L3 communications Integrated Systems

Subject:

STRUCTURAL FILM ADHESIVES, REQUIREMENTS FOR

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TECHNICAL MATERIAL SPECIFICATION

REV	DATE	PARAGRAPH AFFECTED	CHANGE CATEGORY	CHANGE DESCRIPTION AND REASON
B	2006	All	Non-Critical	Revised to reflect correct company name and logo.
		1.2	Non-Critical	Revised to reflect current effectivity.
		3.1.6.1	Non-Critical	Raised temperature requirement from 0°F to 10°F or below.
		4.4.2	Critical	Added Mechanical Data Sheet form number 8-27017-1.

TECHNICAL MATERIAL SPECIFICATION

Active Amendments and Departures: None

1. SCOPE

1.1 Scope.

This specification establishes the minimum requirements for adhesive films used in the structural bonding of metal to metal, reinforced plastic to reinforced plastic, reinforced plastic to metal, and in metal or reinforced plastic honeycomb sandwich construction for service temperatures ranging from –67° to 350°F.

1.2 Effectivity.

This specification is a complete revision of TMS 12-115A, dated 17 November 2004, and is effective upon release of the document. A solid black bar in the left-hand margin marks changed paragraphs from the previous revision.

1.3 Classification.

Adhesives furnished under this specification shall be of the following types, classes, forms and grades.

1.3.1 Types.

The type shall be based upon the cure temperature as specified:

Type I 250°F Cure
Type II 350°F Cure
Type III Reserved for future use.

1.3.2 Classes.

All adhesives shall be furnished in one of the following classes:

Class 1 Radar Purpose
Class 2 General Purpose
Class 3 Reticulated

1.3.3 Grades.

Adhesives shall be graded according to weight as follows.

Grade 03. 0.03 lbs/sq. ft. ±0.0045	Grade 08. 0.08 lbs/sq. ft. ±0.0050
Grade 04. 0.04 lbs/sq. ft. ±0.0050	Grade 10. 0.10 lbs/sq. ft. ±0.0050
Grade 06. 0.06 lbs/sq. ft. ±0.0050	Grade 15. 0.15 lbs/sq. ft. ±0.0050

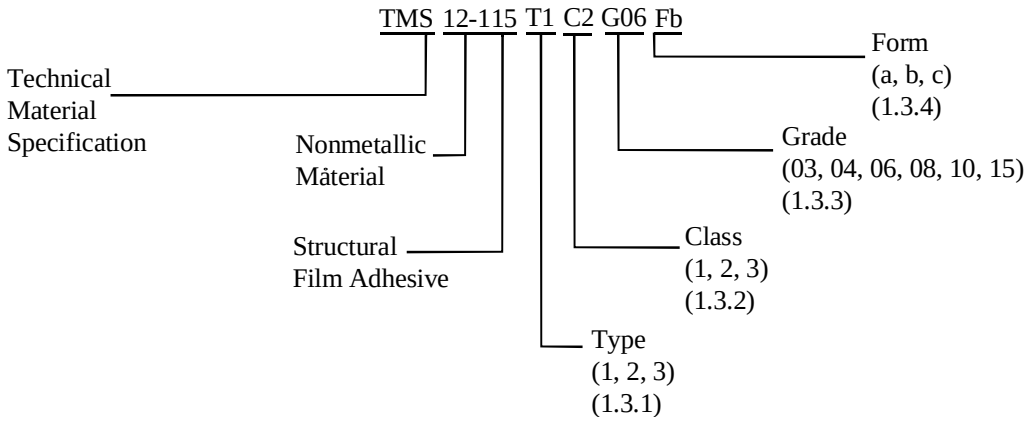
1.3.4 Forms.

Adhesives shall be categorized into one of the following forms:

Form A) High tack.
Form B) Moderate tack.
Form C) Low tack.

1.4 Part number structure.

The part number structure is as follows:



2. APPLICABLE DOCUMENTS

2.1 Government documents.

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the current issue shall apply.

SPECIFICATIONS

Federal

MMM–A–132	Adhesives, Heat Resistant, Airframe Structural, Metal to Metal

STANDARDS

Military

MIL-C-7438	Core Materials, Aluminum, for Sandwich Construction

2.2 Non–Government documents.

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the current issue shall apply.

SPECIFICATIONS

L-3 Communications Integrated Systems Technical Process Specifications

TPS 1–113	Adhesive Bonding, Preparation of Surfaces for

Society of Automotive Engineers

AMS-QQ–A–250/4	Aluminum Alloy 2024, Plate and Sheet
AMS-A-25463	Adhesives, Film Form, Metallic Structural Sandwich Construction

STANDARDS

L-3 Communications Integrated Systems Standards

TAS 8963	Test Panel, Adhesive

3. REQUIREMENTS.

3.1 General material requirements.

3.1.1 Character or quality.

The adhesives shall be thermosetting and shall meet the strength requirements of this specification. The adhesives shall not have a deleterious effect on the surfaces being bonded when subjected to the applicable service temperatures. There shall be no restrictions on the ingredients used in the adhesive other than those imposed by the technical requirements specified herein.

