ISSUE DATE:	1-22-2021
SERVICE BULLETIN SUBJECT:	Door Opening Body Crack Repair
VINs or MODELS AFFECTED:	Service Specified Buses
COMPLETE BY:	Next Service Opportunity
SERVICE BULLETIN #:	FC-21-10
Labor Operation Code:	UZ43Z

NOTICE! It is expected that this process will require 1/2 hour per bus. Please schedule appropriately to minimize vehicle downtime.

DOOR OPENING BODY CRACK REPAIR

Retrofit Description:

This procedure checks customer buses for cracks in the door openings and repairs them as necessary.

PROTERRA
Headquarters: 1815 Rollins Road, Burlingame, CA 94010
East Coast Manufacturing: 1 Whitlee Court, Greenville, SC 29607
West Coast Manufacturing: 383 Cheryl Lane, City of Industry, CA 91789

Tools/Parts Required

Tools and Supplies Required:

- Rotary Tool with Cylindrical Files
- Finger (Belt) Sander
- Vacuum Cleaner
- Shop Towels
- Acetone
- DA Sander
- 80-Grit Sanding Disk
- 320-Grit Sanding Disk
- 600-Grit Sanding Disk
- Craft Paper
- Masking Tape
- Gel Coat Patch Gun
- Blue Dye

Parts Required:

050318	PROMOTED VINYL ESTER RESIN, COMPOSITE, BODY	1 EA
050674	VINYL ESTER PUTTY, COMPOSITE, BODY	1 EA
050675	MEKP, COMPOSITE, BODY	1 EA
050676	CHOP MAT, COMPOSITE, BODY	1 EA
050677	FIBERGLASS CLOTH, COMPOSITE, BODY	1 EA
P018822	GELCOAT, WHITE	1 EA
061493	ROUTER BIT, FLUSH-TRIM, TOP PILOT, 1/2" CUT DIA, 1/2" LOC	1 EA
061494	ROUTER BIT, FLUSH-TRIM, TOP PILOT, 3/4" CUT DIA, 1-3/4" LOC	1 EA
061495	ROUTER BIT, FLUSH-TRIM, TOP PILOT, 1/2" CUT DIA, 1" LOC	1 EA
061496	END MILL, 4 FLUTE, LONG LGTH, SC ALTIN, 1/2" DIA, 2" LOC, 4" OAL	1 EA
061497	END MILL, 4 FLUTE, SQ SC LL , 1/4" DIA, 1-3/4" LOC, 4" OAL	1 EA

Procedure:

1. Please review the OEM procedure at the end of this document before proceeding with this work.
2. Perform the Proterra approved Lockout/Tagout procedure to make the bus safe for work.
3. Perform the OEM repair procedure that is attached to this document in its entirety.
4. Remove the Lockout/Tagout devices and return the bus to service.

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Engineering Document

TTC Bus Rear Door Corner Crack Repair

Document No.: RCO-1142

Revision: -

Configuration Released
09/09/21
T-747

Revisions

Rev.	Changes	Pages Affected	ECN	Date
-	Initial Release	All	-	2021-09-09

Approval

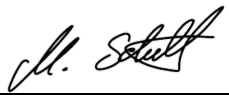
Approval		Signature	Date
Prepared by:	Peter Kim (Manufacturing Engineering Lead)		09/07/21
Reviewed by:	Tertius Kammeyer (NPI/Training Supervisor)		09/08/2021
Reviewed by:	Matt Clarke (Operations Manager)		09/08/2021
Approved by:	Max Schultes (Chief Technology Officer)		09/08/2021
Approved by:	Atefeh Nabavi (Engineering and Quality Manager)		09/08/2021

Table of Contents

1 Introduction

1.1 Scope

The following procedure was developed by RAMPF Composite Solutions Inc. to accurately instruct field service technicians to perform the repair outline in this document. The repair architecture (size of repair area, selected materials, sizes and fiber orientations etc.) are not part of RAMPF Composite Solutions Inc. scope of work in this document and are reflecting the instructions received by TPI (original manufacturer of the composite structure) for TTC bus 3728. RAMPF Composite Solutions Inc. does not comment if the repair is adequate for the damage and solely outlines the important and necessary steps to provide a robust set of work instructions that enables repeatable and reliable execution of the repair.

