

INCH-POUND

MMM-A-132B

1 April 1994

SUPERSEDING

MMM-A-132A

24 AUGUST 1981

FEDERAL SPECIFICATION

ADHESIVES, HEAT RESISTANT, AIRFRAME STRUCTURAL,
METAL TO METAL

This specification has been approved by the Commissioner, Federal Supply Service, General Services Administration for use by all Federal agencies.

* 1. SCOPE

1.1 Scope. This specification covers the requirements for heat resistant adhesives for use in bonding primary and secondary structural and external metallic airframe parts which will be exposed to temperatures within the range of -67° to 500°F (-55° to 260°C) (see 1.2 and 6.1).

1.2 Classification. Adhesives shall be of the following types, classes, forms, and cure groups as specified (see 6.2b).

1.2.1 Types.

- | | | |
|---------|---|---|
| Type I | - | For long-time exposure to temperatures from -67° to 180°F (-55° to 82°C).
(Available in classes, see 1.2.2.) |
| Type II | - | For long-time exposure to temperatures from -67° to 300°F (-55° to 149°C). |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division Lakehurst, Code SR3, Highway 547, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8040.

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MMM-A-132B

- | | | |
|----------|---|--|
| Type III | - | For long-time exposure to temperatures from -67° to 300°F (-55° to 149°C) and short-time exposures to temperatures from 300° to 500°F (149° to 260°C). |
| Type IV | - | For long-time exposure to temperatures from -67° to 500°F (-55 to 260°C). |

1.2.2 Classes. Type I adhesive shall be furnished in one of the following classes:

- | | | |
|---------|---|--------------------------------------|
| Class 1 | - | High T-peel and blister detection. |
| Class 2 | - | Normal T-peel and blister detection. |
| Class 3 | - | No T-peel and no blister detection. |

1.2.3 Forms.

- | | | |
|--------|---|----------------|
| Form F | - | Film |
| Form P | - | Paste (liquid) |

1.2.4 Cure temperature groups.

- | | | |
|---------|---|---------------------------------------|
| Group 1 | - | Cure temperatures 100°F or less |
| Group 2 | - | Cure temperatures over 100°F to 200°F |
| Group 3 | - | Cure temperatures over 200°F to 300°F |
| Group 4 | - | Cure temperatures over 300°F |

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2c).

SPECIFICATIONS

FEDERAL

- | | | |
|------------|---|--------------------------------------|
| QQ-A-250/4 | - | Aluminum Alloy 2024, Plate and Sheet |
|------------|---|--------------------------------------|

MMM-A-132B

PPP-B-566	-	Boxes, Folding, Paperboard
PPP-B-601	-	Boxes, Wood, Cleated-Plywood
PPP-B-636	-	Boxes, Shipping, Fiberboard
PPP-B-676	-	Boxes, Setup
PPP-C-96	-	Cans, Metal, 28 Gage and Lighter

MILITARY

MIL-T-5624	-	Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST
MIL-T-9046	-	Titanium and Titanium Alloy, Sheet, Strip and Plate
MIL-B-22191	-	Barrier Materials, Transparent, Flexible, Heat Sealable
MIL-S-25043	-	Steel Plate, Sheet, and Strip, 17-7 Ph, Corrosion Resistant, Precipitation Hardening
MIL-H-83282	-	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537

STANDARDS

FEDERAL

FED-STD-123	-	Marking for Shipment (Civil Agencies)
FED-STD-313	-	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	-	Marking for Shipment and Storage

* (Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from: DODSSP - Customer Service, the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

MMM-A-132B

* 2.1.2 Other government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

CODE OF FEDERAL REGULATIONS

Title 49 CFR - Transportation

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20370.)

* 2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2c).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay)

(Application for copies should be addressed to the American Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D3166 - Standard Specification for Fatigue Properties of Adhesives in Shear by Tension Loading (Metal/Metal) -

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

* AMERICAN TRUCKING ASSOCIATION

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Association, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

MMM-A-132B

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The adhesives furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.3). In addition, the retention of the qualification for adhesives on the applicable qualified products lists shall be dependent on periodic verification of continued compliance with the requirements of this specification (see 4.3.3).

3.2 Materials.

3.2.1 Formulation. The adhesives shall be thermosetting. There shall be no restrictions on the chemical structure of the adhesives.

3.2.2 Curing agents. Curing agents shall be supplied for mixing with the adhesive or shall be incorporated into the adhesive.

3.2.3 Solvent. When a solvent is required for the adhesive, it shall be furnished as part of the adhesive system by the manufacturer and its function shall be identified on the label.

3.2.4 Filler. A filler may be incorporated into the adhesive. Any such filler shall be considered as a part of the adhesive system and shall remain uniformly dispersed and suspended in the mixed adhesive during its normal pot life. The filler shall be readily dispersible throughout the adhesive during its entire usable storage life. The filler shall be highly moisture and corrosion-resistant and shall withstand the maximum temperatures stated for the adhesive.

3.2.5 Forms (see 1.2.3).

MMM-A-132B

3.2.5.1 Form F (film). Film adhesives shall consist either entirely of adhesive or adhesive with a carrier. The film thickness (in mils) and corresponding weight (in pounds per square foot to the nearest 0.001 pound) shall be stated. Film adhesives of a given type and composition manufactured in more than one weight range shall be separately tested. However, films of the same type and composition within those weights shall be considered for acceptance.

3.2.5.2 Form P (paste). Adhesives in paste form shall mix readily to a smooth solution or suspension of consistency suitable for application and shall be free of lumps. The components shall not settle out or separate during a normal working day.

3.2.6 Primer. Primers may be furnished with the adhesive. The manufacturer shall specify the primer to be used. The primer shall be identified on the Qualified Products List along with the adhesive and shall become an integral part of that adhesive system.

3.2.7 Formulation changes. An adhesive shall be approved only for the formulation on which qualification tests are made. Approval of an adhesive as a type II, III, or IV adhesive does not convey automatic approval of same as an adhesive of lower type number nor does approval of a given form of adhesive within a given type convey automatic approval of another form of the same type even though the two forms may be the same basic chemical composition. Film adhesives of a given basic chemical composition and type, but with different fillers or carriers, shall be considered as different forms of that adhesive and shall require specific and separate qualification approval. Any changes by the manufacturer, such the adding of materials, pigments, hardeners, carriers, dyes, and fillers, or changing the type or form of the adhesive or the method of manufacture or changing the mixing application (including metal treatment) or curing procedures, or any other change, shall be cause for designating the adhesive as a new product which shall not be considered approved and which shall require specific and separate qualification testing and approval. The changed adhesive shall be given a new code number and shall be resubmitted for approval under this specification.

3.3 Working characteristics.

3.3.1 Application. The adhesives shall be capable of being readily applied to treated surfaces of the metals (see 6.1) in accordance with the manufacturer's instructions (see 3.5). However, the adhesive system shall be capable of being used at temperatures between 60° and 100°F (16° and 38°C), and at relative humidities up to 75 percent.

3.3.2 Pot life. The minimum pot life of the mixed adhesive, ready and usable for bonding, shall be of practical length for production fabrication applications.

MMM-A-132B

3.3.3 Curing conditions. Unless otherwise specified by the acquisition activity, the curing time, temperature, and pressure shall be within the limitations specified herein.

3.3.3.1 Curing times and temperatures. Maximum time to fully cured state for the cure temperature groups in 1.2.4 shall be as follows:

- Group 1 - 7 days @ 100°F or less
- Group 2 - 24 hours @ over 100°F to 200°F
- Group 3 - 2 hours @ over 200°F to 300°F
- Group 4 - 2 hours @ over 300°F

Additionally, types I and II adhesives shall require not longer than 2 hours for curing at temperatures not exceeding 350°F (177°C) at the adhesive line. Types III and IV shall cure/post cure at temperatures not to exceed 600°F (316°C) at the adhesive line.

