MMM-A-181D
January 23, 1980
SUPERSEDING
Fed. Spec. MMM-A-181C
November 15, 1973

FEDERAL SPECIFICATION

ADHESIVES, PHENOL, RESORCINOL, OR MELAMINE BASE

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

1. SCOPE

1.1 Scope. This specification covers general-purpose, 2-part adhesives, or optionally a 1-part adhesive for type III (see 3.1.1), for wood assembly gluing. The adhesives are for the manufacture of laminated members and other wooden articles where a high-strength, durable adhesive is required.

1.2 Classification.

1.2.1 Types, grades, and classes. The adhesive covered by this specification shall be of the following types, grades and classes (see 6.2):

Type I - Room-temperature setting (24 deg. to 35 deg. C (75 deg. to 95 deg. F)) glue-line temperature.

Grade A - Two-years storage life
Grade B - Six-months storage life

Type II - Intermediate-temperature setting (35 deg. to 88 deg. C (95 deg. to 190 deg. F)) glue-line temperature.

Grade C - Six-months storage life

Class 2 - Liquid[1]
Class 2 - Powder[1]

Type III - High-temperature setting (88 to 149 deg. C (190 to 300 deg. F)) glue-line temperature

Grade E - One-year storage life

Class 1 - Liquid[1]
Class 2 - Powder[1]

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specification

PPP-B-636 - Boxes, Shipping, Fiberboard
PPP-C-96 - Cans, Metal, 28 Gage and Lighter

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and handbooks as outlined under General Information in the Index of Federal Specifications and Standards, and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications required by activities outside the Federal government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, Houston, New York, Philadelphia, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal specifications, standards, and handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

[1] NOTE: Unless otherwise specified (see 6.2), class 1 shall be supplied.

Military Standard:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of Military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Laws and Regulations:

Department of Transportation (DOT):

49 CFR 100-199 - Rules and Regulations for the Transportation of Hazardous Materials

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Standards:

D 905 - Test for Strength Properties of Adhesive Bonds in Shear by Compression Loading.
D 906 - Test for Strength Properties of Adhesives in Plywood Type Construction in Shear by Tension Loading.
D 1151 - Test for Effect of Moisture and Temperature on Adhesive Bonds.
D 1583 - Test for Hydrogen Ion Concentration of Dry Adhesive Films.

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

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification

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

Uniform Classification Committee, Agent:

Uniform Freight Classification

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

3. REQUIREMENTS

3.1 Material. The material used in the manufacture of the adhesive shall be such as to produce finished adhesive conforming to this specification.

3.1.1 The adhesive shall be furnished as a liquid with separate hardener, or when specified (see 6.2), as a powder with separate hardener. The hardener for the type III adhesive may be incorporated as a component part of the resin.

3.2 Resins. Only resins based on phenol, melamine, or resorcinol shall be used in making the adhesive.

3.3 Insoluble matter. The quantity of insoluble matter, including filler and any insoluble partially polymerized resin, shall be not more than 20 percent by weight of the nonvolatile constituents of the adhesive when mixed and ready for use (see 4.5.1).

3.4 Hardener. Hardener shall be supplied in either powder or liquid form. Where the hardener is furnished in powder form, it may be combined with part or all of the filler. The hardener shall be mixed with the adhesive prior to application to the joint.

3.5 Filler. Where filler is used it shall be an inert, insoluble powder incapable of being dissolved in or being swelled excessively by water. The filler may be combined with the resin or supplied separately (see 3.3). Amylaceous fillers such as flour or starch, and protein fillers shall not be permitted (see 4.5.2).

3.6 pH of set film. The set-adhesive film shall develop a pH value of not less than 3.5 nor more than 10.5 when determined as specified in 4.5.3.

3.7 Cleanability. The mixed adhesive shall be capable of being cleaned from spreading equipment and containers when tested as specified in 4.5.4.

3.8 Liquid working life. Adhesive shall have a minimum working life of 2-1/2 hours at 23.9 deg. +/- 2.8 deg. C (75 deg. +/- 5 deg. F), when determined as specified in 4.5.5.

3.9 Curing cycle. The curing cycle of the mixed adhesives to cure to the hardened state for the tests specified in 4.5.6 and 4.5.7 shall be as follows:

Type I - The curing cycle of type I adhesive shall be in accordance with 4.5.6.1.1 or 4.5.7.1.1, as applicable.

