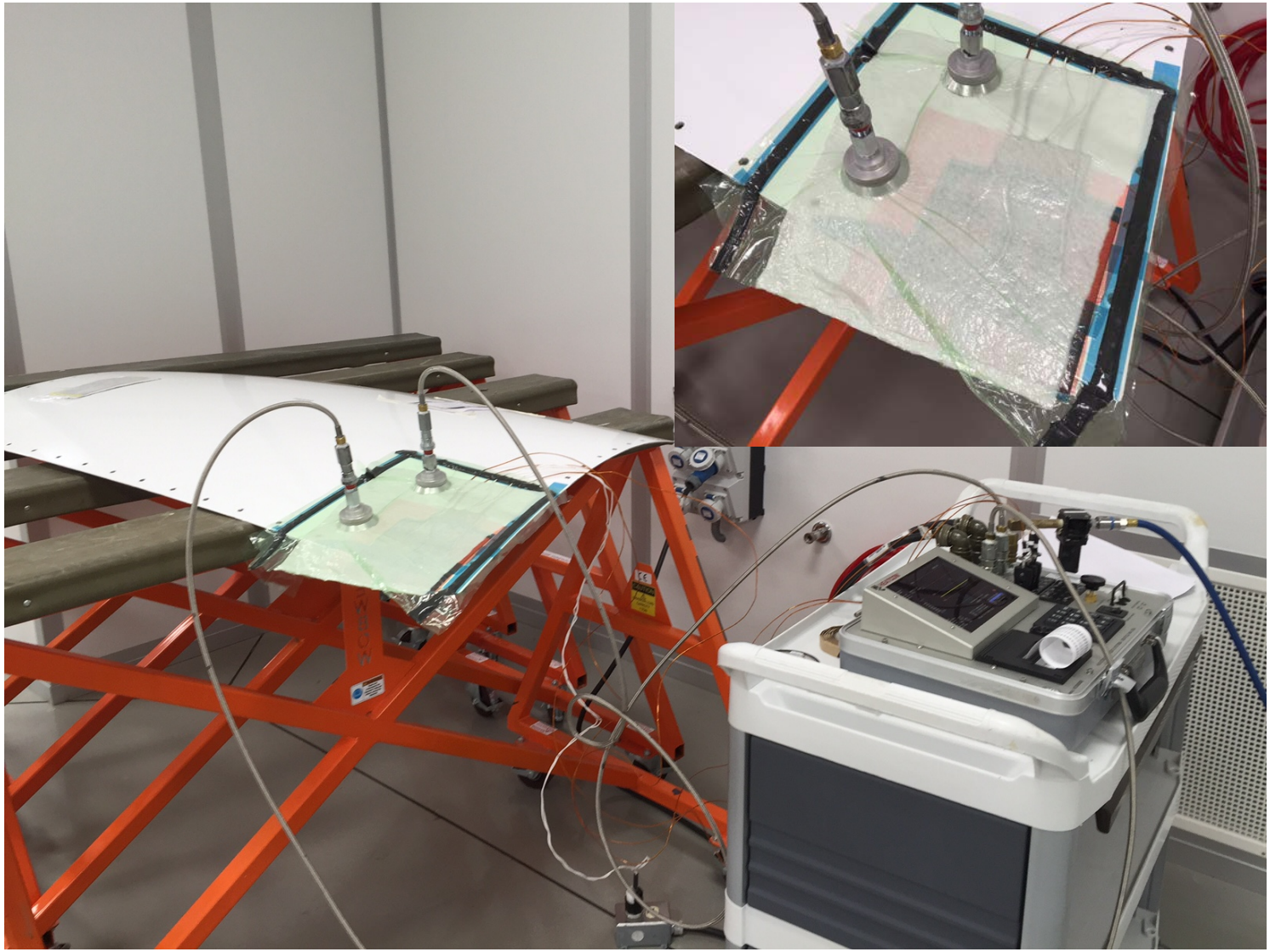
AGENDA:

- Vacuum bagging layup and types.
- Vacuum Bagging material.
- Step sanding and taper sanding, or not.
- Heating devices and molding.
- Tool.
- Hot bonder with accessories.
- Composite Structure build up:
  - Monolithic Structure
  - Sandwich structure.
- Cure cycle
- Failure awareness during layup and cure cycle.

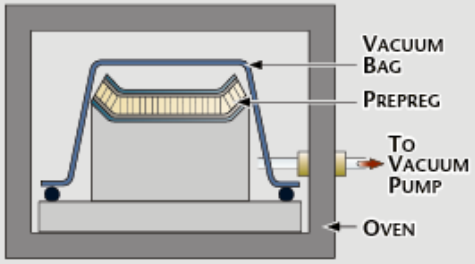
SKILLMAN DAY 2

VACUUM BAGGING

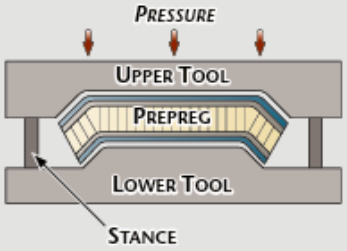
TECHNICAL EDUCATION COPENHAGEN



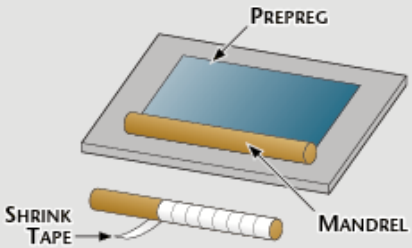
VACUUM BAGGING AND OTHER CURING PROCESSES



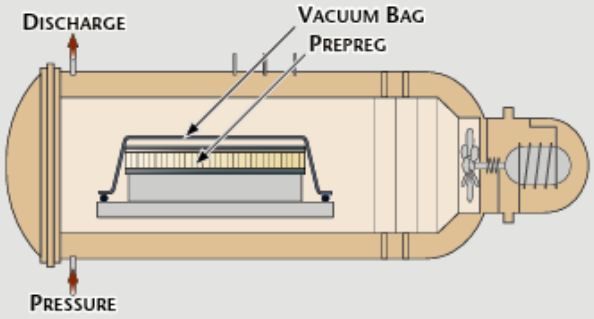
VACUUM BAG PROCESS



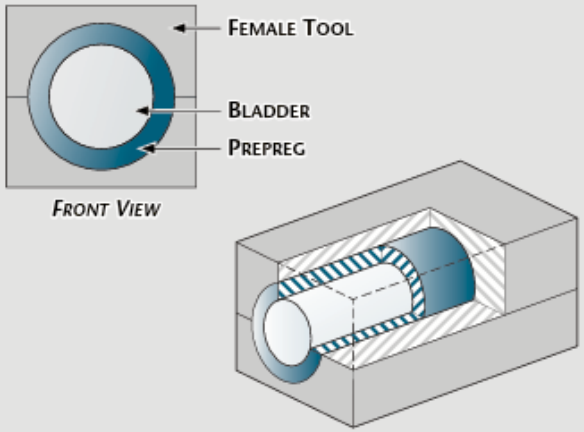
MATCH MOULDING PROCESS
- *Oven Cure or Hot press*



