AEROSPACE MATERIAL SPECIFICATION

AMS3920™	REV. A

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Superseding AMS3920

Acceptance Criteria Adhesive-Bonded Metal-Faced Sandwich Structures

RATIONALE

AMS3920A has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE:

1.1 Application:

This specification establishes the acceptance criteria and inspection requirements for adhesive-bonded sandwich structures including the metal-to-metal bonding found in these structures, but usage is not limited to such applications and each application should be considered individually.

1.2 Classification:

The classification of adhesive bonded structures specified in this specification shall be of the following types:

Type 1: Components which are fracture or fatigue critical as defined in MIL-I-6870 and components, the single failure of which would cause significant danger to operating personnel or would result in an operational penalty. This includes loss of major components, loss of control, unintentional release, inability to release armament stores, or failure of weapon installation components.

Type 2: All components not classified as Type 1.

1.2.1 Structural Classification: The structural classification, Type 1 or Type 2, will be specified on the engineering drawing. All structures shall be considered Type 1 unless otherwise specified on the drawing.

1.2.2 Structural Imperfections: Structural imperfections specified in this specification shall be face-to-core voids and disbonds, metal-to-metal voids, bond voids, porosity, core splice voids, core splice gaps, dents, and markoffs. These imperfections are defined in 8.2.

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2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

2.2 U.S. Government Publications:

(R)

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 191115094.

MIL-I-6870 Inspection Program Requirements, Nondestructive Testing, For Aircraft and Missile Materials and Parts

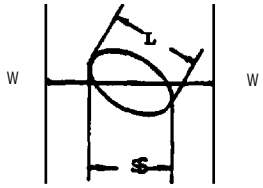
3. TECHNICAL REQUIREMENTS:

3.1 Procedure:

3.1.1 Purchaser will specify the allowable imperfections for adhesive-bonded, metal-faced structures, including metal-to-metal bonds, on the engineering drawing or in the process specification; if not so specified, the following requirements shall apply:

3.1.2 Imperfection Dimensions: When measured as shown in Figure 1, individual disbonds or voids shall not have any dimension greater than 15 times the thickness of the thinnest adherend, or 1 inch (25 mm), whichever is smaller, or an “S” dimension greater than 15% of the shortest ‘W” through the defect.

3.1.2 (Continued):



where:

S is the width of void in the “W” direction
L is the longest dimension of void
W is the smallest dimension of the metal-to-metal bond area containing the void (width of adhesive bond)
The width of void is in the "W" direction
When “W” is less than 2 inches (51 mm), “S” shall be less than 0.25 inch (6.4 mm)

FIGURE 1 - Dimensions

3.1.3 Permissible Areas:

3.1.3.1 The maximum permissible area of an individual void or disbond is as follows:

3.1.3.1 .1 Type 1 Structure: 0.375 square inch (242 mm^2)

3.1.3.1.2 Type 2 Structure: 0.500 square inch (323 mm^2)

3.1.3.2 The minimum permissible spacing distance as measured in Figure 2 between void boundaries is as follows:

3.1.3.2.1 Type 1 Structure: Four times the largest void or disbond dimension measured on a line between the centers of the two voids.

3.1.3.2.2 Type 2 Structure: Three times the void or disbond dimension.

3.1.3.3 No voids, disbonds, or porosity shall be permitted within 0.125 inch (3.18 mm) of any bond joint edge.

3.1.3.4 The aggregate unbonded length of disbonds along any straight area, between two parallel lines 0.25 inch (6.4 mm) apart shall not exceed 15% of the length of the bond line, measured along the direction of the parallel lines.

