

Test Project

Module C Aircraft Composite Inspection Repair

Aircraft Maintenance

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Introduction

Composite materials are becoming more important in the construction of aerospace structures. Aircraft parts made from composite materials, such as fairings, spoilers, and flight controls, were developed during the 1960s for their weight savings over aluminum parts. New generation large aircraft are designed with all composite fuselage and wing structures, and the repair of these advanced composite materials requires an in-depth knowledge of composite structures, materials, and tooling. The primary advantages of composite materials are their high strength, relatively low weight, and corrosion resistance.

Marking Scheme

MODULE C- AIRCRAFT COMPOSITE INSPECTION REPAIR

Inspection and Defect Mapping

Damage Repair

Vacuum Bagging

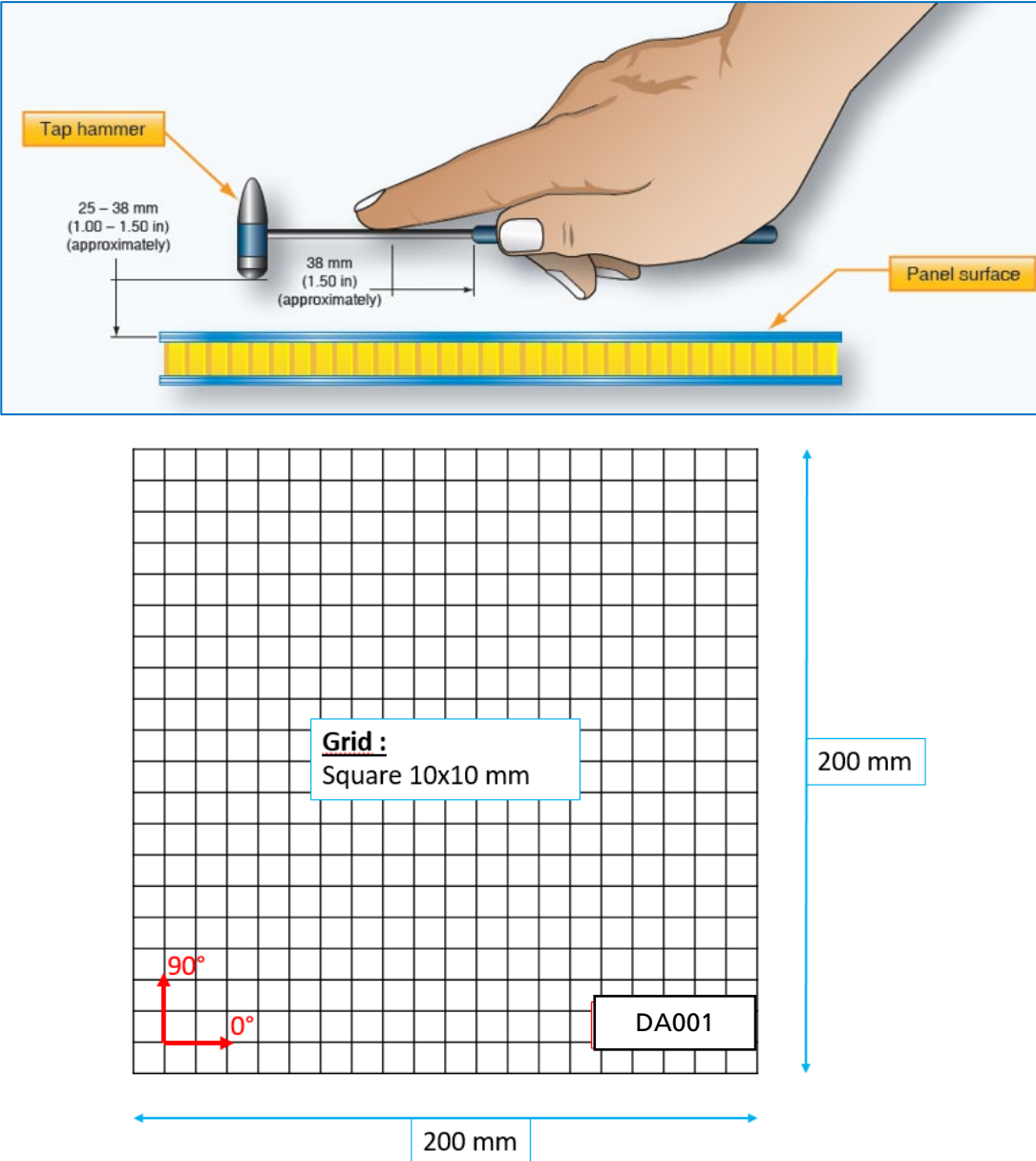
Instructions to the Competitor

NAME	(FIRST)	(LAST)
COUNTRY		
START TIME		END TIME
Objective	To perform composite panel damage inspection and repair.	
Time	3 hours 15 mins to complete.	
Process:		
1	A sandwich composite panel suffered an impact, which caused a damage. Competitor is required to carry out visual inspection and a resonance tap test to check for further damage on the structure and mark out the affected area.	
2	Another sandwich panel has external skin delamination with depression on the honeycomb core. The size of the defect is compliant with reparability criteria < 60 mm. Competitor is required to carry out a core repair and wet layup repair on the sandwich panel in accordance with FAA-H-8083-31A-AMT-Airframe-Vol-1, chapter 7.	
