INCH-POUND
MIL-DTL-3316D
24 March 2020
SUPERSEDING
MIL-A-3316C
20 October 1987

DETAIL SPECIFICATION

ADHESIVES, FIRE-RESISTANT – FOR THERMAL INSULATION

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

1. SCOPE

1.1 Scope. This specification covers fire-resistant adhesives for securing cloth and tape to thermal insulations and for securing thermal insulations to metal surfaces.

1.2 Classification. The adhesives are of the following classes and grades, as specified (see 6.2).

1.2.1 Classes. Classes of adhesives are as follows:

a. Class 1 – For bonding fibrous glass cloth to unfaced fibrous glass insulation, sealing the edges of and bonding fibrous glass tape to the joints of fibrous glass board, and bonding lagging cloth to thermal insulation.

b. Class 2 – For attaching fibrous glass insulation to metal surfaces.

c. Class 3 – For attaching cork and fibrous glass insulation board to metal surfaces.

1.2.2 Grades. Grades of adhesives are as follows:

a. Grade A – Pigmented white.

b. Grade B – Pigmented red (sealer coating to identify asbestos-free system).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-20079	-	Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line “Document Comment”. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 8040

MIL-DTL-24607 - Enamel, Interior, Nonflaming (Dry), Chlorinated Alkyd Resin, Semigloss

MIL-DTL-32585 - Insulation, Thermal and Acoustic, Fibrous Glass

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1916 - DoD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at https://quicksearch.dla.mil.)

2.2.2 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 of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9510-AB-ATM-010 - Nuclear Powered Submarine Atmosphere Control Manual

(Copies of the chapter titled "Material Control Program" are available by email request to CommandStandards@navy mil.)

T9070-AK-DPC-010/078-1 - Composite Materials, Surface Ships, Topside Structural and Other Topside Applications – Fire Performance Requirements

T9070-AL-DPC-020/077-2 - NAVSEA Hazardous Material Avoidance Process

(Copies of these documents are available online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis navy mil/ by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. These documents are available for ordering (hard copy) via the Naval Logistics Library (NLL) at https://nll navsup navy mil. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy.mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D217 - Standard Test Methods for Cone Penetration of Lubricating Grease

ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings

ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

ASTM D823 - Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings and Related Products on Test Panels

ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

ASTM D1475 - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products

ASTM D2196 - Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer

ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints

ASTM D3891 - Standard Practice for Preparation of Glass Panels for Testing Paint, Varnish, Lacquer, and Related Products

ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

(Copies of these documents are available online at www.astm.org.)

INTERNATIONAL MARITIME ORGANIZATION (IMO)

Fire Test Procedures (FTP) Code - International Code for Application of Fire Test Procedures

(Copies of this document are available online at www.imo.org.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories

(Copies of this document are available online at www.iso.org.)

SAE INTERNATIONAL

SAE-AMS-STD-595/31158 - Colors Used in Government Procurement; Red, Flat (Light Red International)

(Copies of this document are available online at www.sae.org.)

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T 803 - Puncture Test of Container Board

(Copies of this document are available online at www.tappi.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, 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 that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Material. The adhesive shall meet the requirements herein without heating or the addition of other ingredients and shall be free of all ingredients that may adversely affect serviceability, have a deleterious effect on thermal insulation and fibrous glass cloth, or corrode bare steel in adhesion tests or primed steel in service. Adhesives shall not contain mercury or mercury compounds and shall be asbestos free.

3.3 Stability.

3.3.1 Storage stability. The adhesives shall meet all of the requirements specified herein when tested as specified in 4.6.3.1.

3.3.2 Freeze-thaw stability. The adhesive shall meet the requirements specified herein when tested as specified in 4.6.3.2.

3.4 Toxicity. When evaluated in accordance with 4.6.4, the adhesive shall pose no serious or high risk to the health of personnel or the environment when used for its intended purpose (see 4.6.4 and 6.7).

3.5 Prohibited materials. The adhesive shall not contain any chemicals categorized as “prohibited” in accordance with T9070-AL-DPC-020/077-2.

3.6 Off-gassing. The adhesive shall be evaluated for off-gassing in accordance with the requirements of 4.6.6. Based on the circumstances of use and the chemical nature of the adhesive, the Navy will determine whether off-gas testing is required or if an administrative assessment is acceptable. In order to be considered acceptable for use in submarines, the adhesive shall be assigned to either the "Permitted" or "Limited" category (see 4.6.6 and 6.8).

3.7 Flash point.

3.7.1 Class 1 adhesive. The flash point of class 1 adhesive shall be higher than 110 °F when tested as specified in 4.6.7.

3.7.2 Classes 2 and 3 adhesives. The flash points of classes 2 and 3 adhesives shall be higher than 80 °F when tested as specified in 4.6.7.

3.8 Consistency.

3.8.1 Class 1 adhesive. The consistency of class 1 adhesive at 80 °F, after it has been stirred moderately by hand, shall be appropriate for both brush and hand application to the surface of faced and unfaced fibrous glass insulation board conforming to type I, form 1 of MIL-DTL-32585 and to the surface of fibrous glass cloth conforming to type I, class 2 of MIL-C-20079. The consistency of the adhesive shall be not less than 50,000 or more than 150,000 centipoise (cP) units when tested as specified in 4.6.8.1.

3.8.2 Class 2 adhesive. The consistency of class 2 adhesive shall be not less than 90 or more than 130 Krebs units when tested as specified in 4.6.8.2.

3.8.3 Class 3 adhesive. The consistency of class 3 adhesive shall be such as to allow a cone penetration average of not less than 25 or more than 35 millimeters (mm) (1 or more than 1.4 inches) when tested as specified in 4.6.8.3.

