INCH-POUND

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MILITARY SPECIFICATION

ALUMINUM HONEYCOMB SANDWICH ASSEMBLIES, MANUFACTURE OF

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AMSC N/A FSC 1560

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1. SCOPE

1.1 Scope. This specification covers the requirements for fabrication and acceptance of adhesive bonded, aluminum faced, nonperforated aluminum honeycomb core, sandwich assemblies intended for use as aircraft spare parts.

1.1.1 This version is specifically applicable to

_____

part (assembly). Refer to the assembly by designating the part noun and number, National Stock Number (Federal Stock Class), Engineering Drawing title, and number if different from the above part number (See 6.2).

1.2 Classification. The adhesive assemblies furnished under this specification shall be of the following types, classes, and pressure application.

Type I - Primary structure
Type II - Secondary structure
Class 1 - For long time (192 hours) exposure to 180 °F
Class 2 - For long time (192 hours) exposure to 250 °F
Class 3 - For long time (192 hours) exposure to 350 °F
Class 4 - For limited (3 hours) exposure to 420 °F
(Note: Class 4 apply to F-15 honeycomb assemblies only.)

Pressure Application:

A. Autoclave	D. Vacuum Bag Only
B. Platen Press	E. Not Specified
C. Cavity Press	

1.2.1 The classification of assemblies procured to this specification shall be specified on the applicable Engineering drawing, the Data Requirements (Form 2), and/or by the information as follows:

1.2.1.1 Classification for this part is type ___, Class _____.

1.3 This specification pertains to the qualification of contractors (manufacturers, fabricators, suppliers) for the fabrication of these types and classes of assemblies.

1.4 This specification is applicable when specified on Engineering drawings, supplemental data, and/or by the Contracting Officer (CO). The Technical Representative to the Contracting Officer will be designated as the TRCO within this

document. The Defense Contract Administration Service shall be the designate of the ACO.

1.5 This specification meets the minimum requirements of MIL-A-9067C "Requirements For Adhesive Bonding, Process and Inspection".

1.6 In order to meet the requirements of this specification, all assemblies must be fabricated in accordance with the Manufacturing Process (see 3.4), Materials (see 3.3), Facilities and Equipment (see 3.2), by qualified vendors and subcontractors (see 3.1) and accepted by the Quality Assurance Provisions (see 4) of this specification.

1.7 All blanks within this specification are to be filled with the information found in 6.2.1. The TRCO has primary responsibility for filling these blanks. The Contractor has the responsibility for ensuring all applicable information is supplied to him.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation at the time of solicitation (see 6.2.1).

SPECIFICATIONS

FEDERAL

O-T-620 - Trichloroethane - 1,1,1,Technical, Inhibited (Methyl Chloroform)

TT-M-261 - Methyl Ethyl Ketone For Use In Organic Coatings (MEK)

TT-T-266 - Thinner, Dope and Lacquer (Cellulose Nitrate)

UU-P-268 - Paper, Kraft, Untreated, Wrapping

PPP-F-320 -Fiberboard: Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes

MILITARY

MIL-H-6088 - Heat Treatment of Aluminum Alloys

MIL-I-6870 - Inspection Program Requirements, Non-Destructive: For Aircraft and Missile Materials and Parts

MIL-C-7438 - Core Material, Aluminum, For Sandwich Construction

MIL-A-8625 - Anodic Coatings For Aluminum And Aluminum Alloys

MIL-Q-9858 - Quality Program Requirements

MIL-I-45208 - Inspection System Requirements

MIL-C-81769 - Chemical Milling Of Metals, Specification For

MIL-C-5541 - Chemical Conversion Coating on Aluminum Alloys

MIL-A-9067 - Adhesive Bonding, Process And Inspection Requirements For

STANDARDS

MILITARY

MIL-STD-129 - Marking For Shipment and Storage

MIL-STD-130 - Identification Marking of US Military Property

MIL-STD-105 - Sampling Procedures And Tables For Inspection By Attributes

MIL-STD-410 - Nondestructive Testing Personnel Qualification And Certification

MIL-STD-453 - Inspection, Radiographic

HANDBOOK

MILITARY

MIL-HDBK-337 - Adhesive Bonded Aerospace Structure Repair

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the CO.)

2.2 Non-Government Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-government documents which is current on the date of the solicitation.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

ARP1524 - Surface Preparation And Priming Of Aluminum Alloy Parts For High Durability Structural Adhesive Bonding - Phosphoric Acid Anodizing.

AMS3689 - Adhesive, Foaming, Honeycomb Core Splice, Structural, -67 to +350 °F.

(Application for copies of SAE publications should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1002 - Strength Properties Of Adhesives In Shear By Tension Loading (Metal-to-Metal)

ASTM D 1781 - Climbing Drum Peel Test For Adhesives

ASTM D 3762 - Adhesive-Bonded Surface Durability of Aluminum (Wedge Test)

(Applications for copies of ASTM publications should be addressed to the American Society For Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained in writing from the governing agency and such exemption forwarded to the CO.

3. REQUIREMENTS

3.1 Qualification.

3.1.1 Qualification of adhesive bonded assembly (part) supplier (contractor fabricator, manufacturer).

3.1.1.1 Items furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.2 and 6.3).

3.1.1.2 Any departure from the requirements and quality assurance provisions of this document shall require a waiver which must be approved/disapproved in writing by the CO.

3.1.2 Qualification/Certification of personnel.

3.1.2.1 Qualification of bonding personnel. Adhesive bonding operations shall be performed only by qualified personnel. Bonding personnel shall be qualified by complying with all of the following:

(a) Passing a written test

(b) Passing a practical proficiency test

(c) Receiving on-the-job training

3.1.2.1.1 Qualified personnel are those who have demonstrated the knowledge and practical proficiency to indicate they possess the skills and job knowledge necessary to meet the requirements of this specification.

3.1.2.1.2 A list of qualified bonding personnel shall be maintained and issued indicating qualification and level of proficiency (such as, preparation of services for adhesive bonding, machining core, lay-up of assemblies, vacuum bagging and autoclave operations).

3.1.2.1.3 This list shall be available for review by Government personnel.

3.1.2.2 Qualification and certification of nondestructive testing personnel.

3.1.2.2.1 Nondestructive testing personnel shall be qualified and certified to MIL-STD-410.

3.1.2.2.1.1 A list of qualified and certified nondestructive testing personnel shall be maintained and issued indicating qualification and certification level of proficiency. This list shall also contain the level of qualification of Nondestructive Testing Personnel required for each inspection procedure as stated in MIL-I-6870.

3.1.2.2.1.2 This list shall be available for review by Government personnel.

3.1.2.3 Qualification and certification of quality assurance personnel.

3.1.2.3.1 All quality assurance personnel shall be qualified and certified by the supplier. The Government reserves the right of disapproval of any procedures for qualifying/certifying personnel.

3.1.2.3.1.1 A list of qualified and certified quality assurance personnel for the current contract shall be maintained and issued indicating qualification and certification level of proficiency.

3.1.2.3.1.2 This list and qualification procedures shall be available for review by Government personnel.

3.1.2.4 Qualification of material suppliers.

3.1.2.4.1 Aluminum honeycomb core suppliers must be approved by the Government, under MIL-C-7438 for the particular alloy, cell size, foil thickness and core density. All core must be nonperforated.

3.1.2.4.2 Aluminum suppliers of material used to fabricate skins, doublers, closures, ribs, etc. shall be approved under the applicable government or other specification listed herein for the particular product being supplied.

3.1.2.4.3 Adhesives (primers, films, foams, pastes) and sealant suppliers shall be approved under the applicable government or other specification listed herein for the particular product being supplied.

3.1.2.4.4 The supplier of assemblies to this specification shall obtain from all suppliers of material used in the assemblies certification that their materials have been qualified by the government, or other organization controlling a non-government specification, to that specification as identified in 3.3.

3.2 Manufacturing facilities and equipment. Manufacturing facilities and equipment used to fabricate assemblies in accordance with this specification shall comply with the following requirements.

3.2.1 Adhesive/primer storage.

3.2.1.1 Adhesive storage facilities shall be used exclusively for that function.

3.2.1.2 Refrigerators and freezers shall be equipped with temperature at time recorders.

3.2.1.3 Freezers shall be maintained at 0 ^{o}F or lower. Refrigerators shall be maintained at 50 ^{o}F or lower. Adhesives and primers outage time, during which freezers and refrigerators are defrosted (automatic or non-automatic) shall be as per 3.4.2.1.11.

3.2.2 Honeycomb core carving (machining).

3.2.2.1 Core carving equipment shall not contaminate the core with oil, moisture, or any contaminant detrimental to bonding.

3.2.2.1.1 The oil or fluid used in the core carver equipment shall contain a fluorescent dye capable of being detected by "black light" in the event the oil or fluid contaminates the honeycomb core. Presence of material containing the dye shall be detectable using the procedure specified in 4.3.3.12.

3.2.2.2 The core carver shall be so constructed to hold the core rigidly in place during the carving operation, such as with a vacuum chuck, ice chuck, polyethylene glycol, etc.

3.2.2.3 The core carver shall be capable of carving honeycomb core to a tolerance of plus or minus 0.005 inch in thickness.

3.2.2.4 During multi-stage bonding, if core is machined after cleaning and will not be recleaned by vapor degreasing after machining, the core carving equipment shall be located in an area that complies with the following:

3.2.2.4.1 The area shall be completely enclosed.

3.2.2.4.2 Concrete floors shall be sealed with an appropriate latex, epoxy, or polyurethane sealer unless covered by vinyl or other composition material. These latter covering materials may be waxed (non-silicone containing).

3.2.2.4.3 Sweeping of the major bulk of debris on the floor is permissible. However, the use of dust mops and sweeping compounds is prohibited. The area shall be kept clean by periodic vacuuming, general cleaning and stripping and resealing or rewaxing the floors.

3.2.2.4.4 Personnel shall wear clean white cotton gloves when handling cleaned or primed parts.

3.2.2.4.5 The operation of fume producing equipment and fuel powered combustion engines shall be prohibited. Battery powered equipment is permitted.

3.2.2.4.6 Filters in the air supply system shall be of the commercial disposable or recleaning type.

3.2.2.4.7 An air pressurization system capable of maintaining a minimum pressure differential of 0.05 inches of water such

that dust and dirt do not blow into the area when the doors are opened, and capable of meeting the requirements of 3.2.2.4.8 shall be provided.

3.2.2.4.8 If the area is directly connected to the adhesive bonding lay-up area, the core carving area shall be at a lesser pressure than the lay-up area to prevent sanding and machining dust from entering the lay-up area.

3.2.2.4.9 Eating, drinking and smoking shall be prohibited.

3.2.2.4.10 The use of any material dispensed from an aerosol container is prohibited.

3.2.2.4.11 Lubrication of equipment shall be performed in a manner to prevent lubricants from being deposited on other surfaces of the equipment or on assemblies.

3.2.2.4.12 Electrically powered equipment is preferred. Air powered equipment shall be non-lubricated and supplied by filtered oil-free air. Any powered equipment shall be run-up and wiped of excess lubricants before use, making sure that production parts and tanks are protected from contamination during run-up.

3.2.2.4.13 Sanding of core shall be permitted.

3.2.2.4.14 Use of release agents of any kind shall be prohibited in the area.

3.2.2.4.15 Materials containing silicones as a release or adhesive agent may not be present in this area.

3.2.3 Surface preparation facilities.

3.2.3.1 Surface preparation facilities shall be in completely enclosed areas that are maintained at a minimum pressure differential of 0.05 inches of water or they shall be located in buildings where internal combustion engines are not permitted. Any operation which generates air borne contaminates detrimental to bonding operations shall have air movement such that the contaminants are kept out of the surface preparation facility area especially if both operations are conducted in the same building.

3.2.3.2 To preclude solution cross-contamination during

processing, the process flow shall be arranged in such a manner that details proceed from a process solution directly into a rinse tank, with cross-over permitted only after rinsing.

3.2.3.3 Processing tanks shall be equipped with suitable timing and temperature control devices designed to maintain solution operating conditions within prescribed limits. Solutions shall be controlled per 4.3.2. Where required by the process specification, voltage and/or amperage records shall be kept.

3.2.3.4 Air used for agitation of solutions shall be filtered and oil-free.

3.2.3.5 The final rinse of solution processed details shall be accomplished by spraying with clean, deionized water.

3.2.3.6 Chemical milling equipment and facilities shall be capable of producing details meeting the requirements of MIL-C-81769 and the applicable Engineering drawing's dimensions and tolerances.

3.2.3.7 Phosphoric acid anodizing equipment and facilities shall be in compliance with SAE ARP1524. Other processes are subject to approval by the TRCO.

3.2.3.8 Sulphuric acid anodizing equipment and facilities shall be capable of producing details meeting the requirements of MIL-A-8625, Type II, class 1, dichromate sealed.

3.2.3.9 Chromic acid anodizing equipment and facilities shall be capable of producing details meeting the requirements of MIL-A-8625, Type I, Class 1, dichromate sealed.

3.2.4 Adhesive Primer Facilities and Equipment.

3.2.4.1 Spray equipment used for the application of adhesive primers shall be restricted exclusively to that function.

3.2.4.2 Spraying equipment shall be thoroughly cleaned at the completion of primer application.

3.2.4.3 Compressed air used for the application of adhesive primers shall be filtered to remove oil and water.

3.2.4.3.1 The hydrocarbon concentration in compressed air

entering the spray booth shall be 20 parts per million (ppm) by volume or below. If a hydrocarbon detector is not operating on the compressed air line, an infra-red crystal test or test with an organic vapor analyzer (see 3.2.4.3.1.1) shall be performed not less than once per week.

3.2.4.3.1.1 Organic Vapor Analyzer, Century OVA128, Foxboro Analytical, South Norwalk, CT., or approved equal.

3.2.4.3.2 The compressed air used for application of adhesive primers shall have a dew point of 35 °F or lower. The dew point shall be determined continuously by an in-line monitor.

3.2.4.4 Air entering the adhesive primer application area shall be filtered and oil-free.

3.2.4.5 Adhesive primer shall not be applied to details when the area air temperature is less than 60 °F. Air temperature shall be measured and recorded at the beginning of spraying and every four hours thereafter. Records shall be kept as required in 4.3.1.

3.2.4.6 Adhesive primer shall not be applied to details when the relative humidity of the air entering the area exceeds 60%. Humidity shall be measured and recorded at the beginning of spraying and every four hours thereafter. Records shall be kept as required in 4.3.1.

3.2.4.7 Adhesive primer thickness measuring device.

3.2.4.7.1 The device used to determine the thickness of adhesive primers shall be capable of determining the primer thickness to an accuracy of plus or minus 0.0001 inch.

3.2.4.8 Adhesive primer spray booth.

3.2.4.8.1 The adhesive primer spray booth used for the application of adhesive primers to bond details shall be supplied with filtered air moving at a velocity to minimize overspray accumulating on the bond details. Air shall comply with 3.2.4.4.

3.2.4.8.2 The spray booth shall be equipped with a suitable device to remove primer overspray from the air prior to exhausting.

3.2.4.8.3 The spray booth shall be kept clean to prevent contamination of bonding details.

3.2.5 Controlled Environment Areas

3.2.5.1 Storage Area

3.2.5.1.1 This area is to be used to store parts and assemblies that are between stages or steps in the assembly process.

3.2.5.1.2 This area is to be completely separated from all contaminant-producing processes or operations such as sanding, grinding, or painting.

3.2.5.1.2.1 The flooring will be of a smooth, grease-resistant material, with very low dusting and flaking characteristics and with a high resistance to abrasion.

3.2.5.1.2.2 Finished ceilings will be installed to provide a finished surface and to conceal conduits, piping, and ductwork.

3.2.5.1.2.3 Operations requiring noise control should be isolated from the controlled area.

3.2.5.1.3 A minimum pressure differential of 0.05 inches of water shall be maintained on this area by using filtered air to eliminate or minimize the infiltration of contaminated air.

3.2.5.1.4 Doors shall be kept closed when not in use.

3.2.5.1.5 The area should be kept clean by periodic mopping, vacuuming with exhaust to outside the controlled area, or other suitable means. Cleaning is required when visual inspection shows any accumulation of dust, dirt, or other contamination.

3.2.5.1.6 Internal combustion engines shall not be allowed in the area.

3.2.5.1.7 Smoking or eating shall not be permitted in the area.

3.2.5.1.8 Contaminants detrimental to adhesion such as dirt, grease or oil shall not be allowed to accumulate on materials, tools, parts or equipment taken into the area.

3.2.5.2 Lay-up Room (Clean Room)

3.2.5.2.1 The lay-up room (clean room) shall be completely enclosed.

3.2.5.2.1.1 Walls and ceilings will be installed to provide a smooth low dusting surface and to conceal conduits, piping and ductwork. Suspension systems will not be tied to catwalks or mechanical and electrical equipment platforms.

3.2.5.2.1.2 Walls and ceilings will be painted or coated with non-silicone containing coatings. Concrete masonry or any rough textured surface will be filled with an appropriate sealer or treated to give a smooth surface before the wall primer is applied. Painted surfaces will be given a smooth gloss or semigloss finish with an adequate buildup of resin to withstand frequent cleaning with mild detergents and water. Acrylic and alkyd type paints are examples of coatings that are acceptable.

3.2.5.2.1.3 Floor shall be sealed or covered with non-flaking, easily cleaned material such as plastic, paint, vinyl tile, etc. There shall be no silicones in the floor sealant or covering material.

3.2.5.2.2 Operations requiring noise control shall not be located in the clean room.

3.2.5.2.3 All incoming air shall be filtered. Particle count will be less than 1,000,000 particles per cubic foot for particles 0.5 m and greater in size. Filters shall be periodically checked and cleaned or replaced to ensure proper operation.

3.2.5.2.4 There shall be a slight, positive air pressure differential such that unfiltered air does not enter the area through access doors or other openings. Minimum pressure differential is 0.05 inches of water (highest pressure within clean room) between the clean room and the area outside the clean room.

3.2.5.2.5 Doors shall be kept closed when not in use.

3.2.5.2.6 The area should be kept clean by periodic mopping, vacuuming with exhaust to outside the lay-up room, or other suitable means. Cleaning is required when visual inspection

shows any accumulation of dust, dirt, or other contamination.

3.2.5.2.7 Internal combustion engines shall not be allowed in the area.

3.2.5.2.8 Smoking or eating shall not be permitted in the area.

3.2.5.2.9 Contaminants detrimental to adhesion such as dirt, grease or oil shall not be allowed to accumulate on materials, tools, parts or equipment taken into the area.

3.2.5.2.10 Processes or operations which produce uncontrolled spray, dust, fumes, or particulate matter shall not be permitted in the area. Caution: Vacuuming is permitted only when exhausted outside the lay-up room.

