

# 1 SCOPE

## a. Type I

- (1) This specification establishes the product requirements for Class 2, Class 3, and Class 4 water-based primer that is:
  - (a) Suitable for structural bonding of metal-to-metal and honeycomb sandwich when used with structural adhesives with -67 to 350 F service temperatures.
  - (b) Resistant to corrosive environments when used as a protective finish on exposed surface areas of bonded assemblies.
  - (c) Receptive to paint finishes.
- (2) The primer is to be used for metal-to-metal and honeycomb sandwich construction with BMS5-137, Type II adhesives bonded in accordance with [BAC5514-5137](#).
- (3) The application, bake, and process control of this primer is governed by [BAC5514-5137](#).

## b. Type II

- (1) This specification establishes the requirements for structural adhesives for service temperatures of -67 to 350 F.
- (2) The application, cure, and process control of these adhesives are governed by [BAC5514-5137](#).

## c. This specification requires qualified products.

### WARNING

WARNINGS may be included throughout this specification. Do not take these WARNINGS to be all inclusive, nor to completely describe hazards or precautionary measures applicable to specific procedures or operating environments.

Non-Boeing personnel must refer to their employer's safety instructions for information concerning hazards which may occur during operations described in this specification.

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Authorizing Signatures on File

STRUCTURAL ADHESIVE FOR ACOUSTIC  
PANELS - 350 F SERVICE

**BMS5-137L**

CAGE CODE 81205

**BOEING MATERIAL SPECIFICATION**

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**2 CLASSIFICATION**

2.1 TYPE AND CLASS

This specification consists of the following types and classes.

- a. Type I Primer

2.1 TYPE AND CLASS (Continued)

- (1) Class 1 (Obsolete)
- (2) Class 2 Liquid Corrosion Inhibiting Low Volatile Organic Compound (VOC) Adhesive Primer. Class 2 primer has the following attributes: 10 days out time; 0.20 to 0.35 mils thickness range; 270 F - 300 F bake.
- (3) Class 3 Liquid Corrosion Inhibiting Zero Volatile Organic Compound (VOC) Adhesive Primer. Class 3 primer has the following attributes: 30 days out time; 0.15 to 0.35 mils thickness range; 240 F - 325 F bake.
- (4) Class 4 Liquid Corrosion Inhibiting Low VOC Adhesive Primer. Class 4 primer has the following attributes: 7 days out time; 0.15 to 0.40 mils thickness range; 305 F - 325 F bake.

**NOTE:** If no Class, or Class 1 is called out on the Engineering drawing, Class 2, Class 3 or Class 4 is acceptable.

b. Type II Film Adhesive

- (1) Class 1 Supported Film
- (2) Class 2 Unsupported Film, Suitable for Reticulation on [BMS7-209](#) Perforated Plate.

2.2 GRADE (TYPE II ONLY)

Adhesive Grades and thicknesses are listed in [Table I](#).

**TABLE I - TYPE II ADHESIVE GRADE REQUIREMENTS**

CLASS	GRADE	THICKNESS (NOMINAL)	WEIGHT
Class 1	Grade 5	0.007 inch	Listed on QPL
Class 1	Grade 10	0.010 inch	Listed on QPL
Class 1	Grade 15	0.012 inch	Listed on QPL
Class 2	Grade 5	0.007 inch	Listed on QPL

3 **REFERENCES**

The issue of the following references in effect on the date of invitation for bid forms a part of this specification to the extent indicated herein.

- [ASTM D 522](#) - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
- [ASTM D 1475](#) - Standard Test Method for Density of Liquid Coating, Inks, and Related Products
- [ASTM D 1875](#) - Standard Test Method for Density of Adhesives in Fluid Form
- [BAC5514-5137](#) - Structural Bonding with BMS5-137 Adhesives
- [BAC5555](#) - Phosphoric Acid Anodizing of Aluminum for Structural Bonding
- [BAC5845](#) - Application of Polyurethane Enamel
- [BSS7201](#) - Fatigue, Lap, Adhesive Bond
- [BSS7202](#) - Shear, Lap, Adhesive Bond
- [BSS7204](#) - Creep, Lap, Adhesive Bonded
- [BSS7205](#) - Tension, Flatwise, Adhesive Bonded
- [BSS7206](#) - Peel, Metal-to-Metal, Adhesive Bonded
- [BSS7207](#) - Peel, Honeycomb, Adhesive Bonded

### 3 REFERENCES (Continued)

- [BSS7208](#)
  - [BSS7209](#)
  - [BSS7211](#)
  - [BSS7212](#)
  - [BSS7216](#)
  - [BSS7237](#)
  - [BSS7249](#)
  - D6-53356
  - 29CFR 1910.1200
- Crack Extension Force, Adhesive Evaluation
  - Environmental Exposure; Humidity, Sustained Stress, Lap, Adhesive Bonded
  - Environmental Exposure, High Humidity
  - Environmental Exposure, Fluids
  - Solids Content and Volatiles Content
  - Core Beam Shear and Flexure Tests, Honeycomb Sandwich
  - Salt Spray (Fog) Testing
  - Requirements for Process Control Documents for Suppliers of Nonmetallic Raw Materials
  - Hazard Communication Standard

### 4 DEFINITIONS

The following definitions apply to terms that are uncommon or have special meaning as used in this specification.

Batch - A homogeneous unit of finished material manufactured under controlled conditions at one time or a blend of several manufactured units of finished material of the same formulation.

Key Characteristic - A feature whose variation has the greatest impact on the fit, performance, or service life of the finished product from the perspective of the customer.

Key Process Parameter - A process input that is controllable and that has a high statistical correlation with the variation in a key characteristic. Key process parameters are most effectively determined by the use of designed experiments.

Lot - All the material from one batch received in one shipment.

Lot Size - The total number of units in any one lot irrespective of the volume of the container or the length of the roll.

Solvent Resistant - Capable of being wiped without damage or removal of the primer.

Unit - The smallest single portion of material received in any one lot, i.e., a roll of Type II adhesive or a container of Type I primer.