3.9 Coverage and finished weight (class 1 adhesive only). Each specimen of class 1 adhesive shall provide not less than 30 square feet of coverage per gallon when prepared as specified in 4.6.9. The finished weight of the covering for each specimen shall be not more than 5.35 ounces per square foot of application.

3.10 Adhesive strength.

3.10.1 Strength before drying (class 1 adhesive only). When tested as specified in 4.6.10.1, the strength of the adhesive before drying shall be sufficient to prevent fibrous glass cloth from peeling away more than 1 inch at any point from the faced and unfaced surfaces of vertically-mounted fibrous glass insulation board and from the lower faced and unfaced surfaces of horizontally-mounted fibrous glass insulation board.

3.10.2 Drying time and stripping strength.

3.10.2.1 Class 1 adhesive. Class 1 adhesive shall dry to touch within a period of 48 hours and shall have an average adhesive strength of not less than 3 pounds when tested as specified in 4.6.10.2.1.

3.10.2.2 Classes 2 and 3 adhesives. Classes 2 and 3 adhesives shall have an adhesive strength of not less than 300 grams (0.66 pounds) when tested as specified 4.6.10.2.2.

3.11 Color.

3.11.1 Class 1, grade A adhesive. Class 1, grade A adhesive shall be white in color when examined as specified in 4.6.11.1.

3.11.2 Class 1, grade B adhesive. Class 1, grade B adhesive shall be in accordance with SAE-AMS-STD-595/31158 when examined as specified in 4.6.11.2.

3.12 Flexibility. The adhesive shall not develop cracks deep enough to expose the substrate when tested as specified in 4.6.12. Cracks occurring at either end and extending not more than ¼ inch shall be disregarded.

3.13 Washability (class 1 adhesive only). The adhesive shall be washable to the extent that there shall be no definite break-through or detachment of the adhesive when tested as specified in 4.6.13.

3.14 Paintability (class 1 adhesive only). The adhesive shall not discolor or bleed through enamel conforming to MIL-DTL-24607, shall not crack or craze the enamel, and shall be compatible with the enamel when tested as specified in 4.6.14.

3.15 Fire performance.

3.15.1 Surface flammability. The adhesive shall meet the following surface flammability requirements when tested as specified in 4.6.15.2:

a. Critical flux at extinguishment (CFE) shall be equal to or greater than 20 kilowatts (kW) per square meter.

b. Heat for sustained burning (Qsb) shall be equal to or greater than 1.5 megajoules (MJ) per square meter.

c. Total heat release (Qt) shall be less than or equal to 0.7 MJ.

d. Peak heat release rate (Qp) shall be less than or equal to 4 kW.

e. No melting, dripping, or flaming droplets shall be evident.

3.15.2 Smoke density. The maximum smoke density of the adhesives shall be equal to or less than 150 in both non-flaming and flaming modes when tested as specified 4.6.15.3. No melting, dripping, or flaming droplets shall be evident.

3.15.3 Fire gas toxicity. The adhesives shall meet the fire gas toxicity requirements in accordance with T9070-AK-DPC-010/078-1, except the limit for carbon monoxide shall be 600 parts per million. Maximum gas concentrations in both flaming and non-flaming modes shall be measured during the smoke density testing (see 3.15.2) when tested as specified in 4.6.15.4.

3.15.4 Vertical specimen test. There shall be no residual flame or continuous burning of any specimen for more than 3 seconds after the test flame is extinguished when tested as specified in 4.6.15.5.

3.15.5 Horizontal panel test.

3.15.5.1 Class 1 adhesive. When class 1 adhesive is prepared and tested as specified in 4.6.15.6.1 and 4.6.15.6.3, no sustained flaming shall issue from any specimen. Any flame that occurs shall be limited to intermittent short flames from the area directly exposed to the test flames. No flame or glow from the specimen shall reach the angle frame at any point during or after the test period. Flaming shall not continue more than 2 minutes after the burner flame is extinguished. At no time during the test period shall any piece of the specimen having an area greater than 10 square inches fall from the specimen.

3.15.5.2 Classes 2 and 3 adhesives. When classes 2 and 3 adhesives are prepared and tested as specified in 4.6.15.6.2 and 4.6.15.6.3, no sustained flaming shall issue from any specimen and specimens shall not smolder after that test. When the insulation board is pulled off the steel plate, the separation shall occur within the fibrous glass insulation rather than at the glue-line.

3.16 Puncture resistance (class 1 only). The puncture resistance of the finished covering shall be not less than 800 inch-ounces per inch of tear when tested as specified in 4.6.16.

3.17 Workmanship. The adhesive shall be free from grit, lumps, and skins when examined as specified in 4.6.17.

3.18 Unit container content. The unit container shall contain not less than the capacity specified (see 4.6.18 and 6.2).

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification tests shall be conducted at a laboratory acceptable to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall consist of the examinations and tests of 4.6.2 through 4.6.18 as specified in table I.

4.2.1 Periodic retention of qualification. To maintain qualification, inspection for retention of qualification shall be conducted every 3 years at a laboratory acceptable to NAVSEA. Inspection for retention of qualification shall consist of the examinations and tests specified in table I.

4.3 Conformance inspection. Each lot of adhesive offered for acceptance shall undergo conformance inspection, which shall consist of the examinations and tests specified in table I. Test conditions shall be as specified in 4.5 and 4.6 or the applicable test paragraph.

TABLE I. Qualification, conformance, and retention inspections.