TUBE ROLLING PROCESS
- *Oven Cure*



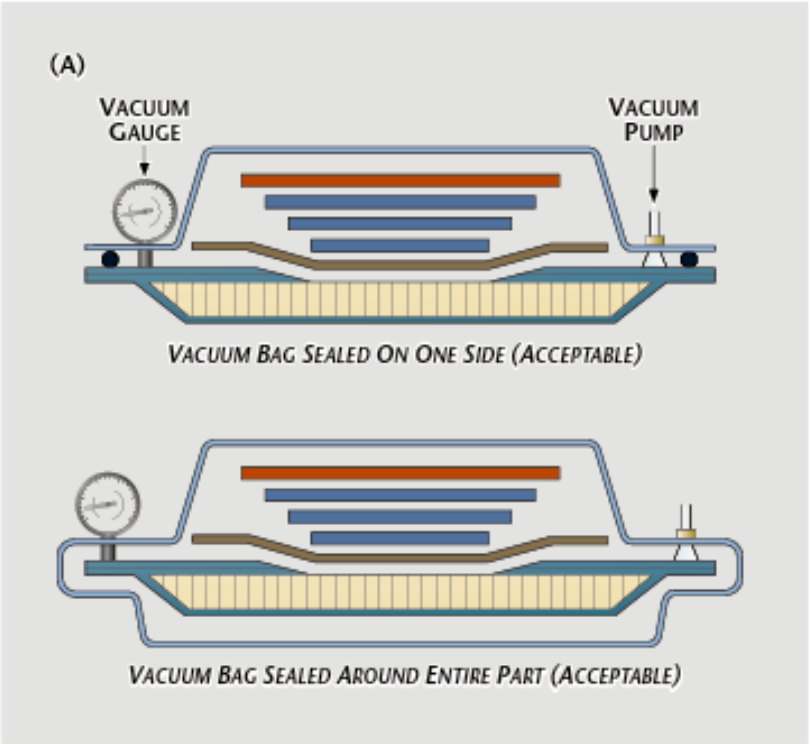
AUTOCLAVE PROCESS

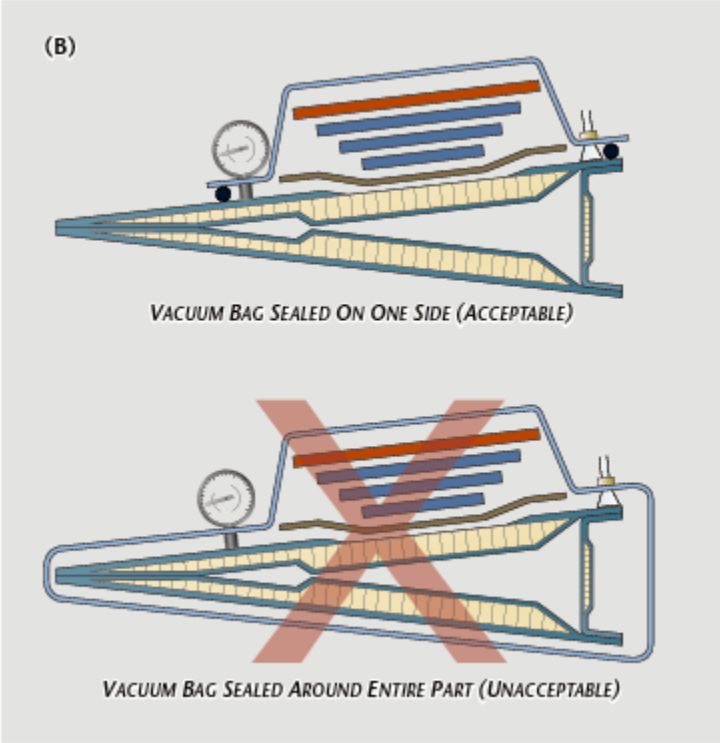


PRESSURE BAG PROCESS

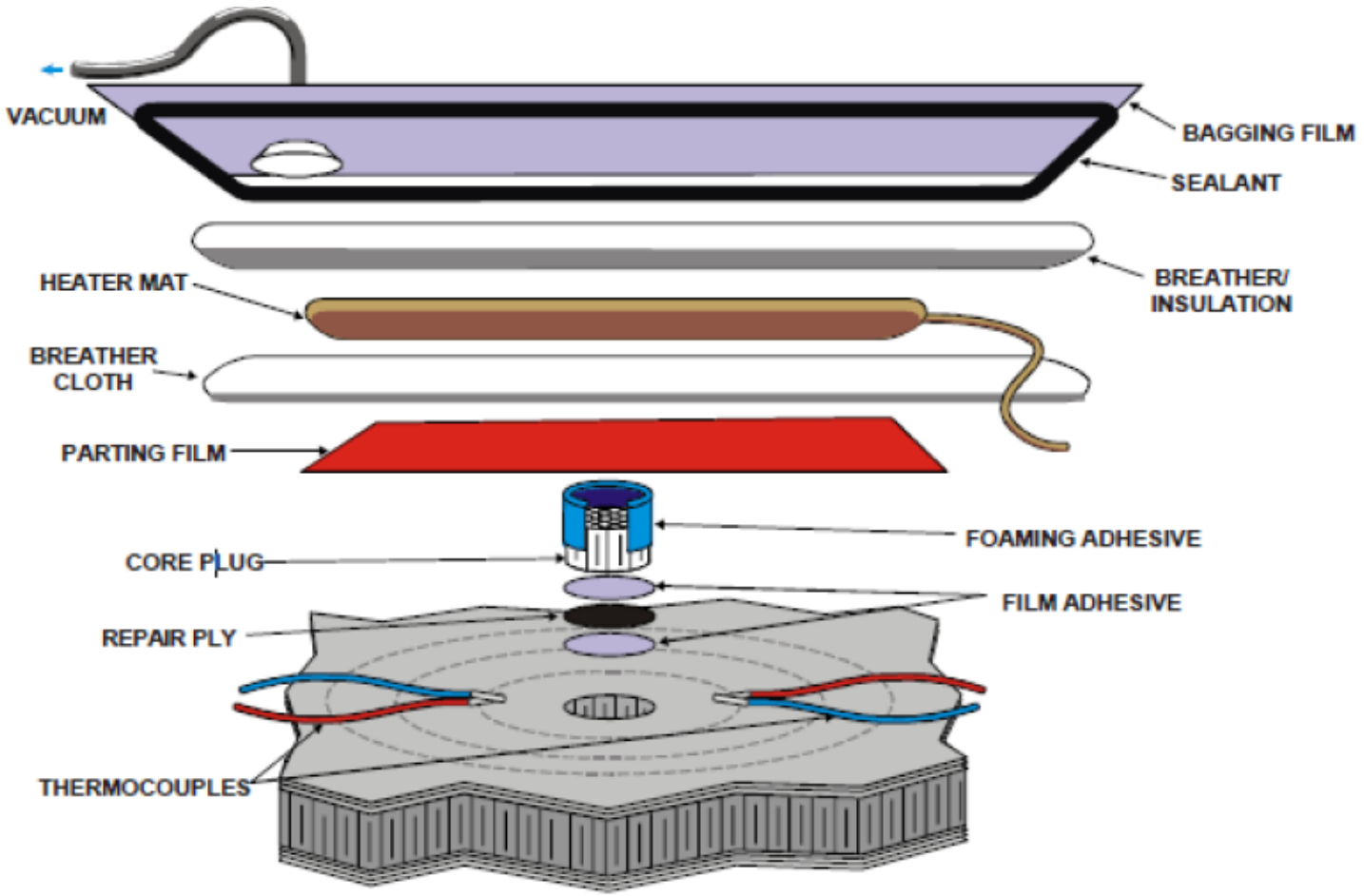
VACUUM BAGGING AND OTHER CURING PROCESSES

TECHNICAL EDUCATION COPENHAGEN

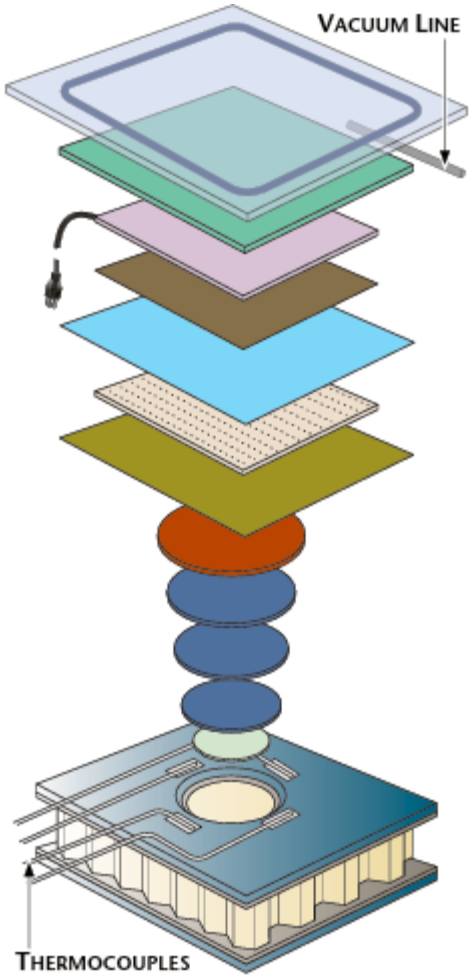




VACUUM BAGGING



VACUUM BAGGING

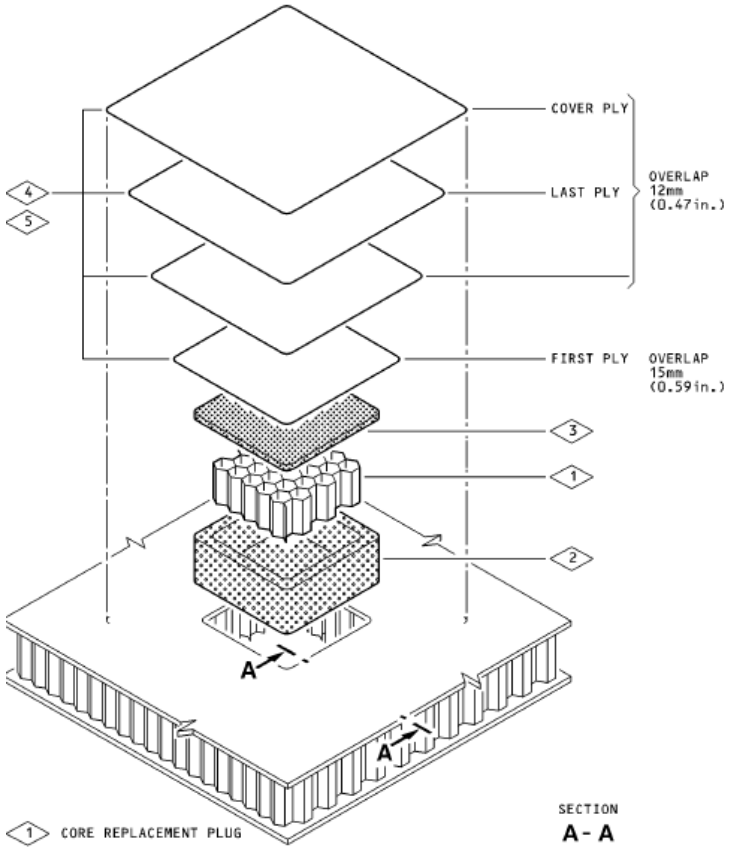


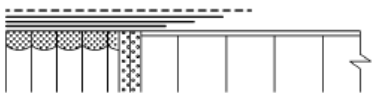
- VACUUM BAG
- SEALING COMPOUND
- SURFACE BREATHER
- HEAT BLANKET
- SOLID PARTING FILM
- SURFACE BLEEDER CLOTH
- PERFORATED PARTING FILM
- PEEL PLY
- EXTRA PLY
- REPAIR PLY
- FILLER PLY

