 4 hours nor more than 6 hours. Beginning at -5° F (-20° C) and at each 10° F (5° C) drop thereafter, the stem of each test jig shall be rotated through 360 degrees 24 times at 8-10 revolutions per minute (rpm). Test fluid conforming to TT-S-735, type I, shall be circulated through the system at 15 pounds per square inch (psi) for 5 minutes at the beginning of the test and immediately before and during each 24 revolutions of the test jig stems. The pressure shall be maintained throughout the test at 15 psi by means of air pressure through an accumulator and the test fluid shall always be in contact with the packings. After a temperature of -65° F (-54° C) has been reached, this temperature shall be maintained continuously for 70 hours. At the end of the first 2 hours, and again at the end of the 70 hours, the stems of the test jigs shall be rotated 24 times. Any sign of leakage during this test shall be cause for rejection.

4.7.1.1 Abbreviated low-temperature resilience: In subsequent parts of the test, when the low-temperature resilience test is repeated, the 70-hour period at -65° F (-54° C) shall be omitted. This will be referred to as the abbreviated low-temperature resilience test. The temperature for the test shall be the measured fluid temperature, not the cold chamber temperature.

4.7.2 Fuel resistance, aging, and interrupted service: Upon completion of the test specified in 4.7.1, the packing shall be removed from the test jigs and allowed to swell in the test fluid conforming to TT-S-735, type III, for 4 days 158° ± 2° F (70° ± 1° C). The packing shall then be dried for 4 hours at 158° ± 2° F (70° ± 1° C) and reassembled in the test jigs. The test jigs shall then be placed in a Geer-type oven for a period of 7 days with the oven temperature at 158° ± 2° F (70° ± 1° C). After the 7-day period at 158° ± 2° F (70° ± 1° C), the type I test fluid shall be circulated through the test jigs for 48 hours at room temperature. This shall be followed by the test specified in 4.7.1.1. Any sign of leakage during this test shall be cause for rejection.

4.7.3 Cycling endurance: Upon completion of the test specified in 4.7.2, test fluid conforming to TT-S-735, type III, shall be circulated through the test jigs at room temperature and at 15 psi pressure. During this period, the test jig stems shall be rotated 5,000 revolutions at 8 to 10 rpm. Upon completion of this cycle, a second cycle of 5,000 revolutions shall be conducted using test fluid conforming to TT-S-735, type I test fluid. At the end of the second cycle, the test specified in 4.7.1.1 shall be performed. Any sign of leakage during this test shall be cause for rejection.

4.7.4 Physical properties: Unless otherwise specified, the physical properties shall be determined as specified in Federal Test Method Standard No. 601.

4.7.4.1 Elongation tests: Elongation tests shall be conducted in the order listed, using the same three test samples conforming to MS29513-218, for each test.

4.7.4.1.1 Tensile stress at 100 percent elongation: The stress shall be determined in pounds per unit area at 100 percent elongation in accordance with Federal Test Method Standard No. 601, Method 4131, using three test specimens.

4.7.4.1.2 Tensile strength: The tensile strength shall be determined in accordance with Federal Test Method Standard No. 601, Method 4111, using the same three specimens used in 4.7.4.1.1.

4.7.4.1.3 Ultimate elongation: The ultimate elongation shall be determined in accordance with Federal Test Method Standard No. 601, Method 4121, using the same three specimens used in 4.7.4.1.1 and 4.7.4.1.2.

4.7.4.2 Specific gravity: The specific gravity shall be determined in accordance with Federal Test Method Standard No. 601, Method 14011. For qualification, six samples conforming to Part No. MS29513-325 shall be divided into two sets of three each. The specific gravity of each sample shall be calculated and the average volume recorded (see table I). For finished product test, three MS29513-325 packings shall be used. For batch tests, the compression set plug specified in 4.4.1.1 shall be used.

4.7.4.3 Volumetric change: The two sets of samples used in 4.7.4.2 shall be subjected to fluid aging as follows:

(a) One set of three shall be immersed in test fluid conforming to TT-S-735, type I.
(b) The second set of three shall be immersed in test fluid conforming to TT-S-735, type III.

The immersion period for both sets shall be 72 hours at a fluid temperature 70° to 80° F (21° to 26.8° C). The ratio of the fluid to the rubber shall be 40 milliliters of test fluid to 1 gram of rubber. Immediately upon completion of the fluid aging period, the change of volume of each sample shall be determined in accordance with Federal Test Method Standard No. 601, Method 6211, and the average change in volume recorded (see table I).