3.3.3.2 Curing pressure. The pressure required for curing the bonded test panels described in this specification shall not exceed 100 pounds per square inch (psi) (see 6.1).

3.3.3.3 Post-curing. Post curing (curing beyond the regular time-temperature-pressure cycle at a reduced temperature or pressure or both) is not desirable but will be acceptable for types III and IV adhesives which attain all the respective minimum strength requirements of this specification only through such post-curing.

* 3.3.4 Storage life. The adhesive manufacturer shall determine the longest period of time from date of manufacture, and the optimum temperature at which the adhesive system, when stored in airtight containers or wrapped in suitable vapor barrier material, will retain the applicable minimum strength requirements in table I. Both temperature and time shall be reported (see 4.3.2.1). The maximum time the adhesive, packaged as specified above, will retain such capabilities when stored at 75° ± 2°F (24° ± 1.1°C) shall also be determined and reported.

3.4 Mechanical properties. Mechanical properties of test specimens prepared and tested as specified in section 4 shall conform to the respective requirements listed in table I.

* 3.5 Instruction sheet. When specified (see 6.2d), the manufacturer shall provide a dated and titled instruction sheet with each shipment of adhesive (see 5.3) outlining instructions for its use on aluminum, titanium, and corrosion-resistant alloys (see 6.1). The instruction sheet shall include the following information:

- a. The general chemical type of the base material used in the adhesive system. Identification of the film carrier (supported). Identification of, and instructions for use, of each segment of a multiple part adhesive system.

MMM-A-132B

- b. Complete procedures for preparation of all metal surfaces prior to bonding with the adhesive.
- c. Complete mixing instructions for the adhesive.
- d. Application procedures including rate of spread or thickness of film, number of coats, drying time and conditions between coats.
- e. Maximum allowable open or closed assembly time and temperature humidity controls and protective measures necessary during storage for adhesive-coated metal, prior to, and after assembly.
- f. Typical time, temperature, and pressure for each segment of the complete curing cycle giving maximum and minimum limits for each condition.
- g. Manufacturer's recommended storage life.

* 3.5.1 Material safety data sheets. When specified by the acquisition activity (see 6.2e), a Material Safety Data Sheet shall be submitted in accordance with FED-STD-313. (See 6.2d)

3.6 Workmanship. Adhesives shall be free of contaminants and shall be prepared in accordance with the best commercial practices for this material. Film adhesives shall be substantially free of folds, foreign matter, wrinkles, and shall have not more than two holes of 1/8-inch maximum diameter per square inch which penetrate through the film.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

* 4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements 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 submission of known

MMM-A-132B

defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall consist of all the inspections and test procedures specified in this specification.

4.3.1 Qualification sample and specimens. The qualification sample shall consist of the test specimens from 4.3.4 prepared from 2 quarts of paste or two, 5 square feet sections of film adhesive for each type or class. The adhesive shall be packaged as specified in section 5 of this specification. Included as part of the samples shall be the required amounts of thinner, curing agent, and primer to give a complete adhesive system. All test specimens and the adhesive shall be forwarded to the Qualifying Laboratory: Commanding Officer, Naval Air Warfare Center Aircraft Division Warminster, ACSTD (Code 6062), P.O. Box 5152, Warminster, PA 18974-5091. The samples (adhesive containers and test panels) shall be plainly and durably marked with the following information.

SAMPLE (PANEL OR ADHESIVE) FOR QUALIFICATION TESTING

ADHESIVE, HEAT RESISTANT, AIRFRAME STRUCTURAL, METAL TO METAL

Name and address of manufacturer.
 Plant address and date adhesive was produced.
 Manufacturer's part number and identification.
 Batch number of adhesive.
 Submitted by (name) for qualification in accordance with the
 * requirements of MMM-A-132B under authorization (reference
 authorizing letter) (see 6 3).

4.3.2 Manufacturer's data.

* 4.3.2.1 Test reports. Two copies of the manufacturer's certified test report shall be forwarded with the qualification sample. The report shall include the information required by 3.3.4, and show, by actual test results and specific paragraph references, the adhesive submitted conforms to all the requirements of this specification.

4.3.2.2 Instructions for use. The manufacturer shall submit two copies of the instruction sheet specified in 3.5.

MMM-A-132B

4.3.3 Retention of qualification. In order to retain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that his product complies with the requirements of this specification. The time of periodic verification by certification shall be in two year intervals from the date of original qualification and shall be initiated by the Government. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

4.3.4 Preparation of test panels. Panels as shown in figures 1 through 4 shall be prepared in sufficient quantities, from a given type of adhesive, to furnish the necessary number of specimens for all the tests applicable to that particular type of adhesive listed in table I. Panels for testing types I and II adhesives for all applicable table I properties shall be prepared from 0.063 inch aluminum sheet conforming to QQ-A-250/4, except 0.020 inch for T-peel. Panels for testing types III and IV adhesives for all applicable table I properties shall be prepared from 0.050 inch 6Al-4V titanium alloy in the duplex annealed condition conforming to MIL-T-9046, or 0.050 inch 17-7 PH corrosion resisting steel, condition TH-1050, conforming to MIL-S-25043 with finish for both metals equivalent to No.2 dull of type 301 corrosion resisting steel. The metal specimens shall be made either in the form of complete lap joint panels (see Figure 1) or pre-punched panels of the general type shown on Figure 2 to eliminate sawing of the specimens after bonding (see 4.3.4.1 and 6.6).

4.3.4.1 Metal finishing. All edges of the metal panels and specimens which will be within (or which will bound) the joints shall be machined true (without burrs or bevels and at right angles to faces) and smooth (RHR 140 maximum, in accordance with ANSI B46.1-85) before the panels are surface treated and bonded. The metal treating and bonding procedures employed shall be in accordance with the adhesive manufacturer's instruction sheet. All test panels shown on Figure 1 shall have an overlap of 0.500 ± 0.010 inch except that fatigue strength panels shall be 0.375 ± 0.010 inch. Panels so prepared shall be cut into 1 inch wide specimens for testing in accordance with the provisions of applicable tests. Panels shall not be cut into specimens until at least 24 hours after bonding. Aluminum alloy panels may be sawed with a bandsaw, with the setting and spacing of teeth and operational speed adjusted to hold frictional heating of the bond to a minimum. Titanium alloy and corrosion resistant steel panels (see figure 1) may be cut with a watercooled abrasive wheel, bandsaw, or a staggered-tooth milling tool with suitable cutting fluid at such operational speed as will hold frictional heating of the bond to a minimum (see 6.6). All panels and specimens shall be so marked that each specimen can be identified at any time with the particular panel from which it was cut and with the particular batch of adhesive with which it was bonded so that any failure may be properly traced to either the adhesive or the mechanics or equipment of bonding.

4.3.5 Number of specimens required for qualification.

MMM-A-132B

4.3.5.1 Tensile shear and creep rupture specimens (tests nos. 1 through 9). A sufficient number of test panels (see Figure 1 or 2) shall be prepared to yield, when sawed, the following number of tensile shear and creep rupture specimens:

<u>Type</u>	<u>No. of specimens</u>
I (all classes)	48
II	54
III	60
IV	66

4.3.5.2 T-peel specimens (test no. 10). T-peel testing is for type I, classes 1 and 2 only. Six specimens, for each class, shall be prepared from panels as shown on Figure 3.

4.3.5.3 Blister detection specimens (test no. 11). Blister detection shall be determined on type I, classes 1 and 2 only. Ten specimens, for each class, shall be cut from panels prepared as shown on Figure 4. The edges of the specimens shall be machined smooth.

4.3.5.4 Fatigue strength specimens (test 12). Two panels prepared as shown on Figure 1 for fatigue strength shall be cut to yield seven 1 ± 0.010 inch wide test specimens. Two specimens from each panel (one from the center and one from one end) shall be designated controls. These specimens shall be subjected to the normal temperature shear test (4.6.1). The remaining specimens shall be fatigue tested (4.6.7).