Characteristic	Requirements			Inspection procedures			Sample units to be tested (4.4.2)	Qual-ification inspection (4.2)	Conf-ormance inspection (4.3)	Retention inspection (4.2.1)
	Adhesive class			Adhesive class						
	1	2	3	1	2	3				
Materials	3.2	3.2	3.2	4.6.2	4.6.2	4.6.2	N/A	X	-	- 1/
Storage stability	3.3.1	3.3.1	3.3.1	4.6.3.1	4.6.3.1	4.6.3.1	N/A	X	-	-
Freeze-thaw stability	3.3.2	3.3.2	3.3.2	4.6.3.2	4.6.3.2	4.6.3.2	1, 2, 3	X	-	X
Toxicity	3.4	3.4	3.4	4.6.4	4.6.4	4.6.4	2	X	-	- 1/
Prohibited materials	3.5	3.5	3.5	4.6.5	4.6.5	4.6.5	N/A	X	-	- 1/
Off-gassing	3.6	3.6	3.6	4.6.6	4.6.6	4.6.6	1, 2, 3	X	-	- 1/
Flash point	3.7.1	3.7.2	3.7.2	4.6.7	4.6.7	4.6.7	2	X	X	X
Consistency	3.8.1	3.8.2	3.8.3	4.6.8.1	4.6.8.2	4.6.8.3	1, 2, 3	X	X	X
Coverage and finished weight	3.9	-	-	4.6.9	-	-	1, 2, 3	X	-	- 1/
Adhesive strength	3.10.1 3.10.2.1	3.10.2.2	3.10.2.2	4.6.10.1 4.6.10.2.1	4.6.10.2.2	4.6.10.2.2	2	X	X	X
Color	3.11	-	-	4.6.11	-	-	2	X	X	X
Flexibility	3.12	3.12	3.12	4.6.12.1 4.6.12.3	4.6.12.2 4.6.12.3	4.6.12.2 4.6.12.3	2	X	X	X
Washability	3.13	-	-	4.6.13	-	-	2	X	-	-
Paintability	3.14	-	-	4.6.14	-	-	2	X	-	-
Surface flammability	3.15.1	3.15.1	3.15.1	4.6.15.2	4.6.15.2	4.6.15.2	2	X	-	X 2/
Smoke density	3.15.2	3.15.2	3.15.2	4.6.15.3	4.6.15.3	4.6.15.3	2	X	-	- 1/
Fire gas toxicity	3.15.3	3.15.3	3.15.3	4.6.15.4	4.6.15.4	4.6.15.4	2	X	-	- 1/
Vertical specimen test	3.15.4	3.15.4	3.15.4	4.6.15.5	4.6.15.5	4.6.15.5	2	X	X	X
Horizontal panel test	3.15.5.1	3.15.5.2	3.15.5.2	4.6.15.6.1 4.6.15.6.3	4.6.15.6.2 4.6.15.6.3	4.6.15.6.2 4.6.15.6.3	2	X	-	X
Puncture resistance	3.16	-	-	4.6.16.1 4.6.16.2	-	-	2	X	-	- 1/
Workmanship	3.17	3.17	3.17	4.6.17	4.6.17	4.6.17	1, 2, 3	X	X	X
Unit container content	3.18	3.18	3.18	4.6.1 4.6.18	4.6.1 4.6.18	4.6.1 4.6.18	1, 2, 3	X	X	X

NOTES:

1/ Testing applies to retention inspection only if the adhesive composition has changed in any way.

2/ Provided the adhesive composition has not changed in any way, NAVSEA will accept a United States Coast Guard (USCG)/IMO certificate of compliance in lieu of retention testing.

4.4 Sampling.

4.4.1 Lot. An inspection lot shall consist of all adhesive processed in one batch and offered for delivery at one time.

4.4.2 Sampling for quality of adhesive. Sampling, except for the examination of filled containers, shall consist of three 1-quart sample units from each batch taken from the pouring station of the batch-mixing tank. The tank shall be stirred until the adhesive is thoroughly mixed. To assure that the adhesive is thoroughly mixed, the 1-quart samples shall be taken in the following units:

a. The first sample shall be taken as emptying of the tank begins (unit number 1).

b. The second sample shall be taken when the tank is half empty (unit number 2).

c. The third sample shall be taken when the tank is nearly empty (unit number 3).

The samples shall be tested as specified in table I. Should any sample fail in any test, the entire lot shall be rejected.

4.4.3 Sampling for examination of filled containers. A random selection of filled containers shall be selected in accordance with MIL-STD-1916 at inspection level I with the Acceptance Quality Limit (AQL) specified (see 6.2). Examination shall be as specified in 4.6.18.

4.4.4 Rejected lots for examination. Any lot rejected in accordance with the sampling plan may nevertheless be accepted by examination of all unit containers in the lot and removal of all defective units.

4.5 Test temperature and humidity conditions. Unless otherwise specified herein, drying, curing, conditioning, and testing during the inspections specified in 4.6.1 through 4.6.18 shall be conducted at room temperature (approximately 75±5 °F) and at a relative humidity of 50±20 percent.

4.6 Tests.

4.6.1 Weight per gallon. A 1-quart container of adhesive taken from sample unit number 2 shall be thoroughly mixed. The weight per gallon of its contents shall be determined in accordance with ASTM D1475 for use in the calculation specified in 4.6.18.

4.6.2 Materials. Materials shall be verified for conformance to 3.2 via a certificate of compliance as required by the qualifying activity.