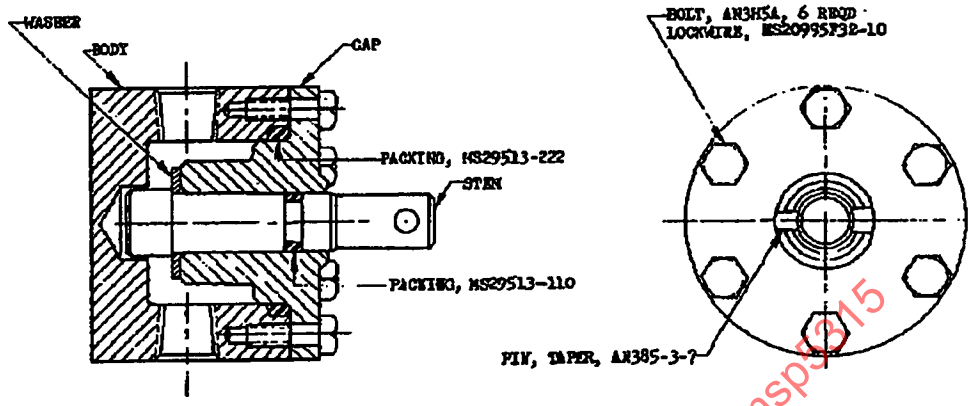
4.7.4.4 Shore "A" hardness: Shore "A" durometer hardness shall be determined and recorded (see table I) on two ASTM compression set plugs in accordance with Federal Test Method Standard No. 601, Method 3021. The plugs shall be of the same compound and equivalent cure as the sample O-rings being tested. Only one compression set plug is required for batch tests as specified in 4.4.1. The results of a minimum of four readings, one of which is centered, shall be averaged.

4.7.4.5 Compression set: The compression set shall be determined in accordance with Federal Test Method Standard No. 601, Method 3311, except that the specimens shall be aged for 70 hours at 158° ± 2° F (70° ± 1° C). The same compression set plugs used in 4.7.4.4 shall be used for this test.

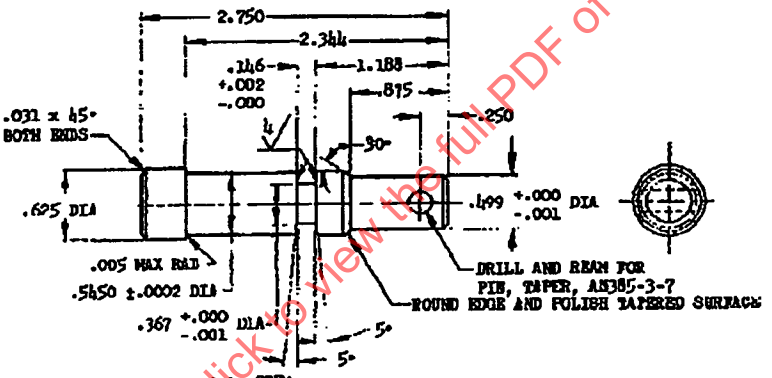
4.7.4.6 Temperature retraction: The temperate retraction test on the unaged packings shall be in accordance with ASTM D1329-60, except that MS29513-218 packing samples shall be used and four or six samples may be tested. The rate of warming shall be 1° F (.56° C) per minute. The temperature retraction 50/10 reading of these unaged packings shall be determined and recorded. A suggested temperature retraction apparatus is shown on figure 2.

4.7.4.7 Corrosion and adhesion: Five samples conforming to MS29513-214 O-ring packings shall be prepared for testing by inserting sufficient quantities of the packing in a desiccator or similar humidity chamber maintained at 95-percent minimum relative humidity and standard temperature for 72 hours minimum. Metallic plates of the metals listed below shall be polished to a surface finish of 5 to 15 microinch roughness height rating. The edge shall also be polished to reduce the formation of edge corrosion. Plates shall be washed with precipitation naphtha, or similar degreasing agent. The metals used shall be as follows:

Aluminum alloy (2024)	QQ-A-250/4
Brass	QQ-B-613
Bronze	QQ-B-750
Steel	MIL-S-18729
Magnesium	QQ-M-44

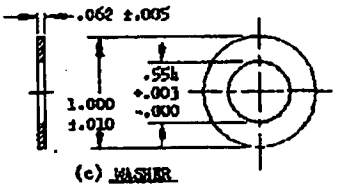


(a) PACKING TEST JIG



(b) STEM

MATERIAL: STEEL, BAR, MIL-S-7720, COMP 303, CONDITION A.
FINISH 63 ALL OVER, MIL-STD-10, GRIND OPTIONAL.
REMOVE BURRS AND BREAK SHARP EDGES .016 MAX.
DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: DECIMALS ±.010, ANGLES ±2°.



(c) WASHER

MATERIAL: STEEL, SHEET, MIL-S-5059.
FINISH 63 ALL OVER, MIL-STD-10.
REMOVE BURRS.
DIMENSIONS IN INCHES.

FIGURE 1 (sheet 1). Packing test jig assembly and details.