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Subject SANDWICH CONSTRUCTION, PLASTIC FACED			

PROCESS SPECIFICATION

Active Amendments:

None

1. SCOPE.

1.1 Scope. This specification establishes the requirements for fabricating sandwich assemblies using glass fabric base plastic laminate facings. This specification is prepared using MIL-P-9400 as a guide.

1.2 Effectivity. This specification is a complete revision of TPS 2-503E, dated 4 November 1998, and supersedes AC003005-002 and AC0M3005-002. For previous design using AC003005-002 and AC0M3005-002, see section 6.3. This specification is effective upon release of the Document Release Notice (DRN). Amendment 098615A has been incorporated into this issue. Changed paragraphs from the previous revision are marked by a solid black bar in the left-hand margin.

1.3 Classification. Sandwich structures shall be classified according to Class which covers the use, Type which covers the construction method and Grade which covers the application (secondary structural or non-structural). As a minimum, the Class and Grade shall be specified on the Engineering Drawing. When no Type is specified on the Engineering Drawing, Type 1 shall apply.

1.3.1 Class.

Class A – Radar purpose (electrical). Parts for Class A shall be limited to Grade A panel applications. Only Type I or Type II construction shall be used to produce Class A structures. Core material shall be plastic honeycomb per AMS-C-8073 Class I, or Nomex honeycomb per AMS 3711 or AMS-C-81986 as specified on the Engineering Drawing.

Class B – General purpose (non-electrical). Parts for Class B may be either Grade A or Grade B panel applications. Class B – Parts may be fabricated by type I, Type II or Type III construction requirements. Core material may be either plastic honeycomb per AMS-C-8073, Nomex honeycomb per AMS 3711 or AMS-C-81986 or aluminum honeycomb per MIL-C-7438 as specified on the Engineering Drawing.

1.3.2 Type.

Type I: Inner and outer skins fabricated against a hard surface (For fabrication of Grade A or B panels. This is the preferred method for Fabrication of Grade A panels).

Method 1 - Inactive for new design.

Method 2 - Outer facing molded separately using a preimpregnated glass cloth and bonded to core using an adhesive film, inner facing formed on assembly using a preimpregnated glass cloth in a two step operation with adhesive film (Refer to 3.4.4.1.1). (Only one mold is needed for this method.)

Method 3 - Inner and outer facings pre-molded separately using a preimpregnated glass cloth, then bonded to the core with adhesive film (Refer to 3.4.4.1.2).

Method 4 - Inactive for new design.

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Type II: Outer skin fabricated against hard surface and inner skin fabricated against core. (For fabrication of Grade A or Grade B panels).

Method 1 - Outer skin molded separately using a preimpregnated glass cloth and bonded to core with an adhesive film, then inner facing fabricated in one lay-up using adhesive film next to the core and the remaining plies consisting of pre impregnated glass cloth (Refer to 3.4.4.2.1).

Method 2 - Outer skin molded separately and bonded to core with an adhesive film, then inner skin fabricated and bonded in another operation using pre impregnated glass cloth with no adhesive film (Refer to 3.4.4.2.2).

Method 3 - Multi-layer sandwich panels: The first skin using a preimpregnated glass cloth is cured, then core is adhesively bonded to skin. Adhesive film is then added to core and second skin using a preimpregnated glass cloth is laid up and cured. The second core is adhesively bonded to the second skin and repeated if more than two honeycomb layers are required (Refer to 3.4.4.2.3).

Method 4 - Outer face is pre-molded using a preimpregnated glass cloth, then core bonded to face using adhesive film in second operation. In third operation, apply adhesive film and lay up necessary inner face preimpregnated glass cloth plies (Refer to 3.4.4.2.4).

Type III: Outer and inner skins fabricated against core. (For fabrication of Grade B panels only).

Method 1 - Both faces fabricated using preimpregnated glass cloth with no adhesive film and bonded to the core in one operation (Refer to 3.4.4.3.1).

Method 2 - Both faces fabricated using preimpregnated glass cloth and bonded to the core in one operation. Both faces consist of adhesive film next to the core with the remaining plies made with pre impregnated glass cloth (Refer to 3.4.4.3.2).

Method 3 - One face fabricated using preimpregnated glass cloth with no adhesive film and bonded to the core in the first operation, with the other facing being fabricated using preimpregnated glass cloth with no adhesive film and bonded to the opposite side of the core in a second lay-up and curing operation (Refer to 3.4.4.3.3).

Method 4 - Outer skin consisting of preimpregnated glass cloth laid up with no adhesive film on mold and core bonded to skin in first operation using the preimpregnated glass cloth as the bonding ply. Inner face consisting of adhesive film and preimpregnated glass cloth is laid up and bonded to core in second operation (Refer to 3.4.4.3.4).



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1.3.3 Grade

Grade A - Secondary Structural Panels
Grade B - Non-structural Panels

If no Grade is specified, Grade A shall apply.