4.3.5.5 Creep rupture specimens (tests 13 through 16). Twelve tensile shear specimens from 4.3.5.1 shall be prepared for creep rupture as shown on Figure 6. The prepared specimens shall be tested as specified in 4.6.8.

4.3.5.6 Specimen identification. Each test panel prepared shall be numbered and each specimen from the test panel shall be further identified to permit rapid discernment of failure patterns which may be a result of a poor bond or other mechanical equipment failure.

4.4 Quality conformance.

* 4.4.1 Lot formation. A lot shall consist of all the adhesive of one type (and class, when applicable) or an equivalent dimension of film, manufactured at one time in one batch (see 6.5.2), forming part of one contract or order, and submitted for inspection at the same time and place.

4.4.2 Sampling.

4.4.2.1 For physical property tests. A single sample of not less than 2 pints of paste adhesive or an amount of film sufficient for all testing shall be taken at random from each lot and tested to the requirements in 4.4.3.1.

MMM-A-132B

Additional samples may be taken if considered necessary to determine conformance of the product to this specification.

4.4.2.2 Packaging. Samples for packaging inspection shall be selected in accordance with Inspection Level S-2 of MIL-STD-105. Sample unit shall one shipping container. Examination shall be as specified in 4.4.3.2.

4.4.3 Quality conformance tests and examinations.

* 4.4.3.1 Physical property tests. The sample selected in 4.4.2.1 shall be tested for normal tensile shear and elevated temperature tensile shear strengths. Two panels for each test shall be prepared as shown on Figure 1, except that a 6 inch width may be used if desired; or Figure 2 configured panels may be used. All available specimens from the panels shall be tested. Failure of any specimen to meet or exceed the minimum requirements specified in table I shall be cause to reject the lot represented by the specimen.

4.4.3.2 Packaging inspection. Samples selected in accordance with 4.4.2.2 shall be visually examined to all the requirements in section 5 of this specification. The acceptable quality level (AQL) for this inspection shall be 2.5 percent defective. In addition, shipping containers fully prepared for delivery shall be inspected for closure defects.

4.5 Test conditions.

4.5.1 Normal (room temperature) conditions. Strength properties shall be determined for types I, II, III, and IV adhesives at $75^{\circ} \pm 5^{\circ}\text{F}$ ($24^{\circ} \pm 2.8^{\circ}\text{C}$), not less than 10 minutes after specimens have reached equilibrium at such temperature. If the validity of property values determined within this range is in question, the test shall be repeated under standard conditions of $73.4^{\circ} \pm 2^{\circ}\text{F}$ ($23^{\circ} \pm 1^{\circ}\text{C}$) and 50 ± 4 percent relative humidity. Specimens shall then be tested only after being exposed for 4 days to this temperature and humidity.

4.5.2 Elevated temperature conditions. Strength properties of type I adhesives shall be determined at $180^{\circ} \pm 5^{\circ}\text{F}$ ($82^{\circ} \pm 2.8^{\circ}\text{C}$), dry heat; those of types II, III, and IV adhesives shall be determined at $300 \pm 5^{\circ}\text{F}$ ($149^{\circ} \pm 2.8^{\circ}\text{C}$), dry heat; and those of types III and IV shall be determined at $500^{\circ} \pm 5^{\circ}\text{F}$ ($260^{\circ} \pm 2.8^{\circ}\text{C}$), dry heat; no sooner than 10 minutes after the specimens have reached equilibrium at those respective temperatures. No less than 3 minutes nor more than 10 minutes shall be required to bring the bonded area of the test specimen to the required temperature after the specimen has been placed in the conditioning chamber. Strength properties of types II, III, and IV adhesives shall be determined at $300^{\circ} \pm 5^{\circ}\text{F}$ ($149^{\circ} \pm 2.8^{\circ}\text{C}$), dry heat; and those of type IV adhesives shall be determined at $500^{\circ} \pm 5^{\circ}\text{F}$ ($260^{\circ} \pm 2.8^{\circ}\text{C}$); 192 hours after the specimens for these long-time elevated temperature strength tests (tests nos. 4 and 5 of table I) have reached equilibrium at those respective temperatures. The specimens for the long-time elevated temperature tests may be placed in circulating air ovens for the 192 hour period, after which they shall be transferred to the preheated unit of the

MMM-A-132B

testing machine. Specimens should not be subjected to thermal shock while being transferred between test ovens. The final testing temperatures of all elevated temperature test specimens shall be of the surface of the metal in the approximate center of the bonded area and shall be determined with a thermocouple attached to the specimen in order to insure accuracy of testing temperature and reproducibility of data. The junction of the thermocouple shall be firmly attached to the specimen in immediate contact with the metal in the position shown on Figure 5. A prototype specimen, located as near to the test specimen as is practicable, may be used as an alternate method to establish specimen temperature. In this alternate method, thermocouples shall be bonded in the joint in the area shown on Figure 5, in both prototype specimen and a specimen located in normal test position in the test fixture. Correlation between the two temperature readings shall then be determined as a guide for subsequent tests.

4.5.3 Low temperature conditions. Low temperature strength properties of all adhesives shall be determined at $-67^{\circ} \pm 5^{\circ}\text{F}$ ($-55^{\circ} \pm 2.8^{\circ}\text{C}$), no sooner than 10 minutes after the specimens have reached equilibrium at the temperature. The surface of the metal of the bonded area shall be $-67^{\circ} \pm 5^{\circ}\text{F}$ ($-55^{\circ} \pm 2.8^{\circ}\text{C}$) as determined with a thermocouple attached to the specimen. The junction of the thermocouple shall be firmly attached to the specimen in immediate contact with the metal in the position shown on Figure 5. The prototype specimen technique described in 4.5.2 may be used for these temperature measurements. No longer than 10 minutes shall be required to bring the bonded area to the required temperature after the specimen has been placed in the conditioning chamber.

4.5.4 High humidity condition. Resistance to humidity exposure shall be determined after 30 days \pm 12 hours exposure of the specimens in a humidity cabinet in which the exposure zone of the closed humidity chamber is maintained at $120^{\circ} \pm 5^{\circ}\text{F}$ ($49^{\circ} \pm 2.8^{\circ}\text{C}$) and 95 to 100 percent relative humidity. The temperature in the chamber shall be recorded at least twice each working day. Condensate from one specimen shall not drip upon any other panel. Distilled water or water containing not more than 200 parts per million of total solids shall be used to maintain the humidity. The test shall be continuous for the duration of the 30 day period. Continuous operation means that the chamber shall be closed and the humidity maintained continuously, except for the short daily interruptions necessary to inspect, rearrange, or remove test panels, or to check or replenish the water in the reservoir. The test specimens shall be individually suspended vertically in the atmosphere above the water and shall not contact the sides of the container or other test specimens.

4.5.5 Fluid immersion conditions. Six test specimens shall be immersed in hydraulic oil conforming MIL-H-83282 and six in turbine fuel conforming to JP-4 of MIL-T-5624 for 7 days \pm 2 hours. The fluid temperature shall be 70° to 80°F (21° to 27°C). All specimens shall be placed in the fluid container to assure full contact with the fluid while not contacting the other specimens.

MMM-A-132B

4.6 Test methods.

4.6.1 Normal temperature tensile shear test (test no 1 in table I). The test specimens shall be gripped tightly and uniformly across the ends in the jaws of the testing machine with the jaws and specimen so aligned that the jaws are directly opposite each other, and in such a position that an imaginary straight line will pass through the center of the bonded area and through the points of suspension. The specimen shall be gripped $2 \pm 1/4$ inch from each edge of the lap joint. The load shall be applied at a rate of 1,200 to 1,400 pounds per square inch per minute or at an equivalent head speed per minute until failure. The load at failure shall be recorded. The testing machine accuracy shall be within 1 percent. Length and width of shear area shall be measured and recorded to the nearest 0.01 inch. All failing loads shall be expressed in pounds per square inch of actual shear area (calculated to the nearest 0.01 square inch). The nature and percent of failure, such as cohesive failure (failure within the adhesive), adhesion failure (adhesive peeling from the metal), or contact failure (lack of complete adhesive-to-metal contact during bonding), and the adhesive thickness shall also be recorded for each specimen. Adhesive thickness shall be measured to the nearest 0.0001 inch with a 10X microscope or an equivalent measuring apparatus. Six specimens shall be tested. The average and minimum strengths of the specimens tested shall equal or exceed the minimum specified in table 1.