4.6.3 Stability.

4.6.3.1 Storage stability. The adhesive shall be stored for 6 months in an airtight container. At the end of this period, the adhesive shall be inspected as specified in 4.6.7, 4.6.8, 4.6.10, 4.6.11, 4.6.12, 4.6.13, 4.6.14, 4.6.15.2, 4.6.15.3, and 4.6.17.

4.6.3.2 Freeze-thaw stability. The freeze-thaw stability test shall be performed prior to the inspections specified in 4.6.7 through 4.6.17. The three 1-quart containers of the sample shall be subjected to a temperature of 16±2 °F for 16 hours and then allowed to return to room temperature (approximately 75±5 °F). The sample shall be mixed thoroughly at low speed just prior to performance of the remaining tests and examinations and shall meet the requirements for each individual test.

4.6.4 Toxicity. A Health Hazard Assessment (HHA) will be conducted to ensure conformance to 3.4 as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the adhesive using data provided by the manufacturer/distributor to the NMCPHC (see 3.4 and 6.7).

4.6.5 Prohibited materials. Prohibited materials shall be verified for conformance to 3.5 as required by the qualifying activity.

4.6.6 Off-gassing. The adhesive shall be evaluated for off-gassing in accordance with S9510-AB-ATM-010 chapter titled "Material Control Program" (see 3.6 and 6.8). If the Navy determines that off-gas testing is required, testing shall be conducted at a NAVSEA approved test facility (see 3.6). The Navy will review the off-gas test results and assign a usage category. Additionally, the Navy will assign a usage category if an administrative review is conducted in lieu of off-gas testing (see 3.6).

4.6.7 Flash point. The flash points of classes 1, 2, and 3 adhesives shall be determined in accordance with ASTM D92. Throughout the test, the adhesive shall be stirred sufficiently to prevent skimming or surface segregation.

4.6.8 Consistency.

4.6.8.1 Class 1 adhesive. The consistency of class 1 adhesive shall be determined by using a Brookfield viscometer, or equal, in accordance with ASTM D2196. The viscometer shall be supplied with a helipath attachment and T-bar (sizes A through F) or disc-type spindles. The adhesive sample shall be penetrated with the spindle to ¼ inch. The viscometer shall then be turned on to a speed of 2.5 revolutions per minute (r/min) to allow the spindle to rotate. The helipath attachment shall then be turned on and dial readings of each revolution through the downward and upward strokes shall be recorded. The helipath shall then be turned off and the spindle speed increased to 5 r/min to allow the spindle to rotate. The helipath attachment shall be turned on again and dial readings of each revolution through the downward and upward strokes shall be recorded. Dial readings shall be multiplied by the appropriate factor to obtain the viscosity readings in cP. A minimum of 10 viscosity readings shall be averaged to obtain the adhesive viscosity.

4.6.8.2 Class 2 adhesive. The consistency of class 2 adhesive shall be determined in accordance with ASTM D562.

4.6.8.3 Class 3 adhesive.

4.6.8.3.1 Apparatus. The apparatus used to test the viscosity of class 3 adhesive shall be as specified in ASTM D217, except that the total weight of the cone and rod shall be 0.165 pounds (75 grams).

4.6.8.3.2 Procedure. The open cup portion of the grease-worker shall be filled with the well-mixed sample at a temperature of 77±1 °F. A straightedge shall be drawn across the surface of the sample to remove any excess material and to present a smooth surface. The apparatus shall be leveled and the plunger lowered until the tip of the penetrometer cone just touches the surface of the sample. The seal shall then be adjusted so the scale-actuating device is in contact with the top of the rod holding the penetrometer cone, and the scale reading shall be recorded. The plunger shall be released suddenly and kept released for 5 seconds. The scale-actuating device shall be moved until it is in contact with the top of the rod holding the penetrometer cone, and the scale reading shall be recorded. The penetration is the difference between the two readings. Five tests shall be made and the average recorded. Tests shall be performed with sufficient rapidity to guard against non-uniformity due to evaporation or skimming. The sample shall be smoothed over before each test.

4.6.9 Coverage and finished weight (class 1 adhesive only). A prime coat of adhesive shall be applied to the facing of a 1-square-foot section of fibrous glass insulation board conforming to type I, form 1 of MIL-DTL-32585. A 1-square-foot piece of fibrous cloth conforming to type I, class 2 of MIL-C-20079 shall then be immediately superimposed upon the primed surface of each board and hand-troweled smooth to eliminate air pockets. A finish coat of adhesive shall be brushed over the glass cloth. Each specimen shall be weighed before and after application of the adhesive. The volume of the adhesive coat in each specimen shall be calculated by dividing the difference in specimen weight before and after application of the adhesive by the density of the adhesive. The area of the coated surface of the specimen shall then be divided by the volume to obtain the coverage in square feet per gallon.

4.6.10 Adhesive strength.

4.6.10.1 Strength before drying (class 1 adhesive only). A 1-square-foot section of type I fibrous glass insulation board and a 1-square-foot section of type II fibrous glass insulation board, both conforming to MIL-DTL-32585, shall each be mounted vertically. Two sections of insulation board identical to the vertically-mounted boards shall be mounted horizontally so that the facing of the type I board is down. A prime coat of adhesive shall then be applied at the same coverage used in 4.6.9 to one side of each of the vertically-mounted boards and to the lower side of each of the horizontally-mounted boards. The adhesive shall be allowed to set for a period ending 5 minutes after the application of the adhesive was started. After the end of that period, and prior to the completion of an additional 5-minute period, a 1-square-foot piece of fibrous glass cloth conforming to type I, class 2 of MIL-C-20079 shall be superimposed upon the primed surface of the specimen and hand-troweled smooth to eliminate air pockets, a finish coat of the adhesive shall be brushed onto the fibrous glass cloth at the same coverage used in 4.6.9, and the fibrous glass cloth shall be peeled back 1 inch from each of two opposite sides of the specimen. At the end of that additional 5-minute period, the fibrous glass cloth shall be allowed to stand without the aid of shoring, pinning, or other mechanical devices and shall be examined for separation from the insulation board.

