

MIL-A-46050C
18 December 1979
SUPERSEDING
MIL-A-46050B
11 December 1970 (see 6.5)

MILITARY SPECIFICATION

ADHESIVES, CYANOACRYLATE, RAPID ROOM-TEMPERATURE CURING, SOLVENTLESS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers solventless, room-temperature curing cyanoacrylate adhesives for use, with or without an activator, when speed of curing is a primary consideration. It also covers the activator which may be used to provide still faster curing and to enable the adhesives to bond to otherwise inhibiting surfaces. These adhesives are used for non-structural applications requiring one-component bonding of small, well-mated surfaces where heat and/or pressure cannot be applied (see 6.1).

1.2 Classification

1.2.1 The adhesives shall be of the following types and classes, as specified (see 6.2 and 6.4):

Type I - Methyl-2-cyanoacrylate
Type II - Ethyl-2-cyanoacrylate
Type III - Isobutyl-2-cyanoacrylate
Type IV - n-Butyl-2-cyanoacrylate

Class 1 - Low viscosity
Class 2 - Medium viscosity
Class 3 - Medium-high viscosity
Class 4 - High viscosity

1.2.2 The surface activators shall be of the following types, as specified (see 6.2):

Type IA - for use with methyl-2-cyanoacrylate
Type IIA - for use with ethyl-2-cyanoacrylate
Type IIIA - for use with isobutyl-2-cyanoacrylate
Type IVA - for use with n-Butyl-2-cyanoacrylate

FSC 8040

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Army Materials and Mechanics Research Center, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1.3 Part Number. Specification part number for items described in this specification will be formulated as shown in section 6.6.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. 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.

STANDARDS

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) Standards:

D 1084 - Viscosity of Adhesives, Test for

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

3. REQUIREMENTS

3.1 Material

3.1.1 Adhesive. Each adhesive shall consist of a suitable alkyl 2- cyanoacrylate monomer compounded to comply with the requirements of this specification applicable to the particular type and class specified.

3.1.2 Surface Activator. The surface activator shall be suitable for the type and class adhesive specified in the instruction sheet (see 3.4).

3.2 Properties of Adhesives

3.2.1 Appearance. All adhesives supplied against this specification shall be homogeneous, colorless, transparent liquids free of lumps, grit and foreign matter.

3.2.2 Viscosity. The viscosities of all adhesive types measured at $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1.1^{\circ}\text{C}$) in accordance with 4.4.1, shall be between the limits specified in Table I.

Table I - Viscosity Limits of Uncured Adhesives

| Viscosity, centipoises (Pa·s) | Class 1 | Class 2 | Class 3 | Class 4 |
|----------------------------------|-----------|------------|------------|--------------|
| Minimum | 1 (0.001) | 70 (0.07) | 400 (0.40) | 4000 (4.0) |
| Maximum | 70 (0.07) | 400 (0.40) | 4000 (4.0) | 10000 (10.0) |

3.2.3 Speed of Cure. Maximum bonding strength of adhesive, with or without activator, shall be attained 24 hours after application at 73°F (23°C) and 50 percent relative humidity for all adherends.

3.2.4 Storage Life. Adhesives shall retain all their original physical properties after 6 months storage in original containers of the type and size specified (see 6.2 and 6.6) when stored between 40 and 73°F (5 and 23°C). A manufacturer's certificate of compliance to this requirement, as described in 4.4.2.3, shall be submitted.

3.3 Properties of Surface Activator

3.3.1 Appearance. When supplied in undiluted form, the activator shall be homogeneous and free of foreign matter, as determined by visual examination.

3.3.2 Activating Ability. The activator shall be capable of accelerating or promoting adhesion as specified in the supplier's instruction sheet, see 3.4.

3.3.3 Storage Life. Surface activators shall retain all their original physical properties after 6 months storage in original, unopened containers when stored at $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1.1^{\circ}\text{C}$). A manufacturer's certificate of compliance to this requirement, as described in 4.4.2.3 shall be submitted.

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3.4 Instruction Sheet. Each shipment of adhesive and surface activator shall be accompanied by one or more, copies of an instruction sheet containing the following information for the type and class adhesive specified in 6.2.

(a) List of adherends recommended for the adhesive or adhesive-activator with typical room-temperature curing times and shear strength values.

(b) List of adherends which are not recommended for bonding with the adhesive or adhesive-activator.

(c) List of chemical environments incompatible with adhesive or adhesive-activator.

(d) Recommended methods of preparing surfaces before bonding.

(e) Recommended storage conditions and shelf life of adhesive and surface activator.

(f) Recommended method of applying adhesive (and activator, if used). Procedures for joining, clamping and curing, including minimum and maximum joint clearances.