4.6.2 Elevated temperature tensile shear test (tests nos 2 through 6 in table I). The 180°F (82°C), 300°F (149°C), and 500°F (260°C) tensile shear tests shall be in accordance with 4.6.1 with the added requirement that an oven or furnace shall be provided to maintain the specimens at the specified test temperature (see 4.5.2). Six specimens shall be tested for tensile shear strength at each elevated temperature shear test listed in table I (tests nos. 2 through 6). The average and minimum shear strength of each set of specimens tested shall equal or exceed that specified in the applicable test of table I.

4.6.3 Low temperature tensile shear test (test no 7 in table I). The low temperature tensile shear test shall be in accordance with 4.6.1, with the added requirement that a chamber shall be provided for maintaining the specimen at $-67^{\circ} \pm 5^{\circ}\text{F}$ ($-55^{\circ} \pm 2.8^{\circ}\text{C}$) (see 4.5.3). Six specimens shall be tested for tensile shear strength at $-67^{\circ} \pm 5^{\circ}\text{F}$ ($-55 \pm 2.8^{\circ}\text{C}$). The average and minimum shear strength of these specimens shall equal or exceed that specified for test no 7 in table I.

4.6.4 Humidity and fluid exposure (tests nos 8 and 9 in table I). Six specimens from each exposure condition (see 4.5.4 and 4.5.5) shall be tested for tensile shear at normal temperature as specified in 4.6.1. Testing shall be conducted within 6 hours after removal from the exposure environment. Obtained minimum and average values shall meet or exceed those in table I for tests nos 8 and 9.

MMM-A-132B

4.6.5 Normal temperature T-peel (test no 10 in table I). The bent, unbonded ends of the test specimen shall be clamped in the test grips of the tensile test machine with the jaws and the specimen so aligned that the jaws are directly opposite each other, and in such a position that the center line of the unbonded area of the specimen passes through the points of suspension. The machine shall be equipped with grips capable of clamping the specimens firmly and without slippage throughout the test. The load shall be applied at a constant head speed of 3 inches per minute (this will cause separation of the bond at a rate of 1.5 inches per minute). An autographic recording of load versus head movement or load versus distance peeled shall be made during the peel test. The peel resistance shall be determined over at least a 5 inch length of bond line after the initial peak. T-peel strength is defined as the average load per unit width of bond line required to produce progressive separation of two laminated flexible adherends, under conditions designated in this test method. (The term flexible, as used here, indicates that the adherends shall have such dimensions and physical properties as to permit bending them through any angle up to 180° without breaking.) The machine and loading range shall be so selected that the maximum load on the specimen falls between 15 and 85 percent of the upper limit of the loading range. The machine shall be autographic, giving a chart that can be read in terms of having inches of separation as one coordinate and applied load as the other coordinate. Average, maximum, and minimum peeling load values for each individual specimen shall be recorded, as well as the average T-peel strength in pounds per inch of width. The width of peel area shall be measured to the nearest 0.001 inch. The nature and percent of failure, such as cohesive failure (failure within the adhesive), adhesion failure (adhesive peeling from the metal), or contact failure (lack to complete adhesive-to-metal contact during bonding), and the adhesive thickness shall also be recorded for each specimen. Adhesive thickness shall be measured in the same manner as for the tensile shear specimens (see 4.6.1). Six specimens shall be tested. The average and individual minimum values shall equal or exceed those specified for test no. 10 in table 1.

4.6.6 Blister detection, normal temperature tensile shear (test no. 11 in table I). Ten specimens from those prepared in 4.3.5.3 shall be subjected to the tensile shear at normal temperature (see 4.6.1). The average and individual minimum values for all specimens shall equal those specified in table I.

4.6.7 Fatigue test normal temperature (test no 12). Specimens prepared in 4.3.5.4 shall be tested in accordance with ASTM D 3166 and the following:

- a. Use testing machine to apply cyclic axial loads at a rate not to exceed 3600 cycles per minute.
- b. Measure adhesive thickness to the nearest 0.0001 inch using a 10X microscope or equivalent measuring device.
- c. Test each specimen with a 750 pound per square inch maximum alternating stress. If any of the specimens fail to conform to the one-million cycle requirement, the adhesive shall be rejected.

MMM-A-132B

Note: The number of cycles of testing to failure at the upper end of the range (10 million) may be reduced, in order to simplify the testing procedure, to 1 million cycles providing the applicable fatigue strength, as determined, conforms to test No 12 in table I.

4.6.8 Creep rupture and deformation (test nos 13 through 16).

4.6.8.1 Procedure. Shear specimens from 4.3.5.5 shall be tested in a deadweight loading test apparatus capable of applying loads accurately within ± 1 percent. The specimens shall be gripped or suspended by means of 0.250 inch diameter pins placed through the holes in each end of the specimen. Care must be exercised to avoid eccentricity in the loading of the adhesive joint. The entire assembly of specimen and loading mechanism must be checked for alignment prior to test. Long pull rods will facilitate obtaining proper alignment. Specimens shall remain loaded with a 1,600 psi stress for normal temperature and 800 psi stress for all elevated temperatures until rupture occurs or until the stress has been applied for 192 hours. The length and width of the shear area shall be measured to the nearest 0.01 inch and shall be recorded. The specimen bond areas shall be calculated to the nearest 0.01 square inch. Creep shall be measured during test in accordance with 4.6.8.2. The time to failure and the amount of creep of each specimen shall be recorded, as well as the nature and percent of joint failure, if any, and the adhesive film thickness. The type of failure shall be determined and the adhesive film thickness measured as specified in 4.6.7b. Twelve specimens of each type shall be tested. Six at normal temperature at 1600 psi stress and six at the appropriate elevated temperature at 800 psi stress. Elevated temperature testing shall be 180°F (82°C) for type I, 300°F (144°C) for type II and III, and 500°F (260°C) for type IV. The source of heat shall not influence the application of the stress and shall be capable of maintaining a $\pm 5^\circ\text{F}$ (2.8°C) tolerance with the test temperature.

4.6.8.2 Creep deformation evaluation. Total deformation (including that due to initial loading) shall be made while the specimen is under stress and at the test temperatures specified in 4.6.8.1. Care shall be taken that the temperature does not affect the accuracy of the deformation measurements. The deformation shall be measured to an accuracy of 0.0001 inch at such intervals of time that a smooth time deformation curve may be plotted. The exact time intervals will depend upon the adhesive being tested and the creep rate of the joint. The deformation may be measured directly by observing the displacement of fine scribe lines across both edges of the specimen near each end and at the center (Figure 5) of the lap joint, using a traveling comparator microscope capable of measuring displacement, as required, to the nearest 0.0001 inch or an equivalent measuring apparatus. The deformation of each specimen shall be determined by averaging the deformation measurements at the six prescribed points on the joint. If an extensometer is used, the gage length multiplied by a value equal to the stress in the metal, divided by modulus of the metal used (10.5 times 10^6 pounds per square inch for corrosion-resisting steel) shall be subtracted from all extensometer readings. The average total deformation of the 6 specimens at 192 hours shall be not greater than that specified in table I. All measurements shall be reported.

MMM-A-132B

* 5. PACKAGING

5.1 Packaging. Packaging shall be level A, B, or commercial, as specified (see 6.2f), and shall comply with performance oriented packaging requirements of Title 49 CFR.

5.1.1 Level A.5.1.1.1 Paste adhesives.

5.1.1.1.1 Unit Packaging. Paste adhesives shall be packaged in cans conforming to PPP-C-96, type V, class 2. Cans shall be the U.S standard pint, quart, or gallon size, as specified (see 6.2g). Closure of can shall be in accordance with appendix to PPP-C-96.