4.6.10.2 Drying time and stripping strength.

4.6.10.2.1 Class 1 adhesive. The facing of a 1-square-foot section of type I fibrous glass insulation board conforming to MIL-DTL-32585 shall be cleaned with solvent (for example, a mixture of equal parts of xylol, methyl ethyl ketone [MEK], and alcohol) to remove possible contaminants. The board, while still wet, shall be wiped with a clean, dry cloth to assure removal of the contaminants. Time shall be allowed for the board to dry thoroughly. A 12- by 6-inch area of the facing of the board shall be coated with the adhesive to an approximate thickness of 1/32 inch, leaving a 12- by 6-inch area uncoated. After the adhesive has dried for 5 minutes, a 1-square-foot piece of fibrous glass cloth conforming to type I, class 2 of MIL-C-20079 shall be superimposed on the facing of the board and pressed and troweled sufficiently to extrude the adhesive through the interstices. The adhered half of the cloth shall then be given a finish coat, which shall be scraped off down to the fabric to remove excess adhesive. Forty-eight hours after application, the adhesive shall be visually inspected for dryness. If the adhesive is not dry, an additional 12 hours of drying time shall be allowed. The facing of the insulation board shall then be carefully sliced away from the fibrous glass cloth. The bonded assembly of the fibrous glass facing and fibrous glass cloth shall then be cut to provide five strips 2 inches wide and 12 inches long. A strip-adhesion test of each strip shall be conducted in accordance with ASTM D903. If the fibrous glass insulation board requires additional treatment prior to the adhesive strength test, the facing of the board shall be primed with a brushed-on coat of a small portion of adhesive that has been thinned for this purpose. This coat shall be dried for 72 hours.

4.6.10.2.2 Classes 2 and 3 adhesives. Six bare 16-gauge cold-rolled steel plates, 5 by 10 inches each, shall be cleaned with solvent (for example, a mixture of equal parts of xylol, MEK, and alcohol) to remove any rust, grease, and contaminants. The steel plates shall be coated with adhesive to approximately 1/32-inch thickness and allowed to set until tacky, but not longer than 15 minutes. Six 3- by 12-inch pieces of bonded fibrous glass insulation conforming to type I, form 2, facing A of MIL-DTL-32585 shall then be applied to the coated steel plates and allowed to dry for 24 hours. Three of these specimens shall be aged at 194±5 °F for 24 hours. Within 6 to 24 hours after removal from the oven, all six specimens shall be supported in a horizontal position with the bonded fibrous glass side down and a 300-gram (0.66-pound) weight suspended from the free end of the insulation for 10 minutes. If failure occurs in the glass insulation, a retest shall be made with specimens of insulation selected for higher strength.

4.6.11 Color.

4.6.11.1 Color (class 1, grade A adhesive). The specimens prepared for the tests specified in 4.6.10.1 shall be examined to determine the color of dry class 1, grade A adhesive. The adhesive color shall meet the requirements of 3.11.1.

4.6.11.2 Color (class 1, grade B adhesive). The specimens prepared for the tests specified in 4.6.10.1 shall be examined to determine the color of dry class 1, grade B adhesive. The adhesive color shall meet the requirements of 3.11.2.

4.6.12 Flexibility.

4.6.12.1 Class 1 adhesive. For class 1 adhesive, the specimen shall be prepared as specified in 4.6.10.2.1 using the adhered half only.

4.6.12.2 Classes 2 and 3 adhesives. For classes 2 and 3 adhesives, six bare 1/32-inch cold-rolled steel plates, 5 by 10 inches each, shall be cleaned with solvent (for example, a mixture of equal parts of xylol, MEK, and alcohol) to remove any rust, grease, and contaminants. After drying, the steel plates shall be coated with adhesive to 0.02±0.002-inch thickness. The coating may be applied either with a film applicator or by spraying in accordance with ASTM D823.

4.6.12.3 Procedure. The coated specimen shall be air dried for 24 hours and then cured (baked) for 75 minutes at 217±4 °F in a circulating-air oven. The coated specimen shall then be conditioned for 1½ to 2 hours at 73±2 °F at a relative humidity of 50±5 percent. The flexibility test shall be conducted with the coated specimen using a ¼-inch diameter mandrel in accordance with ASTM D522/D522M, method B. The test panel shall be placed on a mandrel, coated side up, at a point equidistant from the top and bottom edges of the panel. The panel shall be bent around the mandrel at a uniform rate through a 180-degree angle while holding the specimen at each end. The bend shall be completed in 3 to 5 seconds. The adhesive film shall be examined for cracks exposing the substrate. Cracks occurring at either end and extending no more than ¼ inch shall be disregarded.

4.6.13 Washability (class 1 adhesive only).

4.6.13.1 Apparatus. The apparatus to be used for the washability test for class 1 adhesives shall be as follows:

a. A washability machine with counter and brush in accordance with ASTM D2486.

b. A glass panel, 6 by 18 inches, in accordance with ASTM D3891.

c. A film applicator with a 0.02-inch clearance in accordance with ASTM D823.

d. A bar of “Bon Ami” abrasive soap, or equal.

e. Sample of adhesive to be tested.