This procedure documents the steps required to repair the rear door corner cracks shown below on Toronto Transit Company Bus after corner cracks were excavated and resin-rich areas were removed. The procedure is applicable to all buses consisting of the identified damage – Bus 3728 is referred to in this document. The general approach is to fill the exposed voids from the excavation, and add layers to the external surfaces using a wet layup to reinforce the area and build the profile.

The applicability of this procedure to any particular bus exhibiting these issues is to be clarified with the dispositioning quality authority on a case-by-case basis.

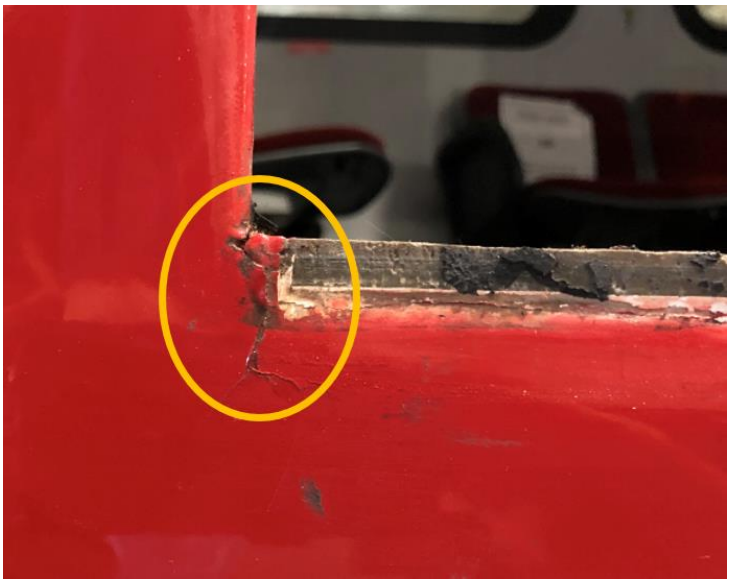


Figure 1 Example of rear door corner crack

1.2 General Personnel Requirements

Personnel shall be familiar with shop safety practices, the location of safety and emergency equipment, and the location and content of **SDS** documentation. Follow all health and safety instructions to make sure personnel and facility comply with all applicable safety and environmental regulations.

Personnel performing work in accordance with this document shall be trained in this process. Personnel shall avoid body contact with adhesives, resins, solvents, and cleaned and prepared bond surfaces by wearing appropriate PPE to maintain contamination free bond surfaces and to avoid unnecessary contact with active chemicals. At the minimum, this includes safety glasses and impervious gloves.

2 Materials and Equipment

Materials and equipment listed in this section are approved for use when performing an operation under this document.

2.1 Materials

- Acetone
- E-BXM 1708, Biaxial glass fabric
- Hydropel H034-AKA-33 VE resin
- Putty No. 876, VE chop fiber mix
- Putty No. 01175 light weight body filler and 10140 Hardener
- Polynt 99F-WD-295 Gelcoat
- Catalyst MEKP 925

2.1.1 Shelf Life

Prior to using a material for this process, review the expiry date on the material label and verify that the material is not past its shelf life.

2.2 Equipment

- Calibrated Scale
- Pencil grinder or rotary tool (1/2” or 1/4” Carbide burr)
- Die grinder (36 grit typ. or diamond grinding wheel)
- Finger belt sander

Prior to starting the repair, ensure all required materials and tools are on hand, in good working order and within the shelf life where applicable.

Any deviation from the above list needs to be approved by the dispositioning authority (I.e. Quality Department/Engineering). Standard lamination tools such as mixing equipment, brushes, rollers etc. are not listed and shall be used as required. Tools required for disassembly of any cover plates, door sills etc. that aren't part of the actual repair aren't listed here and can be used for such purpose without separate approval.