5.1.1.1.2 Intermediate packaging. Paste adhesives, packaged as specified in 5.1.1.1.1, shall be intermediate packaged in accordance with the appendix of PPP-C-96, with containers conforming to PPP-B-636, grade V3c, and shall be within the weight limitations specified for the container. Closure and waterproof sealing of the boxes shall be in accordance with the appendix to PPP-B-636.

5.1.1.2 Film adhesive.

5.1.1.2.1 Unit packaging. Film adhesive, in roll form of size as specified (see 6.2h), shall be wrapped in a suitable release paper, enclosed in vapor barrier material in accordance with MIL-B-22191, and individually packaged in boxes conforming to PPP-B-636, grade W6c or grade W6s or PPP-B-566, variety 4, style, type and class optional. Each box shall be waterproofed as specified for the weatherproofing of slotted boxes in accordance with the appendix of PPP-B-636. The film adhesive is to be supplied in rolls of specified width (inches), length (feet), thickness (mils) and weight (pounds per square foot) (see 6.2g and 6.2h).

5.1.1.2.2 Intermediate packaging. Twelve rolls of film adhesive, packaged as specified in 5.1.1.2.1, shall be intermediate packaged in boxes conforming to PPP-B-636, V3c.

5.1.1.3 Adhesive with curing agents or solvents.

5.1.1.3.1 Unit packaging. When two or more adhesive components are necessary as a unit, the components shall be packaged as a kit, in a box sealed and waterproofed as specified in 5.1.1.2.1.

5.1.1.3.2 Intermediate packaging. Components of kits, packaged as specified in 5.1.1.3.1, shall be intermediate packaged in quantities of 4, 6, or 12 kits, as specified in 5.1.1.2.2 (see 6.2i).

MMM-A-132B

5.1.2 Level B. Packaging for level B shall be as specified in 5.1.1, except that boxes conforming to PPP-B-676 may also be used, and the boxes conforming to PPP-B-636 shall be class domestic. Closure of the boxes shall be in accordance with the appendix to the applicable box specification.

5.1.3 Commercial. The adhesive, liquid or film, shall be packaged in accordance with normal commercial practice. When two adhesive components are necessary as a unit, the components shall be packaged as a kit in a single container. The complete package shall protect the adhesive against damage during shipment, handling, and storage.

5.2 Packing. Packing shall be level A, B, or commercial, as specified (see 6.2f).

5.2.1 Level A. Adhesives, intermediate packaged as specified in 5.1.1.1.2 or 5.1.1.2.2, shall be packed in boxes conforming to PPP-B-601, overseas type, style optional in quantities not to exceed the weight limitation of the container. Box closure and strapping shall be in accordance with the appendix to the box specification. Strapping shall be zinc coated.

5.2.2 Level B. Adhesive, intermediate packaged as specified in 5.1.1.1.2 or 5.1.1.2.2, shall be shipped directly in the intermediate container; no additional overpack is necessary. Boxes shall be strapped in accordance with requirements in the appendix to PPP-B-636.

5.2.3 Commercial. Adhesive, packaged as specified in 5.1, shall be packed to assure carrier acceptance and safe delivery to destination at lowest rating in conformance to requirements of Uniform Freight Classification or National Motor Freight Classification.

5.3 Marking.

* 5.3.1 Civil agencies. Interior and exterior containers shall be marked in accordance with FED-STD-123. Exterior containers shall be marked with date of manufacture of contents, by month and year (not by code), expiration date, and shall be marked with a note relative to storage, such as:

Store at temperatures less than _____°F (insert proper storage temperature relative to form). Film adhesive shall be expedited to cold storage.

5.3.2 Military agencies. Interior and exterior containers shall be marked in accordance with MIL-STD-129. Exterior containers shall be marked with date of contents, by month and year (not by code), expiration date, and shall also be marked with a note relative to storage, such as:

Store at temperature less than _____°F (insert proper storage temperature relative to adhesive form). Film adhesives shall be expedited to cold storage.

MMM-A-132B

5.3.3 Special marking. In addition to marking specified in 5.3.1 and 5.3.2 and the contract or purchase order, each multi-component kit (see 5.1.1) shall be marked with the net volume or net weight of the total adhesive content, and each component of the kit shall be marked to identify the component and show its net volume or weight, as applicable (see 5.1.1).

* 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Adhesives conforming to this specification are intended for use in bonding airframe structural components. However, fabricators are required by the procuring activity to obtain approval of the component and of a process specification applicable to the adhesive and component, prior to use of the adhesive on parts procured on contract. Fabrication and inspection must be made in accordance with the requirements of MIL-A-83377. Types I and II adhesives are intended principally for use on aluminum alloys, and types III and IV adhesives are intended principally for use on corrosion-resisting steel alloys or titanium alloys. Use of either on other metals or combination of metals must be substantiated by tests. Parts or assemblies requiring the use of adhesives covered by this specification should be designed with consideration for the heat and pressure required during the bonding operations. The maximum curing pressure specified in 3.3.3.2 is a necessary requirement for determining the suitability of an adhesive for general production use. However, shop facilities permitting higher pressures in accordance with the manufacturer's instructions may be used whenever practicable.

6.1.1 Nonmetal bonding. When the adhesives covered by this specification are used for bonding constructions other than metal-to-metal, the use of the adhesive shall be substantiated by the tests specified herein, using the combination of the materials in question.

6.1.2 Sandwich construction. Adhesives covered by this specification are not intended for use in bonding sandwich constructions, unless they conform and are qualified to MIL-A-25463.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of specification.
- b. Type, class, form and cure group of adhesive required (see 1.2).
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- d. Instruction sheet, when required (see 3.5).

MMM-A-132B

- e. When Material Safety Data Sheet is required (see 3.5.1).
- f. Level of packaging and packing required (see 5.1 and 5.2).
- g. Amounts and unit quantity required (see 5.1.1.1.1 and 5.1.1.2.1).
- h. Length, width, and thickness of film required (see 5.1.1.2.1).
- i. Number of kits to be packed in intermediate pack (see 5.1.1.3.2).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-MMM-A-132 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Washington, D.C. 20361; however, information pertaining to qualification of products shall be obtained from the Commander, Naval Air Warfare Center Aircraft Division Warminster, (Code 6062), P.O. Box 5152, Warminster, PA 18974-0591.

* 6.4 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 227.405 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.5.2	DI-NDTI-80809	Test/Inspection Report	

The above DID's were those cleared as of the date of this solicitation. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.5 Definitions.

MMM-A-132B

6.5.1 Long time and Short time exposure. The terms long time exposure and short time exposures as used in 1.2 and other paragraphs are relative terms. The 192 hours and 10 minutes are merely qualification exposure times for testing purposes as opposed to actual in service times. Fabricators concerned with elevated temperature exposures and times beyond those specified herein should provide substantiating data of the adequacy of the adhesives for the intended use.

6.5.2 Batch. A batch shall be defined as that quantity of material which has been manufactured at one time or subjected to some unit chemical or physical mixing process intended to make the final product homogeneous.

6.6 Precaution. Severe bond damage has been caused when cutting corrosion-resisting steel or titanium alloy specimens from bonded panels using saws and lubricating fluids. Certain of the fluids penetrate the adhesive bonds under these conditions. Damage may also be caused by vibration or heating from the cutting operation. Shop tests should be made to determine that the sawing techniques used will not harm the bonds. If satisfactory sawing techniques are not readily available, pre-slotted or pre-punched specimens of type shown on Figure 2 should be used.

* 6.7 Subject term (key word) listing.

Bonding
Cement
Epoxy
Glue
Resin

* 6.8 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the past previous issue.