3.1.2 Formulation.

The adhesive films shall be approved only for the formulation that has shown conformance to the requirements specified herein. The approved formulation shall be listed on Qualified Products List (QPL) 12–115 by the manufacturer's product code. Any formulation changes by the manufacturer, such as the adding of fillers, change in carrier, changing the type or method of manufacture, changes in the weight per square foot in excess of the tolerances specified in 1.3.3 shall be cause for designating the adhesive as a new product which shall not be considered approved. The changed adhesive shall be resubmitted for approval under this specification.

3.1.3 Product characteristics.

All adhesive films, which meet the requirements of this specification, shall be categorized in type, class, form, and grade as follows.

3.1.3.1 Type identification.

Type I Type I adhesive films are indicated when service temperatures are less than 250°F. These films shall achieve allowable strength when cured at 250°F per 3.1.5.2. Minimum strength requirements for Type I film are given in Table I for test temperatures from –67°F to 180°F. The determination of Type I adhesive strengths at temperatures higher than 180°F shall be considered out of the scope of this TMS and shall not be a vendor requirement.

Type II Type II adhesive films are indicated when service temperatures are greater than 250°F but do not exceed 350°F. Type II adhesives shall achieve allowable strength when cured at 350°F per 3.1.5.2. Minimum strength requirements are given in Table I for test temperatures from –67°F to 300°F. The determination of Type II adhesive strengths at temperatures higher than 300°F shall be considered out of the scope of this TMS and shall not be a vendor requirement.

3.1.3.2 Class identification.

The adhesive films shall be categorized by class according to their use with metal or non-metal (composite) materials.

Class l Used in the bonding of reinforced plastic to reinforced plastic, or in reinforced plastic honeycomb sandwich construction, when radar transparency is a requirement. These films shall have no metal fillers or other materials which would impair the transmission of radio waves.

Class 2 Used in the bonding of reinforced plastic to reinforced plastic, metal to metal or metal to reinforced plastic, or aluminum or reinforced plastic honeycomb sandwich construction, when radar transparency is not a requirement. The bonding of metals requires use of corrosion inhibiting adhesive primer.

Class 3 Unsupported, reticulated adhesive films, used especially for perforated face skins. This class is used for sound attenuation applications.

3.1.3.3 Material grade.

The manufacturer shall specify the median weight of the adhesive with the carrier, if applicable, within a range as specified in 1.3.3. The film weight shall be provided in pounds per square foot. Film adhesives of a given type and class manufactured in more than one weight shall be tested separately for qualification approval. Approval of such materials in both the minimum and maximum weights will convey automatic approval of materials with weights between the maximum and minimum. The honeycomb sandwich requirements of Table I are for grade 08 weight and higher.

3.1.3.4 Material form.

All adhesives shall be in film form. The films shall be rated for tack according to the levels presented below. The level of tack shall be determined per 4.6.6.

Tack Level	Description
High	Material sticks to vertical tool and self, with or without resin transfer.
Moderate	Material sticks to vertical tool.
Low	Material is dry and not sticky.

3.1.4 Primer.

A corrosion inhibiting primer shall be used on all metal surfaces following surface preparation and before bonding of parts. The primer shall be compatible with the adhesive and shall be considered an integral part of the adhesive system. The primer shall be identified on the Qualified Products List along with the adhesive.

3.1.5 Working characteristics.

3.1.5.1 Working life.

The open assembly time for each adhesive shall be at least as long as the periods listed below. Out time is defined as the period of time between removal from refrigeration until starting the cure cycle. This allowable time period may differ between products.

Type I – 120 hours, min. @ 75°F. max,

Type II – 240 hours, min. @ 75°F. max.

3.1.5.2 Cure time and temperature.

The cure time and temperature for each type of adhesive shall be as listed:

	Minimum Cure Temp. °F	Cure Time (Min.)	Heat–up Rate (Deg. per Min.)
Type I:	250 ± 10	60	2 – 6
Type II:	350 ± 10	60	2 – 6

3.1.5.3 Curing pressure.

The pressure required for adhesively bonding parts shall be within the range of 10 to 25 psi.

3.1.5.4 Mechanical properties.

The adhesive shall meet or exceed the mechanical properties specified in Table I when tested per 4.4.

3.1.6 Environmental conditions.

All adhesives shall be ready for application per the manufacturers instructions when at room temperature (65° to 85°F) and at a maximum relative humidity of 60%.