VACUUM BAGGING

TECHNICAL EDUCATION COPENHAGEN

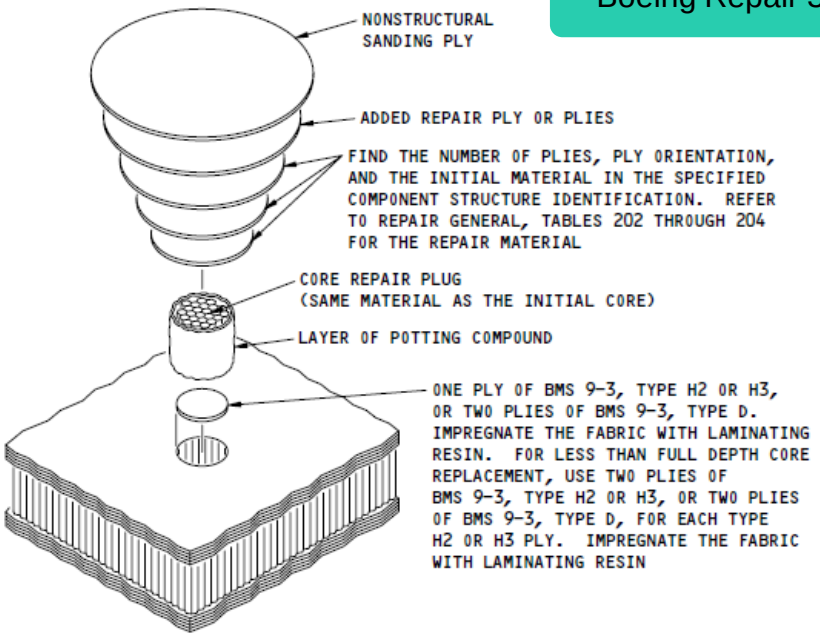
Airbus Repair

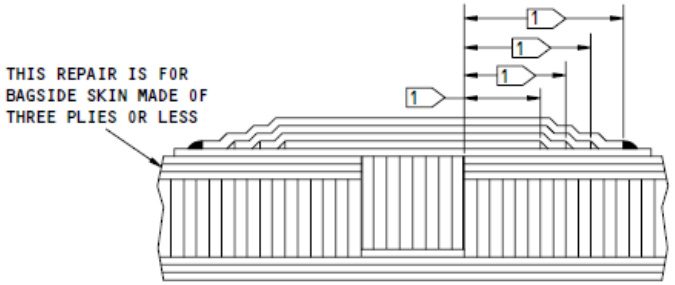




Wet Lay-Up Repair - one skin damaged

Boeing Repair 3



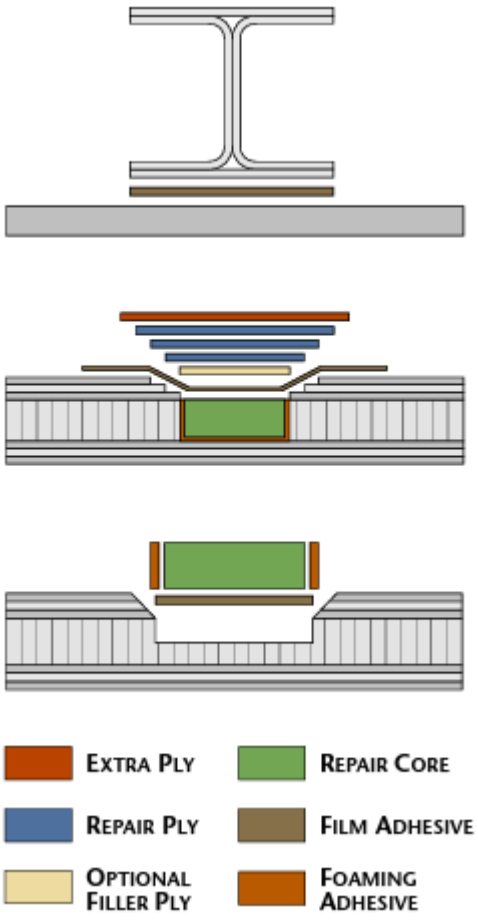


SECTION THROUGH REPAIR

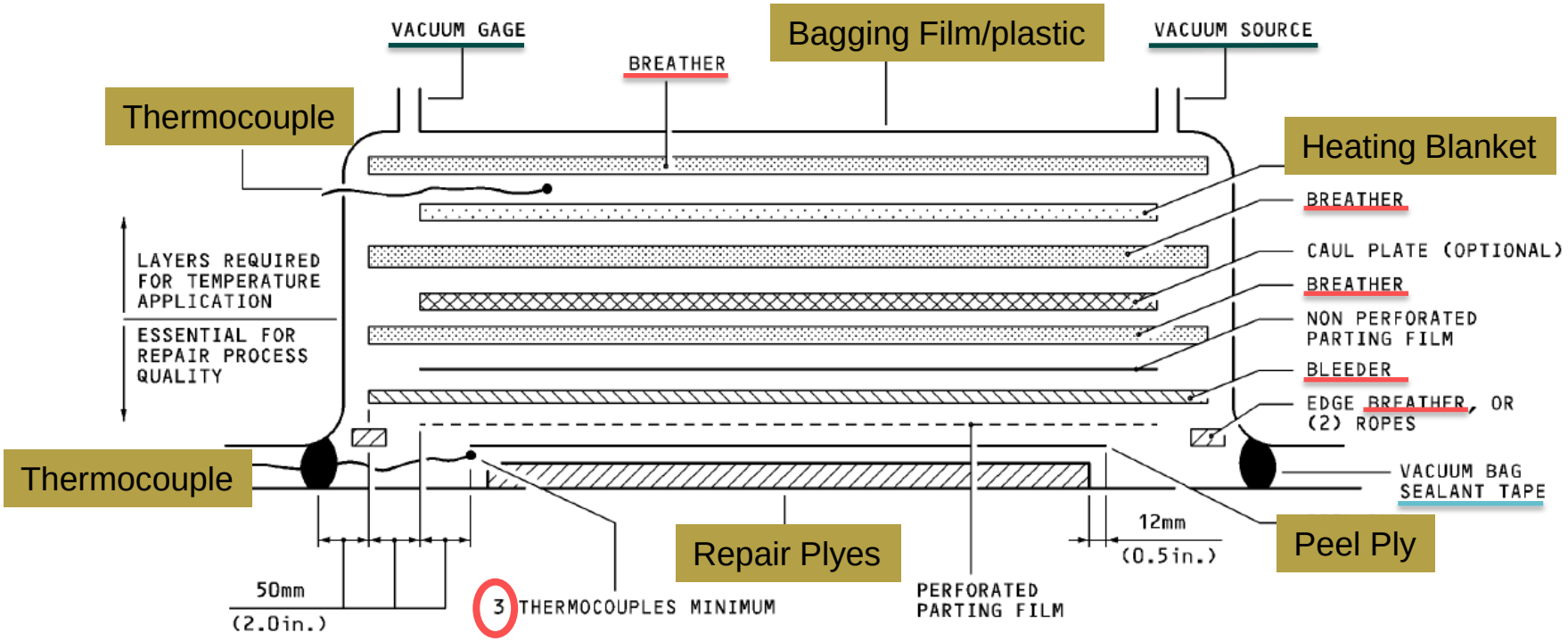
NOTES

1 REFER TO REPAIR GENERAL, FIGURE 207 FOR THE NECESSARY TAPER AND OVERLAP.

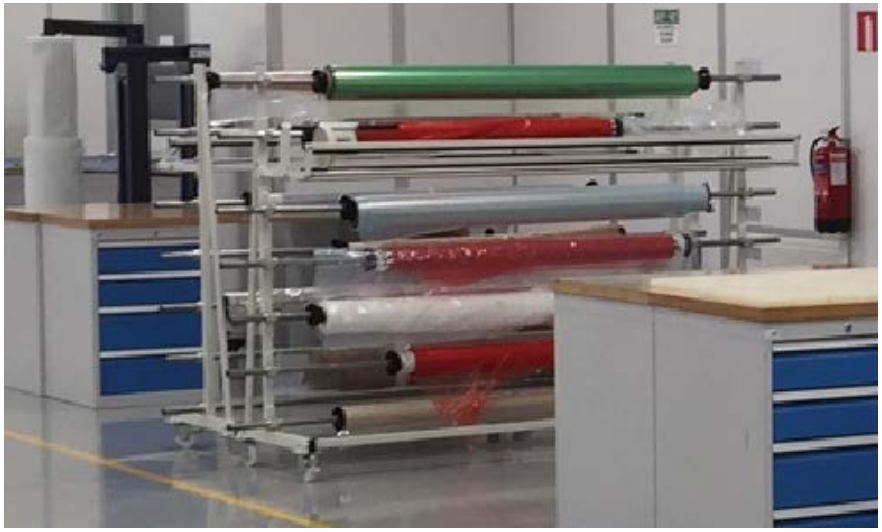
VACUUM BAGGING

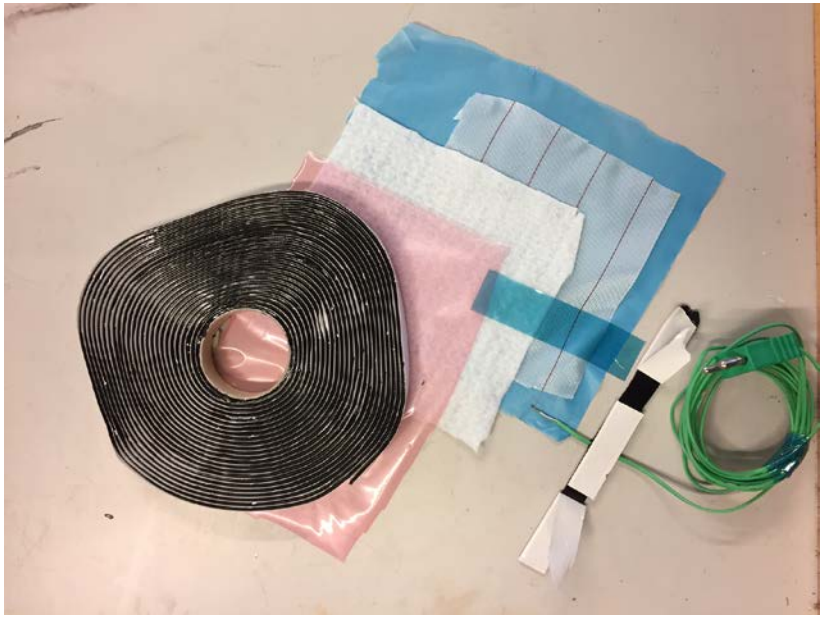


Vacuum bagging material.



