

MMM-A-100D
 February 7, 1978
 SUPERSEDING
 Fed. Spec. MMM-A-100C
 July 25, 1967

FEDERAL SPECIFICATION

ADHESIVE, ANIMAL GLUE

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers animal glue adhesives for use in woodworking.

1.2 Classification.

1.2.1 Types and grades. Animal glue shall be of the following types and grades, as specified (see 6.2):

- Type I - Dry form (flake, ground or powdered, as specified) (see 6.2)
- Grades - J1, J2
- Type II - Liquid form

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

- UU-S-48 - Sacks, Shipping, Paper.
- PPP-B-566 - Boxes, Folding, Paperboard.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-B-665 - Boxes: Paperboard, Metal Edged and Components.
- PPP-B-676 - Boxes, Setup.
- PPP-B-1806 - Barrels and Kegs: Wood Slack.
- PPP-C-96 - Cans, Metal, 28 Gage and Lighter.
- PPP-D-723 - Drums, Fiber.
- PPP-D-729 - Drum, Shipping and Storage, Steel, 55-gallon.
- PPP-P-704 - Pails, Metal: (Shipping, Steel, 1 through 12 Gallons).

FSC 8040

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Federal Standard:

FED-STD-123 - Marking for Shipment (Civil Agencies).

(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, U.S. 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 Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Philadelphia, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Houston, 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.)

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

MIL-STD-129 - Marking for Shipment and Storage.

(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.)

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) Standard:D 905-49 - Strength Properties of Adhesive Bonds
in Shear by Compression Loading

(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 Trucking Associations, 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, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

3. REQUIREMENTS

3.1 Material. Animal glue shall be manufactured from raw materials derived from animals.

3.2 Type I.

3.2.1 Properties. Type I glue shall comply with the requirements specified in table I, when tested as specified in 4.2.2.4.

TABLE I. Properties of type I glues

Grade	J1	J2
Moisture <u>1/</u> content, percent	12	12
Viscosity, millipoises, minimum	83 (8.3 mPa.s)	100 (10.0 mPa.s)
Jelly strength, grams	237 to 266	299 to 330
pH <u>2/</u>	6.5	6.5
Foam, millimeters, maximum	25	25
Odor and keeping quality	Free from any odor or decomposition after 48 hours incubation	

1/ Tolerance \pm 3 percent.

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2/ Tolerance \pm 1.0 pH unit.3.3 Type II.

3.3.1 Properties. Type II glue shall comply with the requirements specified in table II, when tested as specified in 4.2.2.4.

TABLE II. Properties of type II glue

	Minimum	Maximum
Hygroscopicity, percent	---	15
Viscosity, centipoises:		
At 85°F (29°C)	1800 (1.8 Pa.s)	---
At 70°F (21°C)	---	50,000 (50.0 Pa.s)
pH	5.7	7.7
Shear strength, pounds per square inch	2800 (19.3 MPa) and 50 percent wood failure	---
Foam, percent	---	50
Odor	No odor of decomposition as received	

3.4 Workmanship. The adhesive shall be homogeneous, free from dirt and foreign matter and the occurrence of defects shall not exceed the applicable acceptable quality levels (AQLs) in section 4.

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 in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government.

4.2 Quality conformance inspection. Sampling for inspection shall be in accordance with the provisions of MIL-STD-105, except where otherwise indicated hereinafter.

4.2.1 Component and material inspection. In accordance with 4.1, the components and materials shall be inspected in accordance with the requirements of referenced specifications, drawings, and standards unless otherwise excluded, amended, modified, or qualified in this specification or applicable purchase document.

4.2.2 Inspection of end item.

4.2.2.1 Examination of end item. The packaged adhesives shall be examined for defects in appearance, fill, closure, condition of container, and marking of container. The sample size shall be one container (gallon can, sack, barrel, as applicable). The lot size, for purpose of sampling, shall be expressed in units of one container of adhesive from each batch.

<u>Examine</u>	<u>Defect</u>
Appearance	Not homogeneous. Not powder (as applicable). Not liquid (as applicable). Any dirt or foreign matter.
Container (package)	Not type specified. Broken or damaged. Improper closure. Any leakage.
Container (label)	Marking smeared or blurred, missing, incomplete, illegible.