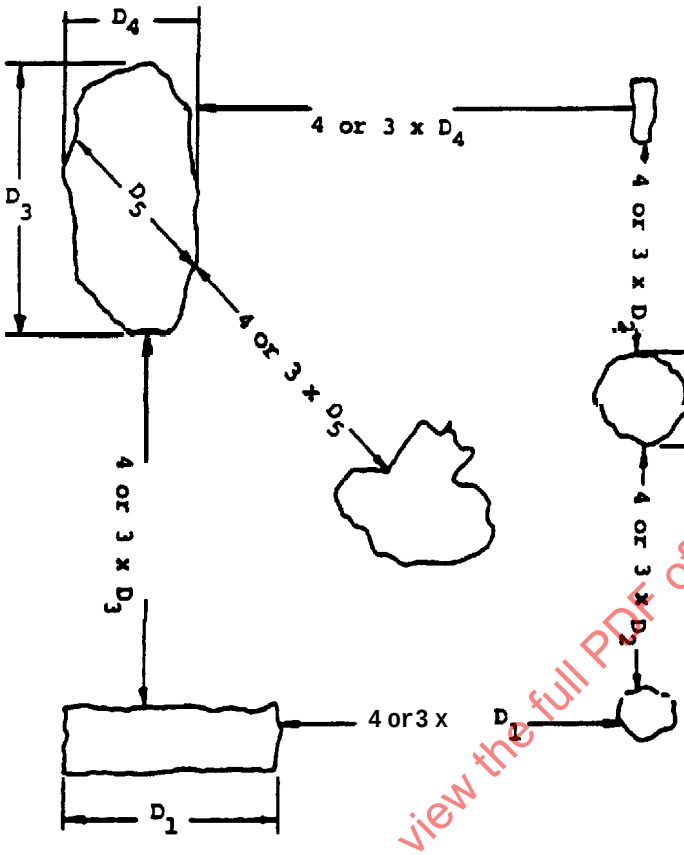


FIGURE 2 - Measuring Disbond Spacing

3.1.3.5 The maximum permissible void or disbond area of the metal-to-metal bond area within an assembly is 1% on Type 1 structures, and 2% on Type 2 structures.

3.1.3.6 The maximum permissible disbond area of the metal-to-metal bond area contained within a 6-inch (152-mm) diameter circle is 8% of that area so contained for Type 1 and 2 structures.

3.1.4 Face-To-Core Bonds: Voids or disbonds shall be limited to 0.50 inch (12.7 mm) diameter for Type 1 and 0.75 inch (19 mm) diameter for Type 2 face-to-core or doubler-to-core bonds.

3.1.5 Core Splice, Core-To-Edge Member, or Core-To-Insert Bonds:

3.1.5.1 The maximum permissible core gap that is filled with adhesive, or the equivalent, shall be equal to 0.125 inch (3.18 mm) for Type 1 structures and to one cell diameter of the largest cell common to the core joint or 0.25 inch (6.4 mm), whichever is smaller, for Type 2 structures, as shown in Figures 3,4, and 5.

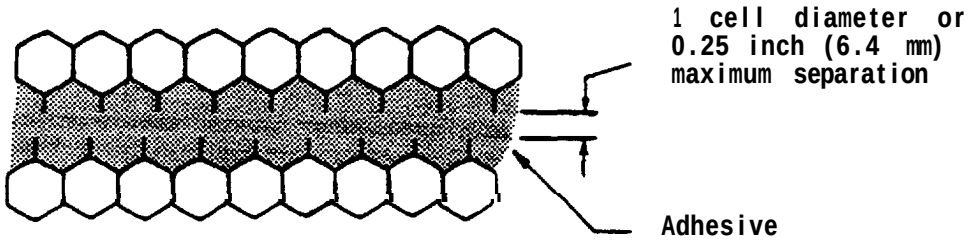
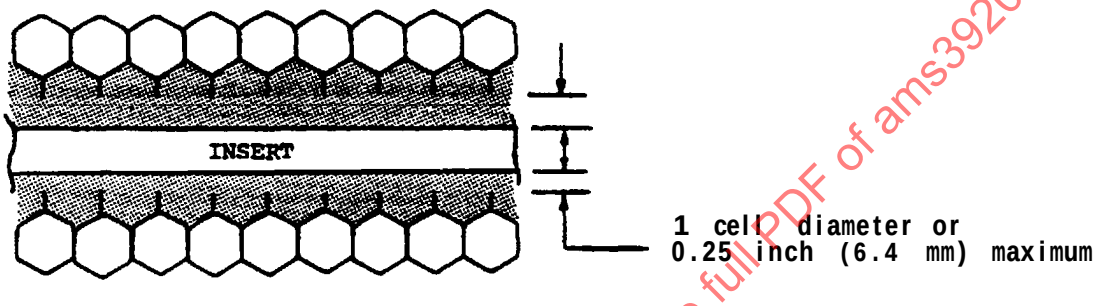