(g) Each instruction sheet shall contain a precautionary statement as follows:

"DANGER: HAZARDOUS ADHESIVE

Do not get in eyes, on skin or clothing. Do not breathe vapor. Use with adequate ventilation. Do not use near sparks, heat or open flames. Contact will result in rapid bonding of tissues and may bond skin-to-skin or to other materials.

FIRST AID TREATMENT - In case of accident, flush area (skin, eyes, clothing) with plenty of water. Remove adhesive from skin with paper towels. Eyelids should be held open and the eyes flushed with water. Obtain medical attention for oral or eye contact. Repeated soaking in warm water may hasten loosening of polymerized adhesive."

3.5 Suitability for Use with Explosives. When suitability (of either the adhesive or the activator) for use with a particular explosive or propellant is required, a special test shall be conducted at a designated Government laboratory to determine compliance of the material. The procuring activity shall request this test to be conducted and shall specify the particular explosive or propellant to be used, the temperature and time of contact, and the testing laboratory (see 6.2 and 6.3).

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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. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Inspection. Inspection shall consist of the examinations of 4.3 and the tests of 4.4. Unless otherwise specified (see 4.2.1, 4.2.2, and 6.2), these inspections shall be conducted on each lot of adhesive and of activator supplied against this specification and shall constitute the basis of acceptance or rejection of the lot.

4.2.1 Sampling for Inspection. Sampling for inspection shall be performed in accordance with the provisions set forth in MIL-STD-105, except where otherwise indicated. For the purpose of sampling, an inspection lot of adhesives and activator for tests by the manufacturer shall consist of all adhesive and activator of the same type, class and manufacturer's designation, made by the same process, and submitted for inspection at the same time. An inspection lot of packaged adhesive and activator, which may be a subplot of the above for examination and testing, shall consist of that portion of the same adhesive and activator which has been packaged in the same type and size of container. Unless otherwise specified, once a lot of adhesive or activator has been tested for certain properties and has been found to conform to the corresponding requirements, sublots of that adhesive or activator, packaged in different types or sizes of containers, need not be retested by the manufacturer for those properties except for certification of storage life. However, the Government reserves the right to check test any such subplot for any or all properties. Unless otherwise specified, once a lot of packaged adhesive or activator has been completely inspected and found to be satisfactory, portions of that lot may be shipped to different customers without additional inspection.

4.2.2 Sampling for Tests

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4.2.2.1 Adhesive. A one-ounce (28-g) or larger sample of the adhesive shall be selected at random from the lot for the tests of 4.4.1, 4.4.2.1 and 4.4.4. When the testing is to be performed by the manufacturer, the lot shall be a lot of adhesive, as defined in 4.2.1. For verification testing by the purchaser, the lot shall be a packaged lot, as defined in 4.2.1, and the results shall be considered applicable only to that packaged lot. The manufacturer shall store and test each type and size container of adhesive for which he wishes to certify storage life.

4.2.2.2 Surface Activator. One unit container of activator shall be selected at random from the lot of activator for the tests of 4.4.2.2, 4.4.3 and 4.4.4 (see 6.2 and 6.3).

4.2.3 Sampling for Examination. Unless otherwise specified, samples of filled containers from each packaged lot of adhesive and activator (see 4.2.1) shall be selected in accordance with MIL-STD-105 at inspection level 1. The lot size for use in determining the sample size in accordance with MIL-STD-105 shall be expressed in number of unit containers for examination for defects of material and container, and in number of boxes for packing defects.

4.3 Examination. The sample of 4.2.3 shall be examined for the defects of Tables II and III, as applicable, against an AQL of 4.0 percent defective, except for the safety markings where the AQL of 1.5 percent defective is applicable.

Table II - Examination of Adhesive

| Examine | Requirement Reference | Defect | Method of Inspection |
|----------------|-----------------------|--|----------------------|
| Adhesive | 3.2.1 | Transparency | Visual |
| Unit Container | 5.1.2, 5.3, 5.3.1 | Applicator inoperable | (1) |
| | | Closing cap does not open without damaging container | Manual |
| | | Improper type | Visual |
| | | Improper size | Visual |
| | | Improper closure | Visual |
| | | Damaged or leaking | Visual |
| | | Improper weight | (2) |
| | | Label missing or improper marking | Visual |

Table 11 - Examination of Adhesive (cont'd)

| Examine | Requirement Reference | Defect | Method of Inspection |
|--------------|-------------------------|---|--|
| Package | 5.1.2, 5.3, 5.3.1 | Contains fewer than specified or stated no. of unit containers Improper type Damaged Improperly closed Improper marking | Visual Visual Visual Visual Visual |
| Boxes open | 5.2 | Improper type Improper size Not properly packed | Visual Visual Visual |
| Boxes closed | 5.2, 5.3, 5.3.1 | Loose or improper strapping Improperly closed Improper marking | Visual Visual Visual |
| Shipment | 3.4 6.2 3.2.4 | Instruction sheet missing, improper, insufficient no. of copies Certificate, missing or improper | Visual Visual Visual |

(1) When the container is equipped with a brush, wick, or ball applicator, the applicator shall be rubbed on a clean surface to determine whether it is functional. Satisfactorily examined containers may be returned to the lot. Containers having a sealed dispensing tip shall not be subjected to this examination.