### 5 MATERIAL REQUIREMENTS

- a. The Type I material shall function as an adhesive primer when used with Type II and shall meet all the mechanical property requirements in accordance with [Section 5.1.4](#).
- b. Type I materials shall be suitable for application in thicknesses of 0.00020 to 0.00035 inch for Class 2, 0.00015 to 0.00035 inch for Class 3, and 0.00015 to 0.00040 inch for Class 4 and shall bake to MEK solvent resistance within 60 minutes at 270 to 300 F for Class 2, at 240 to 325 F for Class 3, and at 305 to 325 F for Class 4.

5.1 PROPERTIES

5.1.1 WORKMANSHIP (TYPE II ONLY)

- a. Creases, folds, tears, cracks, and defects shall not be allowed between the first and last yard of the Type II adhesive unless each is flagged and an equivalent yardage (1 linear foot minimum) is added to the roll. No more than five such anomalies will be allowed per roll.
- b. The following items will be considered to be defects:
  - (1) More than three pinholes per linear foot of material which are larger than 0.05 inch but smaller than 0.20 inch.
  - (2) Any pinhole larger than 0.20 inch. Multiple pinholes larger than 0.20 inch may be flagged as a single defect if they are contained within 1 linear foot of material.
  - (3) Thinouts wider than 0.05 inch or longer than 4 inches.
- c. Flags shall consist of a single color polyethylene backing material extending out beyond the edges of the roll.

5.1.2 PRIMERS AND ADHESIVE FILMS

- a. Type I Primers
  - (1) The primer shall readily mix to form a homogeneous mixture suitable for application in accordance with [BAC5514-5137](#).
  - (2) The primer shall be able to meet the requirements of [Section 5](#) after aging a minimum of 10 days at  $90 \pm 5$  F for Class 2; a minimum of 30 days at  $90 \pm 5$  F for Class 3; and a minimum of 7 days at  $90 \pm 5$  F for Class 4.
  - (3) Primers shall be colored (color to be contrasting with aluminum details).
  - (4) The liquid primer shall meet the requirements of Tests 1(1), 2, 3, and 12 of [Table II](#).
  - (5) The primer shall be suitable for bonding after exposure to single or multiple cure cycles after double solvent wiping with MEK.
- b. Type II Adhesive Films
  - (1) The adhesive shall be uniform and free from foreign material and shall not have characteristics that are detrimental to use or fabrication.
  - (2) Type II, Class 1 and 2 adhesives shall be furnished in the weights indicated in [Table I](#). Roll length shall be at least 20 yards with a minimum width of 36 inches, unless otherwise specified in the purchase order.
  - (3) Type II, Class 1 and 2 adhesives shall have less than 2 percent volatiles when tested in accordance with [BSS7216](#), Type II.
  - (4) Type II, Class 2 shall be suitable for reticulation application to [BMS7-209](#) perforated plate. During reticulation, the adhesive shall be subjected to the maximum time and temperature specified by [BAC5514-5137](#). After bonding, the reticulated adhesive shall pass the honeycomb properties requirements in accordance with [Section 5.1.4](#).

5.1.2 PRIMERS AND ADHESIVE FILMS (Continued)

(5) Type II shall be thermosetting and compatible with Type I.

**TABLE II - PROPERTIES OF TYPE I PRIMER AND PRIMED SURFACES**

ITEM	TEST PROCEDURE	REQUIREMENTS	TEST METHOD
1	Appearance (1) Liquid Primer (2) Baked Primer	Free of foreign contaminants. No evidence of gelling or agglomeration of constituents. No streaks, blisters, or other surface irregularities. Smooth, uniform coating. MEK solvent resistant.	None
2	Nonvolatile	Listed in QPL	<a href="#">Section 8.2.9</a>
3	Weight per Gallon	Listed in QPL	<a href="#">Section 8.2.8</a>
4	Metal Anchorage	No cracking, flaking, or loss of adhesion	<a href="#">Section 8.2.5</a>
5	Impact Resistance	No cracking or loss of adhesion at 40 in-lbs (face or reverse side)	<a href="#">Section 8.2.2</a> and <a href="#">Section 8.2.6</a>
6	Pencil Hardness	4H minimum	<a href="#">Section 8.2.7</a>
7	Fluid resistance 75 ± 5 F  (1) Distilled, Deionized, or Demineralized Water (2) <a href="#">BMS3-11</a> Fluid (3) <a href="#">MIL-PRF-5606</a> Fluid (4) <a href="#">MIL-PRF-7808</a> Jet Engine Oil (5) <a href="#">ASTM D 471</a>	No film failure (i.e., blistering, pencil hardness reduction, cracking, peeling) or loss of adhesion  7 days  30 days (7 days for Receiving Inspection) <a href="#">FL 1</a>  7 days  7 days  7 days <a href="#">FL 1</a>	<a href="#">Section 8.2.1</a> , <a href="#">Section 8.2.2</a> and <a href="#">Section 8.2.7</a>
8	Corrosion Resistance (1) Salt Spray  (2) Filiform (Acid-Humidity)	No film or substrate degradation more than 0.125 inch beyond scribe mark after 40 day salt spray. No loss of adhesion.  No blisters, corrosion or loss of adhesion beyond 0.125 inch from scribe after 30 day exposure.	<a href="#">BSS7249</a> , <a href="#">Section 8.2.1</a> and <a href="#">Section 8.2.2</a>  <a href="#">Section 8.2.1</a> and <a href="#">Section 8.2.2</a>
9	Humidity Resistance	No film failure or loss of adhesion after 30 day 95 to 100 percent R. H. at 120 ± 5 F	<a href="#">Section 8.2.1</a> and <a href="#">Section 8.2.2</a>
10	Heat Resistance	No film failure or loss of adhesion after 70 hours at 350 ± 10 F <a href="#">FL 2</a>	<a href="#">Section 8.2.2</a> and <a href="#">Section 8.2.4</a>
11	Low Temperature Shock	No film failure or loss of adhesion after 160 F to -65 F cycle	<a href="#">Section 8.2.3</a>
12	Quantitative Inhibitor Analysis	Listed in QPL	<a href="#">Section 8.2.9</a>

**FL 1** A maximum reduction of two units pencil hardness is allowed.

5.1.2 PRIMERS AND ADHESIVE FILMS (Continued)

**FL 2** Slight discoloration is permitted.

5.1.3 PROPERTIES OF PRIMED PANELS

The baked primer shall pass tests 1(2) and 4 through 11 of [Table II](#).