3 Procedure

3.1 Assessment/Surface Preparation

3.1.1 Obtain quality check sheet and record date and bus number

3.1.2 Take photo of bus identification number located here:

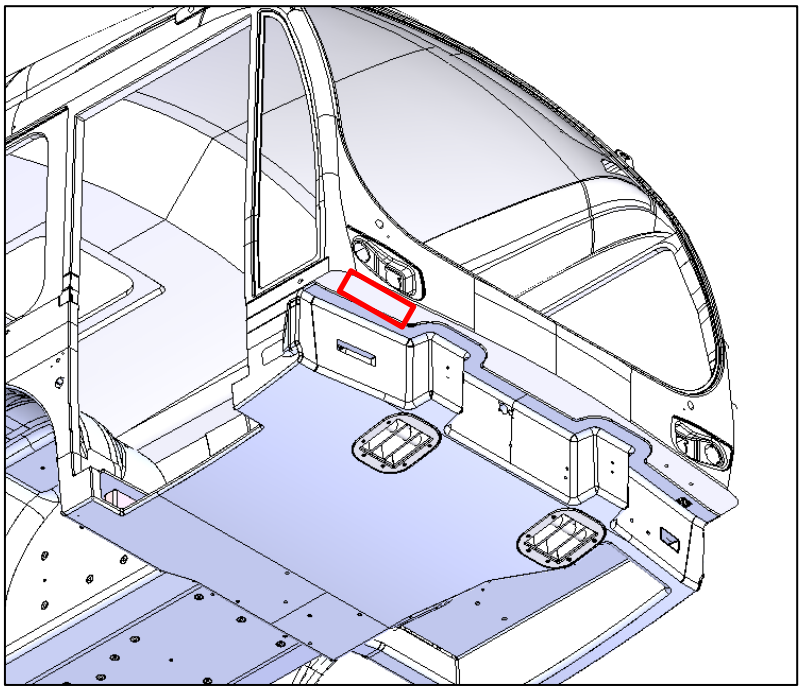


Figure 2 Location of the bus ID

3.1.3 Take photo of rear door corner prior to disassembly

3.1.4 Remove the following parts & hardware:

a. Door panel & associated hardware
b. Threshold heater blanket
c. Auxiliary heat assembly

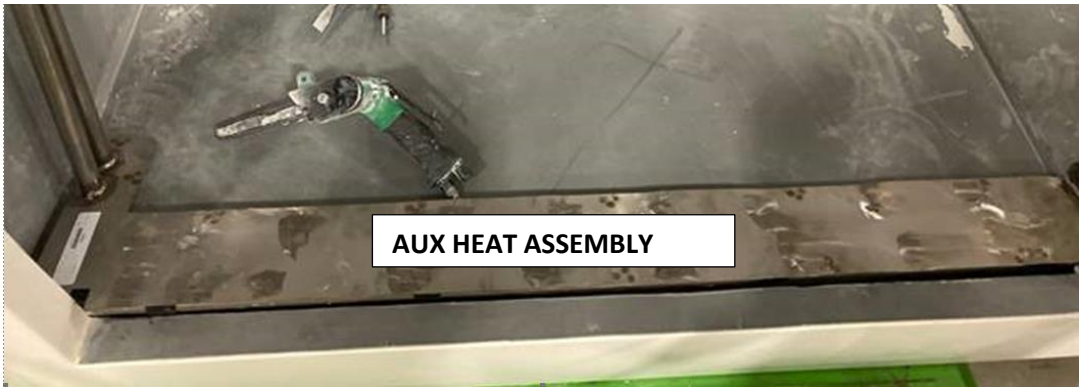


Figure 3 Location of Aux Heat Assembly

3.1.5 Using a small grinding wheel or diamond cutter, create an opening in the threshold/sill where shown:

Figure 4 Drilling location for the crack repair

3.1.6 Sand/grind into the visible gelcoat crack on the side body face using a Rotary tool with a cylindrical file attachment. Assess the depth of crack on the face and proceed.

Rotary tools:

Cylindrical File:

3.1.7 Sand outward from the crack using a finger sander with a 36 grit belt, removing the gel coat from the surrounding area.

Finger (Belt) Sander:

3.1.8 Continue sanding/grinding into laminate until existing crack has been removed and shows no further propagation. Void or cavity between bonded parts (floor & body) may be exposed when sanding through the laminate.