4.2.2.2 Examination of preparation for delivery. An examination shall be made to determine that markings, packaging, packing contents, and weights comply with section 5. The sample unit shall be one shipping container fully packed, selected just prior to the closing operation. Closure defects listed below shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot.

<u>Examine</u>	<u>Defect</u>
Markings (exterior and interior)	Incorrect; incomplete; illegible; omitted; of improper size, location, sequence, or method of application.
Materials	Any component missing, damaged, or not as specified.

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<u>Examine</u>	<u>Defect</u>
Workmanship	Inadequate application of components, such as incomplete closure of shipping container flaps, loose or inadequate sealing, improper taping, strapping, or stapling. Bulged or distorted shipping container.
Contents	Number of units of adhesive per shipping container is more or less than required.

4.2.2.3 Inspection levels and acceptable quality levels (AQLs). The inspection levels and AQLs expressed in defects per 100 units shall be as follows:

	<u>Inspection level</u>	<u>AQL</u>
For defects in 4.2.2.1	I	4.0
For defects in 4.2.2.2	S-1	2.5

4.2.2.4 Testing of the end item. The methods of testing specified in table III, as applicable, shall be followed for each lot (production batch). The lot shall be expressed in pounds (kg) of type I adhesive and in gallons (liter) of type II adhesive. The sample unit for testing shall be one pound (0.46 kg) or one gallon (3.79 liter) composite, as applicable, selected in equal portions from samples selected at random throughout the lot. The samples shall be selected in the frequency listed below and thoroughly mixed to form the composite. The composite shall be placed in a clean, dry container with a minimum of air space within and then sealed to protect against moisture. All test reports shall contain the individual values utilized in expressing the final results. The lot shall be unacceptable if the average of determinations on the composite sample fails to meet any of the test requirements specified.

<u>Lot size</u>	<u>Sample frequency</u>
(Gallons, (liter) or pounds (kg) as applicable)	
800 or less	2
801 up to and including 22,000	3
22,001 or more	5

TABLE III. Instructions for testing

Characteristics	Requirement paragraph	Test method paragraph	Number of de-terminations per sample unit	Results reported	
				To nearest	Pass or fail
<u>Type I</u>					
Moisture content	3.2.1	4.3.1.1	1	1 percent	-
Viscosity	3.2.1	4.3.1.2	3	Millipoise (0.1 mPa.s)	-
Jelly strength	3.2.1	4.3.1.3	3	1 gram	-
pH	3.2.1	4.3.1.4	2	0.1 pH unit	-
Foam	3.2.1	4.3.1.5	2	1 mm	-
Odor	3.2.1	4.3.1.6	2	-	X
<u>Type II</u>					
Hygroscopicity	3.3.1	4.3.2.1	1	1 percent	-
Viscosity	3.3.1	4.3.2.2	2	100 centipoise (0.1 Pa.s)	-
pH	3.3.1	4.3.2.3	2	0.1 pH unit	-
Shear strength	3.3.1	4.3.2.4	20	50 psi (0.1 MPa)	-
Foam	3.3.1	4.3.2.5	1	5 percent	-
Odor	3.3.1	4.3.2.6	1	-	X

4.3 Test methods.

4.3.1 Type I. The following test methods apply to all type I adhesives.

4.3.1.1 Moisture content. Determine the loss in weight of a 10 g specimen, previously reduced to a size that will pass a No. 4 mesh screen, by drying for 16 hours in a well ventilated oven heated at $105^{\circ} \pm 3^{\circ}\text{C}$ and using the following calculation:

$$\text{Moisture content, percent} = \frac{\text{original wt. of specimen} - \text{wt. of specimen after drying} \times 100}{\text{original weight of specimen}}$$

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4.3.1.2 Viscosity.

4.3.1.2.1 Preparation of specimens. Three separate solutions of the adhesive shall be prepared as follows: Enough adhesive sample shall be taken (calculated from the moisture content previously determined under 4.3.1.1), to give the equivalent of 13.20 ± 0.05 g of dry adhesive (for example, 15 g if the adhesive contains 12 percent moisture) and placed in a standard wide-mouthed bottle, 150-ml capacity with an inside diameter of 59 ± 2 mm, an outside diameter of 66 ± 1 mm, and an overall height of 85 ± 2 mm. The bottle shall be fitted with a No. 9 rubber stopper. Enough distilled water shall be added to the adhesive to make a total of 106.80 ± 0.05 g of water including that naturally contained in the adhesive (for example 105 g of distilled water if the adhesive has 12 percent moisture content). This will give an eleven percent solution of adhesive. The adhesive and water shall be thoroughly mixed by stirring with a glass rod and then allowed to stand at a temperature of 10 to 15°C for at least 16 hours. The solution shall then be melted by raising the temperature of the solution to 60°C. The time required to bring the solution to 60°C shall not exceed 15 minutes.