1.4. Order of precedence. If there is a conflict between the Engineering drawing and this specification, the Engineering drawing shall take precedence.

2. APPLICABLE DOCUMENTS.

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

SPECIFICATIONS

Military

MIL-C-7438	Core Material, Aluminum, for Sandwich Construction
MIL-P-9400	Plastic Laminated and Sandwich Construction Parts and Assembly, Aircraft Structural, Process Specification Requirements

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

SPECIFICATIONS

L-3 Communications Integrated Systems Technical Material Specifications

TMS 12-114	Sandwich Edge Filling and Potting Compound
TMS 12-115	Structural Film Adhesive, Requirements for

L-3 Communications Integrated Systems Technical Process Specifications

TPS 1-510	Adhesive Bonding, Structural, Using Adhesive Films
TPS 2-502	Process For Potting Inserts and Edges into Sandwich Panels
TPS 2-522	Fiberglass Reinforced Plastic Laminates, Vacuum-Bagged, Fabrication of
TPS 7-200	Environmental Controlled Requirements for



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American Society for Testing and Materials

ASTM C393 Standard Test Method for Flexural Properties of Sandwich Constructions

ASTM D638 Standard Test Method for Tensile Properties of Plastics

Society of Automotive Engineers

AMS 3711 Core Honeycomb Fibrous, Aramid Base, Phenolic Coated

AMS-C-8073 Core Material, Plastic Honeycomb, Laminated Glass Fabric Base, for Aircraft Structural and Electronic Applications

AMS-C-81986 Core Material, Plastic Honeycomb, Nylon Paper Base; for Aircraft Structural Applications

3. REQUIREMENTS.

3.1 Equipment.

3.1.1 Tooling.

3.1.1.1 Grade A tooling. For Grade A contoured panels, tooling shall be required to form the faces and to bond assemblies and for Grade A flat panels, as a minimum a shop aid (caul plate) shall be used.

3.1.1.2 Grade B tooling. For Grade B flat panels, no tooling /shop aid is required. For Grade B contoured panels, a shop aid as a minimum is required. The same tool or shop aid may be used for all forming and bonding operations.

3.1.2 Miscellaneous equipment.

3.1.2.1 Vacuum pump and associated accessories capable of maintaining a minimum vacuum of 26 inches of mercury.

3.1.2.2 Circulating air oven capable of maintaining uniform heat up to the specified cure temperature, $\pm 10^{\circ}\text{F}$, for the resin system in use.

3.1.2.3 Mixing, measuring, bagging and curing equipment necessary for plastic and bonding fabrication.

3.2 Materials.

3.2.1 Preimpregnated glass fabric. Preimpregnated glass fabric (Grade A or B, Form B) of the required Composition, Type and Category per TPS 2-522 as specified on the Engineering Drawing.



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3.2.2 Core material. Plastic honeycomb core material conforming to AMS-C-8073, AMS-C-81986 or AMS 3711 or Aluminum honeycomb core conforming to MIL-C-7438. The type, class, grade, cell size and density per the applicable specification shall be as specified on the Engineering Drawing. Core material other than those specified herein may be used when specified on the Engineering Drawing in which case Grade A panel test requirements and acceptable test values shall be specified on the Engineering Drawing.

3.2.3 Adhesive film. Adhesive materials conforming to TMS 12-115. The adhesive type, class, and grade per TMS 12-115 shall be as specified on the Engineering Drawing and shall depend upon the class of sandwich construction required. Adhesives other than those specified herein may be used when specified on the Engineering Drawing, in which case as a minimum shall meet the test requirements of 3.3.4 or the test requirements and acceptable test values shall be specified on the Engineering Drawing. For sandwich construction requiring high peel strength requirements, adhesive film with a minimum weight of .08 lb./sq. ft. is recommended.

3.2.3.1 Adhesive film for Class A applications.

- a. Adhesive film (250°F cure) - TMS 12-115 Type 1 Class 1 Grade 08 unless otherwise specified on the Engineering Drawing.
- b. Adhesive film (350°F cure) - TMS 12-115 Type 2 Class 1 Grade 08 unless otherwise specified on the Engineering Drawing

3.2.3.2 Adhesive film for Class B applications.

- a. Adhesive film (250°F cure) - TMS 12-115 Type 1 Class 2 Grade 08 unless otherwise specified on the Engineering Drawing.
- b. Adhesive film (350°F cure) - TMS 12-115 Type 2 Class 2 Grade 08 unless otherwise specified on the Engineering Drawing.

3.2.4 Release agents.

3.2.4.1 Release-All Safelease 30, supplied by Airtech International Inc., CAGE 53912 or equivalent.

3.2.4.2 200FTP release fabric, supplied by Richmond Aircraft Products, CAGE 85670 or equivalent.