5.1.4 PROPERTIES OF BONDED SPECIMENS, TYPES I AND II

Bonded specimens prepared in accordance with [Section 8](#) shall meet the minimum requirements listed in [Table III](#), [Table IV](#), [Table V](#), [Table VI](#), and [Table VII](#).

**TABLE III - MINIMUM PROPERTIES OF METAL-TO-METAL SPECIMENS**

TEST	BSS TEST METHOD REFERENCE (SEE 8)	NUMBER OF SPECIMENS REQUIRED		MINIMUM REQUIREMENT  TYPE II, CLASS 1 AND 2
		PER BATCH FL 1	TOTAL	
1. Shear to $75 \pm 10$ F	<a href="#">BSS7202</a> , Type III	10	30	3200 psi <a href="#">FL 3</a>
2. Shear at $-67 \pm 5$ F	<a href="#">BSS7202</a> , Type III	10	30	2500 psi <a href="#">FL 3</a>
3. Shear at $350 \pm 5$ F	<a href="#">BSS7202</a> , Type III	10	30	1500 psi <a href="#">FL 2</a>
4. Fatigue at $75 \pm 10$ F	<a href="#">BSS7201</a> , Type I; Specimen <a href="#">BSS7202</a> , Type IIIA	3	9	$10^7$ cycles at 1250 psi $10^5$ cycles at 1900 psi
5. Creep Rupture - Deformation at $75 \pm 10$ F under 1600 psi load for 192 hours	<a href="#">BSS7204</a> ; Specimen <a href="#">BSS7202</a> , Type III	5	15	0.015 inch minimum
6. Creep Rupture - Deformation at $300 \pm 5$ F under 800 psi load for 192 hours	<a href="#">BSS7204</a> ; Specimen <a href="#">BSS7202</a> , Type III	5	15	0.015 inch minimum
7. Shear at $75 \pm 10$ F after 1000 hours at $350 \pm 5$ F	<a href="#">BSS7202</a> , Type III	10	30	3000 psi <a href="#">FL 3</a>
8. Shear at $350 \pm 5$ F after 1000 hours at $350 \pm 5$ F	<a href="#">BSS7202</a> , Type III	10	30	1500 psi Class 1 <a href="#">FL 2</a> 1300 psi Class 2 <a href="#">FL 2</a>

**FL 1** Per batch for three batches for qualification.

**FL 2** Determination of Calculated Minimum Value:

$X_{min} = X_q - 3.064 S_q$  where  $X_q$  and  $S_q$  are the qualification mean and qualification standard deviation of all the individual measurements from all the batches of a particular grade.

**FL 3** Minimum Average Requirement for each batch.



## 5.1.4

## PROPERTIES OF BONDED SPECIMENS, TYPES I AND II (Continued)

TABLE IV - PHYSICAL PROPERTIES OF HONEYCOMB SPECIMENS

TEST	TEST METHOD (SEE SECTION 8)	NUMBER OF SPECIMENS REQUIRED		MINIMUM REQUIREMENT FL 2	
		PER BATCH FL 1	TOTAL	TYPE II, CLASS 1, GRADE 10 OR GRADE 15	TYPE II, CLASS 2, GRADE 5
1. Flatwise Tensile at 75 ± 10 F	BSS7205	10	30	900 psi	900 psi
2. Flatwise Tensile at 350 ± 5 F	BSS7205	10	30	300 psi	200 psi
3. Flatwise Tensile at 350 ± 5 F after 1000 hours at 350 ± 5 F	BSS7205	10	30	300 psi	190 psi
4. Short Beam Shear at 75 ± 10 F	BSS7237, Type I	10	30	675 psi	675 psi

**FL 1** Number of specimens per batch for three batches for qualification.

**FL 2** Determination of Calculated Minimum Value:

$X_{\min} = X_q - 3.064 S_q$  where  $X_q$  and  $S_q$  are the qualification mean and qualification standard deviation of all the individual measurements from all the batches of a particular grade.

TABLE V - AIR FLOW RESISTANCE

TEST	TEST METHOD	NUMBER OF SPECIMENS REQUIRED		MAXIMUM ALLOWABLES
		PER BATCH FL 1	TOTAL	FLOW RESISTANCE
Airflow Resistance Skin Reticulated FL 2	8.3.2	3	9	10 percent

**FL 1** Number of specimens per batch for three batches for qualification.

**FL 2** Test required for Type II, Class 2 only.

TABLE VI - MINIMUM PROPERTIES OF PEEL SPECIMENS

TEST	TEST METHOD (SEE SECTION 8)	NUMBER OF SPECIMENS REQUIRED		MINIMUM REQUIREMENT							
				CLASS 1, GRADE 5		CLASS 1, GRADE 10		CLASS 1, GRADE 15		CLASS 2, GRADE 5	
		PER BATCH FL 1	TOTAL	IND	AVG	IND	AVG	IND	AVG	IND	AVG
1. Metal-to-metal Climbing Drum Peel at 75 ± 10 F (in-lb/in width)	BSS7206	10	30	15	20	15	20	---	---	15	20

## 5.1.4 PROPERTIES OF BONDED SPECIMENS, TYPES I AND II (Continued)

TABLE VI - MINIMUM PROPERTIES OF PEEL SPECIMENS (Continued)

TEST	TEST METHOD (SEE SECTION 8)	NUMBER OF SPECIMENS REQUIRED		MINIMUM REQUIREMENT							
				CLASS 1, GRADE 5		CLASS 1, GRADE 10		CLASS 1, GRADE 15		CLASS 2, GRADE 5	
		PER BATCH FL 1	TOTAL	IND	AVG	IND	AVG	IND	AVG	IND	AVG
2. Honeycomb Peel at 75 ± 10 F (in-lb/3 inch width)	<a href="#">BSS7207</a>	10	30	---	---	30	35	55	65	17	22

FL 1 Number of specimens per batches for qualification.