3.2.5.2.11 The area shall be temperature and humidity controlled such that the minimum temperature is 65 ^{o}F with a corresponding relative humidity not greater than 70% and the maximum temperature is 85 ^{o}F with a corresponding relative humidity not greater than 40%. All temperature and relative humidity values between the minimum and maximum acceptable values listed above are a straight line relationship.

3.2.5.2.12 Structural fiberglass, graphite (carbon), boron, aramid epoxy composites may be laid-up or assembled concurrently with metal bond assemblies, utilizing the same controlled contamination area. The following restrictions must be adhered to throughout the entire controlled contamination areas.

(a) All precautions and requirements for cleanliness and contamination control as stated above must be enforced.

(b) Tools must be prepared prior to entering the controlled contamination area. Only non-silicone containing parting agents may be applied to tooling details.

(c) Wherever possible metal bonding operations shall be segregated from composite lay-up operations.

(d) White cotton gloves, wipers for cleaning and tapes shall conform to the requirements of Materials (see 3.3).

(e) The following materials and procedures are prohibited in the controlled area:

(i) Uncured parting agents.

(ii) Use of hand cream.

(iii) Application of conductive coatings.

(iv) Application of gel coats to molds.

(v) All grinding, sanding, or milling operations.

(vi) Deposition of graphite (carbon) or boron dust or fibers on bond faying surfaces.

(vii) Waxes, compounds containing silicone, or any material detrimental to adhesion.

3.2.6 Prefit fixtures.

3.2.6.1 Prefit fixtures shall be designed and constructed to properly position bonding details to determine that the details will correctly fit together in subsequent bonding operations.

3.2.6.2 Prefit fixtures shall be kept clean to prevent contamination of bonding details.

3.2.6.3 Prefit fixtures shall be qualified (certified) prior to production use (see 4.2.3 for Qualification Procedures).

3.2.6.3.1 Dimensional checking for compliance to the applicable tool design is required.

3.2.6.3.2 Prefit of details shall produce an acceptable impression prefit (overlay) (see 3.4.4.2).

3.2.7 Bond fixtures.

3.2.7.1 Bond fixtures shall be constructed of materials capable of withstanding the cure pressure and temperature specified for the assembly.

3.2.7.2 Bond fixtures shall position and hold details properly during the bonding operation. Some details may be designed to

"float" to allow for movement due to thermal expansion and/or compacting of details.

3.2.7.3 Bond fixtures designed for use in the autoclave or cavity press shall permit application of fluid pressure on at least one side of the assembly.

3.2.7.4 Bond fixtures may be equipped with permanently located thermocouples.

3.2.7.5 Every bond fixture shall be qualified (certified) prior to use for production of bonded assemblies (see 4.2.3 for Qualification Procedures).

3.2.7.5.1 A heat survey of each bond fixture is required. The bond fixture shall be loaded with unbonded details or a previously cured assembly during the heat survey. Results of the heat survey shall be used to determine thermocouple locations. Sufficient thermocouples shall be used to monitor the cure properly. Results of heat survey and thermocouple locations shall be recorded and kept as required in 4.3.1.

3.2.7.5.2 The bond fixture shall be equipped with a sufficient number of vacuum ports and static pressure ports to permit uniform application of vacuum and monitoring of the pressure build-up in the vacuum bag during the entire cure cycle.

3.2.7.5.3 An acceptable mechanical prefit of details (see 3.4.4.1) shall be obtained.

3.2.7.5.4 An acceptable impression prefit (see 3.4.4.2) shall be obtained.

3.2.7.6 Bond fixtures may be vacuum bagged on one side or completely enclosed in the vacuum bag.

3.2.8 Drying/curing ovens.

3.2.8.1 Ovens used for drying details prepared for adhesive bonding, drying adhesive primed details, and curing of primers and/or adhesives shall be air circulating and, where practical, restricted for these functions.

3.2.8.2 Ovens shall be equipped with temperature at time

recorders. Temperature records shall be kept as required in 4.3.1.

3.2.8.3 Ovens shall be capable of maintaining temperature within the range specified for the particular operation being performed.

3.2.8.4 Ovens shall be periodically cleaned to prevent accumulation of dust, dirt and other contaminants detrimental to adhesive bonding.

3.2.9 Autoclaves.

3.2.9.1 Autoclaves shall be equipped to provide a vacuum of up to 30 inches of mercury on the assembly being cured through the full cure cycle.

3.2.9.2 Autoclaves shall be capable of applying the specified curing pressure plus or minus 5 psi and the specified cure temperature plus or minus 10 °F, with a heat up rate of 2 to 10 °F per minute on tools and assembly.

3.2.9.3 Pressure application shall be by compressed filtered air, or inert atmosphere (preferred).

3.2.9.4 Temperature, pressure and vacuum at time shall be continuously recorded. Records shall be kept as required in 4.3.1.

3.2.9.5 Autoclaves may be controlled manually, via cam, or computer.

3.2.9.6 Autoclaves shall be periodically cleaned to prevent accumulation of debris that could puncture a vacuum bag.

3.2.10 Platen press.

3.2.10.1 Platen presses shall be capable of applying uniform pressure and temperature to the assembly being bonded. Pressure shall be controllable plus or minus 5 psi, and temperature shall be controllable plus or minus 10 °F on a 12 inch grid pattern with a heat up rate of 2 to 10 °F per minute.

3.2.10.2 Temperature and pressure at time shall be recorded continuously during the bonding operation. Records shall be kept as required in 4.3.1.

3.2.11 Cavity press.

3.2.11.1 Cavity presses shall meet the same requirements as platen presses.

3.2.12 Instrumentation.

3.2.12.1 The temperature and pressure indicating and recording equipment for controlling any process shall be suitable for the purpose intended.

3.2.12.2 Testing equipment used to determine the physical and mechanical properties of specimens fabricated with the bonded assembly or taken from the actual assembly shall be suitable for the purpose intended.

3.2.12.3 The inspected and calibrated level of accuracy of all instrumentation must meet or exceed the tolerances of the process or operation being monitored. Certification procedures are in 4.2.4.

3.2.12.4 All tests and measurements must be checked against standards of greater accuracy. Standards accuracy shall be checked by comparison with legal standards traceable to the National Bureau of Standards or other basic standards acceptable to the TRCO and/or the CO.

3.2.12.5 Calibration and certification of instrumentation shall only be accomplished by qualified and certified quality assurance personnel. (See 3.1.2).

3.2.13 Nondestructive Inspection

3.2.13.1 Suitable radiographic equipment and facilities shall be used to inspect bonded assemblies per 4.5.1.

3.2.13.1.1 Radiographic equipment and facilities shall meet the requirements of MIL-STD-453.

3.2.13.2 Suitable ultrasonic testing equipment and facilities shall be used to inspect bonded assemblies per 4.5.3.1.

3.3 Materials.

3.3.1 Honeycomb core.

3.3.1.1 Only corrosion resistant aluminum honeycomb core, nonperforated, meeting the requirements of and qualified to MIL-C-7438, type _____, class _____, having a cell size of _____, _____ alloy, nominal foil thickness of _____ and nominal density of _____ shall be used in the fabrication of this assembly. Core corrosion resistant treatments conforming to MIL-C-5541 shall not be used.

3.3.1.2 Core ribbon direction shall be as specified on the applicable Engineering drawing.

3.3.1.3 Core splices shall be performed only when specifically authorized and as per the applicable Engineering drawing.

3.3.1.3.1 Core splice adhesive shall be as specified in 3.3.4.1.3.

3.3.1.4 Core shall be of the expanded type unless otherwise approved by the TRCO.

3.3.1.5 The honeycomb core supplier shall be qualified by the Government to Mil-C-7438 and shall certify that each shipment of core meets the requirements of MIL-C-7438. These records shall be available to government personnel for review upon request per 4.3.1.

3.3.2 Assembly faces (skins).

3.3.2.1 The assembly faces (skins) shall be made from _____ aluminum alloy heat treated to _____ temper, and a thickness of _____ and _____ conforming to _____ specification and the applicable engineering drawing.

3.3.2.1.1 Heat treating to the final temper shall be performed by the material supplier or in accordance with MIL-H-6088 or the applicable engineering drawing.

3.3.2.1.2 If material clad on one side is required per 3.3.2.1 and the material is not readily available, the next thicker equivalent gage material clad on both sides may be used and the cladding shall be removed by a suitable chemical milling process (see 3.4.3.1.6) to the required thickness.

3.3.2.1.3 The material supplier shall certify that the face (skin) material meets the requirements of the specification in 3.3.2.1. These records shall be available to government personnel for review upon request per 4.3.1.

3.3.2.1.4 Deviations will require authorization from the CO.

3.3.3 Ribs, doublers, spars, frames, etc.

3.3.3.1 Ribs, doublers, spars, frames and any other assembly component shall be in accordance with the applicable Engineering drawing, except as specified in 3.3.3.2.

3.3.3.2 There shall be no cladding in any bondline (metal-to-metal or metal-to-honeycomb core) associated with these components. Thicker material shall be used and the cladding shall be removed from the bond surfaces by a suitable chemical milling process (see 3.4.3.1.6) to the drawing required thickness.

3.3.3.3 The material supplier shall certify the material supplied meets the requirements of the applicable material called for on the applicable Engineering drawing. These records shall be available for review by government personnel upon request per 4.3.1.

3.3.4 Adhesives and sealants.

3.3.4.1 Adhesives and sealants required for the fabrication of this assembly and applicable qualification and receiving inspection documents are listed below.

3.3.4.1.1 Corrosion inhibited adhesive primer for use on all metal details except core shall be _____ _____and qualified to _____ specification. Receiving inspection tests and minimum acceptable test results shall be per 4.3.4. Primer must be qualified in conjunction with adhesive film specified in 3.3.4.1.2.

3.3.4.1.1.1 If there are no applicable qualification specifications listed in 3.3.4.1.1, the fabricator shall prepare _____ single lap shear specimens per ASTM D 1002 and test the specimens at _____ temperature after exposure for _____ minutes per ASTM D 1002. Minimum acceptable

values are _____. In addition to single lap shear specimens the fabricator shall prepare 6 climbing drum peel specimens per ASTM D 1781 and test 3 at room temperature (peel bag side skin) and 3 at room temperature (peel bag side skin) per ASTM D 1781. Minimum acceptable average peel strength value per specimen is _____ inch pounds per 3 inch width.

3.3.4.1.2 Adhesive film for skin-to-core, skin-to-closure, skin-to- doubler, doubler-to-tripler, skin or doublers-to-inserts and applications shall be _____, of _____ thickness or weight and qualified to _____ specification.

3.3.4.1.2.1 If no qualification specification is listed, qualification tests and minimum acceptable test results covered in 3.3.4.1.1.1 are applicable.

3.3.4.1.3 Core splice, core-to-edge member, core-to-insert foam adhesive shall be _____, of _____ thickness or weight and qualified to _____ specification.

3.3.4.1.3.1 If there are no applicable specifications listed in 3.3.4.1.3, the fabricator shall determine the expansion ratio and density of the foam adhesive per AMS 3689 except cure shall be per 3.4.3.2.12.6. Acceptable expansion ratio is _____ and acceptable density range is _____ pounds per cubic foot. In addition the fabricator shall prepare six beam shear specimens with core splice per AMS 3689 and test three at room temperature, three at _____ °F temperature after exposure for _____ minutes per Minimum acceptable shear strength value per specimen is _____ pounds per square inch at room temperature and _____ pounds per square inch at _____ °F temperature.

3.3.4.1.4 Stiffening (pour) adhesive shall be _____ with minimum tensile strength of _____ and qualified to _____ specification.

3.3.4.1.5 Stabilizing adhesive shall be _____ with minimum tensile strength of _____ and qualified to _____ specification.

3.3.4.1.6 Rigidizing adhesive shall be _____ with minimum tensile strength of _____ and qualified to _____ specification.

3.3.4.1.7 Core filler (potting) compound shall be _____ of _____ density, compression strength of _____ and qualified to _____ specification.

3.3.4.1.7.1 If there are no specifications listed in 3.3.4.1.7, the fabricator shall determine the density, compression strength, flow and curing capability per _____. Acceptable material shall have a density range of _____, compression strength of _____, flow of _____ and be curable at _____ °F temperature after _____ (minutes).

3.3.4.1.8 Sealant used to seal the exterior of the assembly to prevent moisture entrance shall be _____ and qualified to _____ specification.

3.3.4.1.8.1 If there are no applicable specifications listed in 3.3.4.1.8, the fabricator shall prepare _____ specimens of _____ type and test per _____. Minimum acceptable test values are _____.

3.3.4.1.9 The suppliers shall certify that the material supplied meets specifications in 3.3.4. These records shall be available to government personnel for review upon request per 4.3.1.

3.3.4.1.10 Secondary bonding adhesive shall be _____ with minimum tensile strength of _____ and qualified to _____ specification.

3.3.4.1.11 Other materials as specified by the TRCO. (See 6.2.2)

3.3.5 Consumable materials (not part of bonded assembly). The materials listed below are to be used, as applicable, in the fabrication of parts to this specification. These are materials that do not become part of the assembly. Any substitution requires approval of the TRCO.

3.3.5.1 Solvents.

3.3.5.1.1 1,1,1 Trichloroethane, O-T-620.

3.3.5.1.2 Methyl ethyl ketone (MEK), TT-M-261.

3.3.5.1.3 Lacquer thinner, TT-T-266.

3.3.5.2 Mold release agents.

3.3.5.2.1 Fluorocarbon S-122. Miller Stephenson Chemical, Inc., Chicago, IL

3.3.5.2.2 Camie 1000, Camie Chemicals Co., St. Louis, MO

3.3.5.2.3 Frekote 33, Frekote, Inc., Boca Raton, FL

3.3.5.2.4 RAM-225, RAM Chemical Co.

3.3.5.2.5 Airtech A4000 high stretch FEP Film, Airtech International.

3.3.5.2.6 Richmond A5000 high stretch FEP Film, Richmond Corp.

3.3.5.2.7 Taconic 7025, Taconic Plastics, LTD.

3.3.5.2.8 Teflon coated fabric tape, No. 5451, 5453, 3M Company.

3.3.5.3 Breather/bleeder materials

3.3.5.3.1 Glass breather cloth, Style No. 181,1533, 1534, 1000, commercial.

3.3.5.3.2 Airweave N4, N10, Airtech International.

3.3.5.3.3 Bondline PE 40oz., 60oz., Bondline Products.

3.3.5.3.4 Burlington 75051, 90799, Burlington Ind. Fabrics Co.

3.3.5.3.5 Richmond A-3000, Richmond Corp.

3.3.5.4 Miscellaneous.

3.3.5.4.1 FM 641 - Verifilm, glass supported, 0.010 +/- 0.002 (0.065 lb/ft^2) inches thick, green - American Cyanamid Co.

3.3.5.4.2 Mylar Film, Type A, 0.0015 inch thick, E. I. DuPont, Film Div., Wilmington, Del.

3.3.5.4.3 Nylon vacuum bag material. Nylon 6, Nylon 66, Nylon 6/66 copolymer, 2 mils or thicker, Airtech, Richmond. (Must

withstand applicable cure temperature.)

3.3.5.4.4 Gloves, white cotton, lint free, commercial.

3.3.5.4.5 Vacuum bag sealant tape, No. 9151, pink, Schnee Morehead.

3.3.5.4.6 Extruded sealing tape 587.3 or 582, Inmont Corp., St. Louis, MO

3.3.5.4.7 Paper, Kraft, untreated, wrapping, UU-P-268.

3.3.5.4.8 Rubber latex gloves, Duracraft Corp.

3.3.5.4.9 Source of demineralized water, pH 5-8, total solids 50 ppm.

3.3.5.4.10 Aluminum oxide sandpaper, various grit sizes, commercial.

3.3.5.4.11 Cheesecloth, commercial.

3.3.5.4.12 Rubber pressure diaphragm material capable of withstanding multiple cure cycles at the applicable cure temperature, commercial.

3.3.5.4.13 Hexane, U.S. P. grade or higher, commercial.

3.3.5.4.14 Aluminum oxide grit, 120 mesh, commercial.

3.3.5.4.15 Turco 3878 detergent, Turco Products.

3.3.5.4.16 Fluorescent dye, oil soluble, commercial

3.3.5.4.17 Fluorescent dye, water soluble, such as Fluoresce in Dye (Uranine), Fisher Scientific, St. Louis, MO

3.3.5.4.18 Polyethylene glycol - for rigidizing of honeycomb core, commercial.

3.3.5.4.19 Fiberboard, corrugated or solid, PPP-F-320.

3.3.6 Test specimen materials.

3.3.6.1 Materials shall be provided for use in the fabrication of the following test specimens.

(a) Cleaning control (see Tables II and IV).

(b) Process control (see Table III).

(c) Qualification, receiving inspection, and retesting for adhesives primers and sealants as applicable (see 3.3.4).

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3.4 Manufacturing process.

3.4.1 Flow chart (see Figure 1).

3.4.1.1 Processing sequence for bonded assemblies shall be as shown in Figure 1.

3.4.2 Storage, and Handling, and Control.

3.4.2.1 Adhesives and sealants.

3.4.2.1.1 Storage temperature and allowable time out of storage temperature for adhesives and sealants used to fabricate this assembly as applicable are as follows:

(a) Store the adhesive primer of 3.3.4.1.1 at _____ °F. Allowable time out of storage temperature is _____.

(b) Store the film adhesive of 3.3.4.1.2 at _____ °F. Allowable time out of storage temperature is _____.

(c) Store the core splice foaming adhesive of 3.3.4.1.3 at _____ °F. Allowable time out of storage temperature is _____.

(d) Store the stiffening (pour) adhesive of 3.3.4.1.4 at _____ °F. Allowable time out of storage temperature is _____.

(e) Store the stabilizing adhesive of 3.3.4.1.5 at _____ °F. Allowable time out of storage temperature is _____.

(f) Store the core rigidizing adhesive of 3.3.4.1.6 at _____ °F. Allowable time out of storage temperature is _____.

(g) Store the core potting compound of 3.3.4.1.7 at _____ °F. Allowable time out of storage temperature is _____.

(h) Store the sealant compound of 3.3.4.1.8 at _____ °F. Allowable time out of storage temperature is _____.