BAGGING MATERIAL AND TOOL

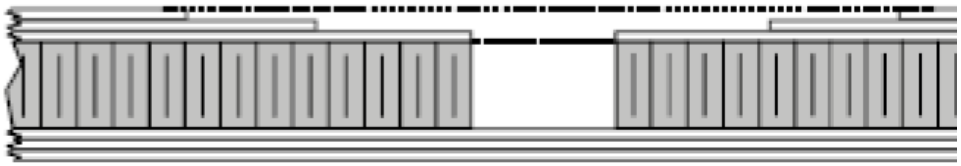




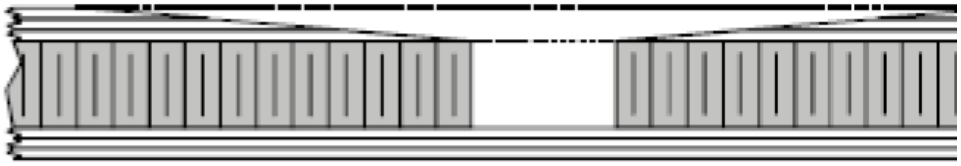
BAGGING MATERIAL AND TOOL

BAGGING MATERIAL AND TOOL

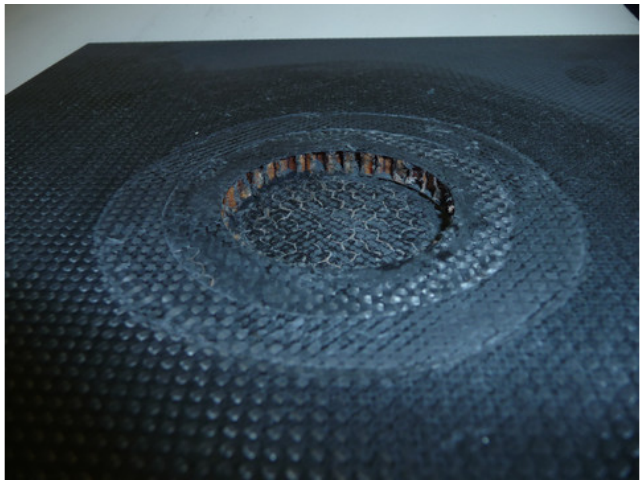
STEP SANDING AND TAPER SANDING

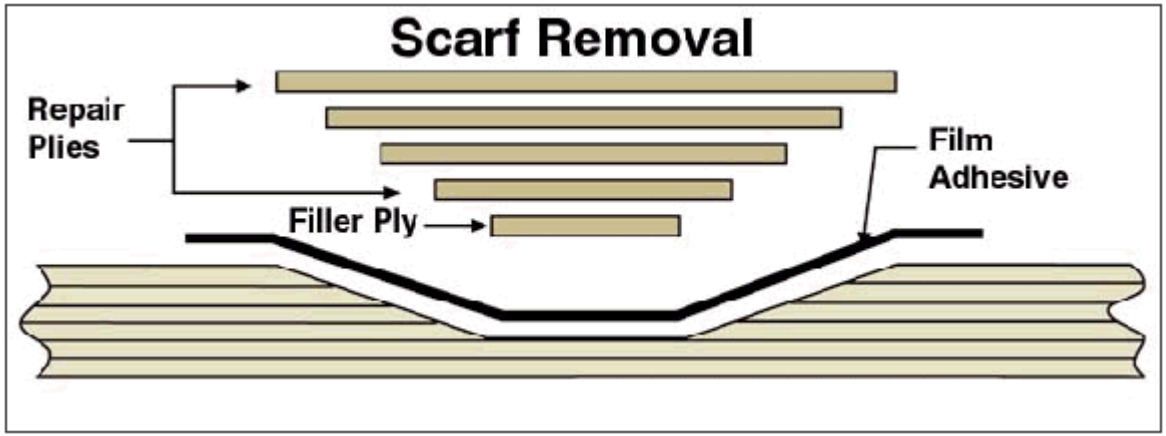


STEP SANDING



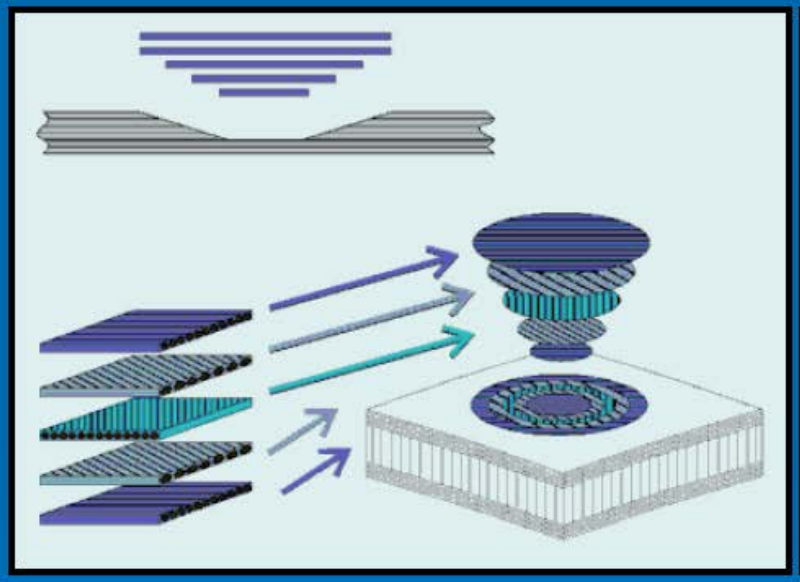
TAPER SANDING

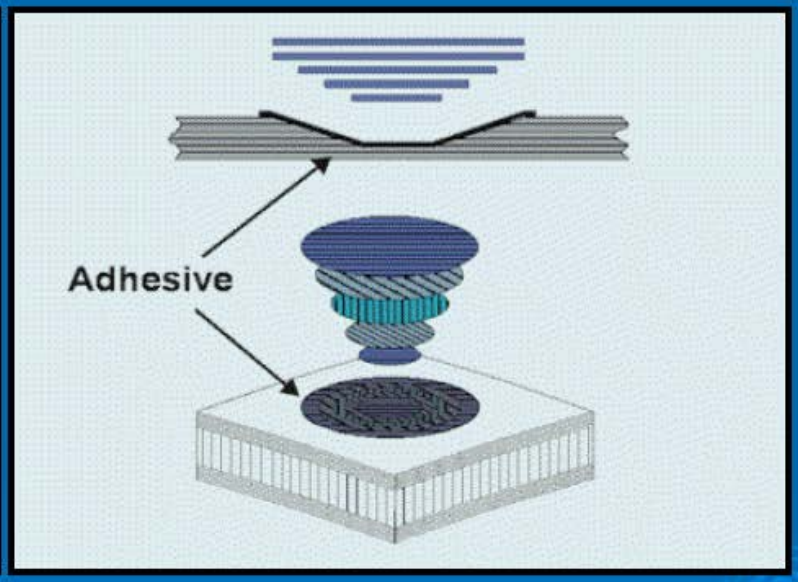




STEP SANDING AND TAPER SANDING

First remove damaged material and prepare area for repair

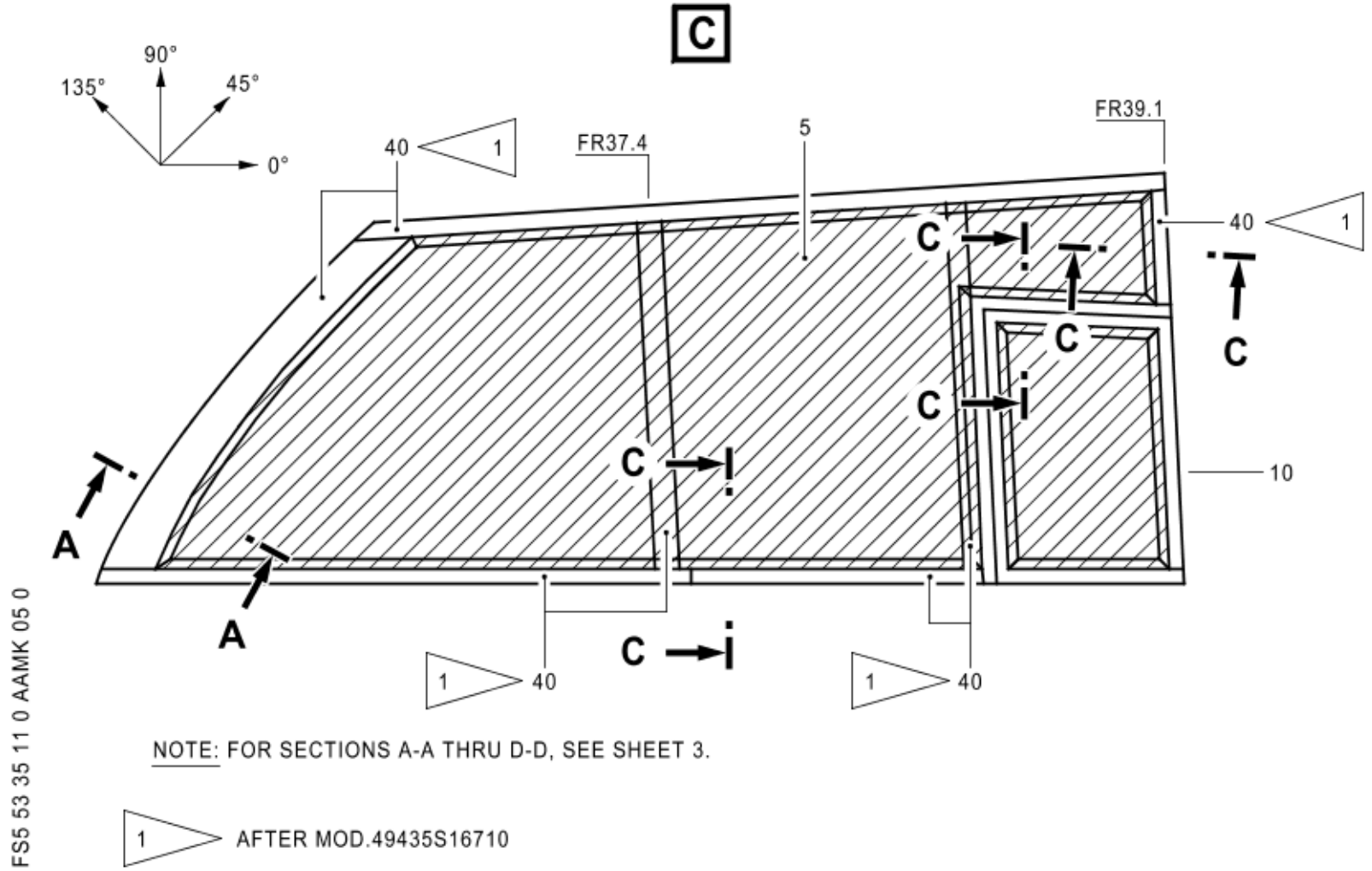




Determine plies/orientations in the original structure & develop repair

Replace plies/orientations to match the original structure

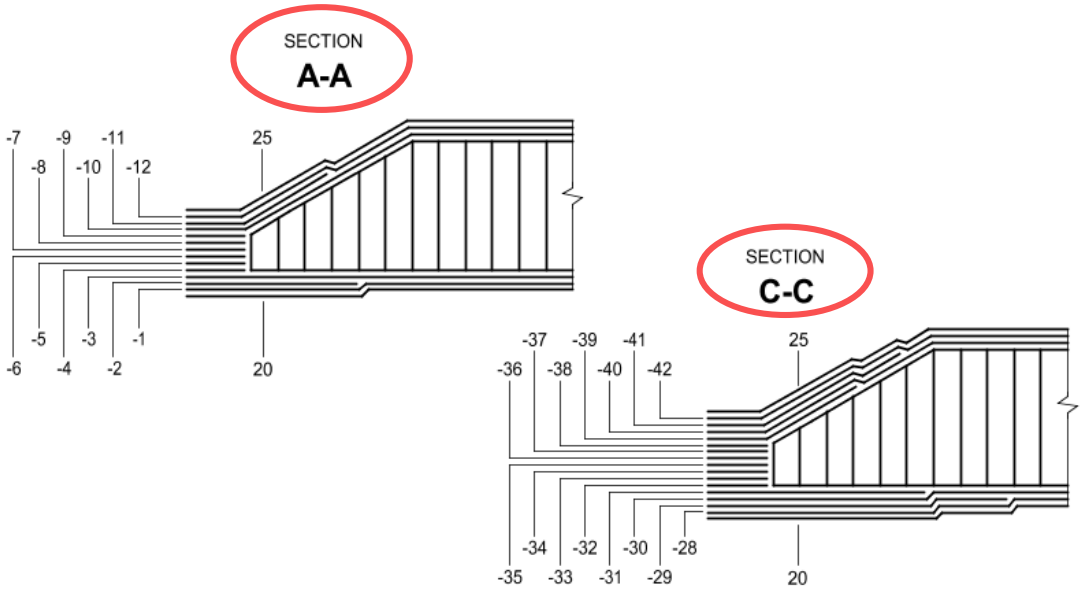
A330 Fairing Panel 191CB



A330 Fairing Panel 191CB

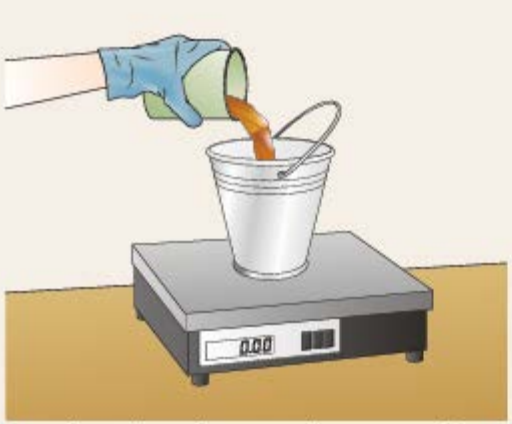
PLY ORIENTATION TABLE

PLY N°	ORIENTATION
-1	0°
-2	45°
-3	90°
-4	0°
-5	0°
-6	0°
-7	0°
-8	0°
-9	0°
-10	90°
-11	45°
-12	0°
-13	0°
-14	45°
-15	90°
-16	0°
-17	0°
-18	45°
-19	0°
-20	0°
-21	0°
-22	45°
-23	0°
-24	0°
-25	90°
-26	45°
-27	0°
-28	0°
-29	45°
-30	90°
-31	0°
-32	0°
-33	45°
-34	0°
-35	0°
-36	0°
-37	45°
-38	0°
-39	0°
-40	90°
-41	45°
-42	0°
-43	45°
-44	0°
-45	90°
-46	90°
-47	0°
-48	45°
-49	0°
-50	0°
-51	0°
-52	45°
-53	90°
-54	0°
-55	0°
-56	45°
-57	0°
-58	0°
-59	0°
-60	45°
-61	0°
-62	0°
-63	0°
-64	90°
-65	90°
-66	45°
-67	0°
-68	0°