3.2.4.3 Wax, Kantstik Paste or Honey Paste Wax, supplied by Specialty Products Co., CAGE 22400 or equivalent.

3.2.5 Miscellaneous materials.

3.2.5.1 Bagging and barrier films.

- a. Capran 980 bagging film, .002 inch thick, manufactured by Allied Chemical Co., CAGE 82196.
- b. Hi-Stretch bagging film 357TFN, supplied by DE-COMP Composite Materials and Supplies, Cleveland OK., CAGE AAAQZ.
- c. Ipplon bagging film DP1000-Orange, .002 inches thick, supplied by Airtech International Inc., CAGE 53912.



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d. VAC-PAK-HS-8171 bagging/barrier film, .002, .003 or .005 inches thick, supplied by Airtech International Inc., CAGE 53912.

e. Perforated barrier film, A4000RP, Red, .001 inch thick, supplied by Airtech International Inc., CAGE 53912, A5000, supplied by Richmond Aircraft Products, Cage 85670 or equivalent. Perforation size to be determined by Manufacturing.

3.2.5.2 Bag sealing compounds.

a. Compound No. 9151, supplied by Schnee-Morehead Chemicals Inc., Irving TX., CAGE AAACK.

b. Tech-Seal 10, supplied by Techniseal Inc., Kansas City, Mo., CAGE Not assigned.

3.2.5.3 Bleeder/breather materials.

a. Style 1581 glass fabric, any supplier.

b. Style 7500 glass fabric, any supplier.

c. Airweave SS, supplied by Airtech International Inc., CAGE 53912.

d. Burlflo 4822 (thin fabric) supplied by Burlington Industrial Fabrics Co., CAGE 88730.

e. Burlflo 75051 (thick fabric) supplied by Burlington Industrial Fabrics Co., CAGE 88730.

3.2.5.4 Cleaning solvents. All cleaning shall be accomplished using technical grade Methyl Propyl Ketone (MPK), acetone, acetone/MPK blend, or other solvent approved by L-3/IS Materials and Process Engineering.

3.2.5.5 Rework resins. Rework resins shall be per the applicable composition per TPS 2-522.

3.2.5.6 Filler material. Fiberglass milled fibers, RP32, 1/32 inch screen size, supplied by Ciba-Geigy Formulated Materials Group, CAGE 02684, or equivalent supplier.

3.2.6 Core splicing adhesive/reinforcement.

a. Thick non-flow adhesive-(room temperature cure).

1. Epoxy resin per TPS 2-522 Composition 2, Form a, thickened to a non-flow consistency with milled glass fibers (3.2.5.6), catalyzed per TPS 2-522 for room temperature curing.

2. TMS 12-114 Type 3 Class 1.

3. TMS 12-114 Type 2 Class 2.

b. Thick non-flow adhesive-(elevated temperature cure),

1. TMS 12-114 Type 2 Class 2.

2. TMS 12-114 Type 2 Class 3.



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c. Foaming adhesive-(elevated temperature cure).

1. Foam adhesive AF-3024 supplied by 3M Company, CAGE 04963.
2. Foam adhesive MA562 supplied by Sovereign Engineered Adhesives, CAGE 1HS43 (Formerly BF Goodrich Adhesives).

3.3 General requirements.

3.3.1 Safety and chemical handling. Hazardous chemicals and waste disposal shall be per the appropriate Safety and Quality Control Procedures.

3.3.2 Environmental controls facility lay-up area. The fabrication of parts to this specification shall be performed in a controlled area conforming to a minimum class 400,000 per TPS 7-200.

3.3.3 Materials qualification, storage and handling.

3.3.3.1 Reinforced plastic laminating materials. Preimpregnated glass cloth and rework resins shall be handled and stored in accordance with procedures outlined in TPS 2-522. Qualification shall be as specified in TPS 2-522.

3.3.3.2 Adhesive film. Adhesive film including core splice film shall be handled and stored in accordance with TPS 1-510. Qualification shall be as specified in TMS 12-115.

3.3.3.3 Core splice paste adhesive reinforcement. Core splice adhesive reinforcement shall be handled and stored in accordance with TMS 12-114 as applicable or the manufacturer's recommended instructions.

3.3.3.4 Honeycomb core material. Whenever possible, core material shall be stored in the same package or container used in shipping. Core removed from this shipping container shall be protected from contamination by covering with clean Kraft paper or equivalent. This packaged or covered core shall be stored in a clean, dry area free as practical from dust contamination. Qualification shall be as specified in applicable controlling material specifications.

3.3.4 Test requirements.

3.3.4.1 Process control test panels.

3.3.4.1.1 Solid laminate test panel. For Grade "A" panels, a 12 X 12 inch parallel laminated, 10 ply (see Table I for exceptions) solid laminate shall be prepared at the same time as the sandwich face or facings it represents. Laminating material used in this test panel shall be from the batch of material used in the detail production part or parts it represents. This panel shall be fabricated and bagged using the same vacuum line hook-up and cured under the same conditions as the production part or parts it represents. This panel shall be identified as the specific sandwich face or faces and production part number or numbers it represents, warp direction, supplier, material and batch number. This panel shall be forwarded to the test laboratory for testing, traceability and acceptance per 4.4. For Grade B panels, a solid laminate test panel is not required.