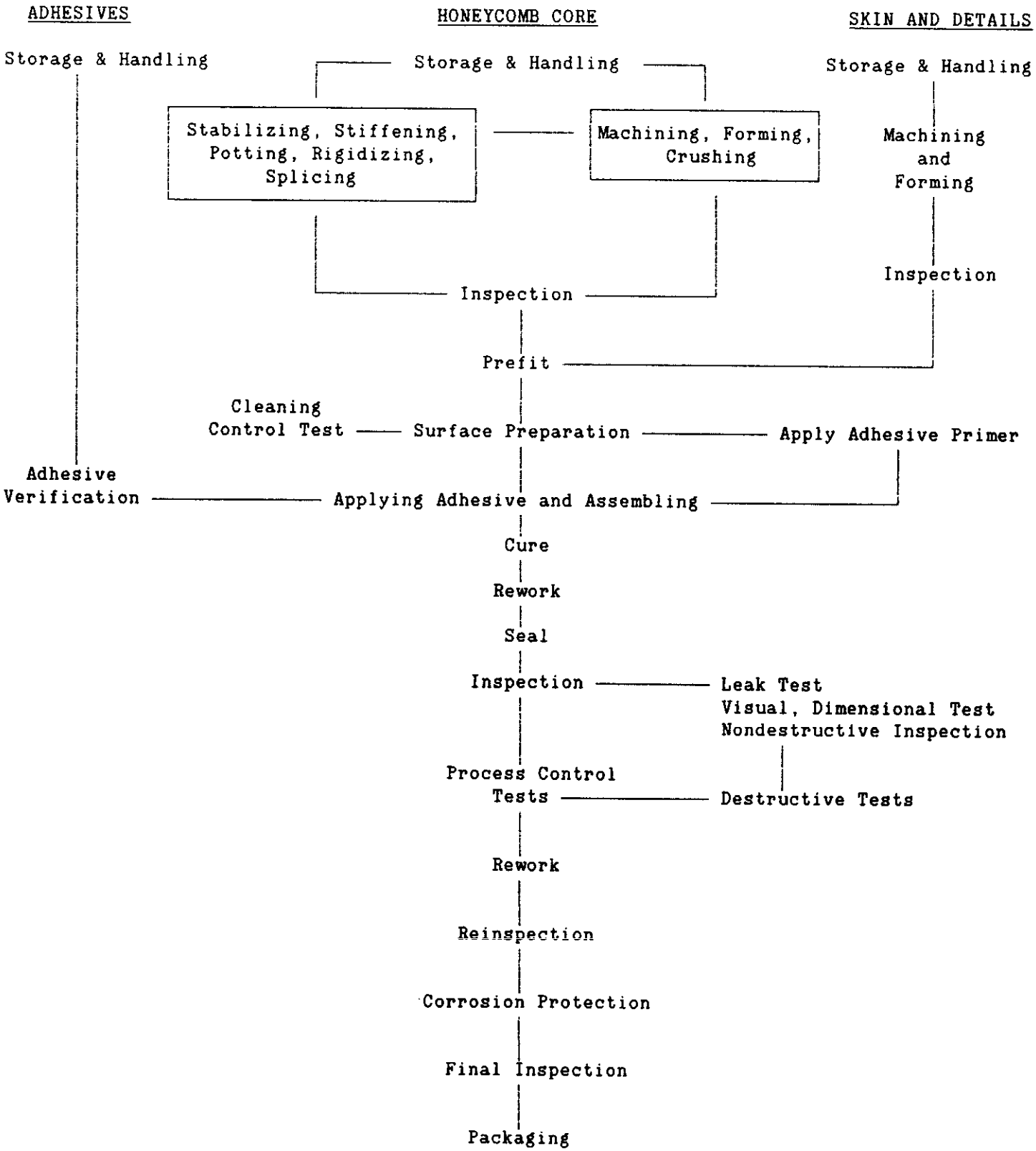


FIGURE 1. Manufacturing Process Flow Chart

(i) Store the secondary bonding adhesive of 3.3.4.1.10 at _____ °F. Allowable time out of storage temperature is _____.

(j) Allowable time out of storage temperature for adhesives and primers during freezer and refrigerator defrost is _____.

(k) The TRCO may add other materials as required.

3.4.2.1.2 The material shall be protected from deformation, moisture, direct sunlight, fluorescent lamp exposure, and other damage.

3.4.2.1.3 Each roll, package, or container shall be marked with complete identification information including storage requirements, date of manufacture, as applicable, inspection date and date of expiration of allowable storage time.

3.4.2.1.4 Materials shall be used on a first-in, first-out basis.

3.4.2.1.5 Unless otherwise specified, when materials are taken from storage for use, the unused portion shall be carefully repackaged to prevent moisture entry and returned to storage as soon as possible.

3.4.2.1.6 Materials not being used shall always be kept in sealed or tightly closed packages or containers.

3.4.2.1.7 Materials exhibiting unusual characteristics during processing (i.e., too much tack or lack of tackiness, lack of drapability, etc.) shall be submitted for Quality Assurance evaluation and disposition.

3.4.2.1.8 Material stored at 0 °F or lower shall be allowed to warm to room temperature for 24 hours in its sealed bag or container before opening the bag or container. Removal of a small quantity of adhesive at 0 °F is permissible provided the removal is done in a 0 °F environment and the contents are allowed to reach room temperature in a separate sealed bag before use and the roll from which the material is removed is returned to its original bag and the bag is sealed in a 0 °F environment. Store adhesive at room temperature in sealed, desiccated (with appropriate indicator to show need for desiccant replacement) metal container for a period not to

exceed that permitted by this specification (see 3.4.2.1.1). If material is not used up at the end of this storage period, it will be discarded or reinspected per 4.3.4 and if accepted it may be usable for the period allowed by this specification.

3.4.2.1.9 Material stored at 35 to 50 ^{o}F shall be allowed to reach room temperature before use. Material may be kept at room temperature, if permitted by this specification, in accordance manufacturers instructions for maximum time permitted, or returned to 35-50 ^{o}F storage after sealing package or container to prevent moisture entry. (See 3.4.2.1.1).

3.4.2.1.10 For raw materials, the allowable storage time before use shall be six months from manufacture unless a different time is stated by the material manufacturer. Materials that have exceeded allowable storage time may be retested if allowed by the manufacturer to the requirements of 3.3.4 to obtain a three to six month extension to the allowable storage time.

3.4.2.1.11 Records shall be kept for each container of material requiring refrigerated storage to show allowable and actual time out of the storage temperature specified in 3.4.2.1.1. When the allowable time out of the storage temperature is reached, the material shall either be rejected or retested per 4.3.4 and 3.3.4.

3.4.2.2 Aluminum honeycomb core.

3.4.2.2.1 All expanded and corrugated aluminum honeycomb core shall always be stored and transported in a container that keeps the core clean, dust and moisture free. Core removed from the container shall be identified with material description and purchase order information. Core shall only be removed from the container for processing.

3.4.2.2.2 Core shall be handled carefully to prevent node delamination, distortion of cells, crushing, or other damage. The node bond strength of corrugated aluminum honeycomb core is less than that of expanded core. Consequently it requires greater care in handling, particularly in large sheets, in order to prevent node bond separation.

3.4.2.2.3 Prevent unnecessary contact with water or other contaminating fumes.

3.4.2.3 Skins (faces) and details.

3.4.2.3.1 Aluminum sheets shall be handled with care to prevent scratching, scraping, corrosion, and shall not be unnecessarily stressed. Individual sheets shall be separated from contact with other sheets with paper (see 3.3.5.4.7) or fiberboard (see 3.3.5.4.19).

3.4.2.3.2 Aluminum sheets, 0.020 inches and less, shall be handled with extreme care at all times to prevent bending, wrinkling, denting, and scratching.

3.4.2.3.3 All skins, details, and test coupons shall be kept free from dust, grease, oil, wax, or other contaminants detrimental to adhesive bonding.

3.4.2.4 Consumables (not part of assembly).

3.4.2.4.1 Store consumable materials (3.3.5) at the manufacturer's recommended temperature. Protect from damage and contamination. Store in original shipping containers. Handle with care.

3.4.2.5 Tools and Fixtures

3.4.2.5.1 Store tools and fixtures, etc. in area(s) where contamination is minimized. Keep details of bond fixtures together to prevent loss. Handle with care to prevent damage.

3.4.2.6 Completed assemblies prior to packaging for shipment.

3.4.2.6.1 Completed assemblies shall be stored and handled in a manner to prevent damage. Honeycomb assemblies are readily damaged due to mishandling. Pay particular attention to protection of bare or painted surfaces to prevent scratching or denting.

3.4.3 Machining, forming and chemical milling.

NOTE: Holes shall not be drilled in skins where honeycomb core will be located to avoid potential water entry paths into the assembly. However, tooling and vent holes are permitted where authorized on the Engineering drawing.

3.4.3.1 Skins and details.

3.4.3.1.1 All necessary machining and forming shall be completed before final prefit. The use of cutting or forming fluids containing silicones is strictly prohibited.

3.4.3.1.2 No rework or metal removal shall be permitted on peened parts without provision for repeening.

3.4.3.1.3 Quality Assurance shall inspect raw materials per 4.3.4 before machining and forming operations begin for corrosion and other damage that would be detrimental to the completed part.

3.4.3.1.4 The contact surfaces of all metal detail parts shall be free of burrs, dimples and other surface imperfections.

3.4.3.1.5 The edge chamfer or radius resulting from the removal of burrs shall not exceed 0.010 inch.

3.4.3.1.6 Chemical milling of skins and other details shall be in accordance with MIL-C-81769 or in accordance with the applicable engineering drawing. (See 3.2.3.6).

3.4.3.1.6.1 Chemical milled parts shall be checked for dimensional compliance to the applicable Engineering drawing. Thickness in chemical milled radii shall be checked in particular. (See 4.3.8).

3.4.3.1.7 Quality Assurance shall inspect each completed detail for compliance to the applicable Engineering drawing, including dimensional and visual checks (see 4.3, 4.4, 4.5).

3.4.3.1.8 Completed skins and details shall be properly handled and stored to prevent damage and contamination detrimental to the adhesive bonding process, such as dust, grease, oil and wax.

3.4.3.2 Aluminum honeycomb core. All materials used to stabilize honeycomb core, such as polyethylene glycol, and lubricants for machinery used in processing honeycomb core shall contain a fluorescent detection dye. Presence of material containing the dye shall be detectable using the procedure specified in 4.3.3.12.

3.4.3.2.1 Sawing blocks.

3.4.3.2.1.1 Unexpanded aluminum core. Care must be exercised in the sawing of core blocks to hold applicable tolerances.

(a) Slices are to be within plus or minus 0.005 inch except as noted in the following.

(b) Slices greater than 4 inches thick may be sliced within plus or minus 0.030 inch if the core is subsequently milled to Engineering drawing tolerance.

(c) A cutting diagram may be established to specify required thickness and tolerance for a particular core detail. If the cutting diagram does not specify tolerances, (a) or (b) above shall apply.

(d) The feed of the core and speed of the saw blade during the sawing operation shall be such that welding of the foil material is kept to a minimum.

(e) The saw blade shall be checked periodically for sharpness. Sliced core when expanded shall be examined for surface defects. Burrs on cell edges of core slices due to the sawing operation are subject to the inspection limits for burrs (see 3.4.3.2.15.11) when inspected per 4.3.4.

3.4.3.2.1.2 Corrugated aluminum honeycomb core. Corrugated core usually has a lower strength node bond than expandable core. Greater care in handling corrugated core must be used during all manufacturing operations. Careless handling of large unsupported slices of corrugated core may result in severe node bond delaminations.

(a) The thickness tolerances on corrugated core are identical to expanded core identified in 3.4.3.2.1.1.

(b) Corrugated core may be cut over Engineering drawing thickness requirements as specified by a detail cutting diagram if the core is subsequently milled to tolerance. Thickness tolerance shall be in accordance with the cutting diagram or 3.4.3.2.1.1.

(c) Saw blades shall be checked frequently when cutting core details from corrugated core because the thick foil tends to burr or smear when sliced with dull blades. Burrs are subject to the inspection limits

(see 3.4.3.2.15.11) when inspected per 4.3.3.

3.4.3.2.2 Sawing slices.

3.4.3.2.2.1 Unless otherwise specified, it is acceptable to prepare the bonding surfaces of core details by sawing. Burrs exceeding the inspection limits of 3.4.3.2.15.11 are unacceptable when inspected per 4.3.3.

3.4.3.2.2.2 Full depth core details which are machined to contour may be sawed to establish a flat reference surface.

3.4.3.2.3 Expanding aluminum core.

3.4.3.2.3.1 Core shall be expanded prior to any further processing steps to within the limits specified in 3.4.3.2.15.2.

3.4.3.2.4 Milling of core materials.

3.4.3.2.4.1 Core may be milled using any suitable means that will produce a finished detail that will meet the requirements of this specification, and when bonded into an assembly, will meet the requirements of the applicable Engineering drawing and the requirements of this specification.

3.4.3.2.4.2 Warpage.

3.4.3.2.4.2.1 Warpage during any stage of the milling operation is cause for rejection of the core detail. Warpage is defined as that degree of distortion which causes the core detail to be unsuitable for use in a bonded structure. (See 3.4.3.2.15.9).

3.4.3.2.4.3 Burrs.

3.4.3.2.4.3.1 Burrs caused by milling are subject to the inspection limits of 3.4.3.2.15.11 when the core is inspected per 4.3.4.

3.4.3.2.5 Sanding of sawed and/or milled aluminum core.

3.4.3.2.5.1 Local sanding of aluminum core details is acceptable provided the core meets the inspection limits for burrs (see 3.4.3.2.15.11) when inspected per 4.3.3. The core

shall be thoroughly cleaned afterwards per 3.4.5.2 to remove all dust, flakes and contamination.

3.4.3.2.6 Die cutting. Cutting dies for aluminum details are acceptable provided the finished detail meets the requirements of this specification. The cell edges shall be cut cleanly. Torn or ripped cells are not acceptable.

3.4.3.2.7 Forming.

3.4.3.2.7.1 Roll forming of aluminum details is acceptable provided the core material meets the requirements of this specification. The roll forming process shall not include overexpanding of core (3.4.3.2.3.1) unless specifically approved by the TRCO.

3.4.3.2.7.2 Hand forming of details to contour using tooling aids is acceptable provided the detail meets the requirements of this specification.

3.4.3.2.8 Honeycomb core shall be stiffened where specified by the applicable Engineering drawing to prevent cell collapse during handling and assembly. The pour adhesive of 3.3.4.1.4 shall be used as the stiffening agent.

3.4.3.2.9 Rigidify local areas of the honeycomb core to prevent crush except where specified on the applicable Engineering drawing. Use the materials specified in 3.3.4.1.6.

3.4.3.2.10 Stabilize core crush areas to prevent distortion after crush using the material specified in 3.3.4.1.5 and the process specified on the applicable Engineering drawing.

3.4.3.2.11 Honeycomb core shall be potted where specified on the applicable Engineering drawing, using the material specified in 3.3.4.1.7 and the procedure specified in the applicable Engineering drawing or per manufacturers instructions.

3.4.3.2.12 Splicing aluminum honeycomb core.

3.4.3.2.12.1 Splices shall be made only where specified on the applicable Engineering drawing.

3.4.3.2.12.2 Where permitted by the applicable Engineering drawing, splicing may be completed before machining, crushing and prefit which then permits installing the core as one piece.

Splicing where permitted by the applicable Engineering drawing may also be made simultaneously with the adhesive bonding operation.

3.4.3.2.12.3 Splice the core using the specified adhesive (see 3.3.4.1.3).

3.4.3.2.12.4 The adhesive shall extend to within 0.032 inch from the core faces and shall not extend beyond them at any point when the splice is made as a separate operation.

3.4.3.2.12.5 The core thickness variation or mismatch across the splice shall not exceed 0.010 inch.

3.4.3.2.12.6 Core splices shall be cured under contact pressure for _____ minutes at _____ temperature when the splice is made as a separate operation or in accordance with the applicable Engineering drawing.

3.4.3.2.13 Store machined and formed core in a Controlled Area so that it is protected from damage and contamination per 3.2.5.1.

3.4.3.2.14 Rework of honeycomb core.

3.4.3.2.14.1 Rework of honeycomb core is prohibited except as allowed in this specification, which includes the following:

(a) Voids in splices shall be reworked using the same material and procedure that was used to make the splice before lay-up.

(b) Fractured cell walls and delaminated node bonds shall be reworked before or during lay-up.

(c) Collapsed and crushed cell walls not exceeding 0.06 inches in depth shall be reworked.

(d) Core details which have local areas of missing perimeter cells shall be reworked.

3.4.3.2.15 Inspection limits. (See 4.3.3 for core inspection). The core in the final assembly must be within the following limits.

3.4.3.2.15.1 Ribbon direction. The core ribbon direction shall be within 5° of the direction specified by the applicable Engineering drawing. If the ribbon direction is more than 5° from the direction shown on the drawing, the detail is unacceptable. (See 4.3.3.1)

3.4.3.2.15.2 Expansion. Details which are outside the following limits are unacceptable. Limits given below are applicable immediately after core has been expanded (prior to any further processing steps).

Core Cell Size (inch)	Nominal Cell Count Measured Normal to Ribbon Direction	Tolerance
1/8	48 in (6 inches)	+/- 4 cells
3/16	32 in (6 inches)	+/- 3 cells
5/32	32 in (5 inches)	+/- 3 cells

3.4.3.2.15.3 Double laps. Core slices which have double laps (two ribbons bonded together) which cause uneven expansion in the ribbon direction are acceptable if there are no more than 4 such lines per 96 inch (W direction, refer to MIL-C-7438) slice with no two lines closer than 18 inches. Core slices exceeding these limits are unacceptable and cause for rejection in bonded assemblies.

3.4.3.2.15.4 Splices. The number and location of splices shall be in accordance with the applicable Engineering drawing. Voids between the core and the material used for making the splice are not acceptable. A mismatch of 0.010 inch (maximum) between spliced core details is acceptable.

3.4.3.2.15.5 Distorted cells (aluminum core). Distorted cells which occur in forming or expansion are acceptable provided:

(a) The cell walls are not fractured (3.4.3.2.15.6).

(b) The cell walls have not been collapsed in a direction parallel to the core thickness.

(c) The ribbon direction has not been changed (4.3.3.1).

3.4.3.2.15.6 Fractured cell walls and delaminated node bonds are unacceptable.

3.4.3.2.15.7 Collapsed and crushed cell walls are unacceptable.

3.4.3.2.15.8 Dimensional discrepancies. Details which are outside the dimension limits of the applicable Engineering drawing are unacceptable.

3.4.3.2.15.9 Warpage. Core details that are warped only to the extent they can be returned to part contour with moderate hand pressure are acceptable, unless the warpage is such that it could result in a bonded part that will not meet the requirements of the applicable Engineering drawing or this specification.

3.4.3.2.15.10 Missing cells. Details which have local areas of missing perimeter cells are unacceptable.

3.4.3.2.15.11 Burrs (lip-over of cell foil).

3.4.3.2.15.11.1 Honeycomb core details, after sawing, milling, etc. which have burrs are acceptable provided:

(a) The burr is firmly attached to the cell foil and does not exceed 0.010 inch.

(b) Less than 20% of the core surface area per side has burrs 0.010 inch or smaller.

(c) Greater than 80% of the core surface area per side has burrs 0.005 inches or smaller.