3	Competitor is required to carry out vacuum bagging to the repaired panel in accordance with FAA-H-8083-31A-AMT-Airframe-Vol-1, chapter 7.	
4	Restore workplace and perform housekeeping	

References: FAA-H-8083-31A-AMT-Airframe-Vol-1, chapter 7 and FAA AC 43-13-1B

The following items are provided:

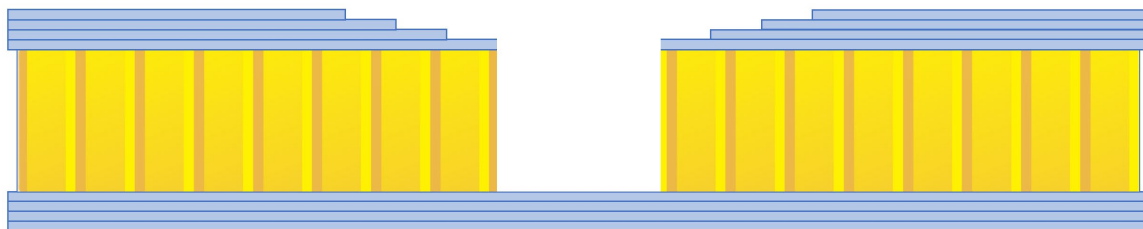
- Drawings, inspection report and process sheet as attached.
- A damaged composite sandwich panel 200 mm x 200 mm for inspection operation.
- A composite panel 400 mm x 400 mm for repair operations.
- The necessary materials required to carry out inspection and repair.

OPERATION	DESCRIPTION
1	<ul style="list-style-type: none"> Carry out a visual inspection and audible tap testing inspection to determine the extent of the damage. Report inspection results on the Inspection Form "Damage Mapping". Shade the damaged area. Tolerance of mapping: + 0.4 inch (10.1 mm)  <p>The diagram illustrates the tap testing process and the corresponding damage mapping grid. The top part shows a hand holding a tap hammer, tapping a panel surface. Dimensions are provided: the hammer head is 25-38 mm (1.00-1.50 in) approximately, and the distance from the hammer head to the point of contact is 38 mm (1.50 in) approximately. The bottom part shows a 200 mm x 200 mm grid with 10x10 mm squares. A label 'Grid : Square 10x10 mm' is present. A red arrow indicates the 90° and 0° directions. A box labeled 'DA001' is shown in the bottom right corner of the grid.</p>

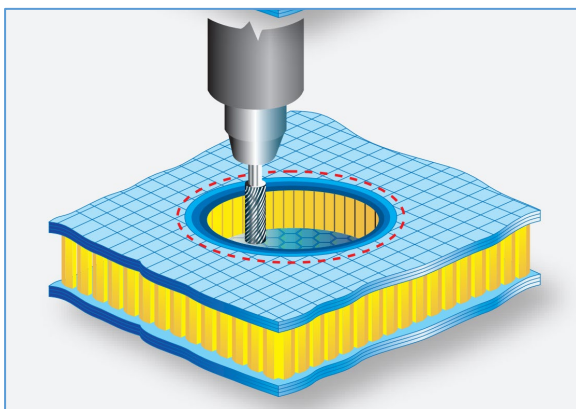
2

Carry out circular step sanding and core routing on full depth:

1. Proceed to core routing on full depth according to the circular marking (50.8mm) on the panel.
Circularity 50.8mm (+/- 4 mm tolerance)
2. Carry out circular stepping according to appendix 4.