3.3.4.1.2 Sandwich test panel. For Grade "A" panels, a flat sandwich test panel 12 X 12 inches in size shall be laid up and cured with each oven load of like production sandwich parts. This test panel shall be fabricated using the same batches of laminating material and adhesive used in the production part or parts it represents. The number and direction of plies in the facings and type core, core thickness and core ribbon directions shall be



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per Table I. This panel shall be fabricated and bagged using the same vacuum line hook-up and cured under the same conditions as the production part or parts it represents.

This panel shall be identified as to the production part number or numbers it represents, core ribbon direction, type and method per this specification of construction used in its fabrication. The supplier material and batch number of the facing laminating material and the adhesive used shall also be identified on each panel. This panel shall be forwarded to the test laboratory for testing, traceability and acceptance per 4.4.

TABLE I
PROCESS CONTROL TEST PANEL REQUIREMENTS

Number of plies per Sandwich Facing (See Note 1)	Two plies of style 7781 fabric plus bonding ply or adhesive film; if facings are other than 7781 use sufficient plies plus bonding ply to obtain a face thickness of 0.03 inch.
Number of Plies per Solid Laminate (See Note 1)	Ten plies of style 7781 fabric; if part facings are other than 7781 use sufficient plies to obtain a panel thickness of approximately 0.100 inch.
Core for Sandwich Test Panel (unless otherwise specified on the drawing).	AMS-C-8073 Type 1-A, 3/16 inch cell size, 4lb. Density. Core thickness shall be 0.270 inches.

NOTE 1 - Plies for both the test sandwich panel and the test solid laminate panel shall be of the same material and batch used in the production parts they represent. The bonding plies or adhesive film shall also be of the same material and batch used in the production parts. These test panels shall be laid up and cured at the same time and under the same cure condition as the production parts they represent. Ply lay-up on solid laminates shall be parallel to warp direction. Ply warp direction of faces on sandwich panel shall be parallel with core ribbon direction.

- 3.3.4.2 Other test requirements.** Other tests, including electrical tests, specified on applicable Engineering drawings or accompanying documents shall be conducted when required.
- 3.3.5 Workmanship.** All laminated facings, for Type I, II, and III, shall meet the requirements of TPS 2-522. No Grade A part shall employ gel resin overlay, integrally molded or otherwise, during its fabrication. Unbonded areas are unacceptable. All external surfaces shall conform with the aerodynamic requirements and this specification. When such parts act as antenna housings, radomes and other electrical applications, the electrical requirements shall be met. Where possible, the exterior surface of the part shall be the surface next to the mold.
- 3.3.6 Laminate lay-up.** Glass cloth used in lamination of the faces shall be positioned on the mold in the direction indicated on the Engineering drawing. In cases where cloth direction is not specified, cloth direction shall be optional. In cases where the cloth direction is not specified, and parts have multiple curvatures, alternate 45° each layer to facilitate draping of material during lay-up. Splicing of glass fabric within the skin laminations shall be kept to a minimum. Spliced areas shall be rotated between the plies keeping overlay and crossing of spliced areas at a minimum. When required in the outer surface, splices should be positioned facing away from the slip stream. Unless specified otherwise, all splices shall have an overlap of one-half inch to one inch.



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- 3.3.7 Core lay-up.** Core ribbon direction shall be as indicated on the applicable Engineering drawing. In cases where the core direction is not specified, the ribbon direction is optional. All pieces of core shall be bonded or spliced together to eliminate gaps per 3.3.8. Core may be reinforced in areas requiring shaping, machining, hard spotting, or as otherwise specified on the Engineering drawing, by filling cells with reinforcing material specified in 3.2.6a or 3.2.6b.
- 3.3.8 Core splicing.** When necessary, core splicing shall be accomplished by one of the methods and limitations listed in 3.3.8.1.
- 3.3.8.1 Core splicing methods.**
- a. For Class A (Radar purposes), core splices within the radar transmission window area shall be avoided if possible. When splices are necessary within this window area, overlay the pieces of core a distance of two cells, then force together. If the drawing on a class A structure does not specify a specific transmission area, the entire area shall be assumed to be a transmission area.
 - b. For Class A non-window areas or Class B, butt splice using one part foaming adhesive (3.2.6c). Cure 90 minutes at 225° to 250°F or 60 minutes at 325° to 350°F. Cure should be accomplished at the same time skins are bonded and cured.
- 3.4 Procedure.**
- 3.4.1 Tool/shop aid preparation.** Tools/shop aids for fabricating honeycomb structures may be made of any material that will withstand the molding pressure and curing temperatures.
- 3.4.1.1** All plaster molds shall be dried a minimum of 72 hours at 125°F to 135°F in a forced air oven before using. No porous mold shall be used without bagging both sides before applying vacuum pressure. Seal all plaster molds with lacquer based sanding sealer, sand smooth, then coat with wax (3.2.4.3), followed by polishing to a high gloss. Two coats of release agent (3.2.4.1) shall be applied as the parting agent.
- 3.4.1.2** Plastic molds shall be sanded smooth, coated with wax (3.2.4.3) and polished, then coated with a thin even film of release agent (3.2.4.1).
- 3.4.1.3** Metal molds shall be waxed, polished, and coated with a thin film of release agent (3.2.4.1).