Figure 5 Excavated corner crack

3.1.9 Feather/taper the sanding outward from the exposed edges the valleys or crack center.

3.1.10 If any wet balsa is observed by hand in the voids, extract the wet balsa, and allow the cavity to dry overnight or accelerate the drying via a heat gun and air movement.

3.1.11 Vacuum or blow out any debris in the voids; vacuum all surface debris and use a clean rag with acetone to remove any remaining dust.

3.1.12 Repair area grinding complete. Record photos of repair area.

3.2 Crack Repair

3.2.1 Ensure all area of exposed surface is clean of dust, debris, grease or any type of surface contamination. Repeat step 3.1.11 if necessary.

3.2.2 Ensure to fill any voids or cavities in the excavated area by using VE chopped fiber putty (No. 876). Required hardener quantity for the VE chopped fiber putty is 2.0% by mass.

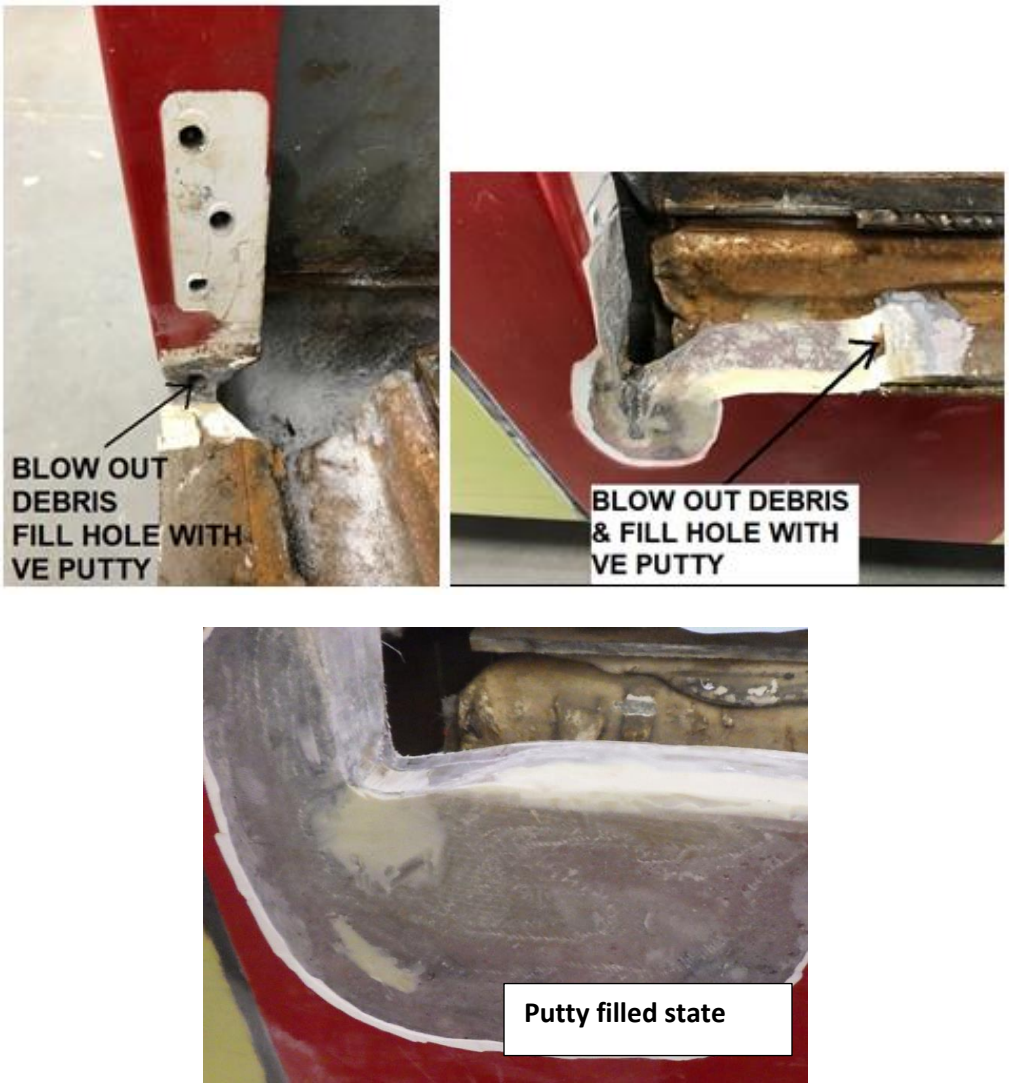


Figure 6 Filling the exposed cavity with VE chopper fiber putty (No. 876)