(2) The minimum weight of filled bottles shall be determined by weighing a filled bottle with known content and comparing this weight with the weights of bottles being inspected. Containers of one-third ounce (9 g) to 1-ounce (28 g) nominal capacity, if packed several to a carton, may be weighed together in the carton in the same manner. The Government reserves the right to require calibration and approval of the weighing instrument.

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Table 111 - Examination of Surface Activator

| Examine | Requirement Paragraph | Defect | Method of Examination |
|------------------------|-----------------------|---|-----------------------|
| Activator | 3.3.1 | Not homogeneous, contains foreign matter | Visual |
| Container of Activator | 5.3 5.3.2 | Container damaged; Not properly labeled | Visual |
| Shipment | 3.4 | Instruction Sheet missing, improper, insufficient no. of copies | Visual |
| | 3.3.3 | Certificate, missing or improper | Visual |

4.4 Test Methods

4.4.1 Viscosity. Test for viscosity in accordance with method B of ASTM D 1084. Use a Brookfield Viscometer, Model LVF or equivalent equipment. Where the sample size is very small, (2 to 10 ml), use a Brookfield Viscometer Small Sample Adapter or equivalent equipment. When testing Class 1, a Brookfield Ultra-Low Viscosity Adapter or Equivalent equipment should be used.

4.4.2 Storage Life.

4.4.2.1 Adhesive. A sample of the adhesive (see 4.2.2.1) packaged in unit containers of the type and size specified (see 6.2) shall be stored for a period of 6 months from date of packaging at the temperature specified in 3.2.4. The stored sample then shall be examined for conformance to 3.2.1 (see 4.3), the ability of the container to be opened and for the operation of the applicator, and tested for viscosity (see 4.4.1).

4.4.2.2 Surface Activator. One unit of activator packaged in the supplier's standard manner shall be stored for a period of 6 months from date of packaging at the temperature specified in 3.3.3. The stored sample shall then be examined for conformance to 3.3.1 and tested to comply with 4.4.3.

4.4.2.3 Certificate. A supplier's certificate of conformance to the storage life requirement shall state that the adhesive and/or activator was prepared from the same type and proportions of ingredients, by the same processing techniques, and packaged in the same type of container which was stored and tested in accordance with 4.4.2 and found to conform to the specified requirements. The lot number of the adhesive and/or activator from which the tested sample was taken, the dates of packaging and of testing, and the results obtained shall be reported or reference shall be made to a previous certificate giving this information. The certificate shall be signed by a responsible agent of the certifying organization and shall be accompanied by evidence of that agent's authority to bind his principal.

4.4.3 Surface Activator. The activator shall produce curing times and adhesive strengths as specified for the various adherends on the supplier's information sheet when tested in accordance with those test methods (see 3.4).

4.4.4 Suitability for Use With Explosives. See 3.5 and 6.3.

5. PREPARATION FOR DELIVERY

5.1 Packaging

5.1.1 Level A. Not applicable.

5.1.2 Level C. Unless otherwise specified (see 6.2), the adhesive shall be packaged with dispensing tips, holding net weights of 1/3, 1/2, 1, 4 and 16 oz (9, 14, 28, 113 and 454 g). All containers shall be packaged in individual or multiple folding or setup cartons. Each carton shall be closed and sealed to prevent accidental opening. Containers without individual cartons overpacked in multiple unit cartons, shall be separated by spacers. Unless otherwise specified, activator shall be packaged in the supplier's standard manner.

5.2 Packing

5.2.1 Level A. Not applicable.

5.2.2 Level C. Packing shall be in accordance with commercial practice adequate to ensure acceptance and safe delivery by the carrier for the mode of transportation employed.

5.3 Marking. All interior and exterior containers of adhesive and activator shall be marked in accordance with MIL-STD-129.

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5.3.1 Marking of Adhesive. Each one-ounce (28-g) bottle of adhesive, and over, shall bear a label warning against contact with skin tissue; advising adequate ventilation; and caution to keep away from children. It should also state, in case of body contact, to flush with water and to get medical attention for oral or eye contact. Each carton of smaller unit containers shall be marked with the same warning statement. In addition, each intermediate carton and each shipping box shall be marked as follows:

(a) Store in a cool, dry place.

(b) Packaging date.

5.3.2 Marking of Activator. In addition to the other markings required by 5.3, all interior and exterior containers of activator shall be marked either with the chemical name and manufacturer of the material or with the supplier's brand name. Containers of diluted activator also shall be marked with the chemical name of the diluent and the packaging date.