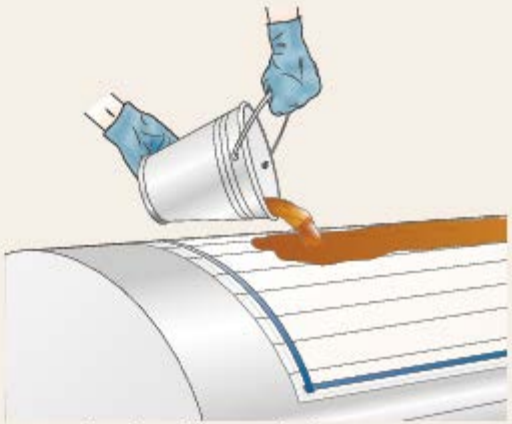


LAY-UP FIBER LAMINATING

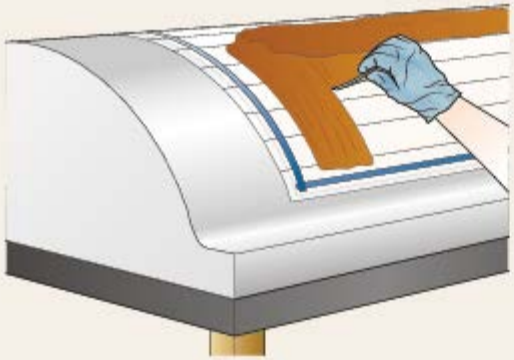
- **Bagging film one upper and lower piece.**
- **Measure weight of Fibers.**
- **Resin 1.2 as general times Fiber weight 1.1.2**
- **Segregate resin to Fiber between the to layer of Bagging film.**
- **Draw the deferent sizes of fibers on outside bagging film.**
- **Cut out the needed sizes and in direction as repair guideline.**
- **Prepared cut out can be stored in freezer on -18°C. to stop Curing process.**
- **Caution Be aware of air bobbles.**



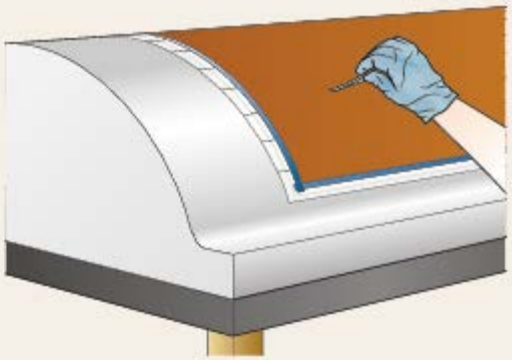
Weigh and mix the required quantity of surface fill



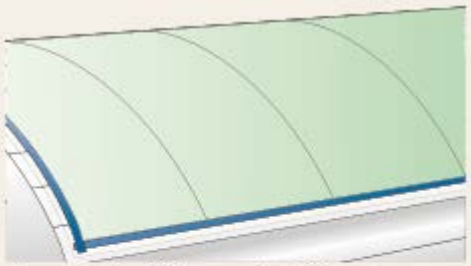
Mixed surface fill is applied



Brush surface fill across at right angles



Smooth out surface fill



Impregnated fiber material layer

Adding a layer of porous release film

Adding a layer of breather material

Vacuum bag added and vacuum hose attached

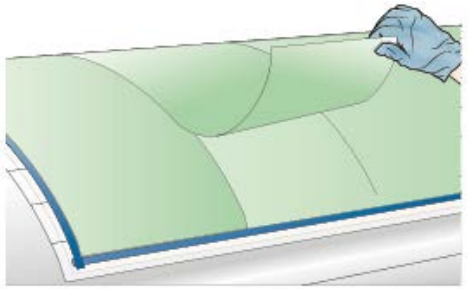
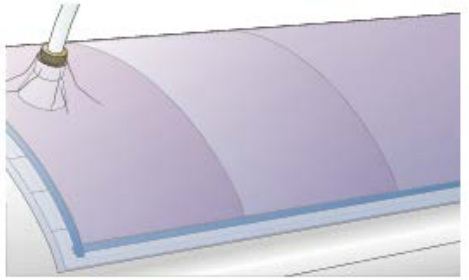


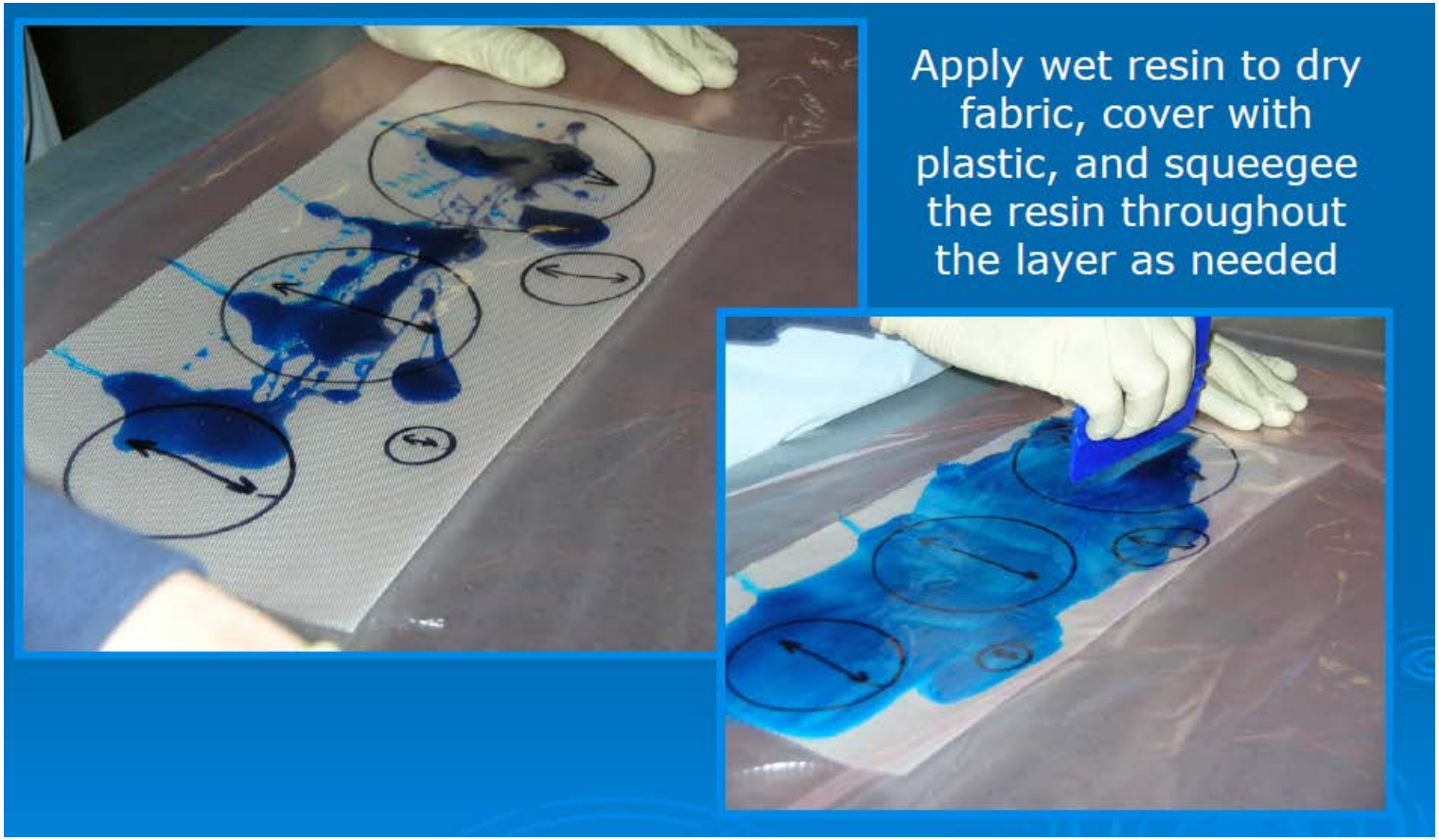
Figure 5-2-7. Application of additional wet layup plies