MMM-A-132B

MILITARY INTEREST:

Custodians:

Army - MR
Navy - AS
Air Force - 11

Review activities:

Army - AR, ME, MI,
Navy - OS
Air Force - 11, 99
MISC-NSA

User activities:

Navy - MC

CIVIL AGENCY COORDINATING
ACTIVITIES:

GSA - FSS
COM - MBS
NASA - JFK
NASA - MSF

PREPARING ACTIVITY:

Navy - AS
(Project No. 8040-0519)

TABLE I. Mechanical properties of bonded joints.

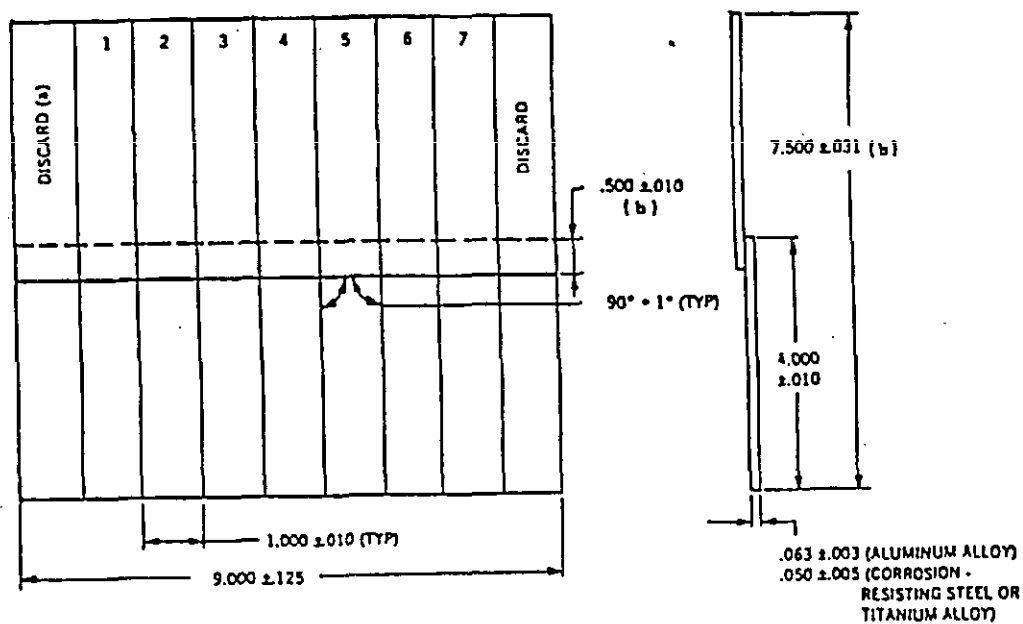
Test Number	Property	Test conditions	Number of specimens tested	Test Para	Adhesive minimum average strength requirements (psi) 1/					
					Class 1	Class 2	Class 3	Type II	Type III	Type IV
1	Tensile shear	Normal Temperature, 75° ± 5°F	6	4.6.1	5,500	3,500	3,000	2,750	2,750	2,750
2	Tensile shear	10 minutes at 180° ± 5°F	6	4.6.2	2,750	2,000	2,000			
3	Tensile shear	10 minutes at 300° ± 5°F	6	4.6.2				2,250	2,000	2,000
4	Tensile shear	192 hours at 300° ± 5°F	6	4.6.2				2,250	2,000	2,000
5	Tensile shear	10 minutes at 500° ± 5°F	6	4.6.2					1,850	1,850
6	Tensile shear	192 hours at 500° ± 5°F	6	4.6.2						1,000
7	Tensile shear	10 minutes at -67° ± 5°F	6	4.6.3	5,500	3,500	2/	2,750	2,750	2,750
8	Tensile shear	Normal temperature, 75° ± 5°F After 30 days at 120° ± 5°F & 95 to 100 % relative humidity	6	4.6.4	4,500	3,250	2,750	2,750	2,500	2,500
9	Tensile shear	Normal temperature, 75° ± 5°F after 7 days immersion in the respective fluids of 4.5.5	6	4.6.4	4,500	3,250	2,750	2,750	2,500	2,500
10	T-peel	Normal temperature, 75° ± 5°F	6	4.6.5	50 3/	20 3/				
11	Blister detection Tensile shear	Normal temperature, 75° ± 5°F	10	4.6.6	4,500	3,250				
12	Fatigue strength	Normal temperature, 75° ± 5°F	6	4.6.7	All types and classes - 750 X 10 ⁶ cycles					
13	Creep rupture	Normal temperature 75° ± 5°F @ 1600 psi	6	4.6.8	All types and classes, 192 hours, 0.015 inch, max deformation					
14	Creep rupture	Type I - 800 psi @ 180° ± 5°F	6	4.6.8	192 hours, 0.015 inch max deformation					
15	Creep rupture	Type II and III - 800 psi @ 300° ± 5°F	6	4.6.8	192 hours, 0.015 inch max deformation					
16	Creep rupture	Type IV - 800 psi @ 500° ± 5°F	6	4.6.8	192 hours, 0.015 inch max deformation					

1/ Minimum average strength of all specimens. Individual values shall be not less than 90 percent of the minimum average strength requirement.

2/ Minimum average strenght for film adhesives = 3,000 psi. Minimum average strength for paste adhesives = 2,000 psi.

3/ Minimum average strength, pound per inch of width.