4.3.1.2.2 Procedure. The viscosity determination shall be made in a standard jacketed pipette viscometer, or any other suitable viscometer capable of measuring viscosity in millipoise (mPa.s). The instrument must be equipped to hold the adhesive solution at approximately a constant temperature. The temperature of the adhesive solution shall be held at $60^\circ \pm 0.2^\circ\text{C}$ and the determination made as soon as the solution has uniformly reached the required temperature. Care should be exercised in filling to see that air is not trapped in the viscometer or in the adhesive solution. A stopwatch, graduated in fifths of a second, shall be used to measure the time required for the solution to pass through the orifice of the instrument. The viscosity shall be expressed in millipoises (mPa.s) and shall be the average of three determinations.

4.3.1.3 Jelly strength. The samples from the viscosity test shall be placed in the standard containers described under 4.3.1.2.1, and used for the jelly-strength determination. The adhesive solutions should be free of air or foam. The solutions shall be allowed to cool in the standard stoppered bottles to approximately 45°C and any water of condensation shall be mixed thoroughly with the solution. The bottles shall then be placed in a chamber or batch controlled at $10^\circ \pm 0.1^\circ\text{C}$ for 16 to 18 hours. The determination of jelly-strength of each of the three solutions shall be made on a Bloom gelometer (see 6.3), or equivalent apparatus adjusted to give a 4 mm depression and to deliver a load of 40 g per second to the surface of the jelly. The test must be completed within 2 minutes from the removal of the sample from the cooling chamber. The jelling-strength shall be reported in grams and shall be the average of the three determinations.

4.3.1.4 pH value.

4.3.1.4.1 Preparation. Portions of the solutions upon which the viscosity and jelly-strength tests were made or other samples of equal concentration shall be used to determine the pH of the adhesive. Either colorimetric or electrometric means may be used.

4.3.1.4.2 Procedure. When colorimetric means are used, the following procedure is recommended: Fifteen ml of the adhesive solution shall be mixed at 60°C with 20 ml of water at the same temperature. Two 10 ml portions of the dilute glue solution shall be placed in test tubes. To each portion, six to eight drops of a 0.02 percent solution of methyl red and a 0.04 percent solution of bromthymol blue, shall be added as indicators. The determination shall be made by comparing the color of the solution with a set of standard colors.

4.3.1.5 Foam. Portions of the samples used in the viscosity and jelly-strength tests or other samples of equal concentration shall be used for a determination of the tendency to foam. Seventy-five ml of the solution at 60°C shall be placed in the standard container described under 4.3.1.2.1, and agitated with a stirrer or propellor. The stirrer shall be placed in the lower one-half of the solution and the speed of the stirrer during test shall be between 13,000 and 15,000 rpm. The solution shall be agitated for 1 minute and then allowed to stand at room temperature for 10 minutes, at the end of which there shall be not more than 25 mm of foam.

4.3.1.6 Odor and keeping qualities. A 50 ml or larger portion of the adhesive solution used in previous tests shall be placed in a covered container and held in an incubator at 37 to 38°C for 48 hours. At the end of this time, it shall be free from any odor or decomposition.

4.3.2 Type II. The following test methods apply to the type II adhesive.

4.3.2.1 Hygroscopicity. Dry a sample of approximately 2 ± 0.005 g spread over 4 square inches (25 cm²) of flat glass surface, to constant weight at 30 to 35 percent relative humidity and a temperature of 21 to 27°C. Then expose the dried sample to a relative humidity of 70 to 75 percent and a temperature of 21 to 27°C for 24 hours. Weigh and calculate the percentage of gain in weight.

4.3.2.2 Viscosity.

4.3.2.2.1 Viscosity at 21°C. The sample shall be stored at 21 ± 0.3 °C for not less than 12 hours. The viscosity shall then be determined with a Brookfield model LVF synchro electric viscosimeter spindle No. 4 at 6 rpm or equivalent apparatus (see 6.3).