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3.4.2 Vacuum bagging and cure procedure for preimpregnated glass cloth and film adhesives (250°F and 350°F cure).

- a. Cover the entire assembly with one ply of release fabric (3.2.4.2) and the number of required plies of breeder fabric (3.2.5.3). Bleeder material may be omitted when curing core to premolded faces with an adhesive film. Unless determined by prior laminates, the ratio of resin bleeder plies to preimpregnated glass cloth plies shall be as follows:

- 1 ply Airweave SS to 6 plies prepreg.
- 1 ply Burlflo 4822 (thin fabric) to 3 plies prepreg.
- 1 Burlflo 75051 (thick fabric) to 6 plies prepreg.
- 1 ply Style 1581 glass fabric to 4 plies prepreg.
- 1 ply Style 7500 glass fabric to 4 plies prepreg.

The release and bleeder/ fabric shall extend beyond the edges of sandwich assembly.

NOTE: A caul plate may be used to assure flatness of the skin being bonded that is not against the mold surface. If a caul plate is being used, it should be positioned on top of the release fabric and underneath the breather materials. The caul plate shall be the same size as the skin it is against.

- b. Cover lay-up with perforated barrier film (3.2.5.1) extending approximately one inch over the part edge.
- c. Cover barrier film with breather material (3.2.5.3) which shall extend flush with edges of bleeder and release fabric. The extended edges of breather fabric shall be covered with a breather chain made of glass fabric. This breather chain can be strips of fabric 3-4 inches wide and folded over twice to make an approximate 1 inch wide 4 ply thick chain or equivalent. This chain shall encircle the sandwich assembly and cover the suction end of the vacuum line.
- d. The number of vacuum lines required per assembly shall be a minimum of one line for each 15 square feet of part surface area. When more than one vacuum line is required they shall be positioned a minimum of four feet apart.
- e. Position vacuum bag sealing compound (3.2.5.2) around the lay-up with no contact of breather materials.
- f. Cover entire assembly with vacuum bagging film (3.2.5.1) extending approximately 2 inches past sealing compound.
- g. Pull and retain a minimum of 26 inches mercury on the assembly during heat-up and cure.
- h. For polyester prepreg, TPS 2-522 Composition 1, and Epoxy prepreg TPS 2-522 Composition 2, preheat by placing the vacuum bagged assembly in an oven and heating @ 2 to 4°F per minute from room temperature to 150 - 175°F for 15 to 30 minutes. Continue the heat-up rate of 2 to 4°F per minute until the part temperature of 210°F ± 5°F is reached. Hold at 210°F ± 5°F for 15 to 30 minutes. Continue heat-up rate to cure temperature. Part temperature is obtained by a thermocouple located inside the vacuum bag, under the breather material and against the mold surface. Additional thermocouples maybe added at the option of Manufacturing to ensure the part temperature is within the cure cycle limitations.



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The addition of thermocouples is dependent on variables such as part size, tool design, skin thickness or multiple skin thickness changes within the part, etc.

- i. Cure adhesive film and prepreg materials at a heat-up rate of 2 to 4°F per minute to cure temperature. The cure cycle for adhesive films shall be as specified in TMS 12-115 (For TMS 12-115 Type 1, Cure cycle 250 ± 10°F for 60 minutes minimum, for TMS 12-115 Type 2, cure cycle 350 ±10°F for 60 minutes minimum). For other preimpregnated glass cloth, the cure cycle shall be as specified in TPS 2-522 for the applicable Composition, Type and Category.
- j. Upon completion of cure the part shall be cooled down to room temperature prior to release from the mold/shop aid. Retain vacuum on the assembly until the part temperature has dropped below 125°F.

Note: Do not release part from mold until all lay-ups are complete.

Note: For secondary operations which are added after the basic sandwich panel is completed, do not expose the structure to temperatures above 150°F when curing the additions unless the structure is returned to the retaining mold, rebagged and retained under a minimum of 26 inches vacuum during curing and cool down.

3.4.3 Face surfaces. Laminated plastic face surfaces shall be prepared using techniques and procedures as prescribed in TPS 2-522, as applicable for the resin system specified.

3.4.4 Fabrication methods for various types of construction.

3.4.4.1 Type I construction: Inner and outer skins fabricated against a hard surface.

3.4.4.1.1 Type I, Method 2 - Outer facing molded separately, inner facing formed on assembly (only one mold needed for this method):

- a. Fabricate outer facing per TPS 2-522 with a release ply (3.2.4.2) on the side that will later be bonded to the core. The warp direction shall be as prescribed on the applicable drawing.
- b. Peel core side release ply off outer facing. Sanding of surface with 80 or finer grit may be used in lieu of release ply; however, the use of a release ply is the preferred method and should be used whenever possible.