Full depth core replacement

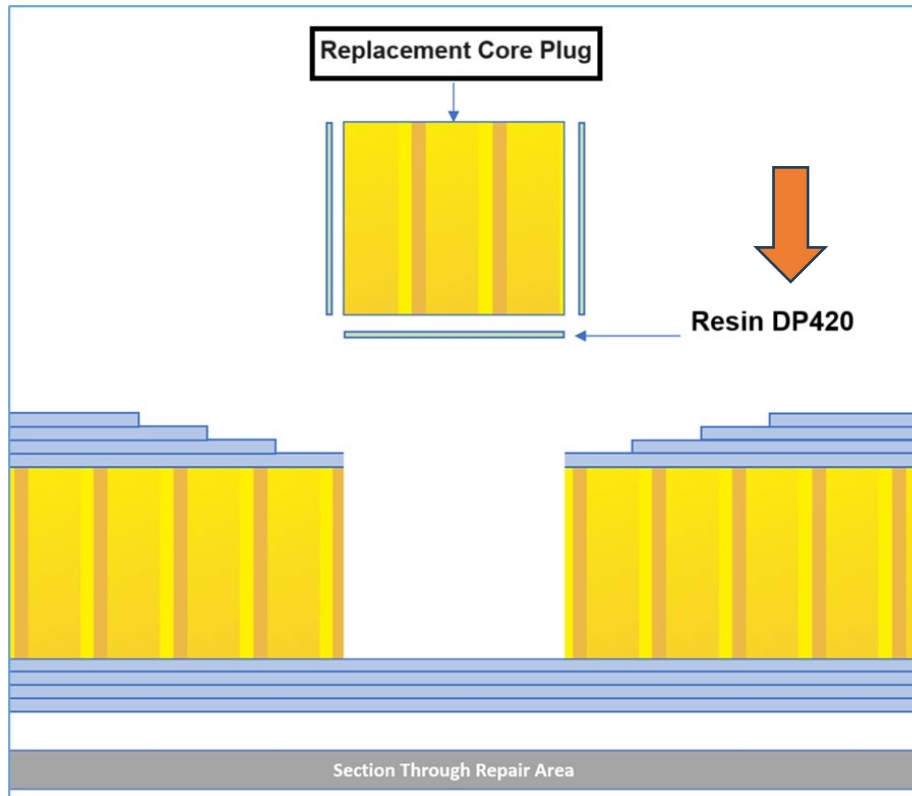


After core routing and step scarfing,

Competitor must show the Experts the completed step sanding and core routing.

3

1. Prepare all the repair materials required to perform the full depth core replacement.
2. Carry-out the repair of the core according to the following diagram:
 - For lower and side adhesive film, use resin DP 420 (specification Appendix-1)
 - For replacement core plug, use honeycomb ref. Nida nomex 4.8 kg - 48 kg.
 - Honeycom replacement plug: 50.8 mm \pm 4 mm.
 - **Show Expert the replacement plug before fitting it into the panel.**