3.1.6.1 Shelf life.

The adhesive, as furnished by the manufacturer, shall be capable of meeting the requirements specified herein after storage in its original unopened container for at least six (6) months at a temperature of 10°F or below in the absence of sunlight.

3.1.6.2 Shelf life extension.

This specification makes provisions for extending the shelf life of these adhesive films. The shelf life of all the types of adhesives may be extended three (3) months when the stored material conforms to the tensile shear strength requirements after the original storage period. This requalification shall expire after 90 days and thereafter the shelf life may be extended for 30 days as long as the material meets the normal temperature tensile shear requirements of Table I when tested per 4.6.2.

3.1.7 Toxic products and safety.

The manufacturer shall include with the shipment of any material a copy of the Material Safety Data Sheet (MSDS). The MSDS shall indicate any potential health hazards of the material and shall indicate the necessary safety equipment required when working with the material.

3.1.8 Workmanship.

The adhesive film shall be uniform, and free of dirt, lumps, foreign matter, and all other defects which would adversely affect its performance. The film shall be prepared per the best commercial practices for this material.

3.1.9 Certification.

The manufacturer shall supply, with each shipment of material, certification that the material supplied conforms to the requirements of this specification.

3.2 Qualification.

The adhesive films furnished under this specification shall be qualified for listing on the applicable QPL. A material shall be listed on the QPL after it has been shown that the adhesive conforms to the requirements specified herein after being tested per 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.

Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to L-3/IS. L-3/IS reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.2 Monitoring procedures for equipment used in process.

The process owner or department performing the process shall verify by process audits or inspections that all equipment used in this process are per the requirements specified herein.

4.3 Monitoring procedures for materials used in process.

The process owner or department performing the process shall verify by process audits or inspections that all materials used in this process are per the requirements specified herein and are within any applicable shelf life limits.

4.4 Special tests and examinations.

4.4.1 Qualification tests.

Qualification tests of the adhesive shall consist of the tests for compliance with the requirements of 3.1.5.4 and conducted per 4.6.

4.4.2 Receiving inspection tests.

The receiving inspection tests and examinations shall consist of the following:

a. Visual examination of the adhesive for conformity to 3.1.7, 3.1.8, and 3.1.9.

b. Tensile shear strength at 73°F ± 5°F: see Table I for acceptance values and 4.6.2 for test procedure.

c. Spot checks as desired; other tests, described in 4.6, may be performed as desired to verify vendor data.

Unused portions of acceptable adhesive shall be returned to storage or Production upon completion of the necessary testing. All test results shall be recorded on the Mechanical Data Sheet, form number 8-27017-1.

4.5 Quality conformance inspection.

The Quality Department shall assure compliance with the requirements of 3.1.4.6 Test methods.

4.6.1 Specimen preparation.

Test specimens shall be cleaned and pretreated per TPS 1–113, Method I, II, or IV for aluminum, prior to adhesive bonding. Test samples shall be primed with the primer to be used for the adhesive bonding application. Adhesive cure shall be per 3.1.5.2 with 10–25 psi maintained on the bond line during the curing process.

4.6.2 Tensile shear strength.

Five specimens shall be prepared and tested for each required test condition. Test specimens shall be 2024–T3 bare aluminum alloy conforming to AMS-QQ–A–250/4 and measuring 0.063 inch thick and 1 inch wide. (Prestamped test panels, L-3 Communications Integrated Systems Standards P/N TAS 8963–1, may be used. Two test panels are required for each of the five tensile lap shear specimens). Exposure to test temperatures, fluids and conditions shown in Table I shall be per MMM–A–l32 after the adhesive is permitted to cure. Perform the tensile shear test per MMM–A–132 at the specified temperature in a suitable testing machine using a loading rate of 1200 to 1400 psi per minute. This rate of loading is approximated by a free crosshead speed of 0.05 inch per minute. Continue the load to failure. Record the failure load in pounds per square inch (psi). The average of the five specimens shall be used as the acceptance criteria.

TABLE I
MECHANICAL PROPERTIES OF BONDED JOINTS

Test	Test Method (Ref)	Test Temp. ±5°F	Minimum Average Requirement 1/	
			Type I	Type II
Tensile Shear (psi)	MMM-A-132	-67	3500	2750
Tensile Shear (psi)	MMM-A-132	73	3500	2750
Tensile Shear (psi)	MMM-A-132	180	2000	2500
Tensile shear (psi)	MMM-A-132	300	N/A	2250
Fatigue Strength (psi) at 10 million cycles	MMM-A-132	73	750	750
Tensile Shear (psi) after exposure to the following	MMM-A-132			
a. 30 days 120 ±5°F temperature and 95 – 100% humidity	MMM-A-132	73	3250	2750
b. 7 days immersion in respective fluids	MMM-A-132	73	3250	2750
Sandwich Peel Strength (lb. in./in. of width)	AMS-A-25463	-67	10	10
Sandwich Peel Strength (lb. in./in. of width)	AMS-A-25463	73	12.5	10
Sandwich Peel Strength (lb. in./in. of width)	AMS-A-25463	180	10	10
Sandwich Flatwise Tensile Strength (psi)	AMS-A-25463	-67	800	800
Sandwich Flatwise Tensile (psi)	AMS-A-25463	73	750	750
Sandwich Flatwise Tensile (psi)	AMS-A-25463	180	400	N/A
Sandwich Flatwise Tensile (psi)	AMS-A-25463	300	N/A	350