3.2.3 Wet out 1 layer of 1708 Biaxial glass with catalyzed VE resin (Hydropel H034-AKA-33 with MEKP 925, typical for all plies listed in this repair) and run the ply from the threshold onto the door jamb. Fiber direction of ±45° is running along the length of the strip. Catalyst mass shall be 1.0% – 2.0% of the total resin mass (e.g. 100 g resin = 1 – 2 g of catalyst). It is recommended that the total mix volume does not exceed 100 g.

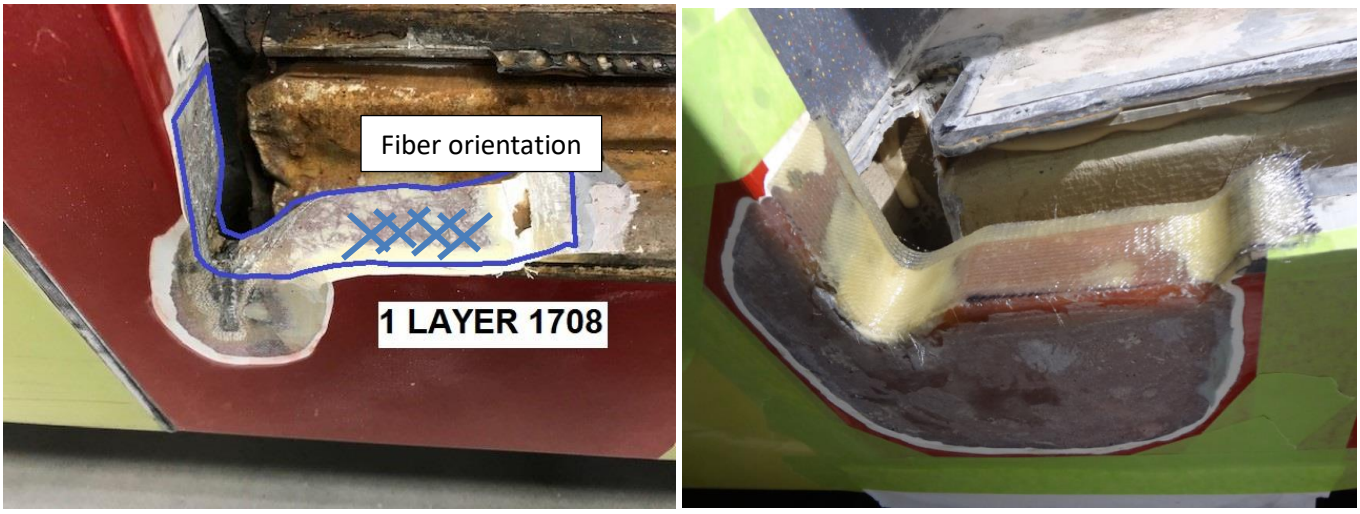
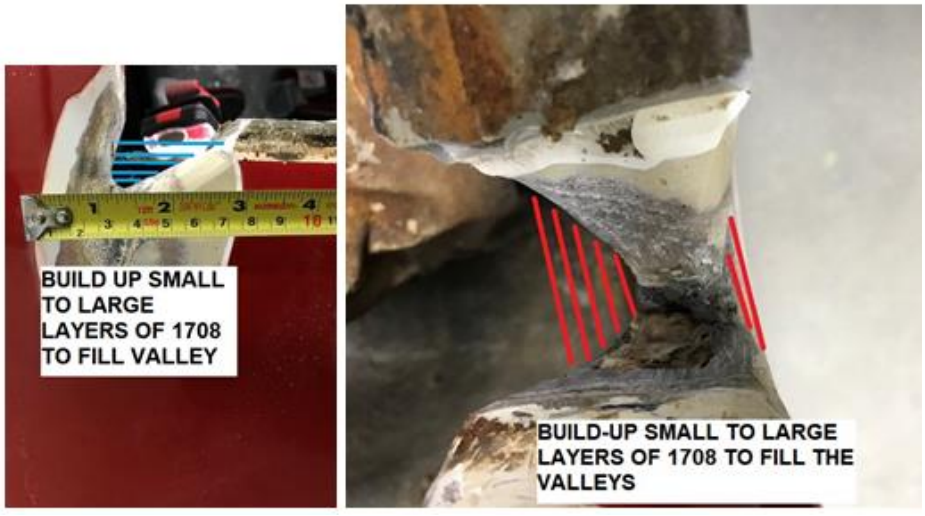