4.6.13.2 Procedure. The glass panel shall be prepared in accordance with ASTM D3891. A film of the adhesive shall be drawn down the entire length of the ground side of the glass panel using the 0.02-inch film applicator. The draw-down shall be 3.5 inches or more in width. The panel shall be allowed to dry for 6 days at room temperature (approximately 75±5 °F). The glass panel shall be placed on the table of the washability machine. The brush shall be soaked in water for 30 minutes, then rubbed vigorously over the bar of abrasive soap until the bristles are saturated with soap. The brush shall then be placed into the machine receptacle and aligned on the coated glass panel so that the brush stroke is entirely within the coated area. During the test, the water shall be permitted to drop or run into the path of the brush at the rate of about 12 drops per minute, or just sufficient to keep the panel wet. The machine shall be started and run for 1,000 double strokes. The panel shall be washed at once in water at moderate temperature and inspected for film within the middle 6 inches of brush travel for definite breaks, wear, or detachment of the film down to the glass. A few small pinpoint areas shall be disregarded.

4.6.14 Paintability (class 1 adhesive only). Class 1 adhesive shall be applied to the fibrous glass cloth facing of a 12- by 12-inch specimen of fibrous glass insulation board conforming to type I, form 1, facing B of MIL-DTL-32585 and allowed to set for 10 minutes. A strip of fibrous glass tape conforming to type II, class 1 of MIL-C-20079 shall then be applied to the adhesive-coated specimen. A coat of adhesive shall be applied over the tape, and the specimen shall be allowed to air dry for 24 hours. A coat of paint conforming to MIL-DTL-24607 shall be applied to the face of the specimen and allowed to air dry for 24 hours, after which a second coat of enamel shall be applied. The specimen shall be inspected after 24 and 48 hours for signs of bleeding, discoloration, and cracking or crazing of the paint.

4.6.15 Fire performance.

4.6.15.1 Fire testing provisions. All fire tests specified in this document shall be conducted by an independent testing laboratory that is accredited to ISO/IEC 17025 and is acceptable to NAVSEA. Accreditation shall be obtained from a recognized accreditation body such as the American Association for Laboratory Accreditation (A2LA) (www.A2LA.org) or the International Code Council's International Accreditation Services (IAS) (www.IASonline.org). The scope of accreditation shall include specific flammability and fire tests required for qualification. All other fire test provisions shall be as specified (see 6.2 and 6.4).

4.6.15.2 Surface flammability. The adhesives shall be tested in accordance with the FTP Code, which provides fire test procedures for surface flammability of bulkhead, ceiling, deck finish materials, and primary deck coverings. The adhesive shall be tested on a nominal ½-inch calcium silicate insulation board. The backer board shall be cut to the dimensions required for the sample size of the specific test conducted. The amount of adhesive, by weight, shall be determined from the manufacturer's recommended wet film coverage and the area of the backer board to be covered. The backer board shall be placed on a scale and the scale zeroed. The required weight of adhesive shall be spread evenly on the backer board with a trowel, and the prepared sample shall be placed in a conditioning room with a temperature of 75±5 °F and 50±10 percent relative humidity for the duration recommended by the manufacturer to dry the adhesive.

4.6.15.3 Smoke density. The smoke density for both flaming and non-flaming modes shall be measured in accordance with ASTM E662. The coating shall be applied to steel substrate, ⅛ inch thick.

4.6.15.4 Fire gas toxicity. Maximum toxic gas concentrations shall be measured and recorded in accordance with T9070-AK-DPC-010/078-1. The adhesive shall be allowed to dry (cure) before measurements are taken.

4.6.15.5 Vertical specimen test. Three strips of fibrous glass tape, 6 inches long and 2 inches wide, conforming to type II, class 1 of MIL-C-20079 shall be coated on both sides with the adhesive, then drawn through two polished metal rods, ½ to 1 inch in diameter. The bars shall be parallel so that, when dried, the tape and the coating shall have an overall thickness of 0.013 inch. The coated strips shall be air dried for 24 hours and then placed in a forced-draft oven for 20 hours at 212 to 221 °F. Twenty-five to 30 minutes after removal from the oven, each specimen shall be suspended vertically in a draft-free location from a clamp that covers the upper ½ inch of the strip. A Meker burner having a 30-millimeter diameter grid and supplied with natural gas of 1,100±100 British thermal units (Btu) per cubic foot shall have its flame adjusted so that its outer zone is 1½ inches high and its light blue inner zone is 1/16 inch high. The temperature of the flame shall be measured using a type K thermocouple at a point 1¼±1/32 inches above the center of the grid and shall be between 1,300 and 1,900 °F. Flame adjustment shall be performed in a darkened area, and a black object shall be placed behind the flame to enhance observation of the flame height. The burner shall be placed directly below the specimen in a position such that its grid is 1 inch below the middle of the lower edge of the specimen. After 5 seconds, the burner shall be extinguished and the length of time that the coating continues to burn after the extinction shall be noted. The results of the three specimens shall be averaged.

4.6.15.6 Horizontal panel test.

4.6.15.6.1 Preparation of class 1 specimen. The adhesive shall be applied to the facing of a 30- by 30- by 1-inch specimen of fibrous glass insulation board conforming to type I, form 1, facing B of MIL-DTL-32585 and to one side of a 30- by 30- by 1-inch specimen of fibrous glass insulation board conforming to type I, form 1, facing A of MIL-DTL-32585 (these specimens may be made up from more than one piece). A 30- by 30-inch piece of fibrous glass cloth conforming to type I, class 2 of MIL-C-20079 shall be superimposed on the primed surface of each of the specimens and hand-troweled smooth until the adhesive extrudes through the interstices of the cloth. A finish coat of adhesive shall be brushed over the cloth. A 36- by 36- by 1/16-inch steel plate, stiffened against sagging, shall be bonded to the opposite side of each specimen. Each specimen shall be dried to constant weight at a temperature recommended by the adhesive manufacturer as being non-injurious to the adhesive under test.