1/ The average strength shall meet the respective minimum average requirement, and the strength of any individual specimen shall be not less than 90% of this minimum average requirement. The honeycomb sandwich requirements are for grade 08 weight and higher.

4.6.3 Fatigue strength.

Fifteen specimens fabricated with 0.063 inch thick 2024–T3 bare aluminum alloy conforming to AMS-QQ–A–250/4 shall be prepared 1±0.010 inch wide and having a 3/8 inch bond joint overlap. Prestamped test panels, L-3 Communications Integrated Systems Standards P/N TAS 8963-1 may be used. Five of these specimens shall be designated controls and tested as normal temperature shear test (4.6.2). The remaining ten specimens shall be fatigue tested per MMM-A-132.

4.6.4 Sandwich peel strength.

Eighteen test specimens 3 inches wide and 12 inches in length shall be cut from a sufficient number of test panels prepared using 0.020–inch 2024–T3 faces conforming to AMS-QQ–A–250/4 bonded to 0.50–inch–thick aluminum core conforming to code 7.9–1/4–40 (5052) of MIL–C–7438 using the adhesive system undergoing the test. The panels shall be fabricated and cut so that the ribbon direction of the core is the same as the 12–inch dimension of the test specimen. Test samples shall be prepared and tested per AMS–A–25463.

4.6.5 Sandwich flatwise tensile shear strength.

Eighteen test specimens shall be prepared from sandwich test panels described in 4.6.4 and tested per AMS–A–25463.

4.6.6 Tack.

Two test specimens shall be cut from each lot of adhesive film for the purpose of classification by level of tack. The test specimens shall be 3 inches by l inch. A plate of corrosion–resistant steel, large enough to accommodate the adhesive film specimens, shall be cleaned to a water break–free condition. The test environment temperature shall be maintained at 70 to 80°F. The specimens shall be tested as follows:

a. Attach one piece of test material to the plate with light pressure applied by a Teflon roller over the backing film.

b. Remove the backing film from the test specimen and apply the second specimen to the first in a similar manner. Remove the backing film from the second specimen.

c. Position the plate vertically and allow to stand for 30 minutes.

d. Specimens which maintain this position for 30 minutes shall be classified as high tack (Form A). Other behaviors shall be noted and the level of tack labeled per 3.1.3.4.

5. PREPARATION FOR DELIVERY

5.1 Packing.

All materials shall be packaged to prevent damage in transit. Adhesives shall be supplied in sheets or rolls with both sides protected by a nonadherent separator film.

5.1.1 Unit packaging.

Adhesives supplied under this specification shall be packaged in clean, airtight, sealed bags of nonadherent material to prevent penetration of moisture or loss of volatiles. The exterior packaging shall be of such a nature as to prevent physical damage or contamination by foreign substances. Each package should be suitably insulated and refrigerated as necessary to ensure maintenance of the shipping temperature requirements.

5.1.2 Instruction sheet.

An instruction sheet providing curing details shall be forwarded with each shipment of adhesive or the instructions shall be printed on the adhesive container.

5.2 Marking.

All adhesive films covered by this specification shall be legibly marked as described herein.

5.2.1 Internal marking.

The container or roll of material shall be identified and labeled with the following information.

a. TMS number (including latest revision letters) and Type, Grade and Class of adhesive.
b. Supplier’s name and address.
c. Supplier’s product designation.
d. Suppliers batch number.
e. Date of manufacture.
f. Unit number of roll.

5.2.2 External marking.

Both ends of the exterior package shall be legibly marked on the outside with the following information:

a. TMS number (including latest revision letter) and Type, Grade and Class of adhesive.
b. Purchase order number.
c. Suppliers name and address.
d. Suppliers product designation.
e. Suppliers batch number.
f. Date of manufacture.
g. Quantity in the shipment.
h. Quantity in this package.
i. Refrigeration requirement (state temperature limitations).

6. NOTES

6.1 Intended use.

Adhesives conforming to the requirements of this specification are intended for the structural and nonstructural bonding of metals, plastics reinforced plastics, glass, and honeycomb sandwich construction using low pressures and wide temperature ranges.

6.2 Ordering data.

Adhesives procured to this specification shall be designated by type, class, grade and form, as applicable.