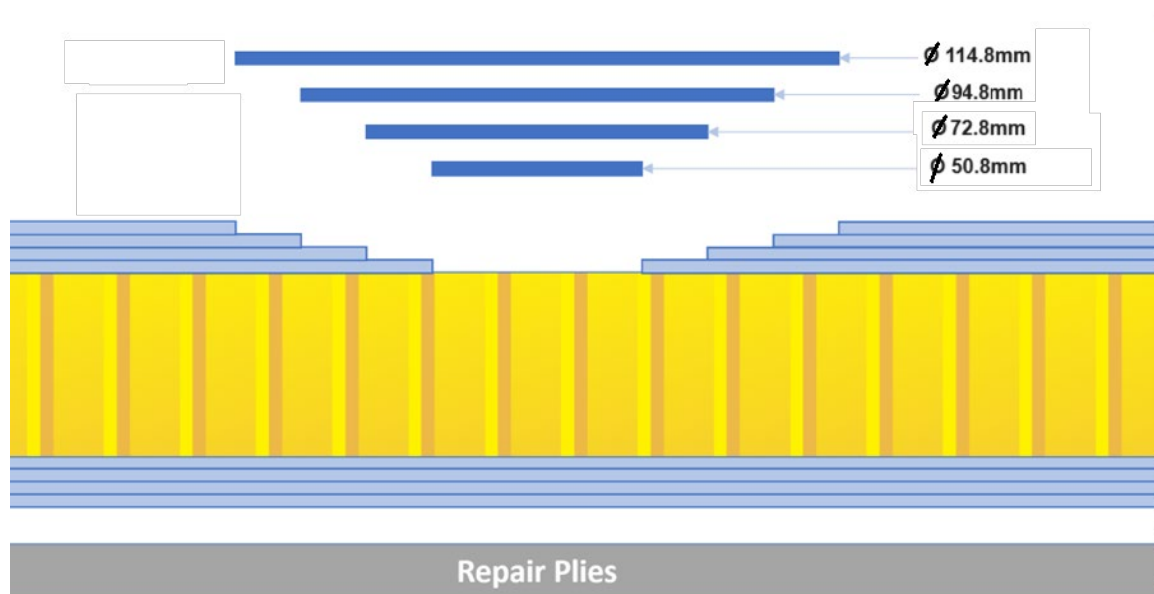


4

Prepare all the repair materials required to perform the plies replacement.

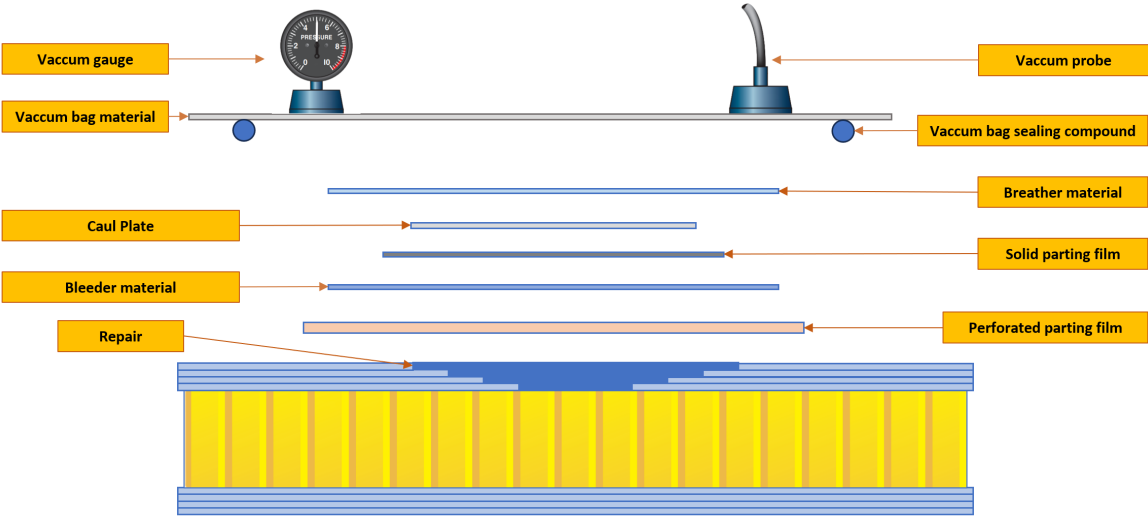
For layup of the repair plies use:

- Carbon Fabric: G803
- Resin for impregnation: LY 5052 (refer to Appendix-1 for mix calculation).
- Fill-in the attached Form for "Resin Mix Calculation Form" (page 12)
- Call the judge to check resin calculation form values and the quantity of resin and hardener weighed.



Proceed to layup of the replacement plies according to the part definition (Appendix-2).

Once the ply materials are in place, proceed to vacuum bagging to remove air and to pressurize the repair for curing.