CAUTION: Limit sanding to release ply surface only, without damage to glass fibers.

- c. Position adhesive film as applicable at the bond line on the prepared core side of the outer facing.
- d. Position core on adhesive film. Core splicing or core shaping operations may be performed here.
- e. Position adhesive film, one ply on top of core. Position a release ply (3.2.4.2) on top of this ply of adhesive film.
- f. Vacuum bag and cure per 3.4.2. Vacuum bag entire sandwich assembly.
- g. Remove the release ply from the inner one ply adhesive film facing.



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- h. Lay up the remaining preimpregnated glass cloth plies and position on inner facing.
- i. Vacuum bag and cure per 3.4.2.
- j. Perform trim operations as required.
- k. Seal trimmed edges per the procedures of TPS 2-522.

3.4.4.1.2 Type I, Method 3 - Inner and outer facings pre-molded separately, then bonded to the core with adhesive film (this method of construction should be used for high bond strength applications). The Engineering drawing shall specify the facing material as purchased sheet stock or fabrication to be per the applicable TPS as follows:

- a. Fabricate both faces with a release ply (3.2.4.2) on the surface to be bonded to the core. Fabrication shall be per TPS 2-522, as applicable, depending upon the resin system specified.
- b. Remove the release ply from the first facing to be bonded and sand prepare the bonding surface as required using #80 grit or finer sandpaper and removing dust with oil free shop air.
- c. Position the prepared facing in the mold used for facings fabrication.
- d. Position a ply of adhesive film (3.2.3.1 or 3.2.3.2) as applicable on top of the facing. To increase the tack of the adhesive film, wipe the facing with a clean cloth moistened with solvent per 3.2.5.5.
- e. Position the core on the adhesive film. Core splicing (3.3.8) may be accomplished here.

NOTE: Sandwich assemblies that require addition of inserts, filler plies, core splicing, core filling, hard spotting, core shaping or machining, may require the core to be bonded to the first skin in order to perform these operations. For this type of sandwich construction complete the following intermediate steps before proceeding to step "F".

- 1. Vacuum bag and cure per 3.4.2.
- 2. Perform the operations as required to meet the requirements of the Engineering Drawing.
- f. Remove the release ply from the next facing and sand prepare the bonding surface as required using #80 grit or finer sandpaper and remove dust with oil free shop air.
- g. Position a ply of adhesive film to the sanded side of this facing. To increase tack of the adhesive film, wipe the facing with a clean cloth moistened with solvent per 3.2.5.5.
- h. Position this facing, with the attached adhesive film, on top of the core.
- i. Vacuum bag and cure per 3.4.2.
- j. Perform trim operations as required.
- k. Seal trimmed edges per the procedures of TPS 2-522.



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3.4.4.2 Type II construction: Outer skin fabricated against hard surface and inner skin fabricated against core.

3.4.4.2.1 Type II, Method 1 - The outer skin shall be molded separately and bonded to the core as prescribed for Type I construction, Method 3. The inner skin shall be fabricated in one lay-up using one ply of adhesive film (as applicable), next to the core with the remaining plies consisting of preimpregnated glass cloth. Vacuum bagging and curing of the inner skin shall be accomplished per 3.4.2.

3.4.4.2.2 Type II, Method 2 - The outer skin shall be molded separately and bonded to the core as prescribed for Type I construction, Method 3. The inner skin shall be fabricated in one lay-up using preimpregnated glass cloth as both the bond ply and the facing laminate. Vacuum bag and cure as prescribed in 3.4.2.

3.4.4.2.3 Type II, Method 3 - Multi-layer sandwich panels:

- a. Lay up outer face in tool (female mold) with a covering release ply, bag and cure per 3.4.2.
- b. Remove the release ply, add adhesive film as applicable, then add core, bag and cure per 3.4.2.
- c. Shape honeycomb, if required, add adhesive film, and preimpregnated glass cloth, plus a release ply, bag and cure 3.4.2.
- d. Remove release ply, add adhesive film, then add core, bag and cure per 3.4.2.
- e. Shape honeycomb as required, add adhesive film, and preimpregnated glass cloth, bag and cure per 3.4.2.

Repeat Steps "d" and "e" if more than two layers of honeycomb are required.