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4.4.3.2.2 Viscosity at 29°C. The sample shall be stored at $29 \pm 0.3^\circ\text{C}$ for not less than 12 hours and the viscosity determined using the apparatus specified in 4.3.2.2.1.

4.3.2.3 pH. The pH of the liquid glue shall be determined by means of a suitable pH meter employing a glass electrode.

4.3.2.4 Shear strength by compression loading. The strength of joints made with the adhesive shall be determined on a standard block prepared as described in 4.3.2.4.1.

4.3.2.4.1 Preparation of test blocks. Test assemblies shall be prepared in accordance with ASTM D 905-49, except that the moisture content of the wood shall be from 6 to 9 percent.

4.3.2.4.2 Gluing of test blocks. With the adhesive and wood at 24 to 29°C, one surface only of each test block assembly shall be coated using 190 to 270 g of liquid glue per square meter (equivalent to 40 to 50 pounds per 1000 square feet of single glue line), the blocks placed together and allowed to stay in closed assembly for 5 minutes. The blocks shall then be placed under pressure of 150 pounds per square inch (1.03 MPa) for at least 16 hours at a temperature of 24 to 29°C, and allowed to condition for not less than 2 additional days at a temperature of 21 to 24°C and relative humidity of not more than 40 percent. They shall then be cut into test specimens as described in ASTM D 905-49. Whenever a specimen fails at a load of less than 2800 pounds per square inch (19.3 MPa) and failure occurs 50 percent or more in the wood, disregard that specimen in computing the average. If the test values of more than one half of the samples are rejected because of low strength and high wood failure, the test shall be repeated.

4.3.2.5 Foam. The foam test shall be run as follows: Two hundred grams of the liquid glue at 29°C in a 1000 ml Griffin beaker shall be beaten for 90 seconds with a mixer (dual-beater assembly) running at 700 rpm. The weight of the foamed adhesive shall be compared to the weight of an equal volume of the unbeaten adhesive. The percent foam shall be calculated as follows:

$$\text{Foam, percent} = \frac{\text{Wt. of unbeaten adhesive} - \text{wt. of foam adhesive}}{\text{Wt. of unbeaten adhesive}} \times 100$$

4.3.2.6 Odor. The liquid glue as received shall be free from any odor of decomposition.

5. PREPARATION FOR DELIVERY

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

5.1.1 Level A, (Military requirements).

5.1.1.1 Type II. One gallon (3.8 liters) cans used for furnished adhesive shall conform to type V, class 2 of PPP-C-96. Plan B nonmetallic coating shall be required.

5.1.2 Level B, (Civil agencies).

5.1.2.1 Type I or II. The type I or II adhesive shall be packaged in accordance with table IV.

5.1.3 Level C. Adhesive shall be packaged to afford adequate protection against deterioration or physical damage during shipment from the supply source to the first receiving activity. The package and the quantity per package shall be the same as that normally used by the contractor for retail distribution.

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

5.2.1 Level A.

5.2.1.1 Type I, all grades. Fifty and 100 pound (23 and 45 kg) quantities of adhesive shall be packed in shipping sacks conforming to construction No. 9-9X(1) and No. 17-17X(1), respectively, type I, II, III, or IV of UU-S-48. Three hundred pound (136 kg) quantities of adhesive shall be packed in barrels conforming to type II of PPP-B-1806.

5.2.1.2 Type II. One gallon (3.8 liters) containers of adhesive, packaged as specified in 5.1, shall be packed in accordance with the applicable requirements of the appendix of PPP-C-96. Five and fifty-five gallon (19 and 208 liter) quantities of adhesive shall be packed in containers as hereinafter specified. The 5-gallon (19 liter) container shall conform to type II, class 3 of PPP-P-704. The 55-gallon (208 liter) container shall conform to type optional of PPP-D-729.

5.2.2 Level B.

5.2.2.1 Military requirements.

5.2.2.1.1 Type I, all grades. Fifty and 100 pound (23 and 45 kg) quantities of adhesive shall be packed in shipping sacks conforming to construction No. 5-5X(1) and No. 15-15X(1), respectively, type I, II, III, or IV of UU-S-48. Three hundred pound (136 kg) quantities of adhesive shall be packed in barrels conforming to type I of PPP-B-1806.

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5.2.2.1.2 Type II. One gallon (3.8 liters) containers of adhesive, packaged as specified in 5.1, shall be packed in accordance with the applicable requirements of the appendix of PPP-C-96. Five and fifty-five gallon (19 and 208 liters) quantities of adhesive shall be packed in containers as specified in 5.2.1.2.