5	<p>Carry-out a single-side vacuum bagging according to the following diagram:</p>  <p>Competitor must inform the Experts to inspect when performing leakage test.</p> <p>Remove the vacuum source and monitor the vacuum gage.</p> <p>Minimal vaccum level measured < 850 mbar/Leakage < 50 mbar in 5 minutes</p> <p>Leakage to be checked with the jury.</p> <ul style="list-style-type: none"> • Vaccum Level at 0 minutes: • Vaccum Level at 5 minutes: <p>Note: No curing cycle is required, as the resin will cure at room temperature.</p>
6	<p>Upon completion of repair task, clean all tools, equipment and work area before leaving.</p> <p>Observe and apply all safety rules and precautions.</p>

TASK CARD	TECHNICAL REF	FAA-H-8083-31A-AMT-AIRFRAME-VOL-1, CHAPTER 7	PAGE:
Carry out a visual inspection and audible tap testing inspection to determine the extent of the damage	Panel P/N	DA001	Reported by
	Date		


S/N	MAINTENANCE REQUIRED	RESOLUTION	RESOLVED BY/DATE
Certifies that the work specified except as otherwise specified was carried out in accordance with the requirement of the Air Navigation Act and in respect to that work the aircraft/engine/aircraft component is considered ready for release to service		Certified by (Signature & ACA) Date	

Inspection form: Damage Mapping.

Each square represents 10 mm x 10 mm

Shade the damaged area. Tolerance of mapping is + 0.4 inch (10.1 mm)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a																				
b																				
c																				
d																				
e																				
f																				
g																				
h																				
i																				
j																				
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DA001

Name: _____

Resin Mix calculation form

1. The weight ratio between fibre and resin is 1:1
2. Compute the values according to the "Appendix 1" sheet for Resin LY 5052.
3. Write down the result below.
4. Total fibre weight = _____ g

RESIN MIX
 Resin weighed (Araldite LY 5052): g
 Hardener weighed (Aradur 5052): g
 Total resin weight: g

Name: _____

Appendix 1:

Resin DP420 – Processing data

3M
Scotch-Weld™
Epoxy Adhesive

DP420 Black • DP420 NS Black • DP420 Off-White • DP420 LH

Technical Data

February, 2016

Product Description 3M™ Scotch-Weld™ Epoxy Adhesives are high performance, two-part epoxy adhesives offering outstanding shear and peel adhesion, and very high levels of durability.

Features	<ul style="list-style-type: none"> • High shear strength • High peel strength • Outstanding environmental performance • Easy mixing • 20 minute worklife 	<ul style="list-style-type: none"> • Controlled flow (3M™ Scotch-Weld™ Epoxy Adhesive DP420 NS Black) • Recognized as meeting UL 94 HB – Underwriters Laboratory Horizontal Burn Flammability Test (3M™ Scotch-Weld™ Epoxy Adhesive DP420 Off-White) • Low halogen content (3M™ Scotch-Weld™ Epoxy Adhesive DP420 LH)
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Typical Uncured Physical Properties Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Product		3M™ Scotch-Weld™ Epoxy Adhesive			
		DP420 Black	DP420 NS Black	DP420 Off-White	DP420 LH
Viscosity (approx.) @ 23°C (73°F)	Base Accelerator	20,000-50,000 cP 8,000-14,000 cP	190,000-270,000 cP 60,000-130,000 cP	20,000-50,000 cP 8,000-14,000 cP	20,000-50,000 cP 8,000-14,000 cP
Base Resin	Base Accelerator	epoxy amine	epoxy amine	epoxy amine	epoxy amine
Colour	Base Accelerator	black amber	black amber	white amber	white amber
Net Weight Lbs./Gallon	Base Accelerator	9.3-9.7 9.0-9.4	9.4-9.8 9.1-9.5	9.3-9.7 9.0-9.4	9.3-9.7 9.0-9.4
Mix Ratio (B:A)	Volume Weight	2:1 2:0.97	2:1 2:0.97	2:1 2:0.97	2:1 2:0.97
Worklife, 23°C (73°F)	20 g mixed 10 g mixed 5 g mixed	15 minutes 20 minutes 30 minutes	— — —	15 minutes 20 minutes 30 minutes	15 minutes 20 minutes 30 minutes

- 1 -



Scotch-Weld™

Epoxy Adhesive

DP420 Black • DP420 NS Black • DP420 Off-White • DP420 LH

Technical Data

February, 2016

Product Description 3M™ Scotch-Weld™ Epoxy Adhesives are high performance, two-part epoxy adhesives offering outstanding shear and peel adhesion, and very high levels of durability.