Figure 7 Application of first reinforcement ply (1708)

3.2.4 Fill any valleys using short strips of 1708 biaxial glass as shown in the side view (left) and top view (right) in the figure below; add just enough layers of 1708 to help level the void with the surrounding intact laminate skins. Strips should gradually increase in size, as needed, but should remain in the same plane and not be directed around corners. Record photo of glass application.



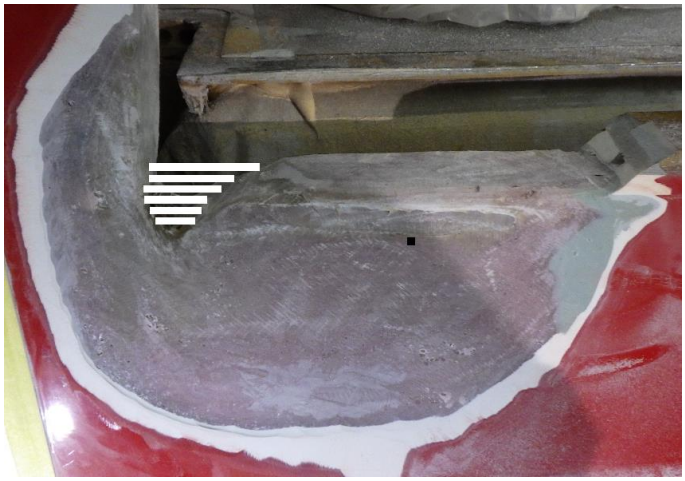


Figure 8 Schematics of filling the "valley" with reinforcement plies (1708)

3.2.5 Alternate 1708 plies from front to back with those running from the sill onto the jamb. Each ply must get bigger than the previous one so that they extend beyond the previous one. All plies have ±45° fiber direction running along the long side of the strip. Record photo of glass application.

1708 layers, 3 plies in each direction (total of 6 plies) that are "woven" together:

a. 1st ply from the front side to the back side.
b. 1st ply from sill to jamb.
c. 2nd ply 15 to 20 mm longer than the 1st (at each end) from front to back.
d. 2nd ply 15 to 20 mm longer than the 1st (at each end) from sill to jamb.
e. 3rd ply 15 to 20 mm longer than the 2nd (at each end) from front to back.
f. 3rd ply 15 to 20 mm longer than the 2nd (at each end) from sill to jamb.