3.4.3.2.15.11.2 Core details with burrs exceeding these inspection limits are unacceptable.

3.4.4 Prefit. All detail parts and core for each individual honeycomb assembly shall be prefit on the bond fixture (tool) or equivalent prefit fixture to assure that required bondline thicknesses will be obtained during subsequent cure.

3.4.4.1 Mechanical prefit. Mechanical prefit of all preproduction and production parts is required and is accomplished by means of physical measurements of components and their mismatch, using calipers, feeler gauges, depth gauges, micrometers or equivalent tools, to determine the

following for all bondlines which consist of 1 layer of the film adhesive specified in 3.3.4.1.2.

3.4.4.1.1 The distance between faying surfaces in a metal-to-metal joint shall not exceed 0.010 inch when using moderate hand pressure to force the joint together.

3.4.4.1.2 The face of the core shall be minus 0.005 to plus 0.005 inch on each side, with reference to the face or flange of an adjacent part.

3.4.4.1.3 Unless otherwise specified on the applicable Engineering drawing, all noncrushed core pieces shall be cut oversize to provide an interference fit at all points of contact with the enclosing edge members. As a guide, the net dimension plus one cell is suggested. The oversize dimension shall not exceed 0.50 inch.

3.4.4.1.4 No rework or metal removal shall be permitted on shot peened forgings or details without provision for further peening.

3.4.4.1.5 When the foam adhesive specified in 3.3.4.1.3 is used for edge bonding, 1/2 the sheet thickness may be deducted when establishing the net core edge dimensions.

3.4.4.2 Impression prefit (overlay). Impression prefit is accomplished by using a non-adhering impression film (Verifilm) in place of the film adhesive in the assembly and conducting a normal cure cycle in the autoclave. The impression film is designed to provide flow characteristics during the cure cycle similar to the flow characteristics of the film adhesive used in the bonding of the assembly.

3.4.4.2.1 Application. Impression prefit (overlay) is required for all new honeycomb assembly designs and new fixtures before fabrication of the initial qualification assembly. Impression prefit may not be used in lieu of destructive testing of production assemblies.

3.4.4.2.2 Procedure. Lay-up and "cure" the impression prefit.

3.4.4.2.3 The Verifilm shall be carefully removed from the joints and interpreted by inspection (see 4.3.7).

3.4.4.2.3.1 Results of the Verifilm shall be used to correct unacceptable fit of details.

3.4.4.3 Prefit parts for each individual honeycomb assembly shall be placed in a separate "kit" after completion of the prefitting operation. Details shall not be switched from one kit to another unless another prefit operation is performed.

3.4.5 Surface preparation.

3.4.5.1 Bond fixtures.

3.4.5.1.1 The surfaces of all bond fixtures shall be kept clean. Adhesive flash shall be carefully removed.

3.4.5.1.2 Bond fixtures shall be periodically checked for leaks and repaired as required.

3.4.5.1.3 Surfaces of the bond fixture that may come in contact with adhesive squeeze-out shall have a mold release agent (3.3.5.2) applied per the manufacturer's instructions.

3.4.5.2 Aluminum honeycomb core.

3.4.5.2.1 Remove glycol rigidizing material. After removal of the glycol and subsequent water rinsing or steam cleaning, inspect the core with "black light" per 4.3.3.12 while the core is still wet with water. The presence of glycol is indicated when a fluorescing area is detected. Repeat cleaning operation and "black light" inspection until all traces of glycol have been removed.

3.4.5.2.2 All aluminum honeycomb core details shall be vapor degreased with 1,1,1-trichloroethane after all machining and cutting operations are complete.

3.4.5.2.3 Core shall be dried after vapor degreasing.

3.4.5.2.4 "Black light" inspect all honeycomb core that has been machined for the presence of oil per 4.3.3.12.

3.4.5.2.5 Honeycomb or detail parts that are not bonded immediately after cleaning and drying shall be wrapped in wax-free kraft paper and stored in a contamination controlled area per 3.2.5.1. Handle clean core only with clean, white cotton gloves. Protect stored, cleaned core from contamination and damage. Maintain part identification with respect to part number and kit number. There is no time limit on the storage

of cleaned, dried honeycomb core details prior to bonding provided the core is stored as specified above.

3.4.5.3 Aluminum alloy parts (other than honeycomb core and castings).

3.4.5.3.1 Parts required by the applicable Engineering drawing to be sulphuric acid anodized or chromic acid anodized on the exterior, nonbondable surfaces shall be so prepared in accordance with MIL-A-8625 Type II, Class 1 (dichromate sealed) or MIL-A-8625 Type I, Class 1 dichromate (sealed), respectively, prior to preparation for adhesive bonding. Bonding surfaces are to be protected by a suitable maskant.

3.4.5.3.1.1 The sulphuric acid and chromic acid anodizing solutions shall be qualified prior to use by the fabrication and testing of five cleaning control specimens.

3.4.5.3.1.1.1 The cleaning control specimens shall consist of five, single lap shear specimens prepared and tested per ASTM D 1002. Each specimen shall equal or exceed the strength requirement specified in Table II of this specification. Records of test results shall be kept per 4.3.1.

3.4.5.3.1.2 After completion of anodizing of the exterior surfaces, the maskant shall be removed from the bond surfaces and applied to the exterior, previously anodized surfaces.

3.4.5.3.2 All aluminum details to be bonded (except core) shall be phosphoric acid anodized per SAE ARP1524 on the bonding surface. This includes skins with previously anodized exterior surfaces. Previously anodized exterior surfaces are to be masked during the phosphoric acid anodizing process. Rinse shall be accomplished within two (2) minutes of removing the detail from the anodize bath.

3.4.5.3.2.1 Do not touch phosphoric acid anodized surfaces that are to be adhesively bonded. Anodized parts shall be primed with adhesive primer per 3.4.6.1 as soon after drying as possible but no longer than 2 hours after drying. If the 2 hour limit is exceeded, the phosphoric acid anodize process must be reaccomplished prior to priming.

Caution: Phosphoric anodized surfaces are easily damaged.

3.4.5.3.2.2 The phosphoric acid anodizing solutions shall be

qualified prior to use by the fabrication and testing of five cleaning control specimens.

3.4.5.3.2.2.1 The cleaning control specimens shall consist of five, wedge specimens prepared and tested per ASTM D 3762. Each specimen shall have maximum crack extensions of less than or equal to the limits specified in Table IV of this specification. Records of test results shall be kept per 4.3.1.

3.4.5.3.2.3 Process control test panels representing each part or group of similar parts cleaned at the same time as required by this specification shall be prepared for bonding at the same time as the assembly details are prepared.

3.4.5.4 Glass reinforced plastic details.

3.4.5.4.1 Glass reinforced plastic details shall be prepared for bonding in accordance with the procedure specified in MIL-HDBK-337.

3.4.5.4.2 Do not touch cleaned surfaces with bare hands. Parts that are not bonded immediately after cleaning and drying shall be wrapped in non-waxed kraft paper and stored in contamination control area per 3.2.5.1 until ready for adhesive bonding. Protect from contamination and damage. There is no time limit for use of cleaned, properly stored and protected glass reinforced plastic details.

3.4.5.5 Stainless steel details. The solutions for cleaning stainless steel (corrosion resistant steel) parts for adhesive bonding shall be qualified prior to use by the fabrication and testing of five cleaning control specimens per Table II and testing per ASTM D 1002. Each specimen shall meet the minimum strength requirement specified in Table II of this specification. Records shall be kept per 4.3.1.

3.4.5.5.1 Prepare stainless steel details for adhesive bonding in accordance with MIL-HDBK-337.

3.4.5.5.2 Shelf life of cleaned stainless steel parts shall be in accordance with MIL-HDBK-337.

3.4.5.5.3 Parts that are not bonded immediately after cleaning shall be wrapped in wax-free kraft paper and stored in contamination controlled area per 3.2.5.1. Protect from damage

and contamination. Handle only with clean, white cotton gloves.

3.4.5.6 Titanium alloys details. The solutions for cleaning titanium for adhesive bonding shall be qualified prior to use by the fabrication and testing of five cleaning control specimens per Table II and ASTM D 1002. Each specimen shall meet the minimum strength requirement specified in Table II of this specification. Records shall be kept per 4.3.1.

3.4.5.6.1 Prepare titanium alloy details for adhesive bonding in accordance with MIL-HDBK-337. The use of halogenated (e.g. chlorine, fluorine, etc) solutions and solvents as cleaning agents shall be prohibited.

3.4.5.6.2 Shelf life of cleaned titanium alloy parts shall be in accordance with MIL-HDBK-337.

3.4.5.6.3 Parts that are not bonded immediately after cleaning shall be wrapped in wax-free kraft paper and stored in contamination controlled area per 3.2.5.1. Protect from damage and contamination. Handle only with clean, white cotton gloves.

3.4.5.7 Multistage bonding.

3.4.5.7.1 Prepare surfaces for multi-stage bonding in accordance with the Engineering drawing.

3.4.6 Application of adhesives.

3.4.6.1 Adhesive primer.

3.4.6.1.1 Apply adhesive primer (see 3.3.4.1.1) to a dried thickness of _____ inches to all bond surfaces of metal details (except core). Corrosion inhibited adhesive primers shall be thoroughly mixed prior to pouring into the spray gun cup or container. Transfer from can to cup or container shall occur as quickly as possible after mixing to avoid settling of the corrosion inhibiting component. Preferred method is to transfer the entire contents of the can into the cup or container. Corrosion inhibited adhesive primers shall be continuously agitated during application to detail components.

3.4.6.1.1.1 Metal details shall be primed within 2 hours maximum after surface preparation for bonding.

3.4.6.1.2 All primed and dried details shall be inspected for adhesive primer thickness per 4.3.6.

3.4.6.1.3 Primed, dried, and inspected metal details that are not bonded immediately shall be wrapped in non-waxed kraft paper and stored in contamination controlled area per 3.2.5.1. They shall be protected from contamination and damage during handling and storage. Handle primed parts only with clean, white cotton gloves.

3.4.6.1.4 Primed and dried details may be stored for up to 7 days before bonding.

3.4.6.2 Film adhesives (see 3.3.4.1.2).

3.4.6.2.1 Apply the 3.3.4.1.2 film adhesive to the areas specified on the applicable Engineering drawing.

CAUTION: It is extremely important to properly fill the gap at the recessed edges of undercut skins (chemical milling radii) and edges of doublers with layers (not rolls) of film adhesive to prevent a water entry path into the bonded assembly.

3.4.6.2.1.1 Details with film adhesive applied shall be bonded immediately or stored in the lay-up room in a manner that prevents contamination and/or handling damage. Accumulated storage time in the lay-up room shall not exceed the allowable time out of storage temperature per 3.4.2.1.10.

3.4.6.3 Foam adhesives.

3.4.6.3.1 Apply the foaming adhesive specified in 3.3.4.1.3 to the areas specified on the applicable Engineering drawing.

3.4.6.3.1.1 Details with foaming adhesive applied shall be bonded immediately or stored in the lay-up room in a manner that prevents contamination and/or handling damage. Accumulated storage time in the lay-up room shall not exceed the allowable time out of storage temperature per 3.4.2.1.10.

3.4.6.4 Core filler compound. (See 3.3.4.1.7).

3.4.6.4.1 Fill the areas of the core as specified on the applicable Engineering drawing with the potting compound specified in 3.3.4.1.7.

3.4.6.4.1.1 Core with cured potting compound installed shall be bonded immediately or stored in the lay-up room in a manner which prevents contamination and/or handling damage. Accumulated storage time in the lay-up room shall not exceed the allowable time out of storage temperature per 3.4.2.1.10.

3.4.7 Assembly of details.

3.4.7.1 Verify that all details are within the time allotments permitted by this specification prior to assembly into the bond fixture.

3.4.7.2 Carefully assemble the details into the bond fixture.

3.4.7.3 Assemble process control specimens as required herein. Process control test panels (specimens) as specified in Tables II, III and IV conforming to ASTM D 1002 for tensile lap shear, ASTM D 1781 for climbing drum peel, ASTM D 3762 for wedge crack test and all other tests as required by the Engineering drawing shall be provided to represent each bonded assembly. Panels shall be processed simultaneously with the assemblies they represent, using the same surface preparation, batch of adhesive, curing facility, fabrication area, and participating personnel. Pressure shall be applied to the test panels by the same source as the assembly. Those assemblies bonded under a vacuum or pressure diaphragm shall have their test panels cured under the same diaphragm, or under a separate diaphragm with the vacuum or pressure lines connected in series with the assembly or assemblies they represent.

3.4.7.4 Complete the bagging procedure including leak check(s). Maximum permissible leakage is one inch of mercury in a two minute period. Sufficient thermocouples must be in the bagged assembly to assure accurate cure temperatures are reached.

3.4.7.5 Bagged assemblies may be cured immediately or stored within the temperature limits of the lay-up room. Storage time shall not exceed the allowable time out of storage temperature per 3.4.2.1.10. Handle bagged assemblies carefully to prevent damage to the vacuum bag and movement of details.

3.4.8 Curing the assembly.

3.4.8.1 Cure the assembly(ies) for _____ minutes at _____ temperature, pressure, and vacuum. Heat up time to

cure temperature shall be _____ °F per minute. Cure starts when all functioning thermocouples have reached the minimum specified temperature.

3.4.8.1.1 A _____ shall be used for applying pressure.

3.4.8.1.2 Record temperature, pressure, vacuum, pressure build-up under the pressure bag or diaphragm versus time during the entire cure, as applicable. Retain records per 4.3.1.

3.4.8.1.3 Cool down time (ramp down) to ambient temperature shall be _____ °F per minute. Vacuum and/or pressure shall not be released from the cured assembly until the assembly reaches 100°F.

3.4.8.2 Cured Assemblies.

3.4.8.2.1 Carefully remove the cured assembly from the bond fixture or surface plate, as applicable.

3.4.8.2.2 Handle and store cured assemblies during all subsequent fabrication and inspection operations to prevent damage, contamination, and/or entry of fluids into the assembly.

3.4.8.3 Cure Cycle Malfunction.

3.4.8.3.1 Follow cure cycle abort procedures in the event there is a cure cycle malfunction such as a pressure build-up under the bag greater than 5 psig.

3.4.8.3.2 Also follow abort procedure in the event of a malfunction occurring during the cure cycle that exceeds the allowable limits for interrupting the cure cycle and fixing the malfunction such as excessive leakage or breaking of the pressure diaphragm.

3.4.8.3.3 The following information and records must be compiled and made available to government personnel upon request in the event of a bag or pressure failure.

3.4.8.3.4 It shall be assumed that a pressure bag break has occurred if any probe indicates a differential of more than 5 psig after settling. A sketch of the cure load showing assembly and quality assurance specimen identification and

locations shall be made on the cure chart immediately after completion of cure each time that a pressure bag breaks during cure. Bag break location shall also be designated. The following information shall be noted on the cure record in addition to the normal information in 3.4.8.1.2.

(a) Time of bag break or pressure failure.

(b) Temperature at bag break or pressure failure.

(c) Effect on vacuum or pressure.

3.4.8.3.5 All quality assurance test specimens for the cure load shall be retained after testing and used with the test results to prepare the contractor's recommended disposition of the assemblies under question. Disposition other than rejection requires approval of the TRCO.

3.4.8.4 Secondary Bonding.

3.4.8.4.1 Some assemblies require secondary bonding operations to be performed after the initial cure cycle as specified on the applicable Engineering drawing. Use the adhesive specified in 3.3.4.1.10.

3.4.8.4.2 Prepare surfaces of bonded assembly for secondary bonding.

CAUTION: Prevent entry of any liquid into the assembly.

3.4.8.4.3 Prepare secondary bond details for bonding per this specification.

3.4.8.4.4 (Mix per manufacturer's direction, if necessary) and apply adhesive, assemble and cure at _____ temperature for _____ minutes under _____ pressure. Use _____ to apply pressure.

CAUTION: If cure requires the use of an autoclave, the assembly shall be positioned and bagged on the bond fixture or envelope bagged to prevent autoclave pressure from entering the assembly through various paths and destroying the honeycomb core.

3.4.8.5 Postbond cleaning of bonded assembly.

3.4.8.5.1 Clean-up bonded assemblies.

3.4.8.5.1.1 Exercise extreme care to prevent entry of fluids into any openings into the assembly.

3.4.8.6 Visual and dimensional inspection of bonded assemblies.

3.4.8.6.1 Each assembly shall be inspected visually for defects and dimensionally for compliance with the applicable Engineering drawing in accordance with 4.5.2.

3.4.9 Authorized rework.

3.4.9.1 Authorized rework procedures are those nonstructural operations that may be performed by a manufacturing organization to bring previously performed work up to quality and in conformance with Engineering drawing and specification requirements prior to submittal to inspection. There shall be no rework of bonds, bond joints or core areas permitted. Nonstructural rework such as part trim, replacement of discrepant fasteners or missing sealant in non-bond joint areas shall be allowed. Rework of bonded assemblies other than that specifically identified in this specification is not allowed.

3.4.10 Final process.

3.4.10.1 Sealing.

3.4.10.1.1 Extreme care shall be exercised to assure proper sealing of the assembly to prevent water entry. Seal the assembly per the applicable Engineering drawing with sealant specified in 3.3.4.1.8.

3.4.10.1.2 Do not seal bonded joints at this time. Only seal nonbonded areas per the applicable Engineering drawing as needed to conduct leak test. These areas are holes, cavities, and open areas intentionally open such as edges of close-outs. Bondlines are sealed after completion of passing the leak test.

3.4.10.1.3 Allow sealant to cure thoroughly per sealant manufacturers directions before handling and leak testing.

3.4.10.2 Leak testing.

3.4.10.2.1 Every bonded honeycomb assembly shall be leak

tested per 4.5.4 unless otherwise specified on the applicable Engineering drawing.

3.4.10.3 Nondestructive testing of bonded assemblies.

3.4.10.3.1 Bonded assemblies shall be nondestructively tested radiographically (see 4.4.1.2), and ultrasonically (see 4.4.1.4) in accordance with Table I requirements.

3.4.10.4 Corrosion protection (finish).

3.4.10.4.1 After completion of all inspection operations per 4.4, completely seal as required per the applicable Engineering drawing. This may include sealing areas that were not previously sealed. Apply finish system, including pretreatment of surfaces for paint adhesion per _____ specification in accordance with the requirements of the applicable Engineering drawing.

3.4.10.5 Identification of assemblies.

3.4.10.5.1 Every assembly shall be identified per the applicable Engineering drawing, contract and serialization number. Identification plates, if required, shall be installed by bonding or mechanically fastening as specified on the applicable Engineering drawing.

3.4.11 Specimen retention.

3.4.11.1 Any specimen pertaining to material inspection or reinspection, cleaning control, process control, and destructive testing that fails to meet the requirement of the applicable specification shall be retained until disposition of the discrepancy has been made.