5.2.2.2 Civil agencies.

5.2.2.2.1 Type I or II. Type I or II adhesive shall be packed in accordance with table IV.

TABLE IV. Packaging and packing - containers - quantities (Civil agencies)

Packaging							
Type I - dry form				Type II - liquid form			
Size	Type	Container	Unit quantity	Size	Can	Filled cans container	Unit quantity
1 pound (0.45 kg)	Flake or ground	PPP-B-566 PPP-B-665 With PPP-B-676 plastic liner	1	4 fl. oz. can (118 ml)	PPP-C-96 type V, class 2	PPP-B-636, class domestic	24
10 pound (4.5 kg)	Flake	UU-S-48 70 lb (32 kg) basis weight pasted bottom	1	1 pt can (470 ml)	PPP-C-96 type V, class 2	PPP-B-636 class domestic	12
				1 qt can (946 ml)	PPP-C-96 type V, class 2		1
				1 gal can (3.8 liters)	PPP-C-96 type V, class 2		1

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TABLE IV. Packaging and packing - containers - quantities (Civil agencies) (cont'd)

Packing						
Type I - dry form				Type II - liquid form		
Size	Type	Container	Shipping quantity	Size	Container	Shipping quantity
1 pound (0.45 kg)	Flake or ground	PPP-B-636, class domestic	48 unit pkgs	4 fl. oz. (118 ml)	PPP-B-636, class domestic w/fiberboard partitions	4 unit pkgs
10 pound (4.5 kg)	Flake	PPP-B-636, class domestic	6 unit pkgs	1 pt (470 ml)	PPP-B-636, class domestic	4 unit pkgs
50 pound (23 kg)	Flake	UU-S-48, 4 - 4X	--	1 qt (946 ml)	PPP-B-636, class domestic.	24 cans
200 pound (91 kg)	Ground	PPP-B-1806, type II PPP-D-723, type I, grade B	--	1 gal (3.8 liter)	PPP-B-636, class domestic	4 cans
300 pound (136 kg)	Flake	PPP-B-1806, type II PPP-D-723, type I, grade B	--			

5.2.3 Level C. Adhesive shall be packed in a manner to insure carrier acceptance and safe delivery at destination at the lowest transportation rate for such supplies. The quantity per shipping container shall be the same as that regularly used by the supplier for retail distribution. Containers shall comply with Uniform Freight Classification or National Motor Freight Classification, as applicable.

5.3 Marking. Marking shall be in accordance with 5.3.1 or 5.3.2, as specified (see 6.2).

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5.3.1 Civil agencies. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with FED-STD-123.

5.3.2 Military requirements. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Type I, grades J1 and J2, adhesive is intended to be used for edge joints in furniture, etc. Type II adhesive is intended to be used for edge joints, veneering, and doweling in furniture. In addition, type II adhesive may be used when short assembly periods or high fabricating temperatures are involved.

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) Type and grade required (see 1.2.1).
- (c) Size of container required (see 5.1 and 5.2).
- (d) Selection of applicable levels of packaging and packing (see 5.1 and 5.2).
- (e) That only one type, style, and size shipping container should be used for any one item for a specific level of shipment (see 5.2.1 and 5.2.2).
- (f) Marking required (see 5.3).

6.3 Bloom gelometer. The Bloom gelometer referenced in 4.3.1.3 may be procured from the Scientific Apparatus Co., Inc., Bloomfield, NJ. A more complete description of the Bloom gelometer and further details in preparing the solutions and making viscosity and jelly-strength tests are given in an article entitled "Standard Methods (revised) for Determining Viscosity and Jelly Strength of Glue," in Industrial and Engineering Chemistry (Analytical Ed. Vol. 2, No. 3, July 15, 1930), pages 348-351.

6.4 Metric equivalents. Metric equivalents, indicated in parentheses throughout this document, are based on practices, conversion factors, and symbols specified in ASTM E 380 Standard for Metric Practice, and are for information only. In each instance, the value stated in US customary units shall be controlling.

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Custodians:

Army - GL
Air Force - 99

Review activities:

Army - MD, MR, EA

Preparing activity:

Army - GL

Civil Agency Coordinating Activities:

GSA-FSS

Project No. 8040-0386

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