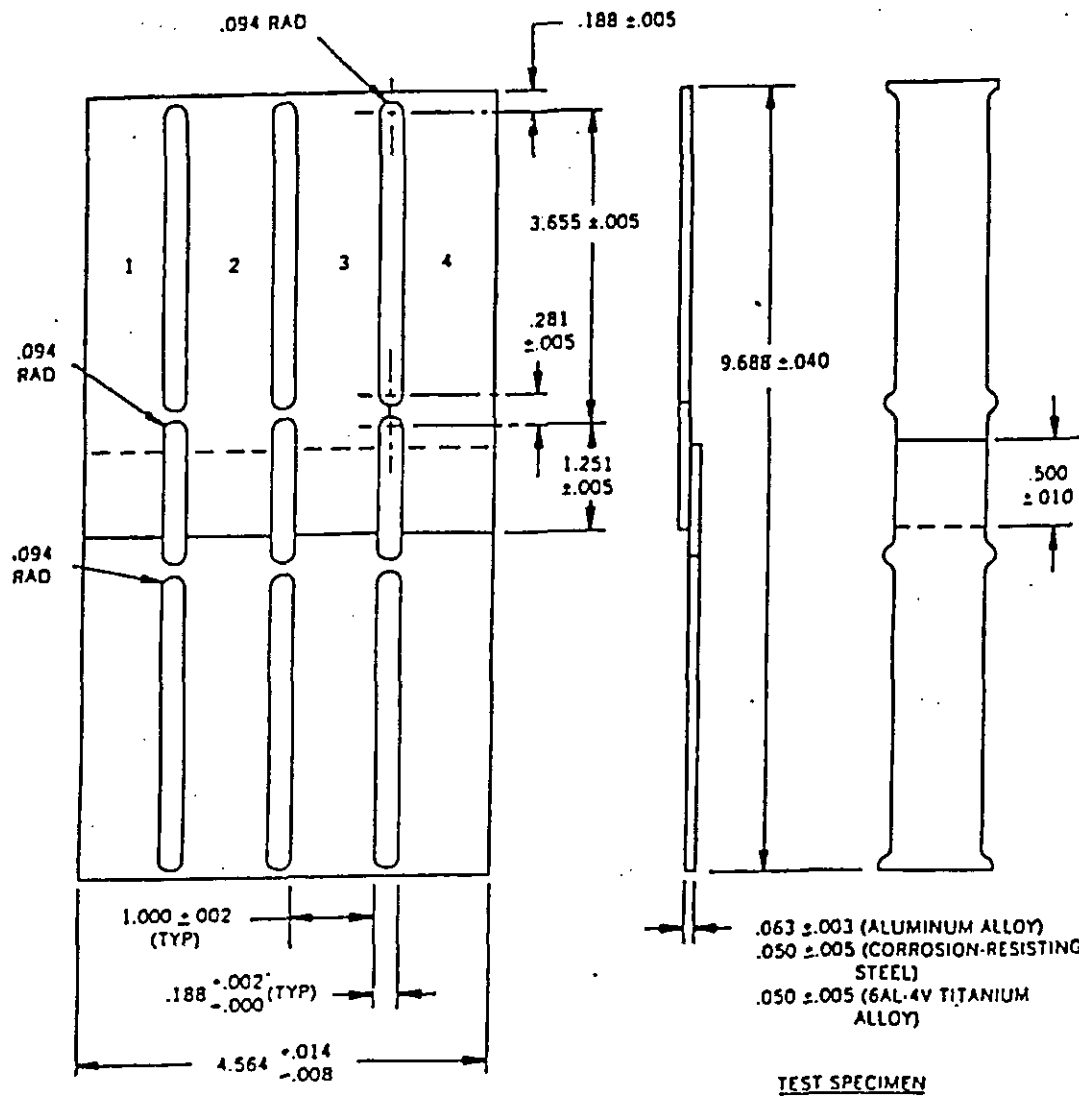
MMM-A-132B



- (a) ALL DISCARDS TO BE OF COMMON WIDTH AS DETERMINED BY WIDTH OF CUTTING TOOL.
- (b) FATIGUE STRENGTH -- 0.375 \pm .010 OVERLAP AND 7.625 \pm .031 LENGTH DIMENSIONS IN INCHES.

FIGURE 1. Standard test panel.

MMM-A-132B

FIGURE 2. Optional panel.

MMM-A-132B

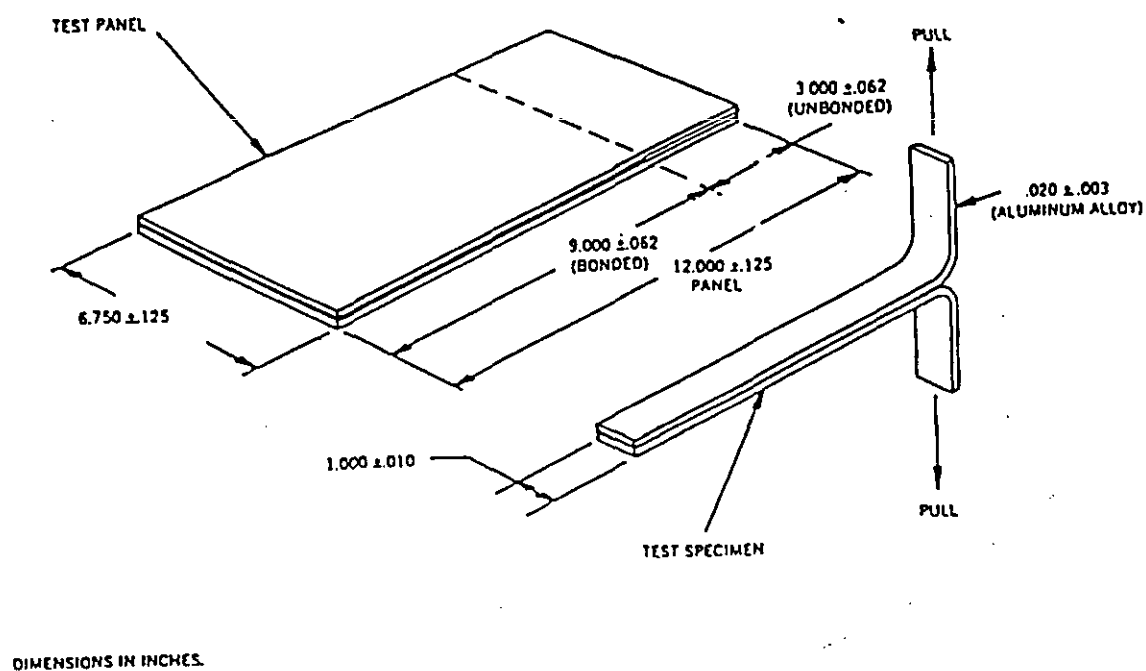
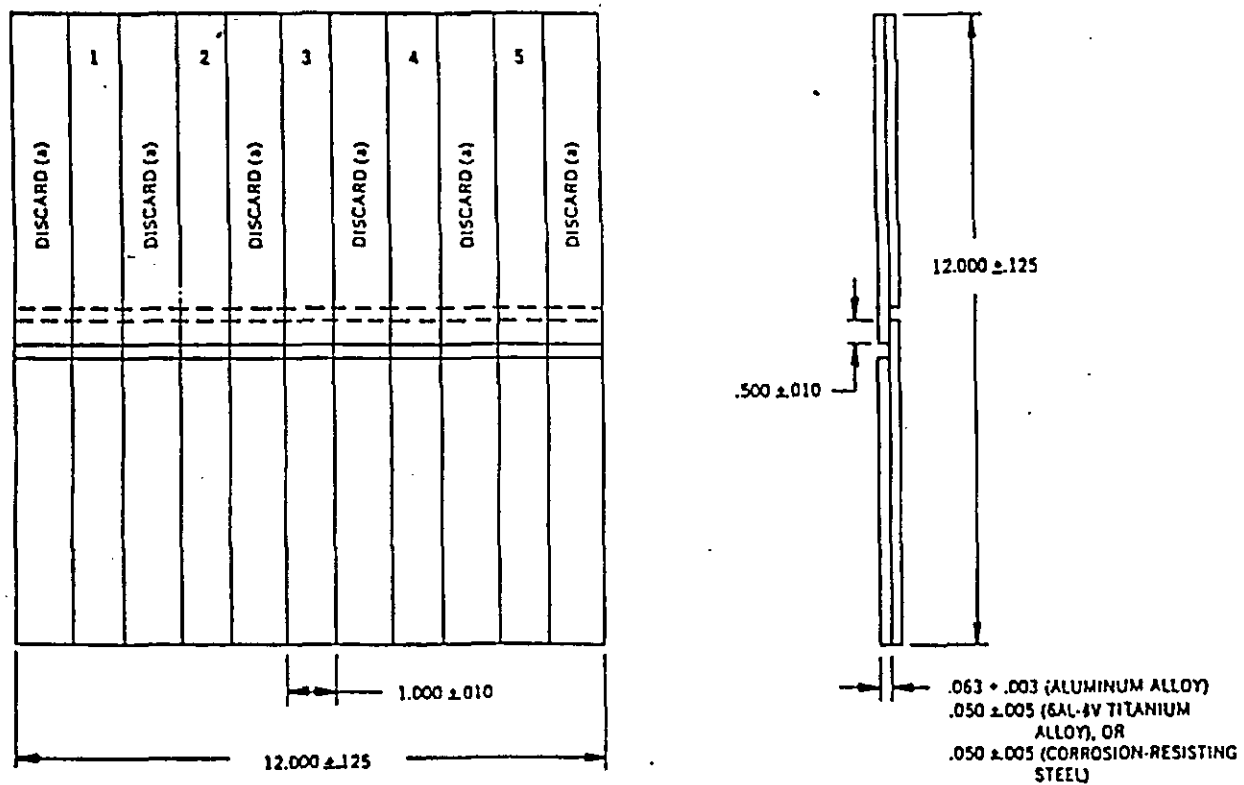


FIGURE 3. T-peek test specimen.