TABLE VII - ENVIRONMENTAL DURABILITY TESTS

TEST	TEST METHOD REFERENCE (SEE SECTION 8)	NUMBER OF SPECIMENS REQUIRED		MINIMUM REQUIREMENT FL 2
		PER BATCH FL 1	TOTAL	TYPE II, CLASS 1 AND 2
1. Crack Extension at 75 ± 10 F	<a href="#">BSS7208</a>	2	6	G <sub>1a</sub> = 3.0 lb/in.
2. Crack Extension after 7 days immersion at 150 ± 5 F in:	<a href="#">BSS7208</a> and <a href="#">BSS7212</a>			
a. JP-4 Fuel <a href="#">FL 3 (MIL-DTL-5624)</a>		2	6	G <sub>1scc</sub> = 2.0 lb/in
b. Hydraulic Fluid ( <a href="#">BMS3-11</a> , Type III)		2	6	G <sub>1scc</sub> = 2.0 lb/in
c. Deicer Glycol ( <a href="#">AMS 1424</a> )		2	6	G <sub>1scc</sub> = 2.0 lb/in
3. Crack Extension after 5 weeks in 140 ± 5 F and 100 percent RH	<a href="#">BSS7208</a> and <a href="#">BSS7211</a>	2	6	G <sub>1scc</sub> = 2.0 lb/in
4. Sustained Stress Loading at 140 ± 5 F and 100 percent RH	<a href="#">BSS7209</a> , Specimen <a href="#">BSS7202</a> , Type III	4	12	No failures in 90 days at 1100 psi

FL 1 Number of specimens per batch, with a minimum of three batches required for qualification.

FL 2 Minimum individual value for any specimen. G<sub>1a</sub> is the crack extension force for unexposed adhesive crack arrest. G<sub>1scc</sub> is the crack extension force for crack arrest during corrosive exposure.

FL 3 Exposure temperature is 75 ± 10 F.

## 5.1.5 PROCESS VARIABLES AND OUT TIME REQUIREMENTS

The Type II adhesives shall meet all requirements of this specification when processed at 90 minute cure time, 340 F and 360 F cure temperature, 1.5 F/min and 10 F/min temperature rise, 30 psi and 100 psi cure pressure, both as-received and after 240 hours aging at 90 F (temperature fluctuations of ± 5 F maximum are permitted) prior to bonding. For Type II, Class 2, interrupt the aging after 48 ± 2 hours, reticulate the adhesive, then continue aging for the balance of the 240 hours.

5.1.5 PROCESS VARIABLES AND OUT TIME REQUIREMENTS (Continued)

**NOTE:** The 100 psi cure pressure does not apply for honeycomb panels.

5.1.6 ADHESIVE CHEMISTRY

The critical elements of the adhesive chemistry of composition and its control limits shall be identified in terms of measurable properties (see [Section 6](#)).

5.2 STORAGE LIFE

BMS5-137 components shall retain their ability to meet the physical property requirements of [Section 5](#) for a minimum period of 12 months from the date of shipment from the manufacturer's facility.

- a. The adhesives shall remain in sealed containers or airtight wrappers, except for opening to obtain samples for acceptance tests.
- b. The temperature requirements of Type I, during storage is 35 to 55 F. Do not freeze. If material becomes frozen, reject the material.
- c. The temperature for Type II material during storage shall remain below zero F.

**6 QUALIFICATION**

- a. Direct all requests for qualification to a Supplier Management (SM) organization of The Boeing Company. SM coordinates all communication between material suppliers and the appropriate Boeing departments.
- b. The material supplier shall have facilities capable of testing in accordance with this specification, or the supplier shall identify a test facility. Boeing Engineering and Quality Assurance shall verify the adequacy of all test facilities and test procedures.
- c. Prior to submitting a material for qualification to this specification, the material supplier shall provide a Material Safety Data Sheet (MSDS) for the candidate material. Prior to completing qualification, the material supplier shall provide the detailed chemical formulation, percent composition, and CAS (Chemical Abstract Service) numbers for the candidate material. Agreements for non-disclosure and control of proprietary information shall be considered and executed as appropriate. The information provided shall be submitted to the appropriate Boeing Environmental, Health, and Safety (EHS) organizations to perform a health hazard evaluation. These organizations determine whether the information as supplied is adequate (or alternatively, whether additional information is necessary) to identify and document appropriate precautions for the material's use.
- d. No changes in approved product formulation, raw materials, and basic methods of manufacture, or plant site for a material qualified to this specification shall be made without notification and prior approval in writing from The Boeing Company. It may be necessary to re-qualify material manufactured with the proposed change, and a revised product designation may be required.
- e. Production material shall be capable of meeting all qualification requirements.
- f. Qualified products are listed in the Qualified Products List (QPL).

6.1 SAMPLES AND TEST REPORTS

- a. Qualification samples submitted for approval shall be accompanied by a test report giving actual data for a minimum of three batches in accordance with Type and Class for all tests in [Section 5](#).

Both individual specimen values and average values for each test shall be reported. Each value reported shall be shown as being for an individually numbered specimen, the numbering of which shall be coded in the report in such a manner as to definitely establish the particular test assembly from which the specimen was cut and the particular batch (batch is defined in [Section 4](#)) with which the test assembly was bonded, together with the date of bonding. Coded identification of the component batches shall include the respective dates of manufacture and sizes of batches. Dates on which the different tests were performed shall be shown in the test report.

- b. In addition to the required tests in [Section 5](#) the vendor shall submit a processing variables study that demonstrates that the material to be qualified meets the requirements of [Section 5.1.5](#). As a minimum, the process variables study shall consist of two material batches evaluated for Tests 1 and 3 of [Table III](#) and Tests 1 and 2 of [Table IV](#) and Test 2 of [Table VI](#). The number of specimens for each batch shall be as required in [Table III](#), [Table IV](#), and [Table VI](#). A plan for this study shall be approved by The Boeing Company.
- c. The material supplier shall have facilities capable of testing in accordance with this specification, or the supplier shall identify such a testing facility. Boeing Engineering and Quality Assurance shall verify the adequacy of all test facilities and test procedures.
- d. Qualification samples shall be submitted from each of three production batches for each candidate Type and Class.

6.2 PROCESS CONTROL DOCUMENT

- a. Supplier shall submit a process control document (PCD) for Boeing review prior to qualification audits of production material.
- b. The PCD shall identify baseline chemical constituents, in-process test procedures and requirements, and manufacturing procedures in accordance with D6-53356. Rationale for the formulation and process parameters (including key process parameters) shall be supported by historical data and experimentation.