3.4.12 Packaging for shipment of completed assemblies.

3.4.12.1 Completed assemblies approved by the supplier's inspection per this specification and government inspection shall be carefully packaged for shipment. (See 5)

3.4.13 Documents retention.

3.4.13.1 Retention of documents and records shall be as specified in 4.3.1.

4. QUALITY ASSURANCE REQUIREMENTS

4.1 Responsibility of Contractor

4.1.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.2 Responsibility for compliance. All items must meet all requirements of this specification. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all the requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual nor does it commit the Government to acceptance of defective material.

4.2 Quality Assurance of Personnel Facilities and Equipment

4.2.1 Test equipment and inspection facilities.

4.2.1.1 The contractor shall insure that test and inspection facilities of sufficient accuracy and quality are established and maintained to permit performance of required inspections.

4.2.1.2 All inspection operations shall be performed in a suitable environment and location for the task being performed.

4.2.2 Personnel

4.2.2.1 All bonding, nondestructive testing, and quality assurance personnel shall be requalified and recertified every two years.

4.2.3 Tooling, Equipment and Fixtures.

4.2.3.1 Every prefit, inspection and bond fixture shall be requalified (recertified) in accordance with the frequency specified in Table I and to procedures in 4.4.2.2 for the particular type of assembly being produced on the fixture. In addition, requalification (recertification) of a fixture is required when there is a major change to its design. Consultation with the TRCO is required to determine if a tooling change is major.

4.2.3.2 Ovens shall be certified for bonding by checking the accuracy of the oven equipment (3.2.8) every six months by a procedure acceptable to the TRCO.

4.2.3.3 Autoclaves shall be certified to the limits of 3.2.9 every four months by a procedure acceptable to the TRCO.

4.2.3.4 Platen presses or cavity presses shall be certified to the requirements of 3.2.10 or 3.2.11 every 4 months by a procedure acceptable to the TRCO.

4.2.3.5 The adhesive primer thickness measuring device shall be calibrated before each use and certified every six months. The requirements for calibration and certification are in 3.2.4.7.

4.2.4 Calibration and certification of instrumentation.

4.2.4.1 The temperature and pressure indicating and recording equipment for controlling any process shall be operationally inspected, calibrated, and certified to the requirements of 3.2.12 every four months to assure continuous accuracy of the equipment.

4.2.4.2 The testing equipment shall be calibrated and certified to the requirements of 3.2.12 every six months. All records will be maintained for minimum of 3 years and will be available for government review per 4.3.1.

4.2.5 Facilities.

4.2.5.1 Controlled Areas and Clean Rooms.

4.2.5.1.1 All filters used in air, oil and contaminate filtration will be periodically checked and cleaned or replaced to ensure all limits of 3.2.5 are maintained.

4.2.5.1.2 Cleaning of floors, ceilings, walls, tables, etc. is required when visual inspection shows any accumulation of dust, dirt, cobwebs, or other contamination. Cleaning will be accomplished in accordance with 3.2.5.1 and 3.2.5.2.

4.2.5.2 Surface Preparation Areas.

4.2.5.2.1 Air used for agitation of solutions shall be filtered and oil-free. All filters used in air, oil, and contaminate filtration will be periodically checked and cleaned or replaced to ensure air lines are free of contaminates (See 3.2.3.4).

4.2.5.3 Adhesive Primer Areas.

4.2.5.3.1 Periodically inspect spray equipment for compliance with 3.2.4.1.

4.3 Quality Assurance of Materials and Processes.

4.3.1 Required documentation.

4.3.1.1 The following documentation shall be obtained, recorded and made available to government personnel upon request:

(a) Procedures and test results on material inspection tests and retests.

(b) Bonding and prefit fixture tool qualification/requalification.

(c) Inspection acceptance of intermediate fabrication sequences.

(d) Complete procedural operations acceptable and reproducible for fabrication of assemblies.

(e) Detailed job sheets.

(f) Complete record of any changes made to materials, tools, fixtures or procedures.

(g) All results from nondestructive testing including which tests, where performed, on which assembly, and by whom.

(h) Dissection sketch of assemblies.

(i) All results from destructive testing, including how dissected, and which tests were performed to what specification.

(j) Process control test results representing the assembly.

(k) Qualification, calibration and certification of instruments and equipment as applicable.

(l) Complete records of any malfunctions encountered during manufacture of assemblies.

(m) All other records as specified.

4.3.1.1.1 The documentation specified in 4.3.1 shall be kept for 3 years after close of contract. The documentation shall identify to which delivery quantity(ies) it applies by contract and serial number.

4.3.2 Required Process Control

4.3.2.1 Chemical Solutions

4.3.2.1.1 Perform chemical analyses of solutions associated with surface preparation of bond details (see 3.4.5) in accordance with the supplier's procedures.

4.3.2.1.2 Schedule for chemical analyses shall be based upon solution usage. Solutions shall be within concentration range specified in the supplier's procedures. The Government reserves the right to disapprove the procedures and schedules used by the manufacturer.

CAUTION: Solutions shall not be used when out of concentration limits.

4.3.2.1.2.1 Determine chemical additions as analyses indicate.

4.3.2.1.3 Any changes in the chemicals used, chemical processes, or schedule of chemical analyses require notification of the CO.

4.3.2.2 Adhesive Primer Application.

4.3.2.2.1 Analyze compressed air used for primer application, using equipment specified in 3.2.4.3.1. Determine that the dew point of the compressed air is being monitored continuously and that it is 35°F or lower (see 3.2.4.3.2).

4.3.2.3 Measure ambient air temperature and humidity in primer application area as specified in 3.2.4.5 and 3.2.4.6.

4.3.3 Inspection of aluminum honeycomb core. Completely inspect all aluminum honeycomb core for all of the following:

4.3.3.1 Ribbon direction. Determine honeycomb core ribbon direction by aligning a straight edge with the nodes of two cells, approximately 8 to 10 inches apart, on a common ribbon.

4.3.3.1.1 In a distorted area of a core slice, "effective" ribbon direction must be determined by aligning a 6 to 10 inch straight edge through the centers of a row of cells. A "row of cells" is the group of cells formed by two adjacent ribbons of foil.

4.3.3.1.2 See 3.4.3.2.15.1 for ribbon direction inspection limits.

4.3.3.2 Expansion. Core details which exceed the limits of 3.4.3.2.15.2 shall be rejected.

4.3.3.3 Double laps. Double laps are two ribbons bonded together. Core with double laps exceeding the inspection limits of 3.4.3.2.15.3 shall be rejected.

4.3.3.4 Splices. Core with splices exceeding the limits of 3.4.3.2.15.4 shall be rejected.

4.3.3.5 Distorted cells. Core with distorted cells exceeding the inspection limits of 3.4.3.2.15.5 shall be rejected.

4.3.3.6 Fractured cell walls and/or delaminated node bonds. Core containing fractured cell walls and/or delaminated node bonds is unacceptable and shall be rejected.

4.3.3.7 Collapsed and crushed cell walls. Core containing collapsed and crushed cell walls is unacceptable and shall be rejected.

4.3.3.8 Dimensional discrepancies. Core details which are

outside the dimension limits of the applicable Engineering drawing and the machined tolerances specified in this document are unacceptable and shall be rejected.

4.3.3.9 Warpage. Core details warped in excess of the inspection limits of 3.4.3.2.15.9 are unacceptable and shall be rejected.

4.3.3.10 Missing cells. Core details containing local areas of missing cells shall be rejected.

4.3.3.11 Burrs. Core details containing burrs exceeding the inspection limits of 3.4.3.2.15.11 shall be rejected.

4.3.3.12 Presence of oil and/or polyethylene glycol.

4.3.3.12.1 Inspect core after machining and glycol removal for presence of oil and/or glycol using a "black light". The presence of oil or glycol is indicated when a fluorescing area is detected. Do not misconstrue excess node bond adhesive as oil or glycol because it will also fluoresce under "black light". Black light intensity shall be at least 1000 microwatts per square centimeter at a distance of 15 inches from the front or outside surface of the black light source/filter.

4.3.3.12.1.1 Core details contaminated with oil and/or glycol are unacceptable and shall be rejected. Recleaning is permitted per 3.4.5.2.

4.3.4 Inspection of raw material and detail parts and skins (unprimed).

4.3.4.1 Perform receiving inspection on each manufacturing lot of raw materials, detail parts and skins to assure the requirements of 3.3.2, 3.3.3, and 3.3.4 are met. Receiving inspection test requirements are the same as qualification requirements except that the number of test specimens is reduced by one half to a minimum of three.

4.3.4.1.1 Raw materials and detail parts and skins which are visually unacceptable shall be rejected.

4.3.4.1.2 Materials may be reinspected per 3.3.4 after allowable storage time has expired.

4.3.5 Inspection of Phosphoric Acid Anodized Parts and Skins.

4.3.5.1 Inspect for phosphoric acid anodize using polarized filters in accordance with ARP 1524. Inspect for incomplete coverage of the anodize on the surface.

4.3.5.2 Inspect for corrosion, scratches, dirt, dents, grease, warpage, and any other form of contamination that would affect the bonding or painting surface.

4.3.6 Inspection of primed detail parts and skins.

4.3.6.1 Inspect primed, dried metal detail parts and skins for primer thickness using a suitable measuring device (see 3.2.4.7). Inspect every _____ square inches for compliance to this specification.

4.3.6.1.1 Details containing primer outside of the thickness range as specified in 3.4.6.1 or non-uniform in paint coverage are unacceptable and shall be rejected.

4.3.7 Inspection of Verifilm (overlay).

4.3.7.1 Inspect the Verifilm visually and dimensionally.

4.3.7.1.1 An acceptable prefit will indicate the following:

(a) Metal-to-Core Bondlines - A noticeable pattern of all core cells in the Verifilm except in core areas which are crushed or located under detail flanges. (Approximate values of plus 0.010 to minus 0.005 inches in depth.)

(b) Metal-to-Metal Bondlines - A maximum thickness of 0.015 inches including the nylon film where one ply of Verifilm is used.

4.3.7.2 Unacceptable indications on the Verifilm shall be rejected.

(a) Very light colored areas indicate high pressure points. Detail part dimensional changes should be made to alleviate this condition.

(b) Very dark, thick, "porous" areas indicate poor fit. Corrective action should be taken to alleviate this condition also.

4.3.8 Inspection of chemically milled details and skins.

4.3.8.1 Inspect chemically milled details and skins visually and dimensionally to the applicable Engineering drawing. Pay particular attention to detail and skin thickness in the chemical milled radii for compliance to minimum thickness requirements of the applicable Engineering drawing.

4.3.8.2 Visually and/or dimensionally unacceptable chemically milled details and skins shall be rejected.

4.4 Inspection of assemblies.

4.4.1 Minimum requirements.

4.4.1.1 Each assembly shall be visually examined per 4.5.2.

4.4.1.2 Assemblies shall be radiographically inspected per 4.5.1 and Table I.

4.4.1.3 There shall be 100% nondestructive inspection of bonded areas other than core per Table I.

4.4.1.4 Each inspected panel's core bonds shall be spot checked by ultrasonic testing (see 4.5.3.1), radiography (see 4.5.1) or tapping (see 4.5.3.2) as required by this document or applicable Engineering drawings. See Table I for frequency of inspection.

4.4.1.5 Each assembly shall be tested for hermetic sealing by performing the leak test specified in 4.5.4.

4.4.1.6 Where required by the applicable Engineering drawing, each assembly shall be checked for weight and balance.

4.4.1.7 Each assembly shall be dimensionally checked to the requirements of the applicable Engineering drawing.

4.4.1.7.1 Part dimensions shall be checked at cross section of parts, at core steps, closeouts and where section lines are shown on the applicable Engineering drawing. If destruction of the part is required to check these dimensions, Nondestructive Inspection of the part and overall dimension checks will be accomplished prior to part destruction.

4.4.1.8 Sampling frequency for NDI testing of the types and

classes of assemblies covered by this specification shall be as specified in Table I.

4.4.1.8.1 Sample size for inspection of bonded assemblies shall be increased as specified in MIL-STD-105 in the event of the finding of an unacceptable defect(s) in the assembly.

4.4.1.9 Repetitive discrepancies. Attention shall be given to quality control destructive and nondestructive testing to prevent repetitive discrepancies. A repetitive discrepancy shall be defined as the same type of discrepant condition occurring in more than three sequentially cured assemblies. Failures from any one test panel shall result in action being taken to correct the cause. A defect which results in an assembly being rejected should result in production of that particular assembly being stopped until the cause is corrected. Every item produced since the last successful test shall be nondestructively inspected. Contractor's Quality Control shall be responsible for initiating action.

4.4.2 Destructive test or overlay (impression prefit).

4.4.2.1 Production assemblies and First articles.

4.4.2.1.1 Production assemblies shall have a destruct test or overlay performed at the sampling frequency specified in Table I or as specified in the engineering data package. The ACO shall select the test item.

4.4.2.1.2 The manufacturer's interpretation of the overlay shall be reviewed with the ACO.

4.4.2.1.3 A dissection sketch shall be prepared and approved by the ACO designating the location and kind of specimen to be taken from the destruct part. The Government reserves the right to inspect and/or dissect any areas or locations.

4.4.2.1.3.1 The kind and number of specimens shall be in accordance with this specification.

4.4.2.1.4 Minimum properties to be tested on destruct tests are as follows (providing the assembly is of sufficient size and geometry). If the Engineering drawings identify additional destruct tests and locations, in addition to the above, then those test identified shall also be performed.

(a) Climbing drum peel (top and bottom skins) in accordance with ASTM D 1781.

(b) Single lap shear in accordance with ASTM D 1002.

(c) Bondline thickness

4.4.2.1.4.1 Minimum specimen requirements values shall be in accordance with this specification unless identified by the Engineering drawing. Refer to the Engineering drawing for the values of the identified additional tests.

4.4.2.1.5 Visually examine the entire assembly for fit of core to edge members and inserts, skin and doublers to core recesses, complete filling of gaps in the core at the ends of doublers and in chemically milled radii, check correlation of nondestructive testing findings, all skin-to-closure, skin-to-doubler, skin-to-insert bonds. Virtually the entire assembly shall be disassembled and examined for discrepancies.

4.4.2.1.6 Retain remains of the destruct assembly including test specimens for _____ (3 years minimum) after completion of contract performance.

4.4.2.2 Qualification assemblies.

4.4.2.2.1 There shall be a qualification assembly for each bond tool and fixture to establish its acceptability and verify adequacy of procedures and tooling.

(a) Each qualification assembly shall be fabricated in accordance with the manufacturing portion (3.4) of this specification.

(b) Each qualification assembly shall be nondestructively inspected per 4.4.1.

(c) Except for inspection fixtures each qualification assembly shall be destructively tested per 4.4.2.

(d) Qualification assemblies shall be dimensionally and visually verified to the Engineering drawing.

4.4.2.2.2 Unacceptable discrepancies found during nondestructive testing and/or destructive testing shall require corrective action and notification of the TRCO. Depending on

the nature and seriousness of the discrepancy, the TRCO shall decide if an additional destruct test and/or overlay is required before production can commence.

4.4.2.2.3 A dissection report shall be prepared containing dissection sketch, process control specimen(s) and destruct part test specimen results, visual and nondestructive testing findings, photographs, X-rays, bondline thickness measurements, check fixture acceptability if applicable and all other pertinent information obtained from destructive testing of the assembly.

4.4.2.2.4 Upon review and based on the acceptability of the contents of the dissection report (See 4.4.2.2.3), the TRCO and the CO shall or shall not authorize the fabrication of the part number per 1.1.1 on the qualified bond fixture (3.2.7.5).

4.4.2.2.5 Retain the remains of the qualification assembly including test specimens for _____ per 4.3.1.

4.5 Inspection test procedures.

4.5.1 Radiographic nondestructive inspection.

4.5.1.1 Conduct radiographic nondestructive inspection per the supplier's approved procedure and Table I for the following applicable areas:

(a) Core splices.

(b) Core shear tie to closure members.

(c) Intersection of core and two or more closure members.

(d) All metal-to-metal joints.

(e) All metal-to-reinforced plastic joints.

(f) Voids in all foam joints.

(g) Core-to-spar joint.

(h) Chemically milled lines and exterior details.

(i) Ribbon direction.

(j) Cell size.

(k) Missing/extra parts.

(l) Excessive adhesive.

(m) Improper/incomplete potting.

(n) Wrong materials (metals-density).

(o) Improper part lay-up.

(p) Unauthorized work (vent holes, repairs, etc.).

4.5.1.1.1 Prepare radiographic nondestructive inspection (NDI) procedures with process specifications and standards in accordance with MIL-I-6870. These procedures shall be approved by the TRCO before initial use.

4.5.1.2 Questionable areas. If assemblies are inspected using a fluoroscope, all questionable areas shall be radiographed and a permanent record retained.

EXCEPTION: If excessive leakage is recorded during autoclave bond cycles (see 3.4.9) or is noted during press bonding, the assembly or assemblies shall automatically be 100% radiographically inspected for core or core splice damage. In addition, the assembly or assemblies shall be 100% nondestructively inspected per 4.5.3.

4.5.1.3 Inspection limits/equipment operating procedures.

4.5.1.3.1 Inspection limits for defects detected radiographically shall be as specified on the Engineering drawings and as specified herein.

4.5.1.3.2 Tack rivet shanks left within the assembly are acceptable to the extent permitted in 4.5.1.3.2.1 unless specified otherwise by the TRCO.

4.5.1.3.2.1 Tack rivet shanks left in sandwich panels as a result of replacing tack rivets with permanent rivets are acceptable providing there are not more than two shanks in the

sandwich cavity at any rivet location and at no more than half the rivet locations. The remaining locations shall have not more than one shank per location. All such rivet shanks shall not be left loose in the assembly core. Pot loose shanks with potting compound per 3.3.4.1.7 to prevent movement.

4.5.1.3.3 Only radiographic film Type I per MIL-STD-453, Table I shall be used. Paper in lieu of film is unacceptable. (This does not apply to permanent positives or paper copies made from X-rays.)

4.5.1.3.4 Radiographic equipment operating procedures shall be in accordance with the equipment manufacturer's instructions and the supplier's approved procedure per 4.5.1.1.1.

4.5.1.4 Rejection procedures.

4.5.1.4.1 Assemblies containing discrepancies (defects) exceeding those permitted by this specification or the applicable engineering drawing shall be rejected.

4.5.1.4.2 Request for waivers shall be submitted to the TRCO.

4.5.2 Visual and dimensional inspection.

4.5.2.1 Each assembly shall be visually examined for uniformity of surface, continuity of adhesive flash around edges, dents, scratches, excessive mark-off, to assure quality of appearance. Each assembly shall be inspected for excessive slippage of details during bonding using Engineering drawing tolerances.