Type II - The curing cycle of type II adhesive shall be not longer than 5 hours and with a temperature not higher than 88 degrees C. (190 degrees F.) measured in the adhesive line.

Type III - The curing cycle of type III adhesive shall be not longer than 5 hours and with a temperature not higher than 149 degrees C. (300 degrees F.) measured in the adhesive line.

3.10 Shear strength by compression loading (type I and II only). The types I and II adhesive shall develop an average-shear strength of not less than 19.210 MPa (2,800 psi), using hard-maple blocks when tested as specified in 4.5.6.

3.11 Plywood shear strength.

3.11.1 Dry. The adhesive shall develop an average strength of not less than 2.76 MPa (400 psi) when tested as specified in 4.5.7.2.

3.11.2 Wet. The adhesive shall develop an average strength of not less than 2.76 MPa (400 psi) when tested as specified in 4.5.7.3).

3.12 Instructions. A label or tag with the following instructions shall be attached to each container or adhesive:

(a) Brief instructions for the storage and care of the adhesive prior to use.

(b) The date of manufacture (by month and year, not by code) and the maximum-storage life recommended by the manufacturer.

(c) Instructions for mixing of the adhesive and working life of the mixed adhesive, including the manufacturer’s recommendations on the maximum and minimum assembly period, for both open and closed assembly, for at least 3 temperatures, covering typical operating conditions such as 23, 24 and 29 degrees C. (70, 75 and 85 degrees F.).

(d) The proper use of the adhesive (see 3.9), detailing the limitations within which recommended pressure periods may be varied by the use of elevated temperatures during pressing and curing periods.

(e) In addition, each tag or label shall contain the following:

"Due to the sensitivity of the adhesive to extremes of temperature, it is recommended that the adhesive be kept out of the sun. All adhesive held in stock should be kept dry, tightly covered, and where practicable, at temperature below 27 degress C. (80 degrees F.).

"Avoid inhaling vapors generated while mixing 2-part adhesive.

"SKIN AND EYE IRRITANT -- This material is irritating to the skin. Avoid unnecessary skin contact. Wash frequently. Do not allow material to harden on skin. If material enters eyes, flush immediately with large quantities of water."

3.13 Flammable liquid. When applicable, material classified as a flammable liquid in accordance with the Department of Transportation document 49 CFR 100-199 (Code of Federal Regulations) shall also be labeled in accordance with the appropriate regulations.

3.14 Storage life. The adhesive shall be suitable for use and shall meet the requirements in 3.8, 3.9, 3.10 and 3.11, after having been stored in accordance with 4.5.8 for the respective period as follows:

Grade A - 2 years from date of manufacture
Grade B - 6 months from date of manufacture
Grade C - 6 months from date of manufacture
Grade E - 12 months from date of manufacture

3.15 Certification. When specified, the contractor shall submit to the procuring agency a letter stating that the resins comply with 3.3 and that storage life shall conform to 3.14. The letter shall state whether the contractor has performed the storage life test (see 4.5.8). The letter shall be signed by a responsible agent of the certifying organization and shall be accompanied by evidence of this agent's authority to bind his principal.

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 as specified herein.

4.2 Lot. Unless otherwise specified by the procuring agency, for purposes of sampling, a lot shall consist of adhesive of one component, type, grade and class, manufactured at one time, as one batch and offered for delivery at one time. When material cannot be identified by batch, a lot shall consist of not more than 1125 kg (2,500 pounds) of adhesive of one component, type, grade and class offered for delivery at one time.

4.3 Sampling.

4.3.1 For examination. A random sample of filled containers shall be selected for examination in accordance with level I of MIL-STD-105.

4.3.2 For tests. A representative .95 liter (1 quart) sample of adhesive and a sufficient quantity of hardener shall be taken from each lot. All of the tests shall be performed on this sample.

4.4 Examination of packaging. An examination shall be made to determine compliance with the requirements of Section 5. The sample unit shall be one shipping container fully prepared for delivery. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with an acceptable quality level (AQL) of 4.0 expressed in terms of percent defective.