6.3 QUALIFICATION AUDIT

- a. Supplier shall submit to an audit of their manufacturing operations, Quality Assurance system, raw materials accountability system, product traceability, process records, test results, and quality assurance records.
- b. Qualification audits shall be conducted during the manufacture of the qualification batches in accordance with D6-53356.
- c. The Boeing Company reserves the right to perform an on-site audit of the manufacturing of any production order after qualification.

## 7 QUALITY CONTROL

### 7.1 SUPPLIER QUALITY CONTROL

- a. The supplier shall verify that each batch has been manufactured in accordance with their approved PCD.
- b. The supplier shall test each batch in accordance with the requirements of [Section 7.3](#), unless a reduced testing plan has been approved by Boeing Quality Assurance. Each shipment shall be accompanied by a test report providing the results of such testing, the BMS5-137 revision level in effect, the batch number and the purchase order number.
- c. All areas of Type II film adhesive shall be visually inspected and areas which do not meet [Section 5.1.1](#) requirements shall be marked accordingly by the supplier.
- d. For a period of 7 years, all records pertaining to acceptance testing and certification shall be maintained. Such records shall be available for inspection by The Boeing Company.

### 7.2 PURCHASER QUALITY CONTROL

- a. Each unit of material shall be checked for compliance with the identification requirements of [Section 9](#). All packages incorrectly identified shall not be released for storage or production until the correct information has been marked on the package, as required by [Section 9](#).
- b. Lot numbers shall be established at the time of receipt based on the date of material shipment and marked on each unit of material received in the lot.
- c. Purchaser Quality Assurance shall review all supplier test data submitted with shipment and perform any additional inspection or testing necessary to assure that the production material meets all requirements specified herein.
- d. Purchaser Quality Assurance shall verify that each lot of material meets the requirements for storage temperature during shipment stated in [Section 10.3](#).
  - (1) The purchaser shall document the procedure used to verify temperature exposure.
  - (2) If any exposure exceeds the maximum allowed out-time, the material shall be rejected.
  - (3) Exposure which exceed the storage temperature and are less than the maximum allowed out-time shall be deducted from the allowed out-time for the material in that lot.
  - (4) If the storage temperature during shipment cannot be verified, the purchaser shall reject the shipment.
- e. The purchaser may establish and implement an alternative documented quality system for procurement and receipt of materials qualified to this specification in lieu of the purchaser quality control requirements stated in [Section 7.2](#). The quality system shall be approved by Boeing Quality Assurance.

### 7.3 SAMPLING, ACCEPTANCE, AND REJECTION CRITERIA

- a. The units to be tested shall be randomly selected in accordance with [Table XI](#) for the supplier.

7.3 SAMPLING, ACCEPTANCE, AND REJECTION CRITERIA (Continued)

b. Acceptance of each lot is contingent on test values meeting the following requirements.

(1) Type I shall meet the requirements of [Table VIII](#), [Table IX](#), and [Table X](#).

(2) Type II shall meet the requirements of [Table VIII](#), [Table IX](#) and [Table X](#).

**TABLE VIII - ACCEPTANCE TESTS FOR PHYSICAL PROPERTIES**

TEST <a href="#">FL 1</a>	REQUIREMENT	TEST SECTION REFERENCES	TYPE
1 Fluid Resistance (pencil hardness) Expose to distilled, deionized, or demineralized H <sub>2</sub> O for 7 days	Test 7 (1), Table II	<a href="#">8.2.7</a> , <a href="#">8.2.1.b.</a> , <a href="#">8.2.2</a>	I
2 Nonvolatile <a href="#">FL 2</a>	Listed on QPL	<a href="#">8.2.9</a>	I
3 Weight per gallon	Listed on QPL	<a href="#">8.2.8</a>	I
4 Quantitative Inhibitor Analysis <a href="#">FL 2</a>	Listed on QPL	<a href="#">8.2.9</a>	I
5 Appearance (1) Liquid Primer  (2) Baked Primer	Free of foreign contaminants. No evidence of gelling or agglomeration of constituents.  No streaks, blisters, or other surface irregularities.	None  None	I
6 Weight <a href="#">FL 2</a> <a href="#">FL 3</a>	Listed on QPL	<a href="#">8.3.1</a>	II

**FL 1** Prepare one test per sample.

**FL 2** Key characteristics

**FL 3** Only two rolls need to be tested.

**TABLE IX - ACCEPTANCE TESTS FOR MECHANICAL PROPERTIES**

TEST <a href="#">FL 1</a>	BONDED ASSEMBLIES PER SAMPLE	SPECIMENS PER SAMPLE	TYPE	TEST METHOD REFERENCE
1. Metal-to-Metal Peel at 75 ± 10 F <a href="#">FL 2</a>	1	3	I, II	<a href="#">BSS7206</a> , Type I
2. Honeycomb Peel at 75 ± 10 F <a href="#">FL 3</a>	1	3	II	<a href="#">BSS7207</a> , Type I
3. Wide Area Lap Shear at 350 ± 5 F <a href="#">FL 4</a>	1	5	I, II	<a href="#">BSS7202</a> , Type IV

**FL 1** Type I and Type II materials may be tested together. If any failures occur, the materials shall then be retested with already qualified products. Should any failures then occur, the material failing shall be rejected.

**FL 2** Type II, Class 1, Grades 5 and 10 only.

**FL 3** Type II, Class 1, Grades 10 and 15 and Class 2 only.

**FL 4** Key characteristics (minimum average values listed in [Table X](#)).

7.3

SAMPLING, ACCEPTANCE, AND REJECTION CRITERIA (Continued)**TABLE X - MINIMUM ACCEPTANCE LIMITS FOR MECHANICAL PROPERTIES**

TEST	CLASS 1, GRADE 5		CLASS 1, GRADE 10		CLASS 1, GRADE 15		CLASS 2, GRADE 5	
	MIN IND	MIN AVG FL 1	MIN IND	MIN AVG FL 1	MIN IND	MIN AVG FL 1	MIN IND	MIN AVG FL 1
1. Metal-to-Metal Peel at 75 ± 10 F (in-lb/in)	15	20	15	20	---	---	---	---
2. Honeycomb Peel at 75 ± 10 F (in-lb/3 inch width)	---	---	30	35	55	65	17	22
3. Wide Area Lap Shear at 350 ± 10 F (psi)	1500	1700	1500	1700	1500	1700	1300	1500

**FL 1** Minimum average is the average of all specimens required for the lot of adhesive being acceptance tested.

**TABLE XI - SUPPLIER SAMPLING CRITERIA**

BATCH SIZE (UNITS)	UNITS TO BE TESTED FL 1
1 to 4	1
5 to 25	4
26 to 50	5
51 to 100	6
101 to 200	7
201 to 300	8
301 to 500	10
Over 500	15

**FL 1** For Type I material, test one unit per batch for Tests 1 and 3 from [Table VIII](#), and test one unit per batch for Tests 1 and 3 from [Table IX](#).