NOTE: Slippage of details during bonding shall not result in excessive corner gaps, angularity of vertical leg of zee members, mislocation of inserts or fittings, etc.

4.5.2.2 Each assembly shall be checked dimensionally and to the contours required by the applicable Engineering drawing.

4.5.2.2.1 Check fixture tools that are qualified per 4.2.3 shall be used as necessary.

4.5.2.3 Each assembly shall be closely examined for unsealed openings into the interior of the core area of the assembly. If such openings are found, the assembly shall be rejected.

All other openings shall be filled with the exterior sealant compound (see 3.4.10.1).

NOTE: The leak test (see 4.5.4) shall be accomplished after sealing.

4.5.2.4 Each assembly shall be visually examined for other discrepancies as may be required by this specification and the applicable engineering drawing.

4.5.3 Bondline nondestructive inspection tests.

4.5.3.1 Ultrasonic inspection.

4.5.3.1.1 Prepare ultrasonic inspection procedures including accept/reject limits with process specifications and standards in accordance with MIL-I-6870. These procedures shall be approved by the TRCO before initial use.

4.5.3.1.2 Assemblies shall be ultrasonically inspected for substandard bond conditions such as voids, disbonds (delaminations) and excessive bondline porosity per Table I.

4.5.3.2 Tap test.

4.5.3.2.1 In areas where test methods such as radiography and ultrasonics are not applicable, a tapping (sonic) technique shall be used to assure that a void does not exist. (See Table I). The tapping technique and areas to be so inspected must be approved by the TRCO.

4.5.3.3 Areas not inspectable.

4.5.3.3.1 If an area of an assembly cannot be inspected, the contractor shall notify the TRCO for disposition and direction.

4.5.3.4 Inspection requirements.

4.5.3.4.1 Equipment. Ultrasonic equipment shall be approved for use by the TRCO, when no ultrasonic equipment is identified by the applicable Engineering drawings, or equipment so identified is not available.

4.5.3.4.2 Instruments and settings. The instruments, standards and settings for ultrasonic inspections of bonded

assemblies shall be as specified in the contractor's approved procedure. Waivers shall be processed through the CO.

4.5.3.4.3 Test methods. Ultrasonic test methods shall be in accordance with the contractor's approved procedure and appropriate standards per 4.5.3.1. Waivers shall be processed through the CO.

4.5.3.4.4 Limits. Limits for acceptance and rejection of discrepancies detected ultrasonically (or by tapping, if applicable), shall be as specified by the TRCO, and this document.

4.5.3.5 Rejection procedures. Assemblies containing discrepancies (defects) exceeding those permitted by this specification (4.5.3.4.4) or the applicable engineering drawing shall be rejected. The rejection document shall be dispositioned by the TRCO.

4.5.3.5.1 Request for waivers may be submitted to the TRCO.

4.5.4 Leak test.

4.5.4.1 Each final assembly shall be leak tested after fastener installation, sealing per 3.4.10.1, visual inspection per 4.5.2, and authorized rework.

4.5.4.2 Procedure.

4.5.4.2.1 Perform the leak test in a suitably sized metal tank that is equipped with a device for lowering and raising parts into and out of the heated water. The device shall have provisions for holding the assemblies securely because all bonded honeycomb panels tend to float.

4.5.4.2.2 Perform leak check by submerging the assembly into 170°F +/- 10°F, clean water for 1 to 2 minutes. Observe the assembly for air bubbles escaping along bond joints which indicate leakage. Mark leaking areas under water. Remove the assembly from the hot water and dry immediately by wiping with cheesecloth or other clean, absorbent material.

CAUTION: 170°F water will cause burns. Wipe water quickly from leak to prevent it from being drawn into the assembly as the part cools.

4.5.4.2.3 After the leak test has been successfully complied

with, the bondlines shall be sealed.

4.5.4.3 Rejection procedure.

4.5.4.3.1 Any assembly that exhibits leaks in the bondlines shall be rejected. Any assembly that exhibits leaks in sealed areas shall be reworked and retested per 4.5.4.4.

NOTE: All air bubbles are not necessarily leaks. Entrapped air on the exterior of the assembly may appear as a leak. In addition, leaks are not always at the point of sighting of the air bubbles because the bubbles can travel along the part surface before coming to the surface of the water.

4.5.4.4 Repair and releak test (Non-bondline).

4.5.4.4.1 Repair of a leaking assembly shall be repaired by resealing only the non-bond joint areas per 3.4.10.1. After the sealant has been properly cured, releak test per 4.5.4. This process of leak testing, repairing the non-bond joint areas and releak testing shall continue until the assembly passes the leak test.

4.6 Evaluation of material qualification, quality control (process control), and cleaning control test panels.

4.6.1 Material qualification (and requalification) test panels, Quality Control/(Process Control) test panels fabricated with each assembly or group of assemblies, as applicable, and cleaning control test panels shall be properly identified, and handled and stored to prevent damage.

4.6.2 The material qualification, quality control test panels and cleaning control test panels shall be carefully cut into the type, number and size of specimens as specified herein.

4.6.3 Testing. Test each specimen to failure in accordance with the procedures specified herein for the specimen.

4.6.4 The acceptance/rejection limits shall be as specified herein or in other documents specified herein.

4.6.5 Rejection procedures.

4.6.5.1 The results of each test specimen shall equal or exceed the minimum acceptable values listed in this specification or in other documents specified herein.

4.6.5.2 If examination of a specimen which fails reveals failure due to machining, drilling, testing and/or similar cause not associated with adhesive or bonding quality, a retest may be made. If the retest values are acceptable, the test panel shall be dispositioned acceptable.

4.6.5.3 Failure of the original test and retest (if applicable) results of the material qualification panel to meet any minimum allowable values shall cause the entire lot of material to be rejected. Failure of the original test and retest (if applicable) results of the process control panel to meet the minimum acceptable values shall cause rejection of the assembly or group of assemblies it represents. Failure of the original test and retests (if applicable) results of the cleaning control panel to meet the minimum acceptable values specified herein shall result in the stoppage of cleaning of details in that process line until corrective action has been taken. Cleaning control test panels must be remade and tested until acceptable values are obtained.

4.6.5.4 Rejection of the material or assembly or group of assemblies shall be appropriately documented.

4.6.5.6 The rejection document shall be retained per 4.3.1. A copy of the document shall be sent to the TRCO and the ACO.

4.6.5.6.1 Before dispositioning the rejection document, the following actions shall be taken, as deemed necessary by the contractor and the TRCO.

(a) Investigate failure of the test panel.

(b) If applicable test a production part assembled from detail parts of the last processing batch prior to the failure by:

(1) performing additional nondestructive inspection.

(2) destructive testing per 4.4.2.

(c) Conducting other tests or taking other actions specified by the contractor or the TRCO.

4.6.5.6.2 Based on the recommendations and contacts of the disposition document, a decision shall be made by both the ACO and the TRCO to accept or reject the production assembly(ies) containing materials and/or parts processed since the last acceptable test or inspection. Corrective action and/or "get well" procedures shall be proposed by the contractor in the disposition document to prevent recurrence of the failure.

4.6.5.6.3 The ACO must approve the disposition document before production resumes.

4.6.6 Disposition of specimens.

4.6.6.1 All quality assurance specimens (tested and untested) which fail to meet the requirements of this specification, including remains from destructive testing, if applicable, shall be retained by the contractor until disposition per 4.6.5 has been made and carried out on all materials or all parts (assemblies) represented by the specimens.

4.7 Inspections of quality control.

4.7.1 The contractor shall establish a quality control program to meet the requirements of this specification in accordance with MIL-I-45208 and paragraphs 3.3 and 3.4 of MIL-Q-9858.

4.7.2 Inspections of quality control shall be made by the contractor during each step of the manufacturing process which include but is not limited to:

4.7.2.1 Check all facilities and equipment. (See 3.2).

4.7.2.2 Adhesives' acceptability. (See 3.4.2.1).

4.7.2.3 Storage of materials. (See 3.4.2).

4.7.2.4 Adhesives' release to production. (See 3.4.2.1).

4.7.2.5 Visual and dimensional inspection of honeycomb core (3.4.3.2.15) and details. (See 3.4.3.1.7).

4.7.2.6 Storage and handling of honeycomb core (See 3.4.2.2) and details (see 3.4.2.3).

4.7.2.7 Prefit of assemblies and control specimens. (See 3.4.4).

4.7.2.8 Surface preparation for adhesive bonding. (See 3.4.5).

(a) Cleaning.

(b) Monitoring of solutions; control specimen tests and routine chemical analysis of solutions.

(c) Racking of part details.

(d) Water-break test.

(e) Time and temperature records of oven dried material (bare core, primer, potted core, etc.).

(f) Machining of honeycomb core.

(g) Removal of core rigidizing materials.

(h) Elapsed time from clean to prime.

(i) Primer thickness (dried).

(j) Presence and amount of oil and water in compressed air used for primer application.

4.7.2.9 Adhesive application. (See 3.4.6).

(a) Elapsed time from prime to adhesive application.

(b) Elapsed time from adhesive application to cure.

4.7.2.10 Bond fixtures. (See 3.2.7).

(a) Heat surveys

(b) Thermocouples

(c) Cleanliness

4.7.2.11 Cure cycle. (See 3.4.8).

(a) Time vs. temperature and pressure.

(b) Pressure build-up under the bag.

(c) Abort procedures.

4.7.2.12 Dimensional and visual examination of bonded assemblies. (See 3.4.8.6).

4.7.2.13 Sealing. (See 3.4.10.1 and 3.4.10.4).

4.7.2.14 Leak test. (See 3.4.10.2).

4.7.2.15 Material and process control tests. (See 3.4.6).

4.7.2.16 Nondestructive inspection of bonded assemblies. (See 3.4.10.3).

4.7.2.17 Destructive testing of bonded assemblies. (See 4.4)

4.7.2.18 Finishing of completed assemblies. (See 3.4.10.4).

4.7.2.19 Specimen retention. (See 3.4.11).

4.7.2.20 Packaging for shipment of finished assemblies. (See 3.4.12).

4.7.2.21 Documents retention. (See 3.4.13).

4.7.3 If there is a nonconformance to the requirements of this specification, the contractor's Quality Control Dept. shall comply with the procedures on Quality Control deficiencies in MIL-I-45208 and consult with other appropriate departments to resolve the nonconformance. Consultation with the ACO and TRCO may also be appropriate.

4.7.4 The government reserves the right to observe any and/or all inspection(s)/procedure(s) to determine adequacy of Quality Assurance in determining that all assemblies comply with the applicable Engineering drawing and this specification.

4.8 Special inspection procedures.

4.8.1 For part number specified in 1.1.1, the following additional and special inspection procedures are applicable:

(a) Nondestructive inspections per _____.

(b) Dissection schedule per _____.

(c) Any of the above as called out in the applicable engineering drawings and this specification.

(d) Any additional as deemed necessary by the ACO or TRCO.

4.9 Reinspection. Reinspection of assemblies is to be accomplished after last rework is completed and prior to final assembly procedures of sealing and application of corrosion protection. Reinspection will consist of evaluating information from all tests and inspections to determine that the production article meets all requirements as specified herein.

4.10 Final Inspection. Final inspection of assemblies is required to ensure that each assembly complies with requirements of this specification and all applicable engineering drawings. Final inspection shall consist of any additional inspection or test deemed necessary to ensure full compliance with this specification.

5. PACKAGING

5.1 Preservation packaging. Preservation-packaging shall be in accordance with contractual requirements.

5.1.1 Packaging. Packaging shall be in accordance with contractual requirements.

5.2 Packing. Packing shall be in accordance with contractual requirements.

5.2.1 Bonded assemblies shall be packed to assure carrier acceptance and safe delivery to destination at lowest rating in conformance to the requirements of Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable.

5.3 Marking.

5.3.1 Marking of the assemblies shall be per drawing requirements. Marking may be in accordance with MIL-STD-130 upon written approval from the CO.

5.3.2 Marking of the packaging shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. It is intended that the requirements of this document be mandatory requirements for use by suppliers (contractors) to assure the quality of adhesive bonded honeycomb assemblies used in aerospace systems. Structural adhesive bonding is a critical process that must be properly controlled to achieve the benefits in lighter weight, lower cost, and fatigue improvement not obtainable in other types of construction.

6.1.1 Classification. Adhesive bonded honeycomb assemblies covered by this specification are of the following types, classes, and pressure application:

Type I - Primary structure.

Type II - Secondary structure.

Class 1 - For long time (192 hours) exposure to 180 ^{o}F.

Class 2 - For long time (192 hours) exposure to 250 ^{o}F.

Class 3 - For long time (192 hours) exposure to 350 ^{o}F.

Class 4 - For limited (3 hours) exposure to 420 ^{o}F. (Note: Class 4 applies to F-15 honeycomb assemblies only).

Pressure Application:

A. Autoclave
B. Platen Press
C. Cavity Press
D. Vacuum Bag Only
E. Not Specified

6.2 Acquisition Requirements

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

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

(b) Honeycomb assembly part noun and number, national stock number, Federal Stock Class, and Engineering Drawing title, Drafter of the drawing, and number if different from the previous data (1.1, 6.2.2).

(c) Classification of this part to this specification by type Class and Pressure Application (1.2, 6.2.2).

(d) Materials required for manufacture of the honeycomb assembly. (See 6.2.2).

(e) Where the first production article should be sent, if required, and the agency designated to perform tests.

(f) Levels of packaging and packing required (See 5).

(g) Special marking, if required.

(h) Special preparation for delivery requirements, if applicable.

(i) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).

6.2.2 Additional Acquisition Requirements. All information required to complete this document is outlined on the chart in Table V. The chart is required to be completed by the TRCO prior to using this specification for acquisition of honeycomb spares in accordance with 6.2.1(d). The contractor will be responsible for using this table to fill in the blanks provided throughout this document. (See 6.6). A check-mark or an "X" in the blank of the first column indicates that particular parameter applies to the assembly of 1.1.1.

6.3 Qualification.

6.3.1 With respect to products qualification to this specification, awards will be made only for Products which are, at the time set for award of contract, qualified for inclusion in Qualified Products List (QPL-H-87990) 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is SA-ALC/MMETE Kelly AFB, TX 78241-5000, and information pertaining to qualification of Bidders may be obtained from that activity.

6.4 Definitions.

6.4.1 See Table VI for definitions.

6.5 Applicable paragraphs to the Contracting Officer or the Technical Representative to the Contracting Officer.

6.5.1 The following is a list of paragraphs requiring action and/or approval by the CO, ACO, or TRCO.

1.4	3.4.8.3.5	4.4.2.2.4	4.5.3.5.1
1.7	4.2.3.1	4.5.1.1.1	4.6.5.6
2.1.1	4.2.3.2	4.5.1.3.2	4.6.5.6.1
2.3	4.2.3.3	4.5.1.4.2	4.6.5.6.1(c)
3.1.1.2	4.2.3.4	4.5.3.1.1	4.6.5.6.2
3.2.3.7	4.3.2.1.3	4.5.3.2.1	4.6.5.6.3
3.3.1.4	4.4.2.1.1	4.5.3.3.1	4.7.3
3.3.5	4.4.2.1.2	4.5.3.4.1	4.8.1
3.4.2.1.1 (j)	4.4.2.1.3	4.5.3.4.4	6.2.1
3.4.3.2.7.1	4.4.2.2.2	4.5.3.5	

6.6 Paragraphs requiring filling-in of blanks.

6.6.1 The following is a list of paragraphs requiring filling-in of blanks with information applicable to a specific assembly. Use the chart outlined in 6.2.2.

1.1.1	3.3.4.1.4	3.4.2.1.1	4.4.2.1.6
1.2.1.1	3.3.4.1.5	3.4.3.2.12.6	4.4.2.2.5
3.3.1.1	3.3.4.1.6	3.4.6.1.1	4.8.1
3.3.2.1	3.3.4.1.7	3.4.8.1	6.2.2
3.3.4.1.1	3.3.4.1.7.1	3.4.8.1.1	Table I
3.3.4.1.1.1	3.3.4.1.8	3.4.8.1.3	Table II
3.3.4.1.2	3.3.4.1.8.1	3.4.8.1.4	Table III
3.3.4.1.3	3.3.4.1.10	3.4.10.4.1	Table IV
3.3.4.1.3.1	3.3.4.1.11	4.3.6.1	

6.7 Subject Terms (keywords) Listing.

Applicable Documents
Qualification
Materials
Consumable Materials
Honeycomb Core Rework
Inspection Limits
Surface Preparation
Cure Cycle Malfunction
Specimen Retention
Document Retention
Packaging

TABLE I. Inspection sampling frequency

Type and Class	Destruct or Overlay	Nondestructive inspection						
		Visual	Dimensions	Leak Test	RT	UT	Tap	Weight/ Balance
I,1	A	C	C	C	C	C	E	F
I,2	A	C	C	C	C	C	E	F
I,3	A	C	C	C	C	C	E	F
I,4	A	C	C	C	C	C	E	F
II,1	B	C	C	C	D	D	E	F
II,2	B	C	C	C	D	D	E	F
II,3	B	C	C	C	D	D	E	F
II,4	B	C	C	C	D	D	E	F

RT - Radiographic testing

UT - Ultrasonic testing

A - Destruct first part (qualification). Overlay or destruct every 25th part thereafter. (See 4.4.1.1 and 4.4.2.1.2).

B - Destruct first part (qualification), overlay or destruct every 50th part thereafter. (See 4.4.2.1.1).

C - Each part

D - Qualification part and every 5th part thereafter.

E - Areas where RT and UT are not applicable, of parts requiring RT and UT.

F - Each part when specified on the applicable Engineering drawing.

TABLE II: Cleaning control test specimens

Process for Cleaning	Type of Test Specimen	Test Specimen Material	Thickness of Material (Inches)	Adhesive Primer	Film Adhesive	Minimum Strength	
						Individual (psi)	Average + Maximum Variation (psi)
Aluminum	Tensile Shear	7075-T6 bare or 2024-T3 bare	0.063				
Titanium	Tensile Shear	Ti-6Al-4V	0.020 to 0.045				
Corrosion Resistant Steel	Tensile Shear	17-7PH or 301/302 Series	0.020 to 0.045				

NOTES:

(1) Cleaning control test specimens for the applicable cleaning process shall be made and tested at least once per week, or any time the cleaning process/solutions is suspect.

(2) Test panel/specimen configuration shall be per ASTM D 1002.

(3) At least 5 specimens shall be made for each process being controlled.

(4) Cure cycle shall be as specified for the type of adhesive system.

(5) All specimens shall be tested at room temperature per ASTM D 1002.

(6) Each specimen shall meet minimum strength requirement specified above.