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Base Resin	Base Accelerator	epoxy amine	epoxy amine	epoxy amine	epoxy amine
Colour	Base Accelerator	black amber	black amber	white amber	white amber
Net Weight Lbs./Gallon	Base Accelerator	9.3-9.7 9.0-9.4	9.4-9.8 9.1-9.5	9.3-9.7 9.0-9.4	9.3-9.7 9.0-9.4
Mix Ratio (B:A)	Volume Weight	2:1 2:0.97	2:1 2:0.97	2:1 2:0.97	2:1 2:0.97
Worklife, 23°C (73°F)	20 g mixed 10 g mixed 5 g mixed	15 minutes 20 minutes 30 minutes	— — —	15 minutes 20 minutes 30 minutes	15 minutes 20 minutes 30 minutes

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PROCESSING DATA

MIX RATIO	Components	Parts by weight	Parts by volume
	Araldite® LY 5052	100	100
	Aradur® 5052	38	47

The components must be weighed accurately and mixed thoroughly to obtain optimal properties. The sides and bottom of mixing vessels must be included in the mixing process. Large mix quantities will show considerable exotherm, leading to short potlives. Preferably mix smaller quantities or divide large mixes into smaller containers.

INITIAL MIX VISCOSITY (ISO 12058-1)	[°C]	[mPa s]
	at 18	1150 - 1350
	at 25	500 - 700
	at 40	200 - 250

VISCOSITY BUILD-UP (ISO 12058-1)	[°C]	[mPa s]	[min]
	at 25	to 1500	50 - 60
	at 25	to 3000	90 - 110
	at 40	to 1500	40 - 45
	at 40	to 3000	50 - 60
	at 60	to 1500	15 - 18
	at 60	to 3000	18 - 22

POT LIFE (TECAM, 100 ML, 65 % RH) LONG POTLIFE MEANS AMPLE TIME TO PRODUCE EVEN BIG OBJECTS.	[°C]	[min]
	at 18	280 - 320
	at 25	110 - 160
	at 40	45 - 55

GEL TIME (HOT PLATE)	[°C]	[min]
	at 25	420 - 500
	at 40	150 - 170
	at 60	40 - 55
	at 80	14 - 17
	at 100	4 - 6
	at 120	2 - 3

The values shown are for small amounts of pure resin/hardener mix. In practice, fibre content and laminate thickness may modify the gel time to a very significant extent. In composite structures the gel time can differ significantly from the given values depending on the fibre content and the laminate thickness.

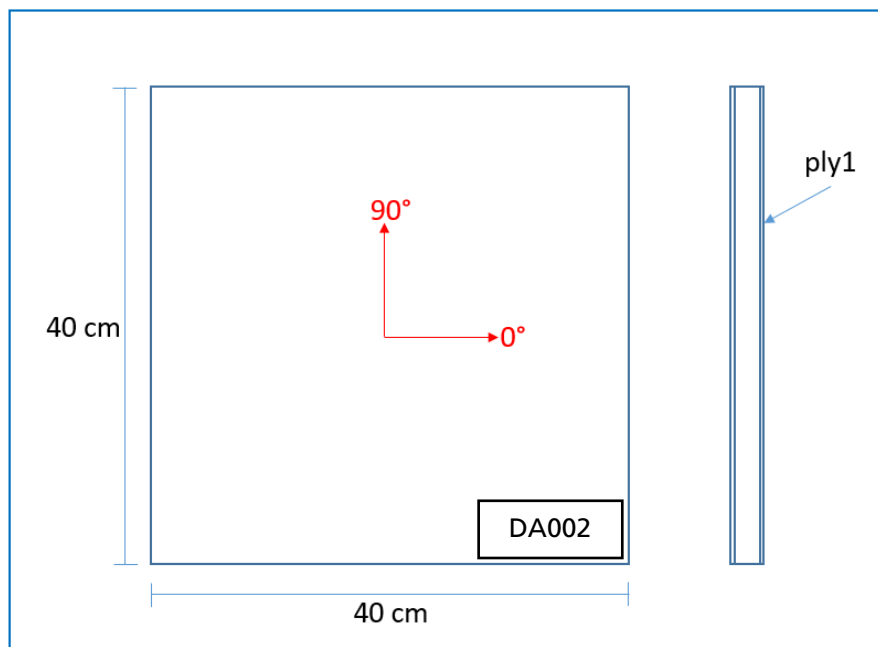
GELATION AT 23 °C (IN THIN LAYERS: 0.4 - 0.7 MM)	Start	[h]
	End	5 - 6.5
		7 - 8