8

**MATERIAL TEST METHODS****WARNING**

This specification involves the use of chemical substances which are hazardous. Boeing personnel shall refer to the work area Hazard Communication Handbook for health effect and control measure information contained in the HazCom Info Sheets and Material Safety Data Sheets. For disposition of hazardous waste materials, consult site environmental engineers for proper disposal methods.

Non-Boeing personnel should refer to manufacturer's Material Safety Data Sheet(s) and their employer's safety instructions.

8.1

TEST SPECIMENS

- Fabricate specimens for bonding properties tests to the configurations of the appropriate BSS standards and using materials listed in [Table XII](#).
- Panels for Type I primer film property tests shall be nominally 0.020 by 4 by 6 inches. Conduct Tests 4, 5, 8, 9, 10, and 11 from [Table II](#) with 2024-T3 bare and clad aluminum. Conduct Tests 6 and 7 from [Table II](#) and impact with 2024-T3 bare aluminum only.

8.1 TEST SPECIMENS (Continued)

- c. Anodize each test panel in accordance with [BAC5555](#) or an alternate phosphoric acid anodizing (PAA) process approved by Boeing in the PCD.
- d. Prime all test panels to a dry film thickness of 0.00020 to 0.00035 inch for Class 2, 0.00015 to 0.00035 inch for Class 3 and 0.00015 to 0.00040 inch for Class 4 in accordance with [BAC5514-5137](#).
  - (1) Panels for bonding properties tests shall have a dry Type I primer film thickness as close as possible to the maximum allowed thickness.
  - (2) Panels for Type I primer film properties tests ( [Table II](#), Tests 4 to 11), shall have a dry film thickness as close as possible to the minimum allowed thickness.
  - (3) Panels for impact shall have a dry film thickness as close as possible to the maximum allowed thickness.
- e. The start of the primer bake may be between 30 minutes and 1 day after the priming operation. Storage during this period shall be in a controlled contamination area in accordance with the Facilities Control section of [BAC5514-5137](#).
- f. Bake the primed panels for 60 to 90 minutes at 270 F to 300 F for Class 2, 240 to 325 F for Class 3, and 305 to 325 F for Class 4.
- g. For Tests 4 through 11 of [Table II](#), the primer shall receive a cure of 350 ± 10 F for 90 minutes minimum, in addition to the primer bake in [Section 8.1.f](#).
- h. Measure the primer thickness by an Isometer (Model No. 2.082), Permascope, or equivalent, on three randomly selected test panels primed by the same operator within the period of one work shift. This is sufficient to certify the entire primed load. If any of the panels selected fails to fall within the specified thickness range, each panel from the primed load in question shall be tested and discarded if it fails to meet the thickness requirement.
- i. Panels for primer film property tests ( [Table II](#), Tests 4 to 11) receive no topcoating, except for [Table II](#), Test 8(2), filiform corrosion, as noted in [Section 8.2.10](#).
- j. For bonding properties test assemblies, after the primer thickness has been approved, apply a layer of adhesive to extend at least 1/8 inch beyond the area to be bonded. Use Grade 5 or Grade 10 supported adhesive for metal-to-metal bonding. Use Grade 5, unsupported and reticulated, or Grade 10 or 15 supported, adhesive for honeycomb bonding.
- k. Cure the bonding properties test panel assemblies in accordance with the applicable section of [BAC5514-5137](#).

**TABLE XII - TEST SPECIMEN MATERIALS**

TEST SPECIMEN	MATERIAL OF CONSTRUCTION	THICKNESS (NOMINAL)
Lap Shear (all Classes)	2024-T3 Bare (Qualification) 2024-T3 Clad (Acceptance Tests)	0.064 inch
Crack Extension (all Classes)	2024-T3 Bare	0.500 inch
Metal-to-Metal Peel	2024-T3 Clad	0.020 inch 0.040 inch



8.1 TEST SPECIMENS (Continued)**TABLE XII - TEST SPECIMEN MATERIALS** (Continued)

TEST SPECIMEN	MATERIAL OF CONSTRUCTION	THICKNESS (NOMINAL)
Honeycomb Peel Core Face Sheets <b>FL 1</b> (Classes 1 and 2)	<a href="#">BMS4-4</a> , Type 4-40N 2024-T3 Clad	0.625 inch 0.020 inch
Flatwise Tensile <b>FL 3</b> Core Face Sheets <b>FL 2</b> (Classes 1 and 2)	<a href="#">BMS4-4</a> , Type 4-40N 2024-T3 Clad	0.625 inch 0.063 inch
Short Beam Shear Core (Aluminum) Face Sheets <b>FL 2</b> (Classes 1 and 2)	<a href="#">BMS4-4</a> , Type 4-40N 2024-T3 Clad	0.625 inch 0.063 inch
Airflow Resistance, Skin Reticulated Core Face Sheets <b>FL 1</b> (Class 2)	<a href="#">BMS4-6</a> , Type 4.1 - 25 2024-T3 Clad	0.625 inch 0.025 to 0.032 inch

**FL 1** For Class 2, use [BMS7-209](#) Perforated Plate, 15 to 20 POA 0.025 inch thick, 0.035 to 0.045 inch hole dia.

**FL 2** For Class 2, use [BMS7-209](#) Perforated Plate, 26 POA 0.063 inch thick, 0.080± 0.004 inch hole dia.

**FL 3** Specimens shall be bonded to test blocks with an adhesive that will not flow through the holes and bond to the core.

8.2 TEST PROCEDURES - TYPE I

## 8.2.1 ENVIRONMENTAL RESISTANCE

Environmental exposures shall be performed in accordance with the appropriate BSS Standard and [Table II](#) and as outlined below.