4.5 Tests.

4.5.1 Nonvolatile and insoluble content.

4.5.1.1 Nonvolatile content. Mix at least 100 g of adhesive according to the manufacturer's directions, weighing to the nearest 0.01 g. Place approximately 10 g of fine, oven-dried, quartz sand in a Petri dish together with a small glass stirring rod, and weigh the dish and its contents to the nearest milligram (mg) on an analytical balance; add approximately 2 g of the mixed adhesive, and weigh again to the nearest mg. Mix the adhesive and sand intimately by means of the stirring rod, and distribute uniformly over the bottom of the dish in as thin a layer as possible. Heat the dish, rod and contents overnight in an oven at 100 degrees +/- 5 degrees C. (212 degrees +/- 9 degrees F.), cool, reweigh, and calculate the percent nonvolatile as follows:

$$\text{Percent nonvolatile} = \frac{\text{(weight of adhesive-loss in weight)}}{\text{weight of adhesive}} \text{ X } 100$$

4.5.1.2 Insoluble matter. Make this determination on the same batch of mixed adhesive used for the determination of nonvolatile content (see 4.5.1.1).

4.5.1.2.1 Phenol and resorcinol resins. Weigh approximately 2 g of the freshly mixed adhesive to the nearest mg in a 100 milliliter (ml) beaker: add 50 ml of absolute methyl alcohol; stir for 3 minutes; then filter through a previously weighed sintered-glass crucible of medium porosity. Transfer all residue to the filter with a second 50-ml portion of methyl alcohol; wash the crucible and residue with approximately 30 ml more of alcohol; dry for 2 hours in an oven at 100 deg. +/- 5 deg. C (212 deg. +/- 9 deg. F); cool in a desiccator; and weigh to the nearest mg. Calculate the insoluble content as a percent of the nonvolatile content as follows:

$$\text{Percent insoluble} = \frac{\text{weight of residue X 100 X 100}}{\text{Weight of adhesive X percent nonvolatile}}$$

4.5.1.2.2 Melamines. Weigh approximately 2 g of the freshly mixed adhesive to the nearest mg in a 100-ml beaker; add 50 ml of a solvent composed of 20 parts of glacial acetic acid, 20 parts of 95-percent ethyl alcohol, and 60 parts of distilled water by volume. Stir the adhesive and solvent for 1 minute, then add 0.5 g of diatomaceous earth[1] (previously acid-washed, oven dried at 100 degrees +/- 5 degrees C. (212 degrees +/- 9 degrees F.) and stored in a desiccator). Continue the stirring 2 minutes longer, then filter through a previously weighed, sintered-glass, crucible of medium porosity. Wash all residue remaining in the beaker onto the filter with at least 30 ml of the solvent, then wash with cold water to remove the acid and finally wash with 20 ml of 95-percent ethyl alcohol. After preliminary drying by suction, dry the crucible with the residue in an oven at 100 degrees +/- 5 degrees C. (212 degrees +/- 9 degrees F.) for 2 hours, cool in a desiccator, and weigh to the nearest mg. Calculate the insoluble content as percent of nonvolatile content as follows:

$$\text{Percent insoluble} = \frac{\text{(weight of residue - 0.5) X 100 X 100}}{\text{weight of adhesive X percent nonvolatile}}$$

4.5.2 Amylaceous matter.

4.5.2.1 Phenol and resorcinol resins. To approximately 1/2 g of mixed adhesive add approximately 5 ml of 95-percent ethyl alcohol in a test tube of small diameter, shake thoroughly, allow insoluble matter to settle, and decant the supernatant liquid. Repeat this process twice with alcohol and three times with distilled water. To the residue after the final decantation, add a drop of a solution made of 5 g of iodine, 5 g of potassium iodide, and 100 ml of distilled water. A decided darkening of the residue denotes the presence of amylaceous matter.

4.5.2.2 Melamine resins. Use the same procedure as specified in 4.5.2.1 except that, instead of the ethyl alcohol, use a solution made up of 20-parts glacial acetic acid, 20-parts ethyl alcohol, and 60-parts distilled water by volume. When the melamine adhesive is supplied with separate hardener, ethyl alcohol shall be used for the unmixed hardener.

4.5.3 pH of set film. The pH of the set film shall be determined as specified in ASTM D 1583.

4.5.4 Cleanability. A portion of the mixed adhesive shall be placed in a glue pot, and before the expiration of its working life and at the proper temperature of use as furnished by the manufacturer, shall be completely cleaned from the pot by water, 0.5 percent sodium hydroxide solution, alcohol, or a mixture of these.