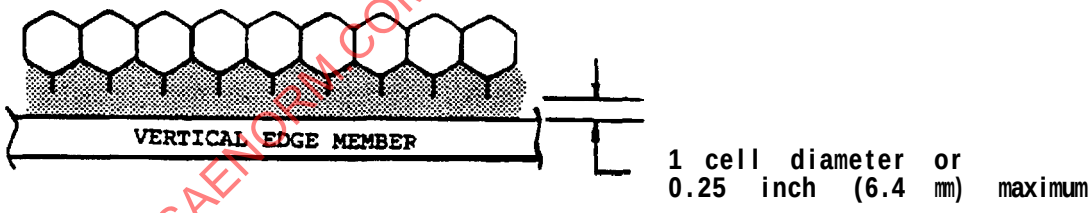
Figure 3 - Core Splice (Type 2 Structure)



NOTES: 1. The maximum void or disbond shall be 0.50 inch (12.7 mm) or three adjacent cells, whichever is smaller, for each linear foot (305 mm).

2. Total void or disbond shall not exceed 5% of total core-to-insert bond area.

FIGURE 4 - Core-to-Insert (Type 2 Structure)



NOTES: 1. Adhesive maximum void or disbond shall be 0.50 inch (12.7 mm) **or** three adjacent cells, whichever is smaller, for each linear foot (305 mm).

2. Total disbond shall not exceed 5% of total core-to-edge member bond area.

FIGURE 5 - Core-to-Vertical Edge Member (Type 2 Structure)

3.1.5.2 The maximum permissible core joint void or disbond dimension shall be 0.50 inch (12.7 mm) or three adjacent cells, whichever is smaller, for each linear foot (305 mm) and shall not exceed 5% of core-to-core bond area (splice height times splice length).

3.1.5.3 The maximum core-to-beveled edge member voids, disbonds, and gaps shall be as shown in Figure 6.

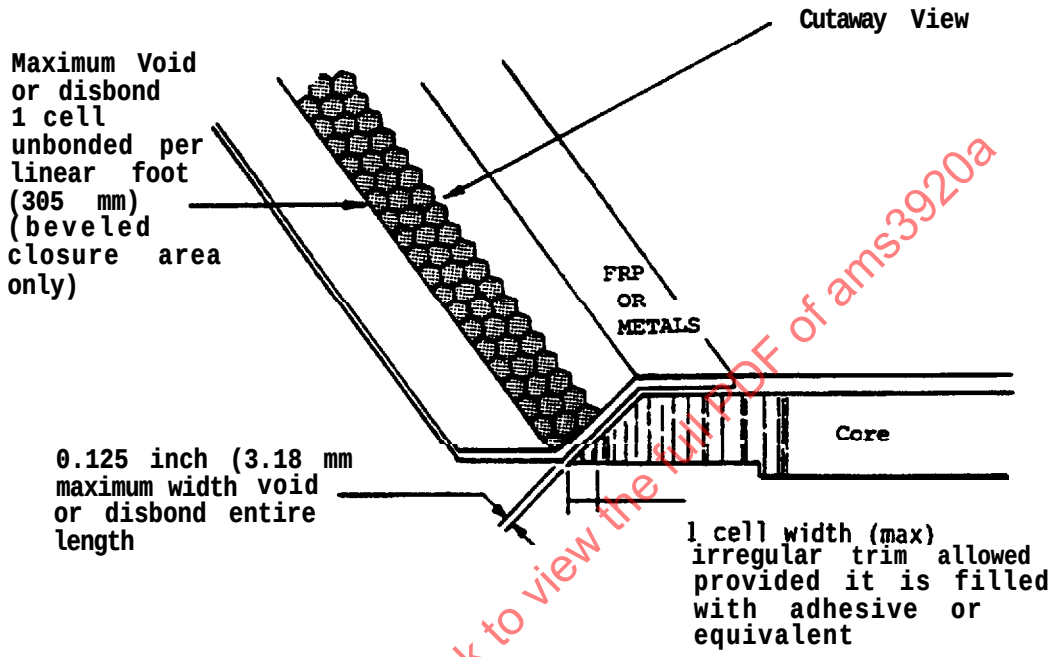


FIGURE 6 - Core-to-Beveled Edge Member

3.1.6 Sandwich Face Dents:

3.1.6.1 Dents: Shall not exhibit creases, sharp edges, or wrinkles as shown in Figure 7. The dent area shall be inspected for disbonds in accordance with 3.1.8.1.