6. Notes

6.1 Intended Use. These adhesives, with or without an activator, should be used where rapid, room-temperature setting and curing are desirable and where heat and/or pressure cannot be applied. They are normally used to adhere plastics, elastomers, metals and combinations of these. Generally, Type I is preferred for metal-to-metal applications and Type II for rubber, plastics and rubber/plastics-to-metal applications. See manufacturer's instruction sheet (3.4) for specific adherends for each type.

6.1.1 This material shall not be used for adhesive bonds in aerospace vehicles for primary or secondary structures where the adhesive is expected to perform a structural function.

6.1.2 Setting time is viscosity related. Lower viscosities will set more rapidly than higher viscosities. (Class 1 will set more rapidly than Class 2 or 3). Not all types may be commercially available in all classes.

6.2 Ordering Data. Procurement documents should specify the following for the adhesive or adhesive-activator:

(a) Title, number and date of this specification.

(b) Definitive Specification Part Number (see 1.3 and 6.6).

(c) Quantity required.

(d) Type of dispensing tip (see 5.1.2).

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(c) Suitability for use with explosives, if required (see 3.5 and 6.3).

(f) Number of additional copies of instruction sheet, if required (see 3.4).

6.3 Suitability For Use With Explosives. Information concerning the suitability of many materials for use with various explosives and chemicals under various conditions is on file at U.S. Army Armament Research and Development Command (U.S. ARRADCOM). Procuring activities desiring information on this subject should first contact U.S. ARRADCOM, Dover, New Jersey, 07801, ATTN: Organic Materials Branch, Large Caliber Weapon Systems Laboratory, LCA-0A, to determine whether the information is already available. Indications are that the activators covered by this specification are more likely to be reactive with explosives than are the adhesives.

6.4 Changes From Previous Issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

6.5 Supersession Data. The relationship of Types and Classes between MIL-A-46050B and MIL-A-46050C is as follows:

MIL-A-46050BAdhesives

Type I

Class 1

Class 2

Type II

Class 1

Surface Activators

none

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Type I

Class 1

Class 2

Class 3 (new)

Class 4 (new)

Type II

Class 1

Class 2

Class 3 (new)

Class 4 (new)

Type III

Class 1

Class 2

Class 3 (new)

Class 4 (new)

none

Type IV (new)

All New Designations

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6.6 Definitive Specification Part Number. The specification part number is a definitive part number which will be formulated to identify each item covered by this specification. The part number will be formulated by selecting from the requirements options available in this specification as follows:

Definitive Military Specification Part Number M46050 - X - X - XX

| | |
|--|--|
| Military Specification Number | |
| Adhesive Type Designator (see 6.6.1) | |
| Adhesive Class Designator or adhesive activator type (see 6.6.2) | |
| Size Designator (see 6.6.3) | |

6.6.1 Type Designator. A one character code derived from the following table:

| Code | Remarks (see 1.2.1) |
|------|---------------------|
| A | Type I |
| B | Type II |
| C | Type III |
| D | Type IV |

6.6.2 Adhesive class or activator designator. A one character code derived from the following table:

| Code | Remarks |
|------|-----------------------|
| 1 | Class 1 (see 1.2.1) |
| 2 | Class 2 (see 1.2.1) |
| 3 | Class 3 (see 1.2.1) |
| 4 | Class 4 (see 1.2.1) |
| A | Type IA (see 1.2.2) |
| B | Type IIA (see 1.2.2) |
| C | Type IIIA (see 1.2.2) |
| D | Type IVA (see 1.2.2) |

6.6.3 Size Designator. A two character code to be used to identify the size of the requested item. The code will be derived from the following table:

| Code | Remarks |
|-------|---|
| 01-16 | Identifies the number of ounces from 1-16 |
| 33 | Denotes 1/3 of an ounce |
| 50 | Denotes 1/2 of an ounce |

Sample Definitive Part Numbers:

| <u>Description of Item</u> | <u>Definitive Part Number</u> |
|--|-------------------------------|
| 5 ounces, Type 1, Class 1, Adhesive | M46050-A-1-05 |
| 1/2 ounce Type 1A Activator | M46050-A-A-50 |

Custodians:

Army - MR
Air Force - 11

Review Activities:

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User Activities:

Army - AR, ME
Air Force - 99
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Army - MR

Civil Agency Coordinating Activities

CSA-FSS

(Project No. 8040-0355)

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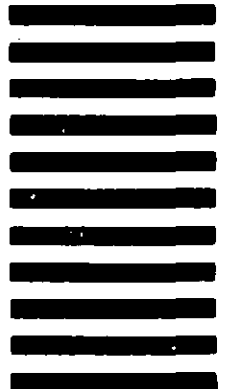
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