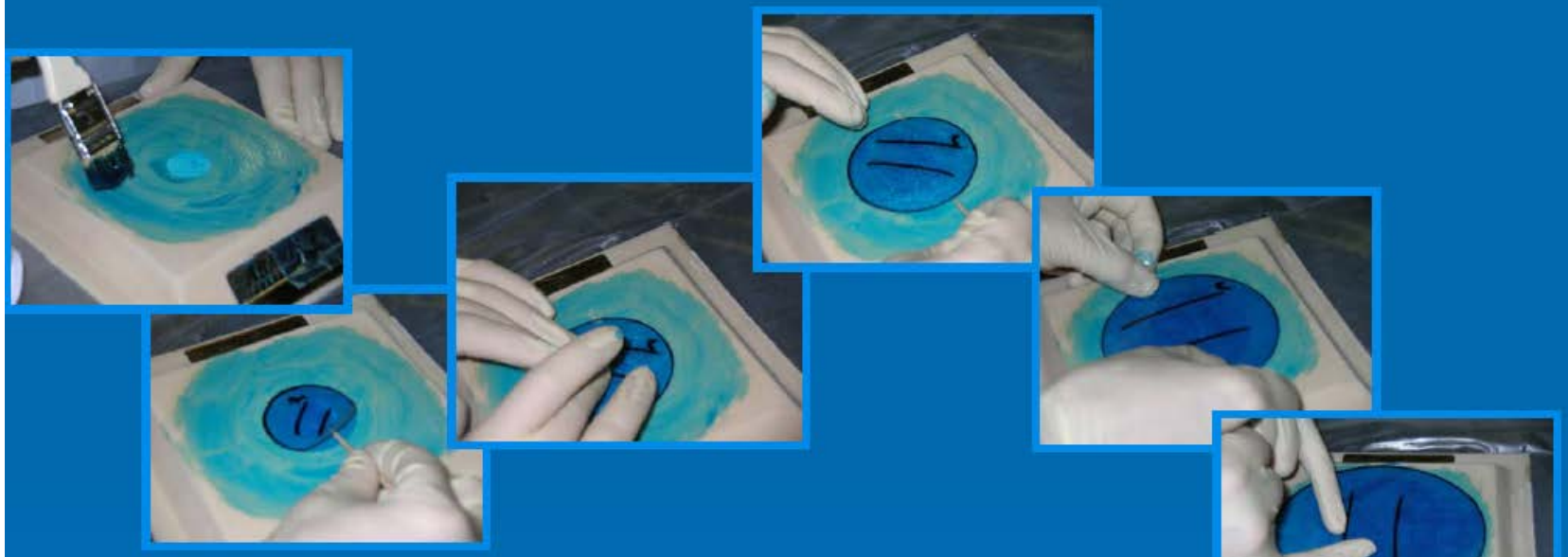
Typical Wet Layup Repair Process

Remove damaged skin & core then taper-scarfed skin

Repair/fill core cavity as required & machine flush

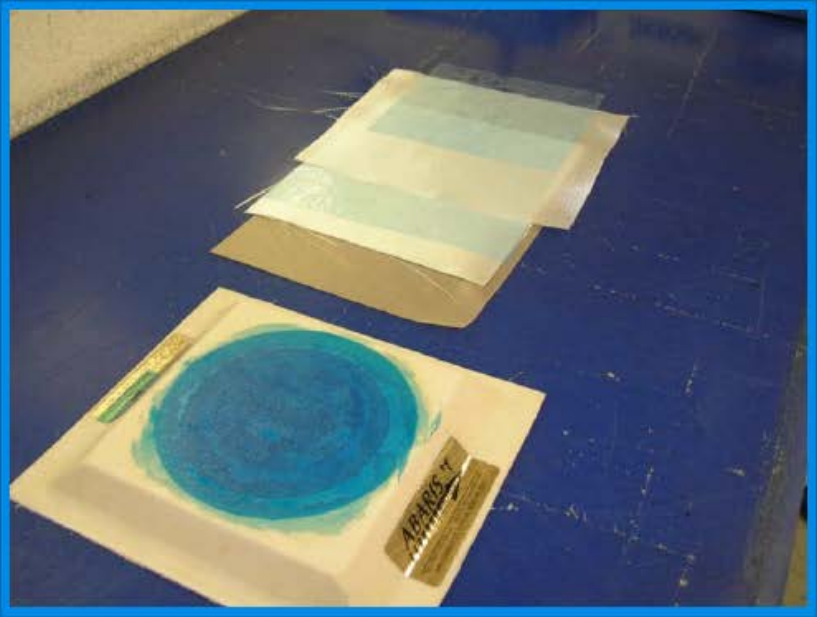

Apply wet resin to dry fabric, cover with plastic, and squeegee the resin throughout the layer as needed

Typical Wet Layup Repair Process



Wet-out the surface with an interface coat of resin and layup each repair ply to match the orientation of corresponding plies in structure

Typical Wet Layup Repair Process

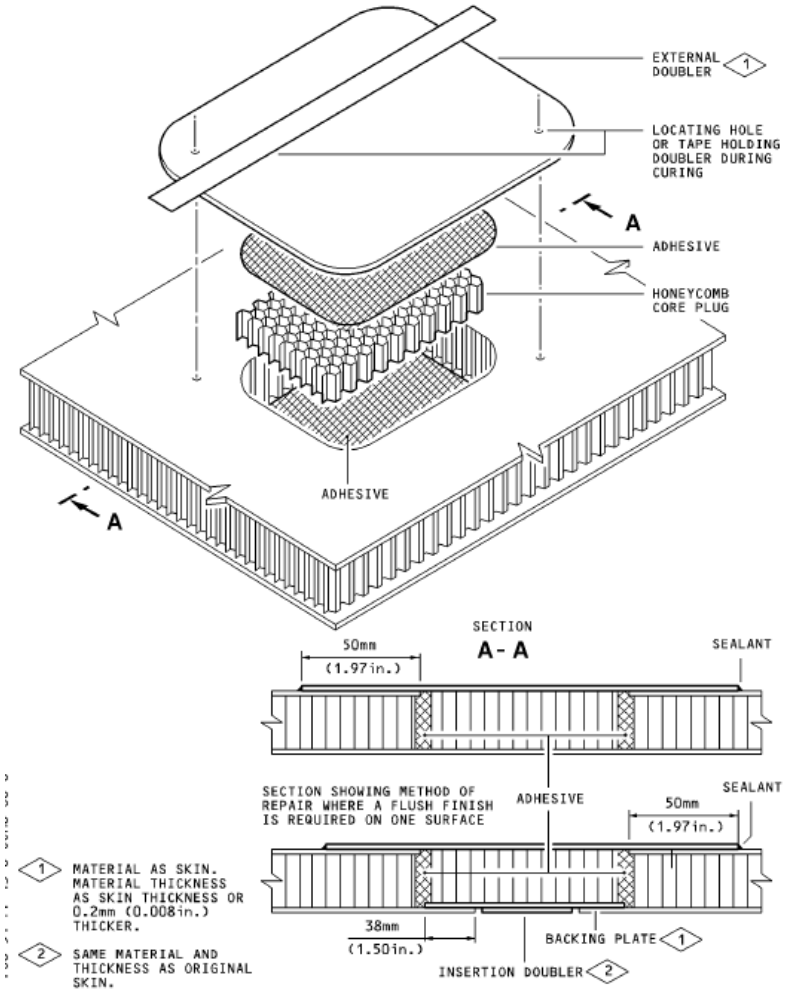


Apply peel ply, bleeder, & breather materials and vacuum bag for cure

Typical Wet Layup Repair Process

After curing, remove breather, bleeder, & peel ply and inspect the repair

- **General Roles:**
  - **Higher cure temperature.**
  - **Film adhesive to be added.**
  - **No spillage of Adhesive.**
  - **Faster repair procedure.**
  - **Stores problem and registration.**



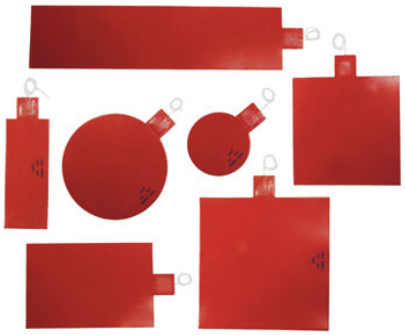
Skin Repair with Core Replacement – one skin or both skins damaged

Heating devises

- Heat/Hot bonder with heat blanket.
- Infrared light
- Heat Bulb
- Heat Gun
- Room temperature curing.
- Autoclave oven





Heating devises

Heating devises

Integral heating tool

Molding

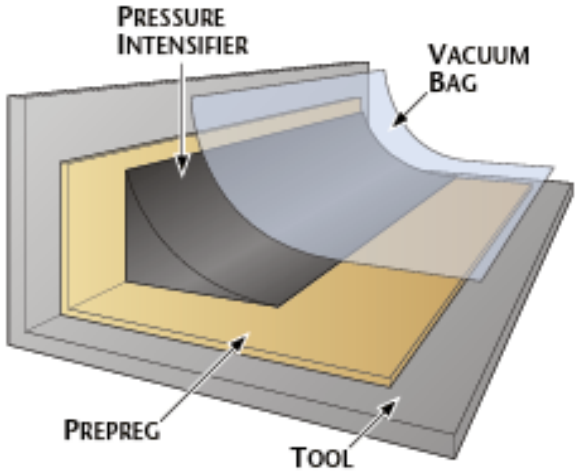


Figure 5-1-10. The pressure intensifier prevents the accumulation of resin in corners and high-void-content areas

From www.flightglobal.com - June 18, 2013 10:30 AM

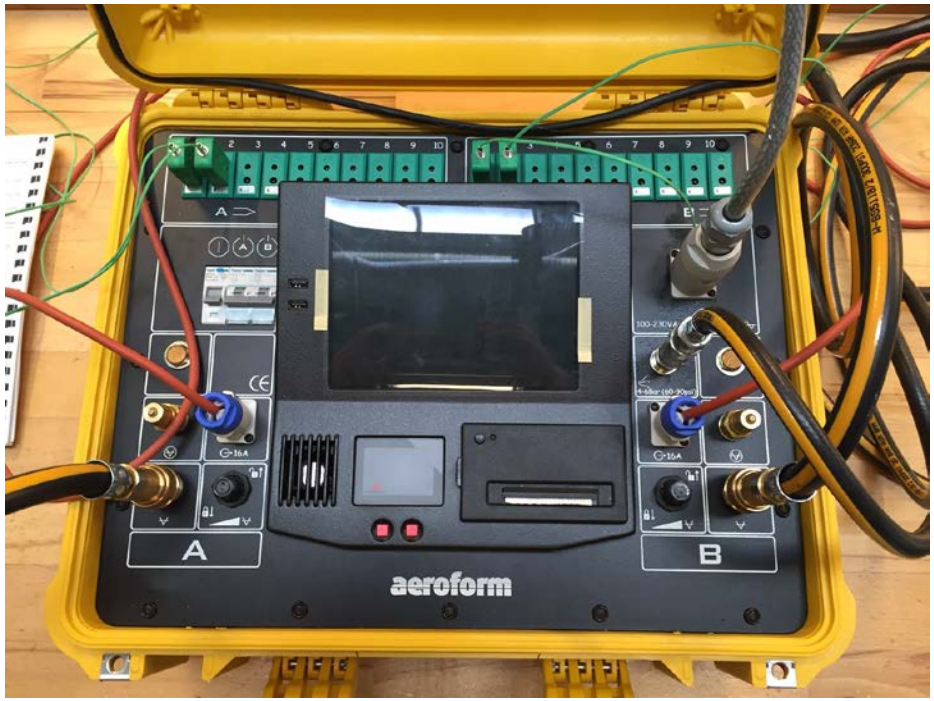
" When the Airbus A350 first took to the skies last week, much attention was focused on the Rolls-Royce Trent XWB powerplants that made the flight possible...."