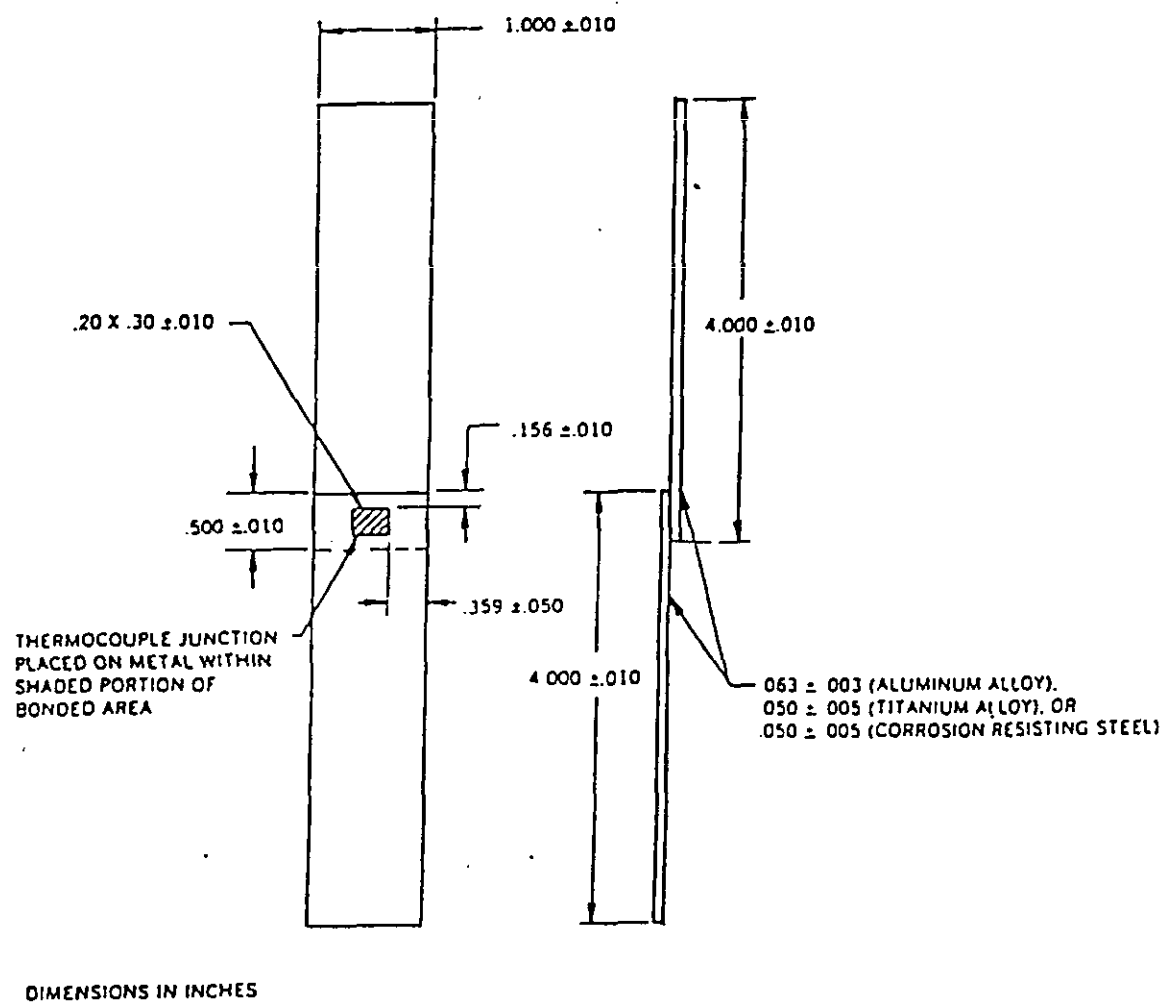
MMM-A-132B



(a) ALL DISCARDS TO BE OF COMMON WIDTH AS DETERMINED BY WIDTH OF CUTTING TOOL
DIMENSIONS IN INCHES.

FIGURE 4. Blister detection test panel.

MMM-A-132B

FIGURE 5. Location of thermocouples on the shear test specimens.

MMM-A-132B

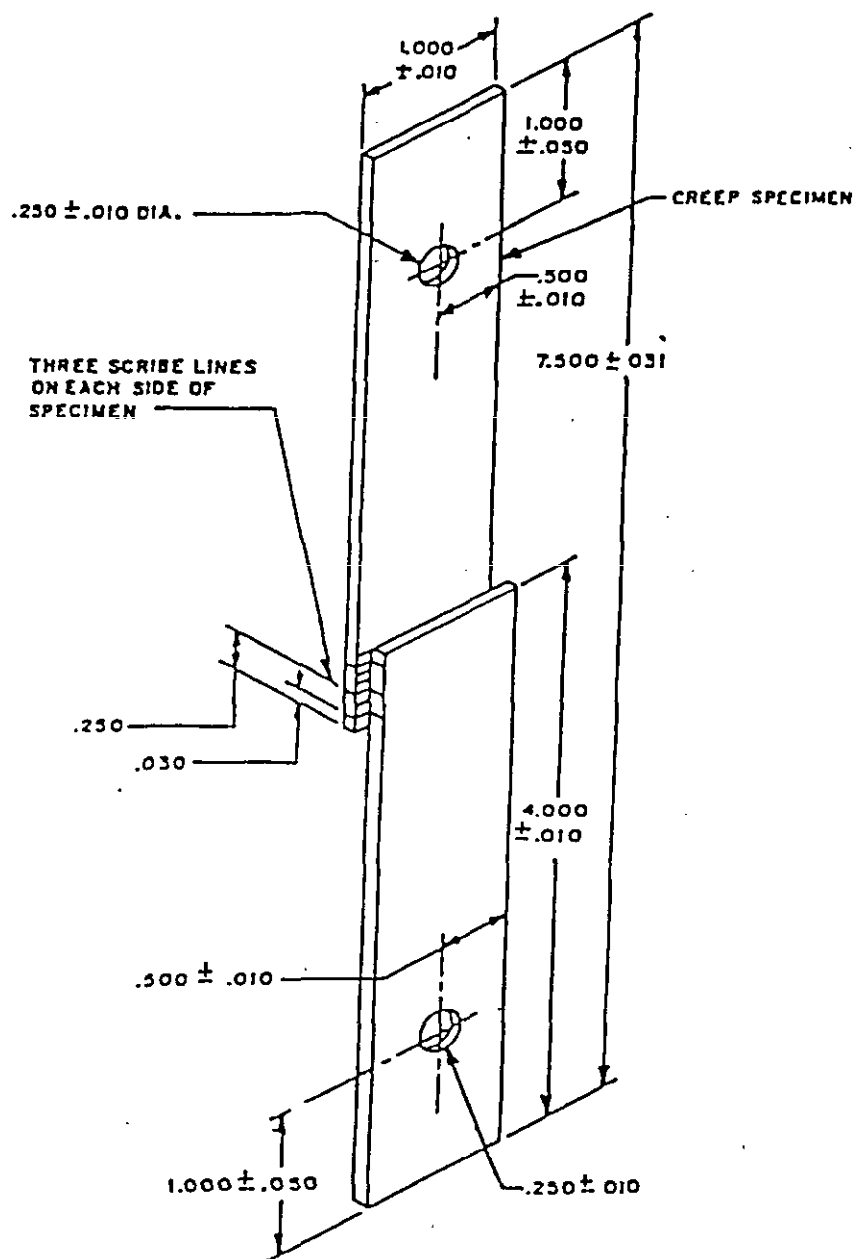


FIGURE 6. Creep rupture test specimen showing location of scribe lines.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MMM-A-132B

2. DOCUMENT DATE (YYMMDD)

940401

3. DOCUMENT TITLE

ADHESIVES, HEAT RESISTANT, AIRFRAME STRUCTURAL, METAL TO METAL

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

7. DATE SUBMITTED (YYMMDD)

(1) Commercial:

(2) AUTOVON:

(If Applicable)

8. PREPARING ACTIVITY

a. NAME

COMMANDING OFFICER, NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION LAKEHURST (API) GROUP
SYSTEMS REQUIREMENTS DEPARTMENT

b. TELEPHONE NUMBER (Include Area Code)

(1) Commercial

(2) AUTOVON

(908) 323-7488

624-7488

c. ADDRESS (Include Zip Code)

CODE SR3
HIGHWAY 547
LAKEHURST, NJ 08733-5100

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Suite 1403, Falls Church, VA 22041-3466
Telephone (703) 756-2340 AUTOVON 289-2340