3.4.4.2.4 Type II, Method 4 - Outer skin fabricated against hard surface and inner skin fabricated against core:

- a. Lay up the required number of plies in the tool (female mold), plus a release ply (3.2.4.2), bag and cure per 3.4.2.
- b. Remove the release ply and sand prepare the surface to be bonded as required using #80 grit or finer sandpaper and remove dust with oil free shop air. Position a ply of adhesive film (3.2.3.1 or 3.2.3.2), as applicable, on the facing. If increased tack of the adhesive film is required, wipe the facing and core surface with a clean cloth moistened with solvent (3.2.5.5). Position the core material on top of the adhesive film. Core splicing (3.3.6) and the addition of filler plies may be accomplished here as required.
- c. Vacuum bag and cure per 3.4.2.
- d. Debag and complete filling, machining and the addition of inserts or hard spots as required to meet the requirements of the Engineering Drawing.
- e. Prepare the assembly to accept the bonding of the inner skin by sanding to remove surface gloss from filler materials and produce a smooth transition in all areas having steps or tapers. Clean entire assembly by use of filtered compressed air.

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f. Position a ply of adhesive film (3.2.3.1 or 3.2.3.2), as applicable, onto the assembly. If increased tack of the adhesive film is required, wipe the surface where the film is to be applied with a clean cloth moistened with solvent (3.2.5.5). Lay up the number of preimpregnated glass cloth plies specified by the Engineering Drawing. This inner skin fabrication shall be per the procedures of TPS 2-522.

g. Vacuum bag and cure per 3.4.2.

h. Demold and perform trim operations as required.

i. Seal trimmed edges per procedures of TPS 2-522.

3.4.4.3 Type III Construction: Outer and inner skins fabricated against core. This type construction can be completed in one single operation using Methods 1 or 2; two bagging and curing (3.4.2) operations are required for Methods 3 and 4.

3.4.4.3.1 Type III, Method 1 - Lay up the outer skin next to the shop aid. All plies shall consist of an adhesive preimpregnated glass cloth of the type and specific material specified on the drawing. Position the core on the preimpregnated glass cloth outer skin laminate lay up. Lay up the inner skin on top of the core. All plies of the inner skin shall also consist of preimpregnated glass cloth. Vacuum bag the entire assembly and cure per 3.4.2.

3.4.4.3.2 Type III, Method 2 - Lay-up the outer skin next to the shop aid. All plies shall consist of preimpregnated glass cloth per 3.2.4 of the type specified, except the ply next to the core shall be an adhesive film per 3.2.6.2. Position the core on the uncured outer skin. Lay up one ply of adhesive film on top of the core, then the remaining plies for the inner skin; these remaining plies shall all consist of preimpregnated glass cloth. Vacuum bag the entire assembly and cure per 3.4.2.

3.4.4.3.3 Type III, Method 3 - All plies shall consist of an adhesive preimpregnated glass fabric of the type and specific preimpregnated glass cloth specified. The outer facing shall be laminated and bonded to the core in one vacuum bagging and curing operation. Following debagging and rework of the exposed core as necessary, the inner ply shall be laminated and bonded to the inside of the honeycomb core in a second vacuum bagging and curing operation.

3.4.4.3.4 Type III, Method 4 - Outer skin and core bonded in first operation; inner skin consisting of adhesive film and preimpregnated glass cloth laminated and bonded in second operation.

a. Using a laminating adhesive prepreg of the type specified, lay up the required number of plies on the shop aid. Lay honeycomb directly on prepreg, bag and cure per 3.4.2.

b. Add adhesive film per 3.2.3.2 to core, lay up required number of preimpregnated glass cloth plies directly on adhesive film, bag and cure per 3.4.2

3.4.5 Fabrication of solid section build-up areas, edges and plugs.

3.4.5.1 Both inner and outer facings shall extend through all such areas in order to provide maximum strength.

3.4.5.2 Required thickness of solid section build-up areas shall be the total thickness minus the two skin thicknesses.



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- 3.4.5.3** Reinforced plastic build-ups shall be accomplished using the same material as the skin material.
- 3.4.6** **Finishing of the assembly.**
- 3.4.6.1** **Parting agent removal.** All parting agents shall be removed from the part.
- 3.4.6.2** **Trimming.** Trimming operations shall be performed as required to meet the Engineering drawing requirements. Parts may be trimmed to dimensions by sawing, grinding, sanding, milling or any other method provided all other requirements in this specification are met. Drilling and machining shall be to accomplished using sharp high speed steel or carbide tools. It is recommended to back up work to prevent delamination. Tolerances specified on applicable drawings shall be maintained. Surfaces, other than the cut or raw edge surfaces, to receive paint or rain erosion coating shall not be coated with this sealing resin. Seal trimmed edges per the procedures in TPS 2-522.
- 3.4.6.3** **Edge fill and seal.** Filling and sealing of exposed sandwich panel edges for local reinforcement, weather proofing and potting of fasteners shall be accomplished per TPS 2-502, when specified on the applicable drawings.
- 3.4.6.4** **Additional finishes.** Additional finishes, i.e. enamel, lacquers, and rain erosion coating finishes shall be applied in accordance with the Engineering drawings and applicable specifications.
- 3.5** **Rework.** Rework is considered as working a non-conforming part back to the Engineering Drawing requirements. Damage in excess of the rework limitations specified herein shall be considered a repair. Repairs shall be made as directed by MRB.
- 3.5.1** **Limits of rework.** All rework shall meet the requirements of this specification. The total of all rework made to the part shall not exceed 10% of the surface area or the limitations in 3.5.2 for the defect type.
- 3.5.2** **Rework resins.** Resins used for rework shall be per TPS 2-522.
- 3.5.3** **Rework of defects.**
- 3.5.3.1** **Rework of laminate facing defects.** The allowable limits and rework methods and procedures shall be per TPS 2-522.
- 3.5.3.2** **Rework skin to core areas.** These small unbonded areas (1/4 inch or smaller) may be repaired by injecting sufficient resin to fill the space between the edges of the core and the unbonded facing. The assembly shall be positioned so as to permit the unbonded area to be the lowest surface as near a flat plane as possible to permit gravity flow and spread out the resin prior to cure. Low pressure shall be maintained on the area during cure. Rework resins and mixing and curing instructions shall be per TPS 2-522.
- 3.6** **Operator training.** Operators performing work to this specification shall be adequately trained. Qualification shall be conferred on trained operators by production supervision, by successful demonstration of a knowledge of this process and the ability to produce parts meeting the requirements of this specification.