Figure 5-1-7. Large Invar tool for aircraft production

Courtesy of Airbus

Hot bonder


Zone A Profile
File name
Superman.prf
Description
DUBLE MATS
Temperature profile
Seg
Rate °C/min
Level °C
Soak Hrs
1 5.0 60.0 2.00
2 1.0 55.0 0.50
3 1.0 40.0 0.20
4 8.0 20.0 0.10
5 0.0 0.0 0.00
6 0.0 0.0 0.00
7 0.0 0.0 0.00
8 0.0 0.0 0.00
Alarm settings
Over temp trip 100.0 °C
Minimum Vacuum 0.0 PSI
Deviation
HI limit 25.0 °C
LO limit 25.0 °C
Heaters
Infrared Lamps
Heater mats
Heater current alarm 0.0 Amps
Open
Save
Apply
Close
Help
Profile length 3.22
Fine adjustments


A
B
aeroform

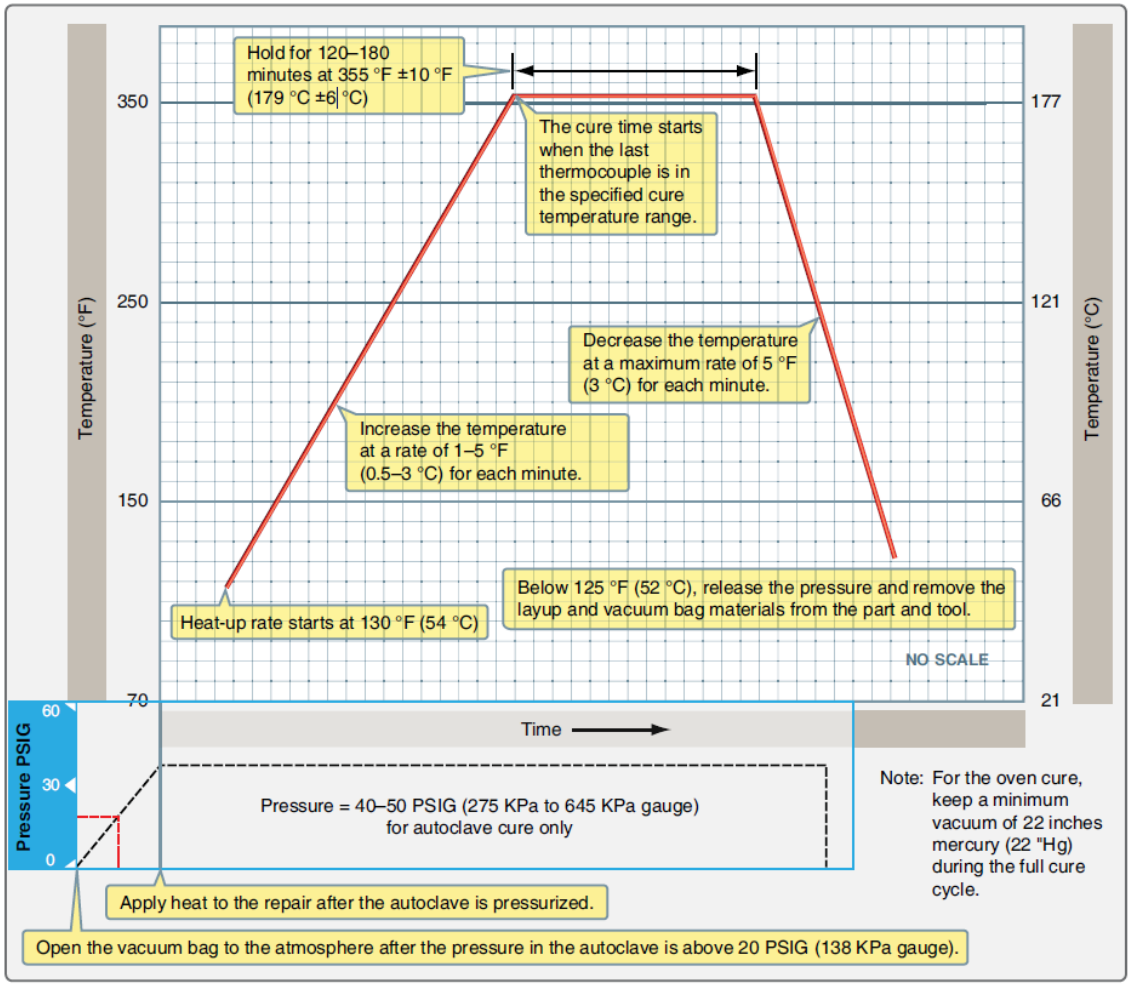
Hot Bonder


Zone A Profile
File name
Superman.prf
Description
DUBLE MATS
Temperature profile
Seg
Rate °C/min
Level °C
Soak Hrs
1 5.0 60.0 2.00
2 1.0 55.0 0.50
3 1.0 40.0 0.20
4 8.0 20.0 0.10
5 0.0 0.0 0.00
6 0.0 0.0 0.00
7 0.0 0.0 0.00
8 0.0 0.0 0.00
Profile length - 3:22
Alarm settings
Over temp trip 100.0 °C
Minimum Vacuum 0.0 PSI
Deviation
HI limit 25.0 °C
LO limit 25.0 °C
Fine adjustments
Heaters
Infrared Lamps
Heater mats
Heater current alarm 0.0 Amps
Open
Save
Apply
Close
Help

Cure Cycle / Varme Teknik

- **RAMP UP**
- **HOLD ON SOAK**
- **COOL DOWN**

- **THE MORE HEAT THE BEATER STRINGS.**
  - **Always follow the SRM instruction.**
    "WHY"



MANUFACTURER/CODE	MATERIAL NO. (CML NO.)	MIXING RATIO (PARTS BY WEIGHT RESIN : HARDENER)	CONSISTENCY	POT LIFE AT 25 °C (77 °F)	GEL TIME AT 25 °C (77 °F) (HOURS)	CURING CYCLE <7>	FLOW ON VERTICAL SURFACES	SHRINKAGE
VANTICO / ARALDITE AW106 + HARDENER HV953U <3> <5>	08-001	100:80	Paste	100 min. for approx. 100 g (3.5 oz) amount	✓ <1>	24 hours at 25 °C (77 °F) or 3 hours at 40 °C (100 °F)	yes <4>	high
					5	1 hour at 70 °C (160 °F) <2>		
3M / EC1838 B/A	08-001A	100:100	Paste	Approx. 1 hour for 100 g (3.50 z) amount	6	7 days at 25 °C (77 °F) or 2 hours at 65 °C (150 °F) <2> or 30 minutes at 90 °C (200 °F) <2>	no	moderate
VANTICO / ARALDITE AV138 + HARDENER HV998	08-010	100:40	Paste	35 min. for approx. 100 g (3.5 oz) amount	3	48 hours at 25 °C (77 °F) or 16 hours at 40 °C (100 °F) or 1 hour at 70 °C (160 °F) <2>	no	moderate
VANTICO / ARALDITE AW134 + HARDENER HY994 <3>	08-010A	100:40	Paste	60 to 70 min. for 100 g (3.5 oz) amount	3	1 hour at 60 °C (140 °F) <2> or 20 minutes at 80 °C (180 °F) <2>	yes <4>	moderate
VANTICO / ARALDITE AW134 + HARDENER HV997 <3>	08-010A	100:60	Paste	50 to 70 min. for 100 g (3.5 oz) amount	3	8 hours at 25 °C (77 °F) or 30 minutes at 60 °C (140 °F) <2> or 15 minutes at 80 °C (180°F) <2>	yes <4>	moderate
HYSOL / EA9321 <3>	08-010D	100:50	Thixothropic	40 min. for approx. 450 g (16 oz) amount	✓ <1>	7 days at 25 °C (77 °F) or 1 hour at 80 °C (176 °F) <2>	yes <4>	moderate
HYSOL / EA9309.3NA <3>	08-017	100:22	Paste	35 min. for approx. 450 g (16 oz) amount	5	3 to 5 days at 25 °C (77 °F) or 1 hour at 80 °C (180 °F) <2>	yes <4>	moderate
3M / EC2216 B/A <3>	08-017A	100:140	Paste	90 min. for 100 g (3.5 oz)	5	7 days at 25 °C (77 °F) or 2 hours at 65 °C (150 °F) <2>	yes <4>	moderate
HYSOL / EA934 NA	08-051	100:33	Thixothropic	40 min. for approx. 450 g (16 oz) amount	2	5 to 7 days at 25 °C (77 °F) or 8 hours at 50 °C (120 °F) or 1 hour at 90 °C (200 °F) <2>	no	moderate
HYSOL / EA9394 A/B	08-078	100:17	Thixothropic	100 min. for 450 g (16 oz) amount	<6>	5 days at 25 °C (77 °F) or 70 minutes at 70 °C (160 °F) <2>	no	moderate
VANTICO / ARALDITE 420 A/B <3>	08-089	100:40	Paste	1 hour for approx. 100 g (3.5 oz) amount	6	7 days at 25 °C (77 °F) or 4 hours at 50 °C (120 °F) or 1 hour at 120 °C (250 °F) <2>	yes <4>	moderate

Table 1 - Paste Adhesives

<1> Gellation at RT (Room Temperature) not required. Cure cycle can be applied directly.

<2> Tolerances: ± 5 °C (9 °F) on curing temperature and 0/+ 15 minutes on curing time.

<3> Not recommended for core closing.

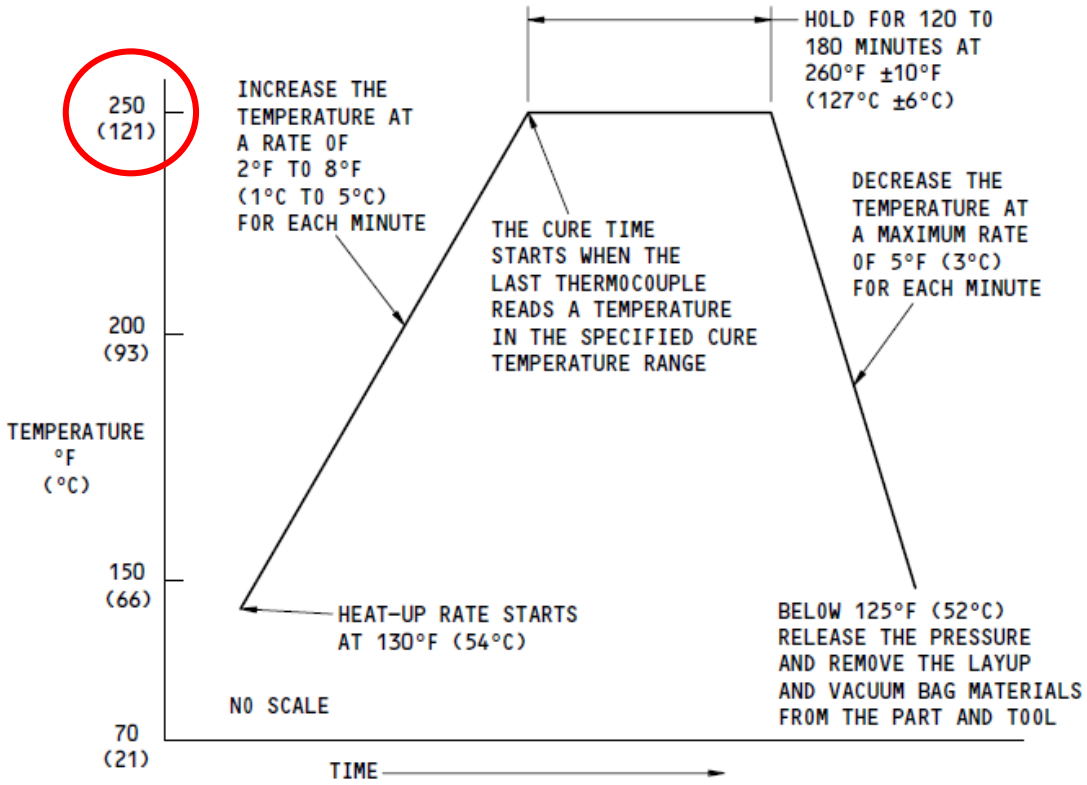
<4> If required add thickening agent (Material No. 05-089), refer to Paragraph 4.A.(3).(e) .

<5> Unless otherwise stated in specific Chapter. Do not use this paste for potting and core splicing.

<6> Wait for 1 hour minimum at RT prior to curing.