TABLE III: Process control test specimens

Metal Being Bonded	Type of Test Specimen	Test Specimen Material	Material Thickness (inches)	Number of Specimens	Adhesive System Primer / Film	Test Temp. °F	Minimum Specimen Strength (psi) Individual	Average
Aluminum	Tensile Shear	7075-T6 bare or 2024-T3 bare	0.063	10		Room Temp and ___°F		
	Climbing Drum Peel	Skins: 7075-T6 bare or 2024-T3 bare Core: 7.9-1/4-40N 5052 (MIL-C-7438)	Skins 0.020 Core 0.500 or 0.625	3		Room Temp		
Titanium	Tensile Shear	Ti-6Al-4V	0.020 to 0.045	10		RT and ___°F		
Corrosion Resistant Steel	Tensile Shear	17-7PH or 301/302 Series	0.020 to 0.045	10		RT and ___°F		

NOTES: (1) Tensile (single lap) shear panels/specimens shall be made and tested per ASTM D 1002 except as specified.

(2) Climbing drum peel specimens shall be made and tested per ASTM D 1781.

(3) When elevated temperature testing is required, test one half of total number of specimens prepared at room temperature (RT) and the other half at the specified elevated temperature.

(4) Each specimen shall meet the applicable minimum strength requirement specified above.

TABLE IV: Cleaning Control Test Specimens[1]

Process for Cleaning	Type of Test Specimen	Test Mat'l and Thickness (Inches)	Test Environment Number per ASTM D 3762	Type of Adh Primer and Film Adhesive	Time Interval (hours)	Max. Crack Extension (Inches)	
						Individual a	Average a
Aluminum	Class 1		7		1	0.20	0.20
	Class 2		8		1	0.20	0.20
	Class 3		9		1	0.20	0.20
	Class 4						

NOTE 1: All tests and coupons to be accomplished in accordance with ASTM D 3762.

Table V: Acquisition Requirements.
Information for filling in blanks.

APPLY TO THIS ASSBLY (Y/N)	PARAGRAPH REFERENCE	INFORMATION TO FILL IN THE BLANKS	COMMENTS/NOTES	
	1.1.1	ASSEMBLY DESIGNATION Part No. _____ Noun _____ FSC/NSN _____ Engr Drawing Title and No. _____ _____ _____		
	1.2.1.1	ASSEMBLY CLASSIFICATION Type _____ Class _____		
	3.3.1.1	HONEYCOMB CORE DESIGNATION(S) Type _____ Class _____ _____ or: Cell Size _____ Alloy _____ Nominal Foil Thickness _____ Nominal Density _____ If more than one type is specified, then: Type _____ Class _____ _____ or: Cell Size _____ Alloy _____ Nominal Foil Thickness _____ Nominal Density _____ Type _____ Class _____		

Table V (con't)

		or: Cell Size _____ Alloy _____ Nominal Foil Thickness _____ Nominal Density _____		
	3.3.2.1	SKINS Alloy_____ Temper_____ Thickness _____ Conformance Specification _____		
	3.3.4.1.1	ADHESIVE PRIMER Part No._____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Inspection Specification _____		
	3.3.4.1.1.1	SHEAR TEST No. of Specimens _____ Temperature _____°F Time _____(minutes) Minimum Strength (psi) _____ CLIMBING DRUM TEST Minimum Average Peel Strength (in-lb/3 in) _____		
	3.3.4.1.2	ADHESIVE FILM Part No. _____ Noun _____ FSC/NSN _____ Other Applications _____ Qualifying Specification _____ Film Thickness or Weight _____		

Table V (con't)

	3.3.4.1.3	FOAM ADHESIVE Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Foam Thickness or Weight _____ Receiving Inspection Spec. _____		
	3.3.4.1.3.1	OTHER FOAM CHARACTERISTICS Expansion Ratio _____:_____ Density Range ___to____lb/cu ft BEAM SHEAR Other Temperature _____°F Time _____(minutes) Minimum Shear Strength _____ _____ lb/in² @ Room Temp Minimum Shear Strength(Other) _____ lb/in² @ ____°F		
	3.3.4.1.4	STIFFENING (POUR) ADHESIVE Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Inspection Specification _____ Tensile Strength _____		
	3.3.4.1.5	STABILIZING ADHESIVE Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Inspection Specification _____ Tensile Strength _____		

Table V (con't)

	3.3.4.1.6	Rigidizing Adhesive Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Inspection Specification _____ Tensile Strength _____		
	3.3.4.1.7	POTTING COMPOUND Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Density _____ Compression Strength _____ Receiving Inspection Spec _____		
	3.3.4.1.7.1	OTHER POTTING COMPOUND CHARACTERISTICS Test Specification _____ Density Range _____ to _____ Compression Strength _____ Flow _____ Cure Temp (°F) _____ Cure Time (minutes) _____		
	3.3.4.1.8	SEALANT Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Receiving Inspection Spec _____		

Table V (con't)

	3.3.4.1.8.1	SEALANT TESTS No. of Specimens _____ Test Specimen: Materials _____ Thickness _____ Qualifying Specification _____ Minimum Test Values _____ _____		
	3.3.4.1.10	SECONDARY BONDING ADHESIVE Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Receiving Inspection Spec _____		
	3.3.4.1.11	OTHER MATERIALS Part No. _____ Noun _____ FSC/NSN _____ Qualifying Specification _____ Receiving Inspection Spec _____		
	3.3.5	CONSUMABLE MATERIALS APPROVED ALTERNATES _____ _____ _____ _____ _____		
	3.4.2.1.1 (a)	STORAGE Adhesive Primer Temperature _____(0°F or lower) (35 to 50°F) or (Room Temp)[1] Allowable time out of storage temperature _____		

Table V (con't)

	(b)	Film Adhesive Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(c)	Foam Adhesive Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(d)	Stiffening (Pour) Adhesive Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(e)	Stabilizing Material Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(f)	Rigidizing Adhesive Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(g)	Potting Compound Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(h)	Sealant Temperature _____(Ø°F or lower) (35 to 5Ø°F) or (Room Temp)[1] Allowable time out of storage temperature _____		

Table V (con't)

	(i)	Secondary Bonding Adhesive Temperature _____(ØºF or lower) (35 to 5ØºF) or (Room Temp)[1] Allowable time out of storage temperature _____		
	(j)	Other Material Temperature _____(ØºF or lower) (35 to 5ØºF) or (Room Temp)[1] Allowable time out of storage temperature _____		
	3.4.3.2.12.6	SPLICING ALUMINUM HONEYCOMB CORE Cure Time (minutes) _____ Cure Temp (ºF) _____		
	3.4.6.1.1	ADHESIVE PRIMER Thickness (Dry) _____inches		
	3.4.8.1	CURING THE ASSEMBLY Time _____ Temperature _____ Pressure _____ Heat-up Rate _____ Equipment _____		
	3.4.8.1.1	CURING Use a _____ for applying pressure.		
	3.4.8.13	RAMP DOWN _____ _____		
	3.4.8.4.4	SECONDARY BONDING CURE CYCLE Temperature _____ Time _____ Pressure _____ Equipment _____		

Table V (con't)

	3.4.10.4.1	FINISH SYSTEM Specification/Code _____ _____ Pretreatment _____ Primer _____ Topcoat _____		
	4.3.1.1(m)	ADDITIONAL REQUIRED DOCUMENTATION _____ _____		
	4.3.6.1	INSPECTION OF PRIMER Inspect every _____ sq. in.		
	4.4.2.1.7	RETAIN DESTRUCT ASSEMBLY Time _____(3 years)[1]		
	4.4.2.2.5	RETAIN QUALIFYING ASSEMBLY Time _____(3 years after close of contract)[1]		
	4.8.1	SPECIAL INSPECTIONS NDI _____ _____ _____ DISSECTION _____ _____ _____		
	TABLE I	VARIATIONS_____ _____ _____ _____ _____		
	TABLE II	MINIMUM STRENGTH (psi) Aluminum _____ Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____		

Table V (con't)

		Titanium Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Corrosion Resistant Steel Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ VARIATIONS _____ _____ _____ _____		
	TABLE III	MINIMUM STRENGTH (psi) <u>Aluminum</u> Tensile (Room Temp) _____ (@____°F) Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Climbing Drum Peel Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ <u>Titanium</u> Tensile (Room Temp) _____ (@____°F) _____ Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ <u>Corrosion Resistant Steel</u> Tensile (Room Temp) _____ (@____°F) _____ Type of Adhesive Primer (3.3.4.1.1) _____		

Table V (con't)

		Type of Film Adhesive (3.3.4.1.2) _____ VARIATIONS _____ _____ _____ _____ _____		
	TABLE IV	CLASS 1 (150°F) Test Environment Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Time Interval _____ Maximum Crack Extension _____ Individual (inches) _____ Average _____		
		CLASS 2 (250°F) Test Environment (8)[1] _____ Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Time Interval (1 hour)[1] _____ Maximum Crack Extension Individual (inches) (.75)[1] ___ Average (.25)[1] _____		
		CLASS 3 (350°F) Test Environment (9)[1] _____ Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Time Interval (1)[1] _____ Maximum Crack Extension Individual (inches) (.75)[1] ___ Average (.25)[1] _____		

Table V (con't)

		CLASS 4 (420°F) Test Environment _____ Type of Adhesive Primer (3.3.4.1.1) _____ Type of Film Adhesive (3.3.4.1.2) _____ Time Interval _____ Maximum Crack Extension Individual (inches) _____ Average _____ VARIATIONS _____ _____ _____ _____ _____ _____ _____		

[1] NOTE: Recommended values.

TABLE VI: Definitions

Accuracy - The degree of conformity of a measured or calculated value to some recognized standard or specified value. Accuracy involves the systematic error of an operation.

Adherend - An object bonded or to be bonded to another object by an adhesive.

Adhesion - The property denoting the ability of a material to resist delamination or separation into two or more layers.

Adhesive - A substance capable of holding two materials together by adhesion. In this specification, the term is used specifically to designate structural adhesives, those which produce attachments capable of transmitting significant structural loads.

Adhesive failure - Delamination due to separation between the adhesive and the adherend interface.

Adhesive flash - Accumulation of adhesive at the edge of the bond line caused by flow of adhesive during cure cycle. This is also called squeeze-out.

Autoclave - A closed vessel for producing an environment of fluid pressure, with or without elevated temperatures, to an enclosed object which is undergoing a chemical reaction, such as curing, or other operation, such as consolidation.

Autoclave molding - A process similar to the pressure bag technique. The lay-up is covered by a pressure bag, and the entire assembly is placed in an autoclave capable of providing heat and pressure for curing the part. The pressure bag is normally vented to the outside.

Bag molding - A method of molding or laminating which involves the application of fluid pressure to a flexible material which transmits the pressure to the material being bonded or molded. Fluid pressure usually is applied by means of air, steam, water or vacuum.

Blown core - A term used to describe the structural deterioration of the core as a result of local over-pressurization (usually due to bag leaks or water/solvents brought to high temperatures) resulting in either misformed cell walls or misformed cells with node separation.

Table VI (con't)

Bond - The adhesion of one surface to another by welding, brazing, or adhesive. For this specification, bonding refers to the use of adhesives. See Joint.

Bondline - A layer of adhesive such as one located between two pieces of metal or between a metal face and honeycomb core.

Bond line temperature - Actual temperature measurement in the bond line or in the adhesive flash (squeeze-out) immediately adjacent to the bond line.

Buckled core - Columnar failure of core cell wall(s). See Figure 4.

Cell - The defined shape of the solid portion of the core of honeycomb structure which completely surrounds a specific air space.

Cell alignment defects - Undesired characteristics of honeycomb core.

Cell size - The distance between ribbons of corrugated core or expanded core. See Figure 2.

Cohesive failure - Delamination due to the adhesive itself failing.

Composite part - A complex part in which two or more distinct, structurally complementary details are combined to produce some structural or functional properties not present in any individual component.

Compressed core - Buckling of core. Compressed core can sometimes be considered a controlled deformation to better conform the core material to the assembly configuration. See Figure 5.

Condensed core - Collapse or deformation of core material in the W direction. Note that condensed core does not always occur at edge members. See Figure 6.

Consolidation - The process of compacting detail layers through elimination of trapped air. See Debulk.

Table VI (con't)

Contaminants - Any form of release agents, lubricants, natural skin oils, perspiration, protective creams, dirt, dust, chips, powder, condensate, or any other material found to impair or otherwise prevent the formation of, or reduce the strength of an adhesive bond.

Core - The central member of a sandwich construction to which the faces of the sandwich assembly are bonded. It is made of a lightweight natural, synthetic, or fabricated material. It separates the facings and supports them against permanent deformation under stress.

Core deformation - A permanent distortion of core shape in any orthotropic core direction. Compare Crushed core, Condensed core, Compressed core.

Core splice - See Splice.

Corrosion - A breakdown of the metal surface due to an electrochemical reaction. Almost all metals are subject to corrosion. Corrosion may be present in parts exposed to water and moisture, in parts without protective coatings and in parts where dissimilar metals come into electrical contact.

Couplant - An acoustic couplant is a film of oil, grease, or water applied to a surface. This is to provide a path for the passage of sonic energy between a sound transmitter and a part surface for Nondestructive Inspection.

Crack - A break or split in the part without complete separation. Cracks may be found in parts which have been ground, heat-treated, fatigued, or stress-corroded.

Crushed core - Collapse or deformation of core material in the L direction. See Figure 7. Note that crushed core does not always occur at edge members.

Cure - To permanently change the properties of a chemical system (i.e. adhesive) by applying heat and pressure. This is a nonreversible process.

Cure cycle - The process of curing an assembly by a controlled increase in temperature and pressure followed by one or more dwell time periods then a controlled decreased of temperature and pressure. Uncontrolled cure processes lead to incomplete

Table VI (con't)

adhesive cures, part shifting in bond tools and blown or deformed core.

Debond - See Disbond.

Debulk - A process to remove the air and compress the assembly details prior to curing by the application of vacuum under a vacuum bag or by using autoclave pressure.

Defect - A discontinuity or fault that is detrimental to the serviceability of the part or material in which it is contained.

Deformation - The change in shape of a specimen caused by the application of a load or force.

Degradation - An undesirable change in material properties.

Delamination - The separation of layers in an assembly because of failure of the adhesive, either as a cohesive failure or as an adhesive failure.

Deviation - Variation from a specified dimension or requirement, usually defining the upper and lower limits.

Disbond - Lack of a bond in a joint area between two separate details resulting from improper fit of details, failure of the adhesive bond, or contamination of one or more of the bonded surfaces.

Discontinuity - An interruption in the normal physical structure of a part. It may be in the form of a crack, forging lap, seam porosity, disbond, etc.

Distorted core - Distorted core may occur during the manufacture of honeycomb core or part assembly. Distortion is either in the L or W direction of the core.

Double foil - A double foil is caused by misplaced adhesive between ribbons. This condition is a manufacturing defect that occurs only during the manufacture of the HOBE (Honeycomb Before Expansion). A double foil is detected only after core is expanded. See Figure 8.

Table VI (con't)

Drape - Ability of adhesives or other materials to conform to an irregular shape.

Dwell time - A period of a process in which process parameters are held constant, e.g. time, temperature, pressure.

Edge member - The configuration of the edge of a sandwich construction where face sheets are formed to close upon each other or solid members are added to the panel edge.

Edgewise - Describes the application of forces in directions parallel and actually in the plane of a sheet of sandwich.

Face sheets - The high density material on both sides of the core materials of the sandwich construction.

Face-to-Core voids - Voids are areas in which adhesive is not present or the distance between the face and the core was greater than the adhesive thickness causing inadequate adhesive contact. See Disbond.

FEP - A type of Teflon film used as a parting agent (non-adhesive) or as a release layer.

Filler - A substance added to an adhesive to improve or alter its working properties, permanence, viscosity, strength, or other qualities.

Finishes - A general term which includes surface treatments, plating, organic finishes (primers and topcoats), corrosion preventive compounds, or any other coating material designed to protect a surface.

Finish system - Constitutes a combination of a surface treatment or plating and organic finishes for protection of a surface.

Flatwise - Describes the application of forces in a direction normal to the plane of the sandwich structure. Flatwise compression and flatwise tension designate forces applied to compress the sandwich core and to pull the facings from the core, respectively. Flatwise flexure designates bending so as to produce curvature of the plane of a sheet of sandwich.

Film adhesive - Adhesives, usually available as one-part

Table VI (con't)

systems, supplied in thin sheets. Adhesive films are either supported by scrim cloth or backing, or unsupported by reinforcement.

Foam adhesive - Adhesive, usually available as one-part systems, supplied in thin sheets. This type of adhesive expands to several times its original thickness upon application of cure temperature and pressure. This adhesive is used to bond core to: edge members, inserts, channels, etc. where a film adhesive is not suitable for adequate bonding.

Gap - A gap exists when a space is left between parts. See Disbond.

Honeycomb - A term used to identify a type of sandwich construction consisting of a lightweight core of a cellular-type physical configuration (metallic or nonmetallic) to which relatively thin, dense, high-strength or high-stiffness face sheets are adhered.

Humidity, Relative - The ratio of the pressure of water vapor present to the pressure of saturated water vapor at the same temperature.

Inclusion - A physical and mechanical discontinuity occurring within a material or part, usually consisting of impurities embedded in the material in the forming stage. The inclusions can be deep in the part or near the surface.

Interface - The boundary between the individual, physically distinguishable constituents of a part.

Isotropic - Having uniform properties in all directions. The measured properties of an isotropic material are independent of the axis of testing. Compare to Orthotropic.

Joint - The location at which two adherends are bonded together.

L direction - See Orthotropic core direction.

Machined fittings - Parts machined from castings, forgings, bars, extrusions, and heavy plate requiring milling operations for part manufacture.

Table VI (con't)

Mechanical properties - The properties of a material that are associated with elastic and inelastic reaction when force is applied, or the properties involving the relationship between stress and strain.

Metal-to-Metal Voids or Disbonds - Any unbonded areas occurring between two solid, nonporous members that are joined by and adhesive bondline.

Mismatched Nodes - A defect caused by misalignment of the ribbon foil during corrugated core manufacture. See Figure 9.

Nested cells - A nested cell is a core manufacturing defect which occurs only during the corrugated core manufacturing process. Nested cells are due to nodes being misaligned by one-half pitch and the node consequently being bonded to the preceding ribbon. See Figure 10.

Node - That part of the ribbon surface which is bonded to another ribbon during manufacture of core. See Figure 2.

Node delamination - Nodes that come apart after being bonded together by node adhesive.

Node separation - Node delamination or unbonded nodes.

Nondestructive evaluation (NDE) - Broadly considered synonymous with NDI.

Nondestructive inspection (NDI) - A process or procedure for determining the quality or characteristics of a material, part, or assembly without permanently altering the subject or its properties.

Nondestructive testing (NDT) - Broadly considered synonymous with NDI.

Orthotropic - Describes material, either facings or cores, having different strength and elastic properties in different directions.