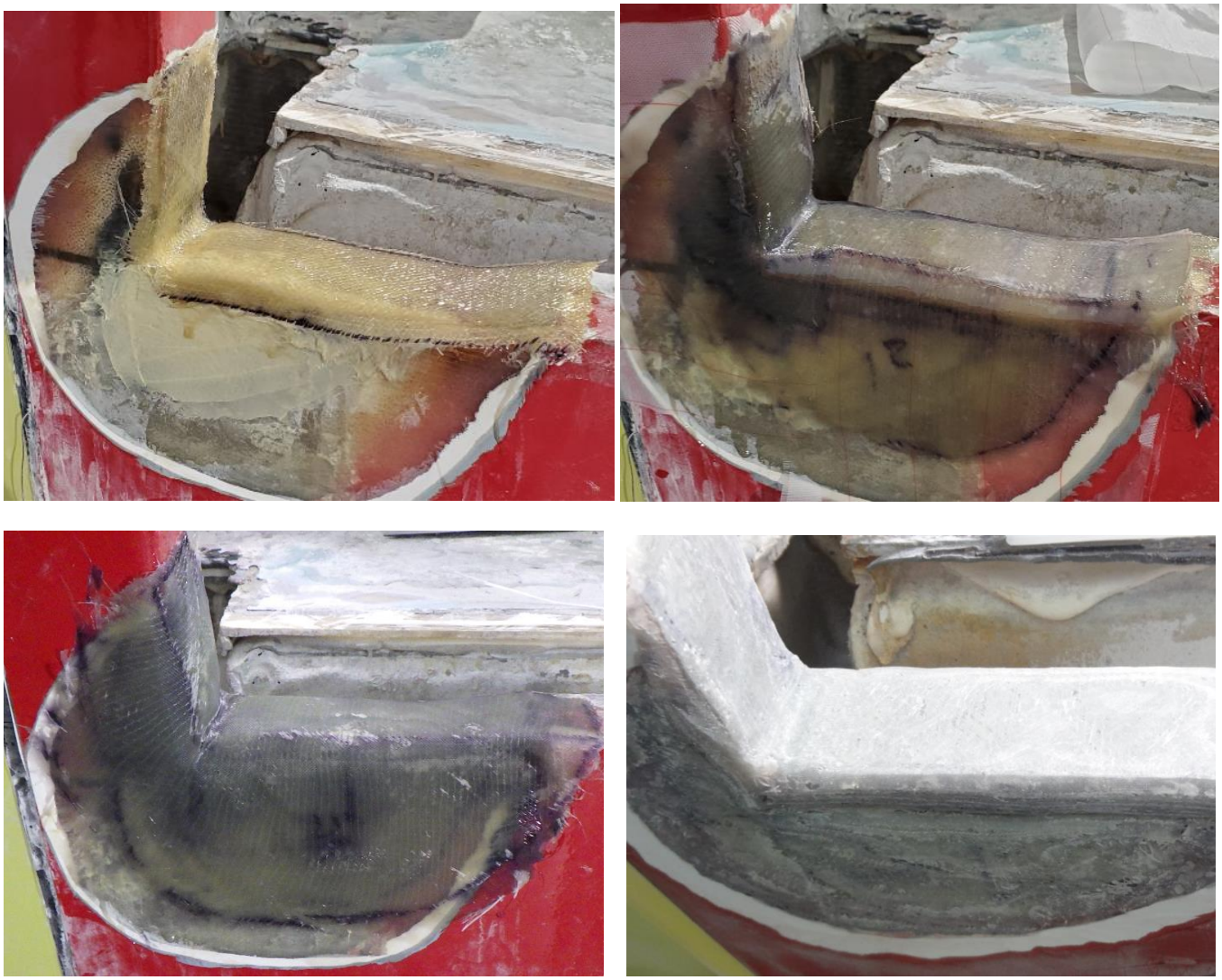


Figure 9 Application of reinforcement plies on the door corner (1708)

3.2.6 If needed, add additional plies of 1708 glass to the threshold/sill to obtain necessary height and width. Stagger the plies so that the ends extend further than the previous ply.

3.2.7 Add 6 plies of 1708 on the backside as shown; start at the corner and overlay the previously installed repair plies. Each additional ply should be 15 to 20mm larger than the previous ply, but only in the the directions as shown in the image below. Ensure to roll each layer with a roller to smooth out the glass and remove any air bubbles. Record photos of glass application at each stage.