3.1.6.2 Dimensions:

3.1.6.2.1 Diameter: The maximum permissible dent diameter shall be 1.5 inches (38 mm) for Type 1 structure and 2 inches (51 mm) for Type 2 structure.

3.1.6.2.2 Depth: The maximum permissible dent depth shall be 0.006 inch (0.15 mm) for Type 1 structure and 0.020 inch (0.51 mm) for Type 2 structure.

3.1.6.2.3 Areas: The maximum permissible dent area within an assembly is 1% on Type 1 structure and 2% on Type 2 structure.

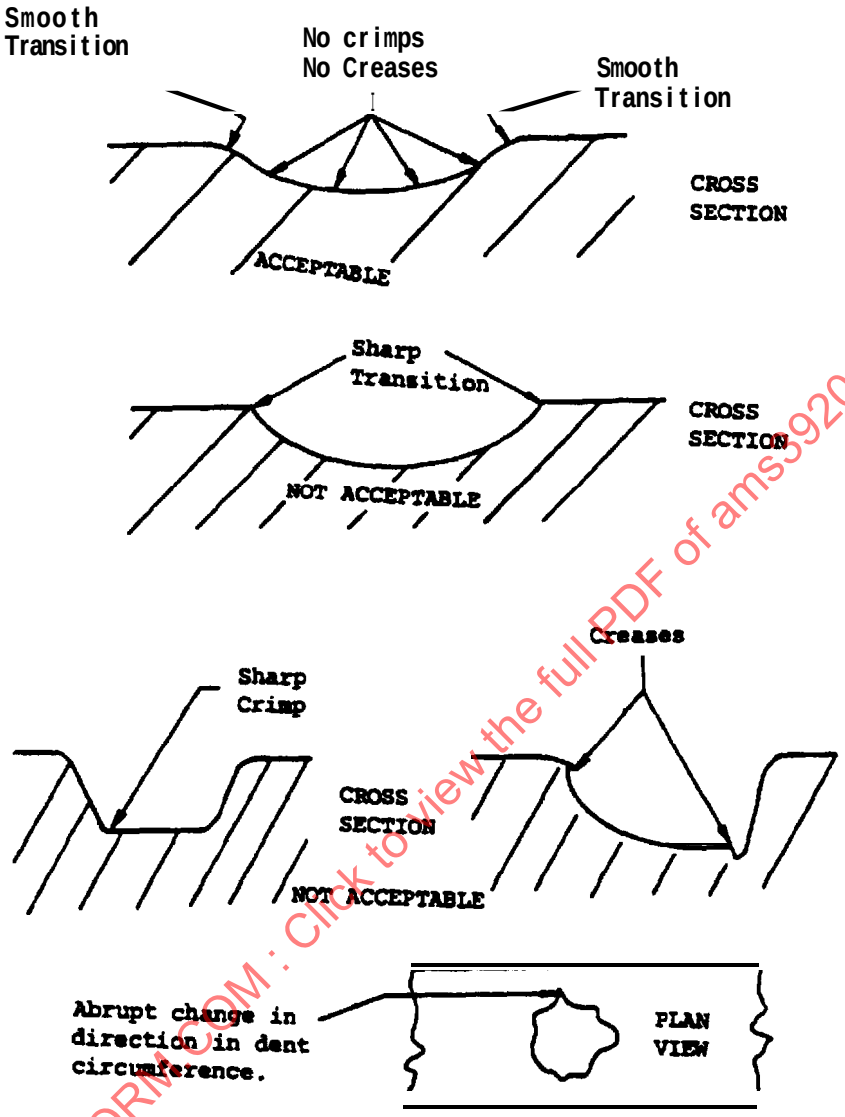
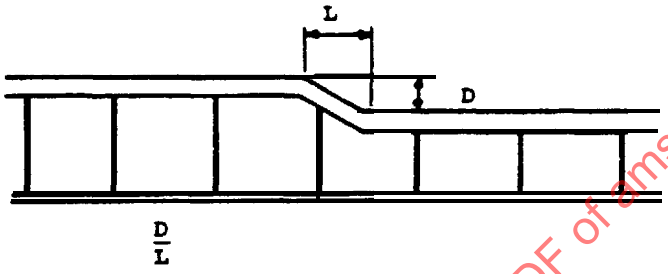