Orthotropic core directions - The identification of the different axes for strength determinations of core (See Figure 2). They are designated as "T", "L", and "W", as follows:

Table VI (con't)

"T" Direction	"L" Direction	"W" Direction
Thickness of core	Longitudinal, Parallel to core ribbons	Transverse, Perpendicular to core ribbons

Out-time - The time a material (i.e. adhesive) is outside its ideal storage environment.

Pitch - The distance between nodes in the L direction. See Figure 2.

Plating - A thin metal coating applied to a metal surface electrolytically, chemically, or by vacuum deposition to increase corrosion or abrasion resistance.

Porosity - A condition of trapped pockets of air, gas, or vacuum within a solid materials, usually expressed as a percentage of the total nonsolid volume to the total volume (solid plus nonsolid) of a unit quantity of material.

Postcure - Additional elevated temperature cure, usually without pressure, to improve final properties or to complete the cure or both.

Pot-life - The length of time an adhesive system can be used or worked before the curing process starts. Also called the working life.

Potting compound - One- or two-part pastes that may be trowelled or cast to fill holes, depressions, core cells, and other honeycomb core cavities.

Primer - A paint coating normally applied over a surface treatment or directly to a surface to increase corrosion resistance and improve the adhesion of subsequent topcoats.

Room temperature - Usually 72 $\pm$ 5 degrees Fahrenheit.

Ruptured core - Core destroyed by the insertion of a fastener, or by drilling or other means causing damage to core after part manufacture. See Figure 12.

Sandwich construction - A structural panel concept consisting

Table VI (con't)

in its simplest form of two relatively thin, parallel sheets of structural material bonded to, and separated by a relatively thick, light-weight core.

Scrim - A reinforcing fabric woven into a mesh construction, Used as a backing to adhesive films to facilitate handling. Usually made of Dacron or Mylar.

Secondary bonding - The joining together by adhesive bonding two or more already cured or bonded parts or details.

Shelf life - The length of time a material, substance, product, or reagent can be stored under specified environmental conditions and continue to meet all applicable specification requirements and/or remain suitable for its intended function.

Shifted core - Shifted core is caused by forcing core into its final assembly configuration prior to bonding. The cell walls of shifted core are no longer considered capable of bearing compressive loads. See Figure 11.

Specimen - A piece or portion of a sample or other material taken to be tested. Specimens normally are prepared to conform to the applicable test method.

Splice - A splice is a fabrication step during assembly of an article when separate pieces of core are adhesively joined after core manufacture. Splices can be in the W or L direction, or at an angle out of the W or L direction.

Split cell walls - A split cell wall is any tear in a core cell wall.

Surface treatment - A treatment which alters the surface of a material by other than mechanical means for the purposes of improving corrosion resistance or to provide a bond for subsequent organic coatings. This definition includes chemical treatment, anodic treatment, and passivation, but excludes alkaline cleaning, degreasing, a solvent washes, pickling, or mechanical blasting treatment.

T direction - See Orthotropic core direction.

Tack - Stickiness of an adhesive before cure.

Table VI (con't)

Tolerance - The total amount by which a quantity is allowed to vary.

Topcoat - A paint coating normally applied over a primer to obtain increased corrosion resistance and to serve as a decorative finish.

Toughness - A measure of a material's ability to absorb work, or the actual work per unit volume or unit mass of material that is required to rupture it. Toughness is proportional to the area under the load-elongation curve from the origin to the breaking point.

Unbond - An area within a bonded interface between two adherends in which the intended bonding action failed to take place. Also used to denote specific areas deliberately prevented from bonding in order to simulate a defective bond, such as in the generation of quality standards specimens. (see Disbond, Debond)

Unbonded nodes - Node that are apart due to lack of adhesive contact.

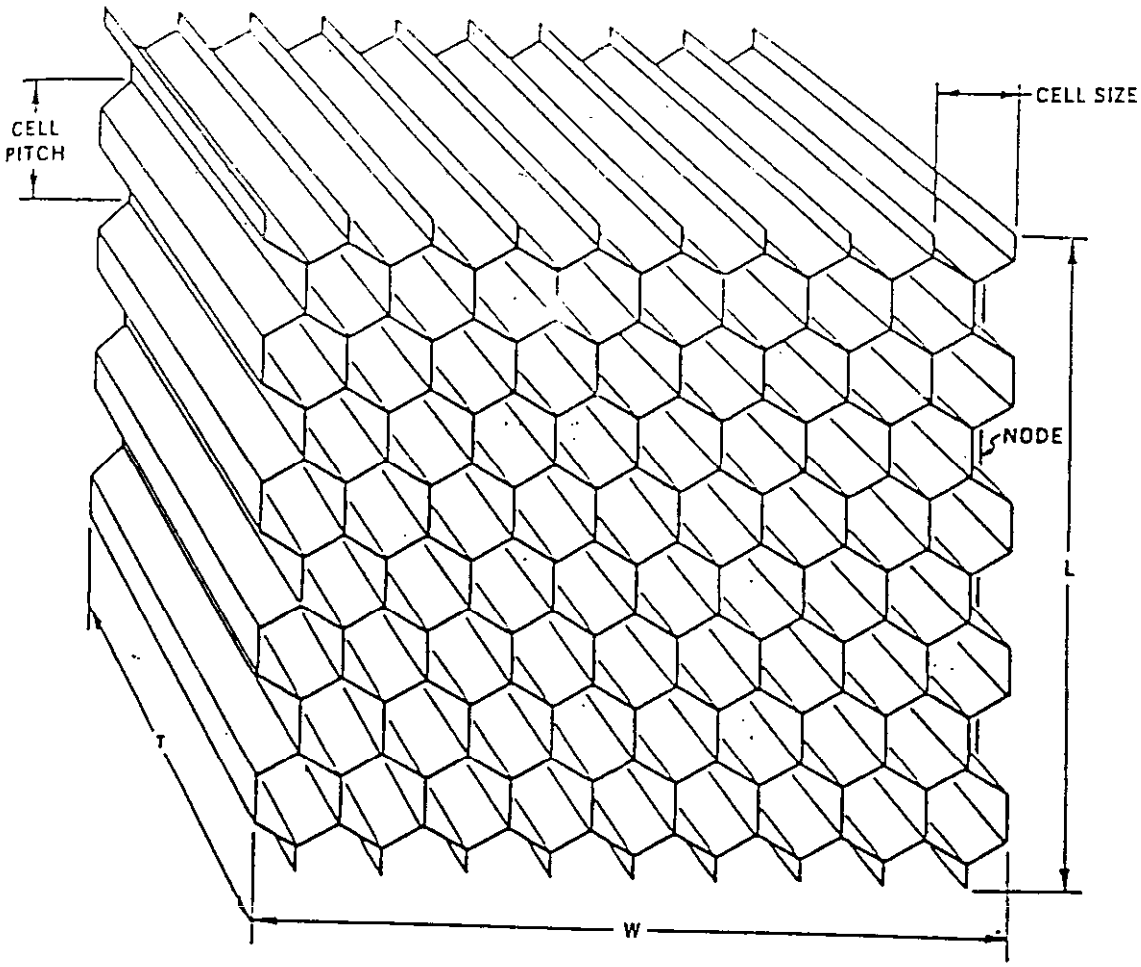
Vacuum bag molding - A process in which the layup is cured under pressure generated by drawing a vacuum in the space between the layup and a flexible sheet placed over it and sealed at the edges.

Verification Film (Verifilm) - Film adhesive with FEP on both sides. Verifilm is used to measure bonding uniformity between honeycomb and face sheets.

Void - A void is an event in which air or volatile(s) bubble entrapment in the adhesive or lack of adequate adhesive causes incomplete bonding.

W direction - See Orthotropic core direction (Figure 2).

Working life - See pot-life.



L = LONGITUDINAL DIRECTION (PARALLEL TO CORE RIBBONS)

W = TRANSVERSE DIRECTION (PERPENDICULAR TO CORE RIBBONS)

T = THICKNESS

FIGURE 2. Honeycomb Core Designations

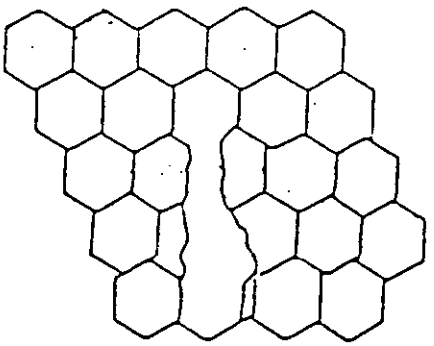


FIGURE 3. Blown Core

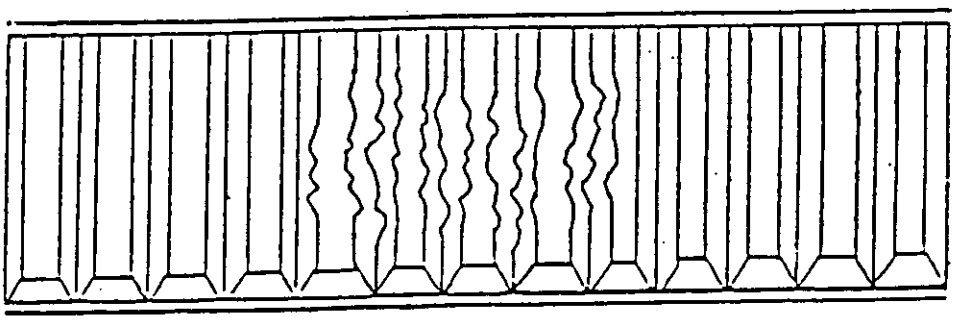


FIGURE 4. Buckled Core (Columnar Failure)

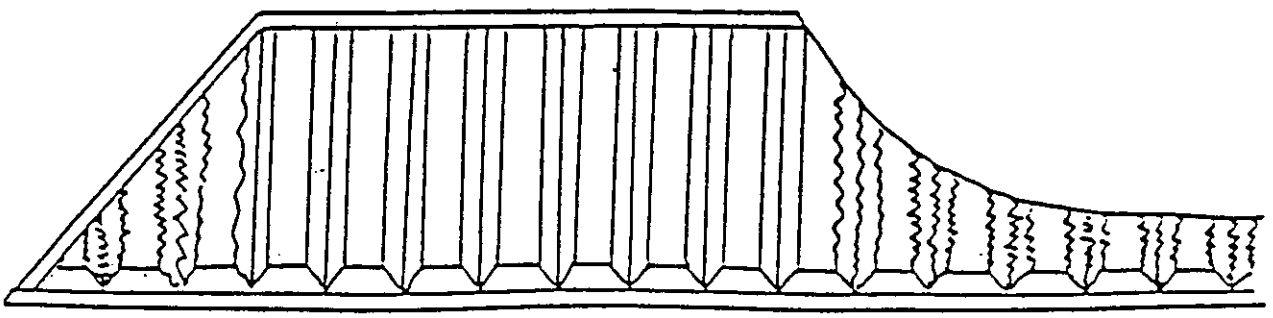


FIGURE 5. Compressed Core for Contoured Part

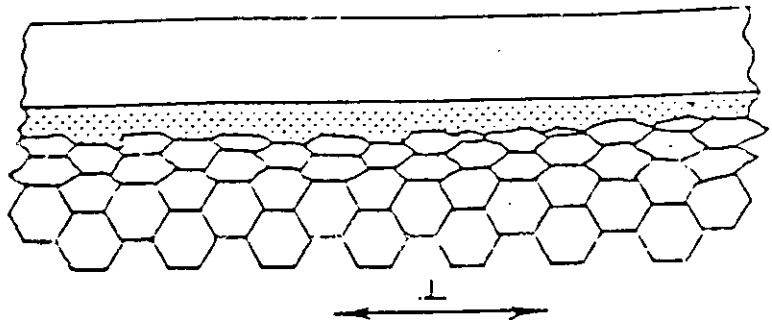


FIGURE 6. Condensed Core

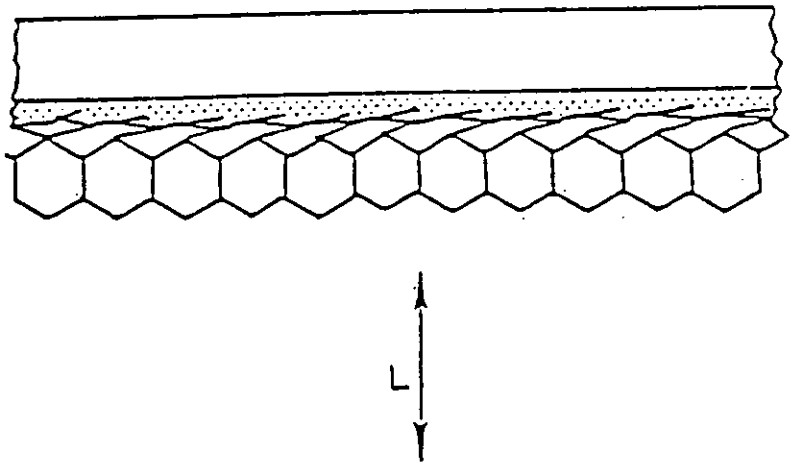


FIGURE 7. Crushed Core

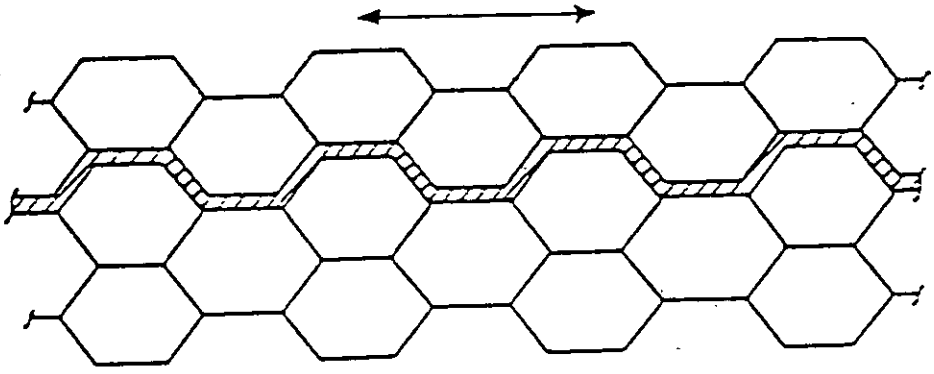


FIGURE 8. Double Foil (Expanded Core)

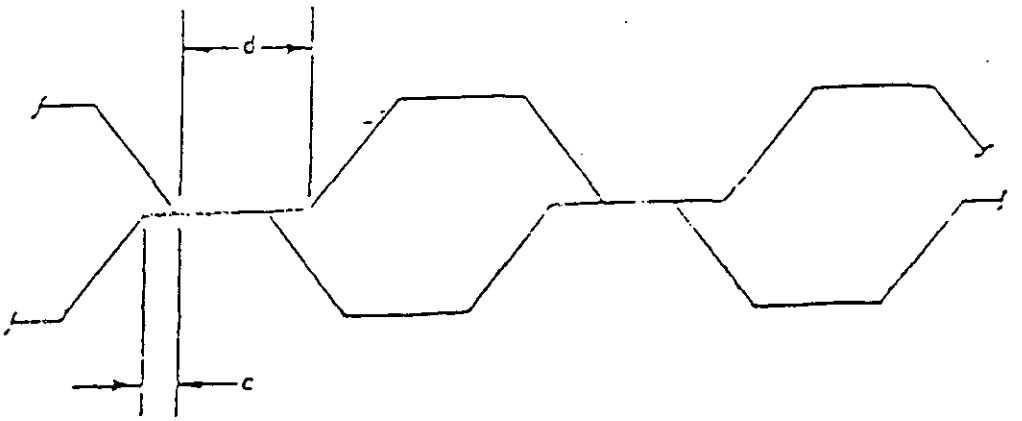


FIGURE 9. Mismatched Nodes (Corrugated Core)

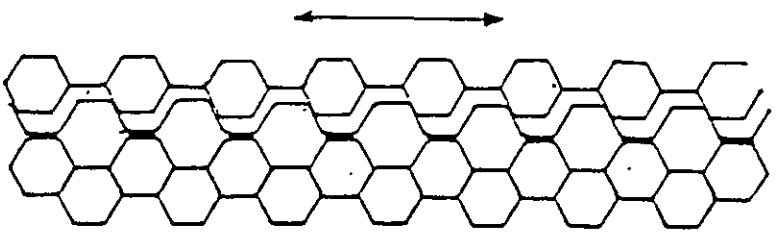


FIGURE 10. Nested Cells

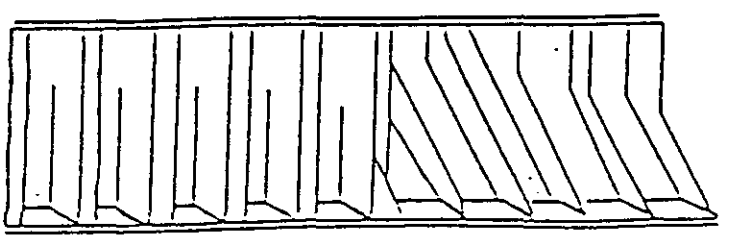


FIGURE 11. Shifted Core

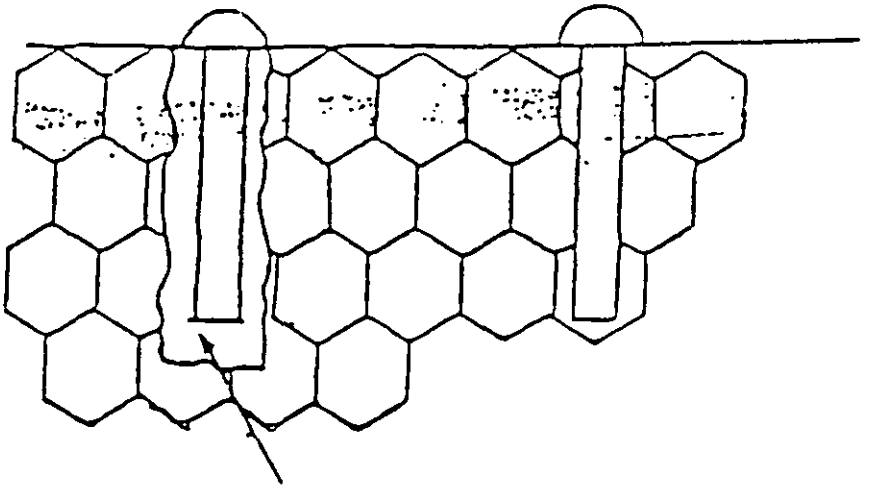


FIGURE 12. Ruptured Core

6.8 Concluding Materials

6.8.1 Concluding Materials

a. Preparing activity
b. Custodians (applied to coordinated specifications).
c. Review and user activities (applies to single department or fully coordinated specifications).
d. Project Number

Custodian:
Air Force - 99

Preparing activity:
Air Force - 82

(Project 1560 - F171)

Review activities:
Army - AV
Navy - AS