TYPICAL CURE CYCLES	1 day 23 °C + 15 h 50 °C or 1 day 23 °C + 4 h 100 °C
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The optimum cure cycle has to be determined case by case, depending on the processing and the economic requirements.

Appendix 2: Composite panel definition

PN: DA002



Stacking table of repair

SEQUENCE	MATERIAL	DIAMETER	TOLERANCE
1	Carbon Fabric: G803 ±45°	Ø 114.8 mm	± 4 mm
2	Carbon Fabric: G803 0/90°	Ø 94.8 mm	± 4 mm
3	Carbon Fabric: G803 ±45°	Ø 72.8 mm	± 4 mm
4	Carbon Fabric: G803 0/90°	Ø 50.8 mm	± 4 mm
5	Honeycomb nomex 4.8 kg – 48 kg	Ø 50.8 mm	± 4 mm

G803: Thickness 0.20 mm/layer

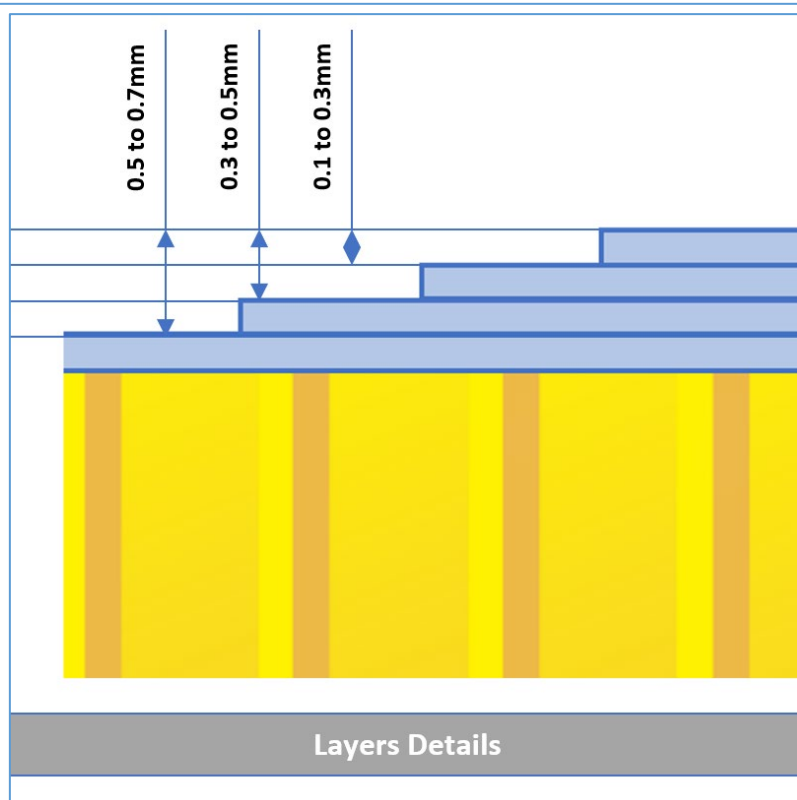
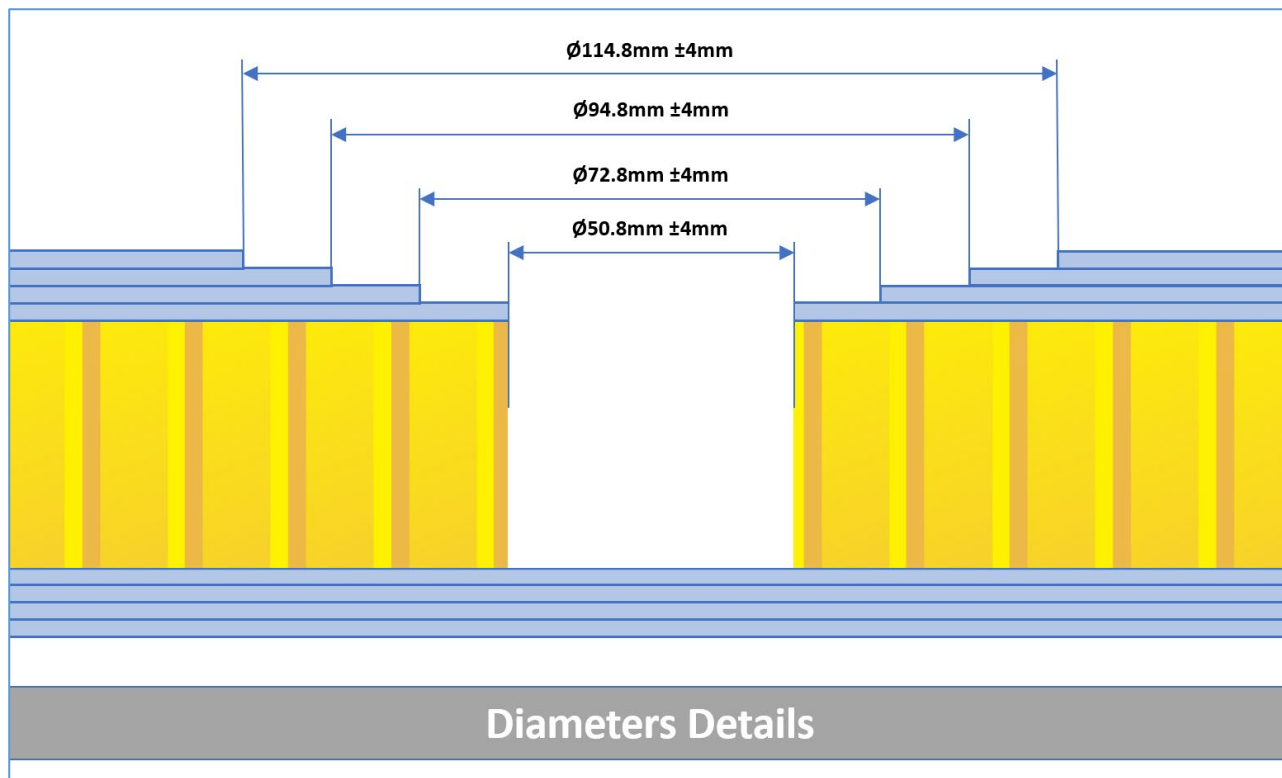
Appendix 3: Part Numbers

DESIGNATION	PART NUMBER
Composite Panel for Tap Test	DA 001
Composite Panel for Repair	DA 002
Marking jigs Ø50.8 mm	DA 003
Marking jigs Ø72.8	DA 004
Marking jigs Ø94.8	DA 005
Marking jigs Ø114.8	DA 006
CAUL PLATE	DA 007

Appendix 4: Stepping Details

Marking Jigs are provided to trace the reference marks for stepping.

Thickness : 0.2mm / Layer



TASK CARD		TECHNICAL REF	FAA-H-8083-31A-AMT-AIRFRAME-VOL-1, CHAPTER 7	PAGE:
Carry out carry out a core repair, wet layup repair and vacuum bagging.	Panel P/N	DA002	Reported by	
	Date			

S/N	MAINTENANCE REQUIRED	RESOLUTION	RESOLVED BY/DATE
Certifies that the work specified except as otherwise specified was carried out in accordance with the requirement of the Air Navigation Act and in respect to that work the aircraft/engine/aircraft component is considered ready for release to service		Certified by (Signature & ACA) Date	