FIGURE 7 - Sandwich Face Dents

3.1.6.2.4 Spacing: The minimum permissible distance between dent centers is 6 inches (152 mm) for Type 1 structures and 4 inches (102 mm) for Type 2 structure. The minimum permissible distance between dent center and the edge of solid members is 10 inches (254 mm) for Type 1 structures and 6 inches (152 mm) for Type 2 structure.

3.1.6.3 Dent Limitations: Dent limitations required for cosmetic purposes shall be established by purchaser's quality assurance organization.

3.1.7 Face Markoff: Markoff requirements shall be in accordance with Figure 8.



Maximum markoff allowed: Type 1: 0.006 inch/inch (0.006 mm/mm)
Type 2: No limit

FIGURE 8 - Markoff

3.1.8 (R) Destructive Inspection: Destructive inspection of an assembly shall be conducted in accordance with 3.1.8.l and 3.1.8.2 to ensure that the bonded components meet the criteria of this specification.

3.1.8.1 (R) Destructive inspection shall be made on parts selected to ensure proper fabrication of parts through the production run. Any evidence of improper cure, adhesion, misalignment, etc, shall be immediately corrected by making necessary adjustment in the cure cycles or in tooling.

3.1.8.1 .1 (R) Above sampling and testing procedures apply to bonded parts that do not use formal bonding tool or fixture.

3.1.8.2 (R) For short production runs of 10 or less items, destructive evaluation testing as outlined in 3.1.8.1 may be waived providing 100% bond line verification is made prior to bonding of each assembly, and 100% nondestructive testing (NDT) of each part is made in accordance with 3.1.9.1 and 3.1.9.2.

3.1.9 (R) Nondestructive Inspection: Shall be in accordance with 3.1.9.1, 3.1.9.2, and 3.1.9.3. Standards shall be of similar construction as the parts to be inspected and shall contain voids or disbonds of the maximum allowable sizes.

3.1.9.1 (R) Purchaser shall submit a complete NDT process specification when required to evaluate the quality of adhesively bonded structures. Purchaser shall specify the type and size of imperfections that are acceptable. The size of the allowable imperfections must be correlated with the capability of the NDT method to be used, realizing that NDT methods and instrumentation have different capabilities for the testing of adhesive bonded structures. The application of these different NDT methods is limited by material types and design configuration.

3.1.9.2 (R) Nondestructive testing of adhesive bonded structures shall only be performed by qualified NDT personnel. Qualified NDT personnel are those who have demonstrated by passing written and practical proficiency tests that they possess the skills and job knowledge necessary to ensure an acceptable level of performance in the nondestructive testing of adhesively bonded structures. A list of qualified NDT personnel shall be maintained and made available to personnel for on-site review. Personnel qualifications shall be reviewed at least annually.

3.1.9.3 (R) Unless otherwise specified by purchaser, bonds shall be inspected on the following minimum frequency as specified in Table 1.

TABLE 1 - NDT Frequency

Bond Condition	Assembly Frequency Type 1	Assembly Frequency Type 2[1]	Area Frequency Types 1, 2
Metal-to-metal	each assembly	AQL	Note 2
Face-to-core sandwich construction	each assembly	AQL	6 inch (152 mm) grid, min

[1] Purchaser to establish inspection plan.
[2] This information to be included in the NDT process specification as required by 3.1.9.1.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R) Purchaser shall supply the nondestructive inspection standards (3.1.9) for required tests. The manufacturer of structures shall supply all samples for required tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the structures conform to the requirements of this specification.

4.1.1 An effective quality assurance system shall be provided to ensure inspection operation performance by personnel who have demonstrated their ability to apply these criteria (See 3.1.9.2).