- For [Table II](#), Items 1, 2, 3, and 12, run one test for each lot of primer being tested. For [Table II](#), Items 4, 5, 6, 7(1), 7(2), 7(3), 7(4), 7(5), 8(1), 8(2), 9, 10, and 11, prepare three test specimens in accordance with Section 8 for each lot of primer being tested.
- Primer film property tests (adhesion, hardness, etc.) shall be completed within 10 minutes after specimens are removed from environmental exposure.
- For Test 5 and Tests 7 through 11 of [Table II](#), panel evaluation after exposure shall include adhesion testing in accordance with [Section 8.2.2](#).
- Pencil hardness testing in accordance with [Section 8.2.7](#) is required after [Table II](#), Item 7 fluid exposures.

8.2.2 ADHESION

The panels from Test 5 and Tests 7 through 11 of [Table II](#) shall be thoroughly dried by wiping with clean dry cheesecloth. The test shall be conducted at  $75 \pm 10$  F. Cut two parallel scratches approximately 1 inch apart, through the coating down to the metal, with a sharp edge scribe. Apply a strip of 1 inch masking tape, 3M No. 250 (not more than 6 months old from date of manufacture) across the scratches at approximately 90 degrees to the panel area to be tested. The tape shall be pressed down using two passes of a  $4.5 \pm 0.5$  pound roller approximately 3.5 inches in diameter by 1.75 inches in width. The roller shall have a rubber coating of 70 to 80 Shore A durometer. As an option, the tape may be pressed down by rolling the tape roll along the strip of applied tape using a firm hand pressure of approximately 4 to 5 pounds. The tape shall be removed in one abrupt motion perpendicular to the panel.

8.2.3 LOW TEMPERATURE SHOCK (TEST 11) Table II

The panels shall be subjected to twenty four of the following cycles:  $25 \pm 3$  minutes at  $160 \pm 5$  F, then, within 5 seconds transfer time,  $5 \pm 1$  minutes at  $-65 \pm 5$  F. On completion of the last cycle, the panels shall be placed in a cold box maintained at  $-65 \pm 5$  F for  $5 \pm 0.5$  hours. The panels shall be rapidly bent over a nominal 4 inch diameter mandrel which has been conditioned at the same temperature. Panel evaluation after exposure shall include adhesion in accordance with [Section 8.2.2](#).

8.2.4 HEAT RESISTANCE (TEST 10) Table II

The panels shall be placed in a mechanical convection oven maintained at  $350 \pm 10$  F for  $70 \pm 2$  hours. The panels shall be removed, cooled to  $75 \pm 10$  F and bent rapidly over a nominal 1-inch-diameter mandrel. Panel evaluation after exposure shall include adhesion in accordance with [Section 8.2.2](#).

8.2.5 METAL ANCHORAGE (TEST 4) Table II

The panels shall be bent through  $180 \pm 5$  degrees over a conical mandrel in accordance with [ASTM D 522](#).

8.2.6 IMPACT (TEST 5) Table II

The coated side of the panels shall be subjected to an impact of  $40 \pm 1$  inch/pounds using a Gardner 160 inch-pound capacity impact testing machine or equivalent. The nominal 1 pound, 0.625 inch diameter falling weight shall be used. The uncoated side of the panel shall be subjected to an impact of  $40 \pm 1$  inch/pounds using the same equipment. Apply 3M No. 250 masking tape over the most highly stressed area on the coated side of each impact spot and test in accordance with [Section 8.2.2](#).

8.2.7 PENCIL HARDNESS (TESTS 6 AND 7) Table II

- a. Preparation of Pencils - A set of drawing pencils (KOH-I-NOOR 1500, Venus Drawing Pencils, A.W. Faber-Castell, or Eagle Turquoise) ranging in hardness from 6B to 9H shall be prepared by stripping the wood away from the end approximately  $3/8$  inch without damaging the lead. The tip of the lead shall be squared by holding the pencil in a vertical position and moving the lead back and forth over 400 grit or finer abrasive paper. The tip of the lead shall be squared after each trial. Alternatively, drafting leads held in a clutch-type holder such as Loctite 9400 may be used.

8.2.7 PENCIL HARDNESS (TESTS 6 AND 7) Table II (Continued)

- b. Procedure - Test panels shall be placed in a horizontal position. Pencils of increasing hardness shall be pushed across the primed surface of the panel at a 45 degree angle until one is found that will cut or scratch the coating. The number of this pencil shall be used to express the pencil hardness. If the 9H pencil does not produce a detectable cut or scratch in the coating, the pencil hardness shall be listed as 9H+.

8.2.8 WEIGHT PER GALLON (TEST 3) Table II

The weight per gallon shall be determined in accordance with [ASTM D 1475](#) or [ASTM D 1875](#).

8.2.9 NONVOLATILE AND QUANTITATIVE INHIBITOR ANALYSIS (TESTS 2 AND 12) Table II

Perform the non-volatile and quantitative inhibitor analysis test in accordance with a Boeing Engineering approved equivalent alternate method that is documented in the process control document for BMS5-137 or the following conventional method:

- a. Tare a minimum of three ignition-loss crucibles and weigh.
- b. Add well mixed bond primer to the crucibles and weigh. The recommended sample size is 2 ml.
- c. Dry at  $250 \pm 5$  F ( $121 \pm 3$  C) to constant weight. Constant weight is reached when successive weighing at minimum intervals of 15 minutes differs by 1 mg or less.
- d. Cool to 65 - 90 F (18 - 32 C) in a desiccator, and compute the percent non-volatile for each of the samples as follows.

$$\text{Percent Non - Volatiles} = \frac{\text{Weight of non volatile residue}}{\text{Weight of the liquid sample}}(100)$$

- e. Place the crucibles in a furnace at 1050 F minimum for 60 minutes minimum.
- f. Cool to 65 - 90 F (18 - 32 C) in a desiccator, weigh, and compute average weight of samples. Compute percent quantitative inhibitor as follows:

$$\text{Percent Quantitative Inhibitor} = \frac{\text{Weight of inhibitor residue}}{\text{Weight of nonvolatile residue}}(100)$$

- g. Cool to  $75 \pm 10$  F in a desiccator, weigh, and compute average weight of the samples. Compute percent nonvolatiles.

$$\text{Percent Nonvolatiles} = \frac{\text{Total weight of nonvolatile residue}}{\text{Weight of 2 ml sample}}(100)$$

- h. Place the crucibles (with covers and residue) in a furnace at  $1100 \pm 50$  F for  $60 \pm 5$  minutes
- i. Cool to  $75 \pm 10$  F in a desiccator, weigh, and compute average weight of the samples. Compute percent inhibitor of the nonvolatile residue.

$$\text{Percent Inhibitor} = \frac{\text{Weight of inhibitor residue}}{\text{Weight of nonvolatile residue}}(100)$$

8.2.9 NONVOLATILE AND QUANTITATIVE INHIBITOR ANALYSIS (TESTS 2 AND 12) Table II  
(Continued)

- j. If results of the 2 ml sample size tests do not fall within the required range for either the nonvolatile or inhibitor content, a 10 ml sample shall be used as a referee test prior to rejection.