4.5.5 Liquid-working life. Pour approximately 200 g of freshly mixed adhesive into a large glass test tube or beaker approximately 35 millimeters in diameter, provided with a glass stirring rod, and immerse the tube with contents in a water bath held at 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.). Stir the adhesive frequently with the rod, and note the time at which the adhesive is considered to be definitely no longer spreadable on wood surface with a stiff-bristle brush. The time to reach this consistency after mixing is the liquid-working life of the adhesive at 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.).

4.5.6 Shear-strength by compression loading (type I and II only).

4.5.6.1 Test specimens. At least 4, separated, hard-maple test blocks shall be prepared in accordance with ASTM D905 except that at least 2 of the test blocks shall be prepared for the minimum assembly time and 2 for the maximum assembly time recommended by the manufacturer, after which 1.73 MPa (250 psi) pressure shall be applied.

4.5.6.1.1 Type I. The blocks shall then be under this pressure for 7 hours at a temperature of 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.). After releasing the pressure, condition the test blocks in accordance with ASTM D905.

4.5.6.1.2 The blocks shall be cured according to the instructions of the manufacturer and in accordance with 3.9. After being cured, the blocks shall be allowed to cool to room temperature before the pressure is released. After releasing the pressure, condition the test blocks in accordance with ASTM D905.

4.5.6.2 Procedure. After conditioning, the test blocks shall be cut and tested in accordance with ASTM D905. Whenever 50 percent or more specimens fail at a load less then 19.3 MPa (2,800 psi) and failure occurs in the wood fiber, the specimen shall be disregarded in computing the average shear strength. If 5 or more specimens fail in this category, a new set of test blocks and specimens shall be prepared and tested. If the average-shear strength is less than 19.3 MPa (2,800 psi) the lot shall be rejected.

4.5.7 Plywood shear strength.

4.5.7.1 Test specimens. At least 9 separate 3-ply plywood test panels shall be prepared in accordance with ASTM D906 except that 3 of the 3-ply panels shall be left in closed assembly time recommended by the manufacturer, after which they shall be placed under pressure of 1.03 to 1.38 MPa (150 to 200 psi).

4.5.7.1.1 Type I. The panels shall be allowed to remain under pressure for at least 7 hours at a temperature of 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.). After releasing the pressure, condition the test panel, cut into test specimens, and number according to ASTM D906.

4.5.7.1.2 Type II and III. The panels shall be cured according to the instructions of the manufacturer and in accordance with 3.9. The panels shall then be removed from the press and cooled to room temperature. Panels shall then be conditioned, cut into test specimens, and numbered in accordance with ASTM D906.

4.5.7.2 Dry shear. The specimens number 1, 4 and 7 from each panel shall be tested dry in accordance with ASTM D906.

4.5.7.3 Wet shear.

4.5.7.3.1 Boiling water. The specimens numbered 2, 5 and 8 shall be immersed in boiling water for 3 hours +/- 10 minutes, removed, and immersed in water at 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.) for 30 +/- 5 minutes and then tested immediately upon removal from the water. Test specimens from the same sample may be immersed in one container but specimens from different samples shall be immersed in separate containers. The specimens shall then be tested in accordance with ASTM D906.

4.5.7.3.2 Cold water. The specimens numbered 3, 6 and 9 shall be subjected to an immersion in water at 23.9 degrees +/- 2.8 degrees C. (75 degrees +/- 5 degrees F.) for 48 +/- 2 hours as specified in ASTM D1151 and immediately tested for shear strength in accordance with ASTM D906.

4.5.7.4 Test reports. Plywood shear-test reports shall include average load at failure, average percent of wood failure, and the number of specimens from which the average was computed. Whenever a specimen fails at a load less than that specified (see 3.10), the failure taking place in 50 percent or more in the wood fiber, the specimen shall be disregarded in computing the average values required.

4.5.8 Storage life. Specimens of adhesive shall be stored in a tightly sealed container for the period required in 3.14 at 23.9 degrees +/- 2.8 degrees C. (75 +/- 5 degrees F.), and then tested for the requirements as specified in 3.14.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or commercial, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Powders adhesive. See para 5.2.1.2 for the preparation for delivery of 45 kg or 135 kg (100 or 300 lb) quantities.