4.6.15.6.2 Preparation of classes 2 and 3 specimens. The adhesive shall be applied to the unfaced sides and to the edges of two fibrous glass insulation boards conforming to type I, form 1, facing B of MIL-DTL-32585 and measuring 15 by 30 by 1 inches each. The two boards shall be secured by the adhesive to a 36- by 36- by 1/16-inch steel plate, stiffened against sagging, so that the boards are butted together to form a 30-square-inch specimen, centered on the steel plate. A piece of glass tape, 30 inches long and 2 inches wide, conforming to type II, class 1 of MIL-C-20079, shall be applied over the seam where the two boards are joined and bonded to the board facings with class 1 adhesive. The specimen shall be allowed to dry for 24 hours. Two coats of enamel conforming to MIL-DTL-24607 shall be brushed over the glass cloth facing of the specimen, each coat being allowed to dry for 24 hours.

4.6.15.6.3 Test procedure. Each specimen shall be tested separately in a room that is free from air currents. The specimen shall be placed horizontally with the insulation down and with the steel plate supported on the flat surface by a 2- by 2- by ½-inch steel angle frame having a 30- by 30-inch clear opening. A gas-air burner of ¾- to ⅞-inch diameter shall be placed vertically with its top 24 inches below the center of the lower surface of the specimen. A thermocouple made of ⅛-inch wires and formed into a 3-inch horizontal coil shall be placed 1 inch below the center of the lower surface of the specimen. The wires shall be bare for a distance of 2 inches from the junction. The test shall be conducted by directing a flame from the burner against the center of the lower surface of the specimen for 40 minutes. During the test, the temperature of the thermocouple shall be read and recorded at intervals not exceeding 2 minutes. The flame shall be regulated to give temperature indications conforming to the time-temperature curve shown on figure 1. The flame shall contact the specimen during the entire test period—an exception may be made for the first 5 minutes if required for proper temperature regulation. At no time during the test shall the flame from the burner contact the specimen at any point that is more than 6 inches from the center of the specimen. The area under the time-temperature curve obtained from the thermocouple readings shall be within 5 percent of the area under the curve on figure 1. The extent and duration of flaming during the test shall be noted. At the end of the test period, the flame shall be extinguished. The specimen shall then be examined to determine the further extent and duration of flaming, glowing, or smoldering. After testing either the class 2 or the class 3 adhesive, the insulation board shall be pulled off the steel plate, and the steel plate shall be examined to determine whether separation occurred within the insulation board or between the insulation board and the steel plate.

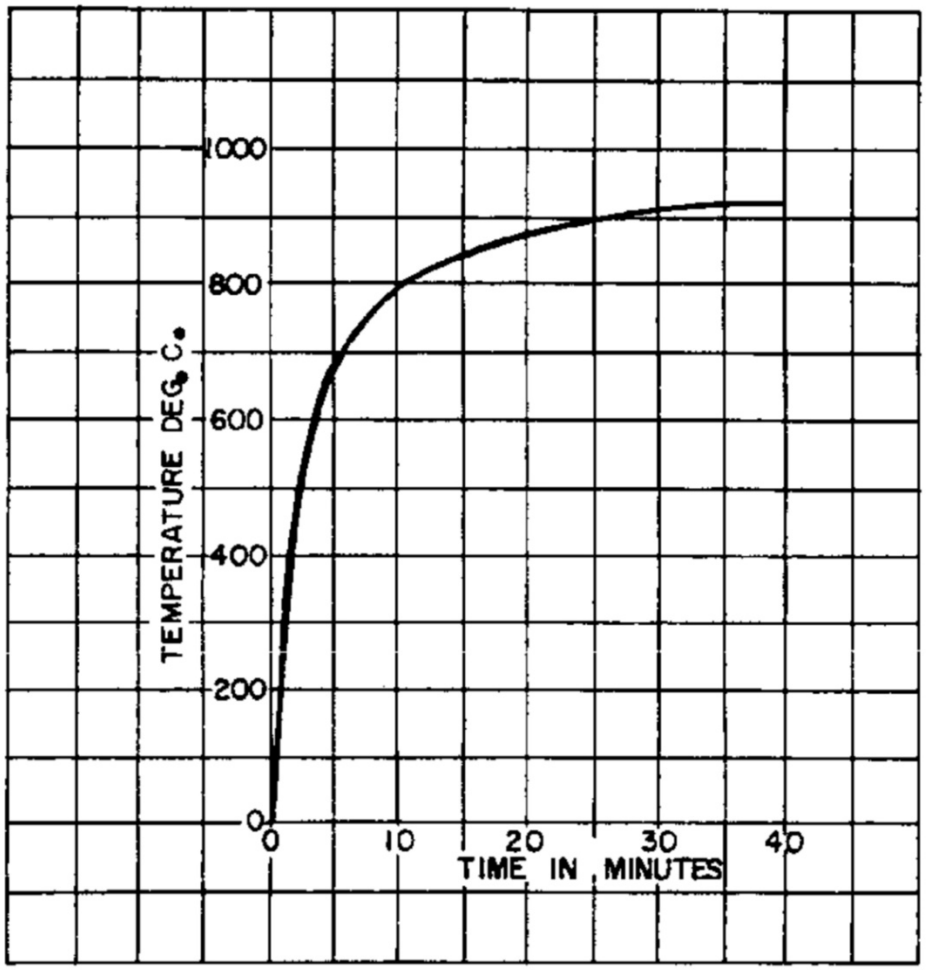

FIGURE 1. Time-temperature curve.