8.2.10 CORROSION RESISTANCE (TEST 8) Table II

For Test 8 of [Table II](#), the panels shall be scribed through the coating to the base metal in two diagonal strike marks extending from corner to corner. Panels with a primer coat only shall be tested in 5 percent salt spray in accordance with [BSS7249](#) for  $40 \pm 1$  days. Panels for filiform corrosion shall be overcoated with [BMS10-60](#), Type I enamel in accordance with [BAC5845](#), scribed and exposed to 12 normal HCl vapor for  $1 \pm 0.1$  hour at  $75 \pm 10$  F, then placed immediately in an  $80 \pm 5$  percent relative humidity environment for  $30 \pm 1$  days.

8.2.11 HUMIDITY RESISTANCE (TEST 9) Table II

The panels shall be placed in a chamber maintained at 100 percent relative humidity at  $120 \pm 5$  F for  $30 \pm 1$  days. Panels shall be removed, cooled to  $75 \pm 10$  F and examined for film failure. Panel evaluation after exposure shall include adhesion in accordance with [Section 8.2.2](#).

8.3 TEST PROCEDURES

8.3.1 WEIGHT TEST (TYPE II)

- a. Cut three specimens of material across the width of the adhesive film. Cut specimens approximately 6.0 by 6.0 inches. Determine the area to the nearest 0.1 square inch.
- b. Remove separator sheets from the film and weigh adhesive film to nearest 0.1 gram.
- c. Report average weights to nearest 0.001 lb/sq ft.

8.3.2 AIR FLOW RESISTANCE TESTING FOR NOISE

For each adhesive sample:

- a. Cut a 9 by 12 inch plate from [BMS7-209](#) aluminum perforated plate 15 to 20 percent open area (POA), 0.025 to 0.032 inch thickness, 0.032 to 0.045 inch hole diameter.
- b. Measure flow resistance of each plate at four reference locations. Airflow into punch entrance side of plate:
  - (1) Airflow velocity 0 to 400 cm/sec range depending on POA.
  - (2) Approximately fifteen increments, approximately thirty points.
- c. Bond aluminum core to punch exit side of panel with Class 2, Grade 5 adhesive reticulated in accordance with [BAC5514-5137](#).
- d. Measure flow resistance of bonded panel as above.
- e. Calculate the airflow adhesive-blockage effect in accordance with the following equation.

8.3.2 AIR FLOW RESISTANCE TESTING FOR NOISE (Continued)

$$B_T = \left[ 1 - \left( \frac{b}{b_B} \right)^{1/2} \right] (100)$$

b = airflow resistance slope (CGS Rayls sec/cm) before bonding

b<sub>B</sub> = airflow resistance slope (CGS Rayls sec/cm) after bonding

**9 MATERIAL IDENTIFICATION**

Each individual container of primer and each roll of adhesive shall be legibly identified and labeled with the items of information listed below. Metal containers shall have the identification securely affixed to the outside of the container.

- a. BMS5-137 (including the latest revision letter), Type, Class and Grade, of the adhesive
- b. Supplier's name
- c. Supplier's Product designation
- d. Batch number
- e. Date of manufacture
- f. Unit number of roll or container
- g. Nonvolatile content (Type I, Class 3 only)
- h. Roll length (Type II only)
- i. Date of shipment

**10 PACKAGING, MARKING, AND SHIPPING**

**10.1 PACKAGING**

Packaging shall be accomplished in such a manner as to assure delivery of material capable of meeting the requirements of this specification.

- a. Type I primer shall be packaged in clean, airtight containers, as specified on the purchase order.
- b. Each roll of Type II adhesive shall be protected by a sealed polyethylene film wrapper. A suitable desiccant shall be contained within each wrapper.
- c. The exterior packaging shall be of such a nature as to prevent physical damage or contamination by foreign substances. Each package shall be suitably insulated and refrigerated, when necessary, to ensure maintenance of the shipping temperature requirements.
- d. Type II adhesive rolls shall be packaged and stored in such a manner that adhesive deformation, fracture, or cold flow does not occur.

**10.2 MARKING**

- a. All labeling shall conform to 29CFR 1910.1200.

10.2 MARKING (Continued)

- b. Each shipping container shall be durably and legibly marked on the outside with the following information:
  - (1) BMS5-137 (including the latest revision letter), Type, Class, and Grade as applicable
  - (2) Supplier's name and product designation
  - (3) Date of manufacture
  - (4) Batch number or lot number
  - (5) Purchase order number
  - (6) Quantity
  - (7) Storage or handling requirements
  - (8) Date of shipment
  - (9) "Do not freeze" warning label (Type I only)

10.3 SHIPPING

- a. The temperature requirement of Type I, during shipment is 35 to 55 F. Do not freeze. If material becomes frozen, the shipment shall be rejected.
- b. When specified on the purchase order, Type I material may be shipped at temperatures between 55 F and 90 F as necessary to allow for expedited shipment of the material. For shipment between 55 F and 90 F, the time above 55 F shall be subtracted from the out-time of the material.
- c. The temperature for Type II material during shipment shall remain below zero F.
- d. Temperature variations during shipment of Type I and Type II materials of  $\pm 10$  F which do not exceed 15 minutes maximum are allowed as long as the total time does not exceed 60 minutes.
- e. Continuous temperature monitoring during shipment is required for both Type I and Type II materials.