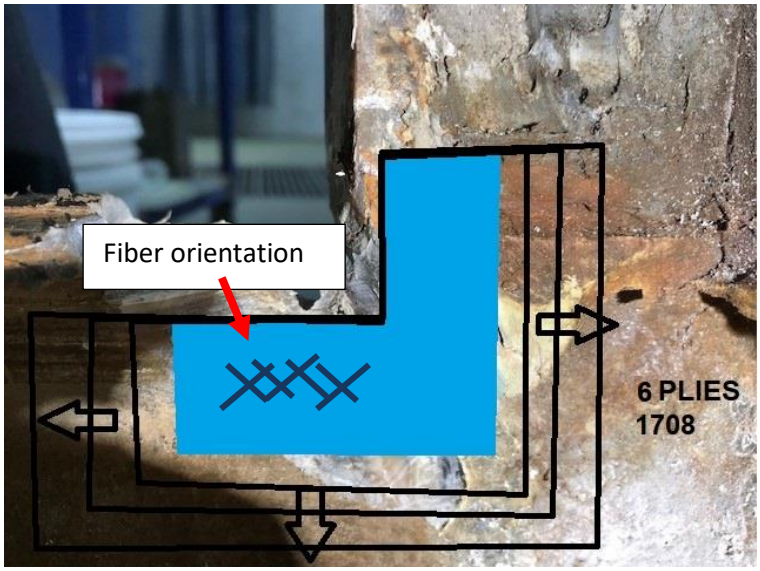


Figure 10 Application of reinforcement plies on the backside of the door

3.2.8 Upon completing the repair, allow to cure for minimum 15 minutes. Record photos of completed repair.

3.3 Gelcoat Patching:

3.3.1 Ensure the faired area is clean of dust and debris, as well as grease by performing solvent (e.g. acestone) wipe.

3.3.2 Fill in pin holes or discontinuous surfaces using No. 01175 lightweight putty (putty No. 01175 light weight body filler), catalyzed with cream hardener 10140. Mix ratio is 100 g filler to 3 ± 0.5 g hardener.

3.3.3 Allow to cure 15-25 minutes before sanding.

3.3.4 Fair the patched area using a DA sander with 80 or 120-grit sanding disk.

3.3.5 Sand the surfaces around the repair with 220 grit on the DA for adhesion and blending of the new gelcoat.

Figure 11 Filled and faired surface of the repair

3.3.6 Mask the area surrounding patch, using craft paper and green masking tape. The masking should start just inside the area sanded with 220 grit.

Figure 12 Masking the repair area prior to gel coating

3.3.7 Mix 970C961 Spray Cure into the gelcoat at a ratio of 16 oz. per gallon (128 oz.) of Polynt 99F gelcoat. The Spray Cure allows the surface of the sprayed gelcoat to cure fully.

	Polynt 99F gelcoat quantity	970C961 spray cure quantity	MEKP 925 catalyst quantity
Sample mix #1	5.3 oz (150 g)	0.7 oz (18.8 g)	0.09 ~ 0.10 oz (2.5 ~ 2.9g)
Sample mix #2	10.6 oz (300 g)	1.4 oz (37.6 g)	0.18 ~ 0.20 oz (5.0 ~ 5.7g)
Sample mix #3	15.9 oz (450 g)	2.1 oz (56.4 g)	0.27 ~ 0.30 oz (7.6 ~ 8.6 g)

3.3.8 Prepare either gel coat patch gun or Preval Sprayer.

3.3.9 Catalyze the gelcoat at a ratio of 10-15 cc MEKP 925 per quart – depending on shop temperature. (High temp. = less MEKP). Refer to the table in 3.3.7.

3.3.10 Perform a test spray on scrap kraft paper away from part. Spray should be uniform in consistency (e.g. no "spitting" or dripping) and color.

3.3.11 Apply the first coat of gelcoat to the area of patch, keeping a perpendicular distance of approx. 12".

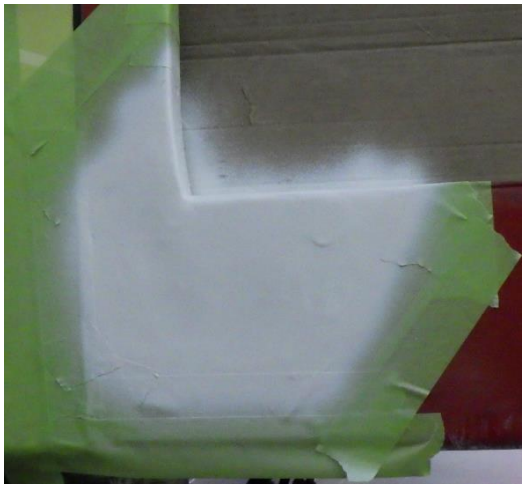


Figure 13 Application of gel coat

3.3.12 Spray 3 more coats with about a minute between each coat. Each coat should cover the repair and extend farther out toward the tape than the previous coat.

3.3.13 Allow gel coat to fully cure for approx. 45 minutes.

3.3.14 Remove masking and inspect.

Figure 14 Completed repair

3.3.15 Fair area using DA with 320 grit & 600 grit sanding disks. Take photos of the finished repair.