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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Organizationally assigned personnel responsible for performing the requirements described herein are also primarily responsible for ensuring the quality of the process activities. Other personnel within the operating department, or others as deemed appropriate by management may be assigned to verify compliance with requirements listed herein. Quality Assurance departments may perform inspections or audits as necessary to provide adequate oversight of process controls.

4.1.1 Final part inspection.

4.1.1.1 Dimensional requirements. All production parts shall be inspected to assure that they meet dimensional requirements of the applicable drawings, specifications or contract.

4.1.1.2 Nondestructive inspection (NDI). All production parts shall be visually inspected for defects. All sandwich face surfaces, including both faces, shall be coin tapped or equivalent NDI tested to assure there are no unbonded or delaminated areas. Any defect noted shall be processed in accordance with allowable limits contained in 3.5.

4.2 Monitoring procedures for equipment used in process. The process owner or department performing the process shall verify by process audits or inspection that all equipment used in this process are per the requirements specified herein.

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

4.4 Production acceptance testing. Test panels prescribed in 3.3.4.1 that are representative of solid laminate face on each production panel and sandwich panels representative of each production part shall be tested and shall meet the acceptance values listed in Table II.

4.4.1 Tensile strength. A minimum of five (5) tensile strength test specimens shall be tested in accordance with ASTM D638 using Type II, 0.250 necked down specimens. Conditioning of specimens is not required.

**TABLE II
TESTS PROCEDURES AND ACCEPTANCE VALUES
OF PROCESS CONTROL TEST PANELS**

TEST PANEL	TEST REQUIREMENT	ACCEPTANCE VALUE
Solid Laminate (Grade A)	Tensile Strength per 4.4.1	Acceptance values shall be as specified in TPS 2-522 for classification of material used
	Compressive Strength per 4.4.2	Acceptance values shall be as specified in TPS 2-522 for classification of material used.
Sandwich (Grade A)	Flexural Strength per 4.4.3	Minimum acceptable average value lb./in width
	W Direction	Span perpendicular to core ribbon = 80
	L Direction	Span parallel to core ribbon = 120



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- 4.4.2 **Compressive strength.** Ultimate compressive strength shall be determined on five specimens tested parallel to the fabric warp direction per test procedures specified in TPS 2-522.
- 4.4.3 **Flexural strength.** Flatwise flexural strength shall be determined employing five 1-1/2 X 4 inch specimens machined in each of the two specified directions. The specimens shall be tested as simple beams (center loading), over a 3 inch span using ¼ inch radius supporting points and ½ inch radius loading point. The flexural strength resulting in lb./in of width for each direction shall be averaged. The specimen rate loading shall be in accordance with ASTM C393.
5. **PREPARATION FOR DELIVERY.** This section is not applicable to this specification.
6. **NOTES.**
- 6.1 **Intended use.** This specification is intended for the fabrication of plastic faced honeycomb sandwich components for use in aircraft radomes and other aircraft structural and non-structural parts. Consult the Materials and Processes Specialist prior to specifying parts manufactured to this specification for use on any FAA certified aircraft.
- 6.2 **Definitions.**
- 6.2.1 **Non-Structural.** Panels used in installations that do not undergo flight or crash loads and do not undergo transportation or environmental loads.
- 6.2.2 **Secondary Structural.** Equipment racks, consoles, equipment mounts, floor and over head support structure, that are not part of the primary airframe structure and experience flight or crash loads.
- 6.3 **Waco previous engineering.** For previous design which specifies AC003005-02 or AC0M3005-002 contact Liaison Engineering for determination of the appropriate Class, Type, and Grade per TPS 2-503.
- 6.4 **Standard drawing note.** When specified on an Engineering drawing, the drawing note should read "Composite sandwich construction per TPS 2-503, Class _, Type _, Method _, Grade _".