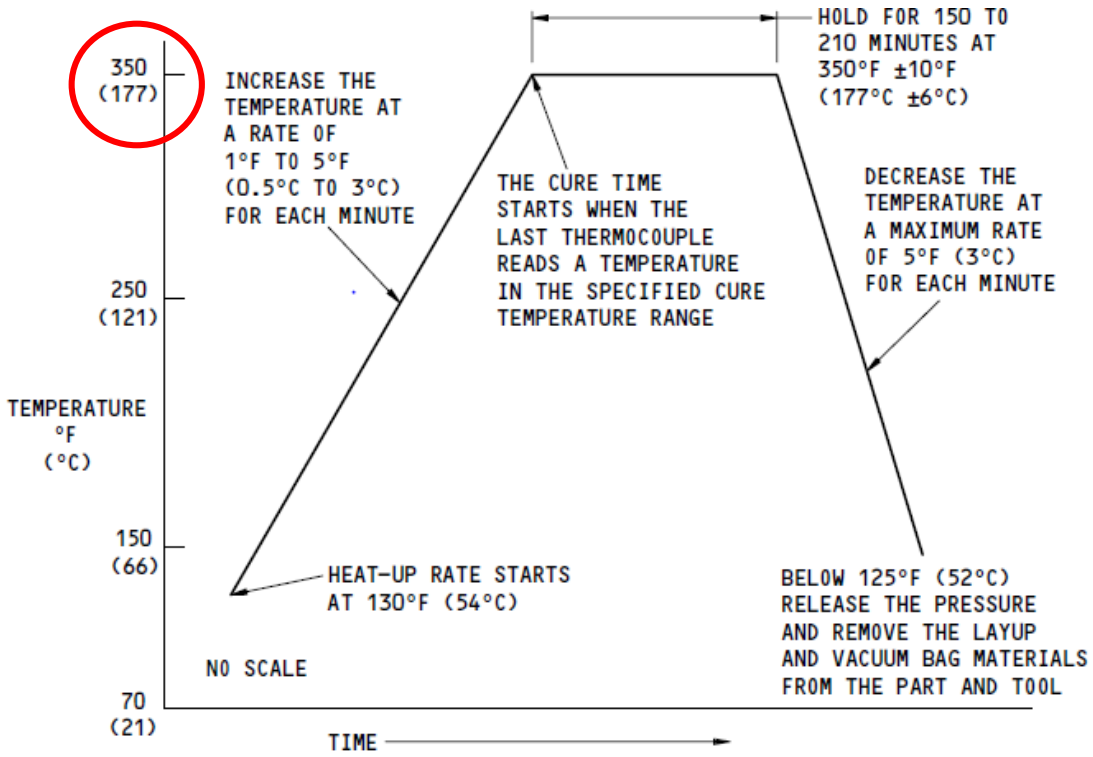
For core closing and potting wait for 6 hours minimum at RT prior to curing. Alternatively: For core closing and potting wait for 10 hours minimum at RT then perform the nex repair steps, refer to Paragraph ✓ 5.H .

<7> Heat up rate 1° C to 3° C (2° F to 6° F) per minute. Cool down rate maximum 3° C (6° F) per minute.



NOTES

- KEEP A MINIMUM VACUUM OF 22 INCHES (0.56 M) OF H_g (MERCURY) DURING THE FULL CURE CYCLE.

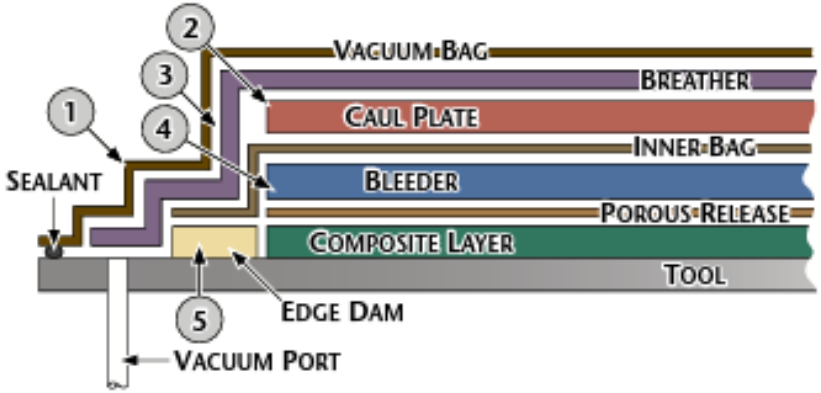


NOTES

- KEEP A MINIMUM VACUUM OF 22 INCHES (0.56 M) OF Hg (MERCURY) DURING THE FULL CURE CYCLE.

FAILURE DURING CURE AND BAGGING

1. Power interrupting
2. Air pressure interrupting
3. Porosity in thick laminate.
4. Entrapped air.
    1. Mixture of air to Matrix.
5. Prober cleaning



1. *Vacuum bag ruptures at sharp corner or bridge causing pressure loss*
2. *Caul plate severs inner bag allowing resin to escape into breather pack*
3. *Caul plate bridges over top of dam causing low pressure area*
4. *Too much bleeder material overbleeds laminate*
5. *Improperly sealed dams allow resin to escape into breather pack*

Theoretical Task

Classroom task

Make a calculation:

1. 112 g Glass fiber need resin 1.2 times with 2-part Epoxy resin (A/B) mixed by 100/35, how much gram resin and harder you need?

2. 80-gram Epoxy resin needed, calculate the needed harder and resin?

Resin/Harder Mix Ratio by Weight: 100/35
Calculation:
Total weight of Resin/hardener mixture is = Glass fabric gram * 1.2

Weight of resin needed = 100/135 * Glass fabric gram * 1.2
Weight of hardener needed = 35/135 * Glass fabric gram * 1.2

Composite sandwich panel fabrication:

Make a sandwich panel with Laminate from task 1, Nomex core and 4 ea. 300 g Glass fiber layers as pr. Drawing. (3 side with 30 mm Monolithic structure and 1 side with 90° sandwich structure.

Caution: USE SANDING ROOM AND PROTECTIVE BREATING MASK WHEN SANDING.

Caution: FOLLOW **MSDS** FOR CORRECTIVE PROTECTION. (Hand protection, ect.……)

Caution: OBSERVE BEFORE WORKING WHERE PROTECTION IS STORED.

1) Prepare the Monolithic laminate from task 1 and 1 ea. Nomex core to fabrication a sandwich panel, with 3 ea. side 45° and 1 ea. Side 90°.

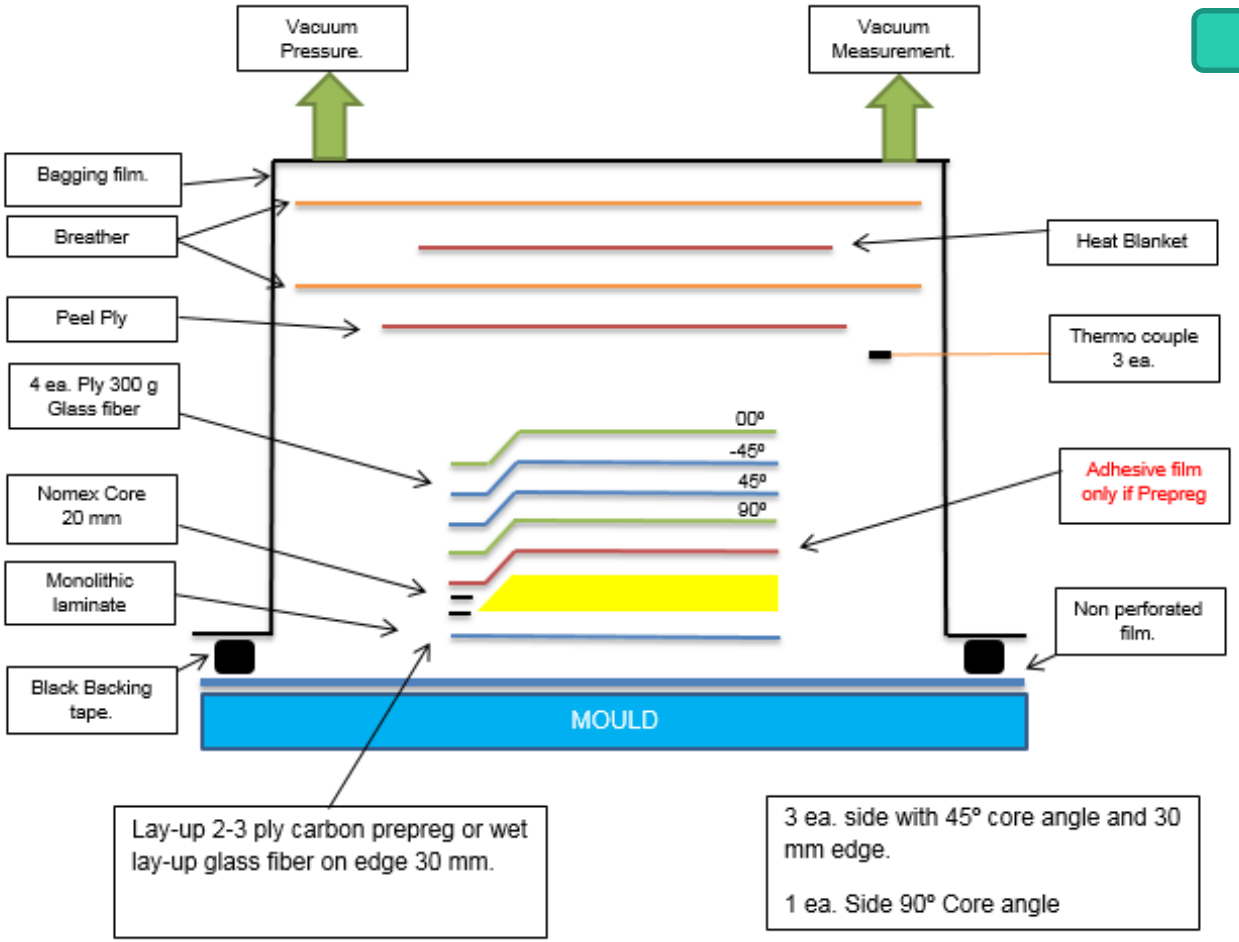
2) Prepare 4 ea. Layers 300g Glass fiber (Wet layup), with resin mixture 1: 1.2

3) Prepare (PRO SET LAM 125/226 Resin, 100/35) mixture of Adhesive (60 G) and mix it together with Micro balloons to make the pasta tick as tooth pasta.

    a. Wet one side of the Monolithic laminate with one layer of the mixed resin above 1, 5 mm thick layer.
    b. Install the Nomex core to the weeded monolithic laminate.
    c. Lay up the prepared 4 ea. 300 g glass fiber as pr. Drawing.

4) Use a mould plate covered with non-perforated film as a resin barrier.
    a. Perform the bagging of the sandwich panel for curing process, together with a gouge plate (Optional) above the Breather.
    b. Install 3 ea. thermo couplers for the curing process.

5) Set the hot bonder for 8 hours/80°C curing process.



190 * 190

240 * 240