4.6.16 Puncture resistance.

4.6.16.1 Specimen preparation. The facing of a 1-square-foot section of type I fibrous glass insulation board conforming to MIL-DTL-32585 shall be cleaned with solvent (for example, a mixture of equal parts of xylol, MEK, and alcohol) to remove possible contaminants. The board, while still wet, shall be wiped with a clean, dry cloth to assure removal of the contaminants. Time shall be allowed for the board to dry thoroughly. A 12- by 12-inch area of the facing of the board shall be coated with the adhesive to an approximate thickness of 1/32 inch. After the adhesive has dried for 5 minutes, a 1-square-foot piece of fibrous glass cloth conforming to type I, class 2 of MIL-C-20079 shall be superimposed on the facing of the board and pressed and troweled sufficiently to extrude the adhesive through the interstices. The cloth shall then be given a finish coat, which shall be scraped off down to the fabric to remove excess adhesive. The coating insulation board and facing shall be allowed to dry for 48 hours.

4.6.16.2 Test method. Puncture resistance shall be determined in accordance with TAPPI T 803, except that the test specimen shall be placed with the finished covering surface down between the clamping plates. Before each test is made, the loose sleeve shall be placed against the base of the puncture point and the pointer set about 1 inch above the expected reading. The pendulum shall be raised to the horizontal position and released by pushing the latch handle to the left. The reading shall be noted on the proper scale after the pendulum has completed its swing.

4.6.17 Workmanship. The adhesive in each of the 1-quart sample units specified in table I and 4.4 shall be examined for the presence of grit, lumps, and skins.

4.6.18 Unit container content. The unit container shall be weighed, and this net weight shall be divided by the weight per gallon of the material, as determined in 4.6.1, to obtain the volumetric content of the container.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. The adhesives covered by this specification are intended for use in securing cloth and tape to thermal insulations (class 1) and for securing thermal insulations to metal surfaces (classes 2 and 3). The use of these adhesives may extend to other facing materials typically used in the insulation industry. The thermal insulation referred to herein may include other insulation products such as acoustic and fire insulation. The requirement for an HHA and the requirement to verify that prohibited materials are omitted make this item military unique. Current stock of adhesives may be used until depleted; future requisitions for adhesives should refer to the current version of this specification. Adhesives procured to this specification are form, fit, and function replacements for prior revisions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Class and grade of adhesive required (see 1.2).

c. The unit container capacity (see 3.18).

d. AQL of 2.5 (see 4.4.3).

e. Additional fire testing provisions (see 4.6.15.1 and 6.4).

f. Packaging requirements (see 5.1).

g. Requirements for the Safety Data Sheet (SDS) and Federal Acquisition Regulation (FAR) clause (see 6.6).

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 No. 3316 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.4 Additional fire testing provisions. NAVSEA reserves the right to witness the tests and perform any of the tests set forth herein where such testing is deemed necessary to assure compliance to prescribed requirements of the qualification tests. A2LA (www.A2LA.org) or International Code Council's IAS (www.IASonline.org) maintain a full list of the approved laboratories that are accredited to ISO/IEC 17025 and provide details on how to obtain and maintain accreditation (see 6.2).

6.5 Cross-reference of classifications. The classes of this specification corresponding to the types of the previous issues are as follows in table II:

TABLE II. Corresponding types by revision.

MIL-DTL-3316D, MIL-A-3316C, and MIL-A-3316B	MIL-A-3316A	MIL-C-3316
Class 1	Types I and II	Type II
Class 2	Type III	Type III
Class 3	----	Type I

6.6 SDS. When specified (see 6.2), an SDS should be provided in accordance with the requirements of FED-STD-313 and 29 CFR 1910.1200. When FED-STD-313 is at variance with the Code of Federal Regulations (CFR), 29 CFR 1910.1200 should take precedence. FED-STD-313 should be modified and supplemented accordingly. The SDS should be included with each shipment of the material covered by this specification. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313. In order to obtain the SDS, FAR clause 52.223-3 must be in the contract (see 6.2).

6.7 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation. The HHA process is described on the NMCPHC's website, http://www.med navy mil/sites/nmcphc/industrial-hygiene/Pages/health-hazard-assessment.aspx.

6.8 Material certification. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the submarine's atmosphere and can result in health hazards to personnel or deleterious effects on machinery. These controls are administered through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, S9510-AB-ATM-010 chapter titled "Material Control Program." Under the Submarine Material Control Program, all materials considered for use on submarines require certification and assignment of a usage category. Under the certification process, candidate materials are selected by Navy activities or contractors, and a request for certification is submitted to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil. The certification request is accompanied by detailed information, including descriptions of the material, method of application, usage, and storage. A chemical analysis is conducted, which can be accomplished through off-gas testing. If off-gas testing is required, it must be conducted in a Government approved laboratory. Information pertaining to this test requirement may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil. Based on the chemical analysis results, a usage category is assigned to the material defining whether, and to what extent, the material may be used on submarines.

6.9 Subject term (key word) listing.

Bonding

Cloth, fibrous glass

Fire performance

Insulation, fibrous glass

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:
Army – MR
Navy – SH

Preparing activity:
Navy – SH
(Project 8040-2019-001)

Review activities:
Navy – AS, CG, OS, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.