5.1.1.2 Liquid adhesive. Liquid adhesives in quantities of 3.8 liters (1 gallon) or less shall be packages in metal cans confirming to type V, class 2 of PPP-C-96. Exterior plan B coating and side seam stripping shall be required. See para 5.2.1 for the preparation for delivery of 19 1., 114 1., and 209 1. (5, 30, and 55 gallons) quantities.

5.1.1.3 Hardener. The hardener shall be furnished in containers to provide the correct quantity required for an individual container of adhesive. Containers shall conform to PPP-C-96. Exterior plan B coating and side seam stripping shall be required.

5.1.2 Commercial. The adhesive in quantities of 3.8 liters (1 gallon) or less along with the correct quantity of hardener shall be packaged in accordance with normal commercial practice. The complete package shall be designed to protect the adhesive against damage during shipment, handling and storage. See para 5.2.2 for preparation for delivery of quantities larger than 3.8 liters (1 gallon).

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

5.2.1 Level A.

5.2.1.1 The adhesive packaged as specified in 5.1.1.2 and hardener packaged as specified in 5.1.1.3 shall be packed in a close-fitting box conforming to PPP-B-636, class weather-resistant. The box shall be closed, waterproofed, and reinforced in accordance with the appendix of PPP-B-636.

5.2.1.2 The 45 and 135 kg (100 and 300 lb) quantities specified in 5.1.1.1 and the 19 1., 114 1. and 209 1. (5, 30 and 55 gallon) quantities specified in 5.1.1.2 shall be furnished in metal cans or metal drums conforming to Item 260 of the National Motor Freight Classification and Rule 40 of the Uniform Freight Classification. The interior coating of the cans and drums shall not affect or be affected by the adhesive.

5.2.2 Commercial. The adhesive and hardener packaged as specified in 5.1.2 shall be packed in a manner that will insure acceptance by common carrier and provide product protection against loss and damage during multiple shipment, handling and storage. The shipping container shall be in compliance with the National Motor Freight Classification and Uniform Freight Classification.

5.3 Marking. Marking shall be as specified in the contract or order.

6. NOTES

6.1 Intended use. The adhesives are used in the manufacture of laminated members and other wooden articles where a high-strength, durable adhesive is required.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

(a) Title, number and date of this specification.
(b) Whether powder form is required (see 1.2.1).
(c) Type and grade (see 1.2.1).
(d) Size of container required (see 5.1).
(e) Selection of the applicable levels of packaging and packing (see 5.1 and 5.2).
(f) Special labeling and marking if required (see 3.12; 5.3).

6.2.1 Adhesive should be purchased by net weight.

6.3 Caution. The user is cautioned that because of the formaldehyde content of the adhesive the usual cleanliness standards should be employed in its use. Where the users actually have adhesive coming in contact with the skin, it has been found that the use of protective creams and frequent washing alleviates any tendency toward industrial dermatitis unless, of course, the particular user is allergic to formaldehyde. It should be emphasized that many industrial dermatitis problems can be solved by proper cleanliness on the part of the worker and by the use of adequate plant ventilation. Meticulous workroom housekeeping and constant employee awareness should be maintained to guard against the two major dangers in resin operations: (1) Skin contact with the resins or other materials, and (2) Exposure to their vapors. The following rules should be adhered to: (1) Inform workers of possible hazards; (2) Provide ventilation to control vapors produced when mixing the resins and hardener as well as to control the particulates during tooling; and (3) Maintain good personal hygiene procedures, provide and enforce the use of appropriate protective clothing and equipment (i.e. gloves, safety goggles, eye lavage and safety showers).

MILITARY CUSTODIANS:

Army - MR
Navy - YD
Air Force - 99

Review Activities:

Army - GL, MD, AR
Navy - YD
Air Force - 99

User Activities:

Army - ER, ME, MI
Navy - AS, OS, SH

Preparing activity:

Army - MR

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS

Project No. 8040-0404

NOTICE OF
VALIDATION

NOT MEASUREMENT SENSITIVE

MMM-A-181D
NOTICE 1
2 August 1989

FEDERAL SPECIFICATION

ADHESIVES, PHENOL, RESORCINOL OR MELAMINE BASE

MMM-A-181D, dated 23 January 1980, has been reviewed and determined to be valid for use in acquisition.

Custodians:
Army - MR
Navy - YD
Air Force - 99

Preparing activity:
Army - MR

AMSC N/A

FSC 8040

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