DG Flugzeugbau GmbH
Otto-Lilienthal-Weg 2 / Am Flugplatz • D-76646 Bruchsal • Germany
Postbox 1480, D-76604 Bruchsal • Germany
Tel. 07251 3020-100 • Telefax 07251 3020-200 • eMail: dg@dg-flugzeugbau.de
Spare part and material sales: Tel. 07251 3020-270 • lager@dg-flugzeugbau.de
www.dg-flugzeugbau.de

REPAIR MANUAL

for the

MOTORGLIDER

DG-800B

Models: DG-800B

German Data Sheet No.: 873

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Approval of translation has been done by best knowledge and judgement.

In any case the original text in German language is authoritative

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1. Preface

The purpose of this repair manual is to provide basic repair instructions for minor damage to GFRP and CFRP gliders. (Glass and Carbon fibre reinforced plastics). Detailed information regarding all the processing of GFRP and CFRP is not given in this manual assuming that all repairwork will only be carried out by people with practical knowledge in the use of these materials.

The repair of gliders should not be used to learn FRP laminating techniques.

Before beginning any repairwork carefully determine what materials, tools, jigs and repair methods are to be used. The required information can be found in this manual. To insure that the aircrafts performance is maintained, the surface finish of the repair work should be of the same quality as the original finish.

When doubts arise as to the repairability of damage, the DG factory should be contacted for further information.

The information in this manual refers only to repairs of minor damage like holes in the underside of the fuselage resulting from a wheel up landing, or damage from hangar accidents etc..

Major damage which is outside the scope of this manual should only be repaired by a certified repair station rated for composite aircraft structure work.

Note: For repair- and servicing work on parts of the equipment and for motorgliders on the power plant, the instructions in the maintenance manual of the aircraft and the manuals belonging to the equipment parts are to be followed.

2. Definition of minor damage

Only the damage listed below can be considered as minor damage repairable by oneself.

1. Any damage limited to gelcoat or filler.

2. Holes in the fuselage underside where the average diameter does not exceed:

Forward fuselage	80 mm (3 in.)
Rear fuselage	40 mm (1.5 in.)
Cracks in fuselage underside max.	
Forward fuselage	120 mm (5 in.)
Rear fuselage	80 mm (3 in.)

The fuselage glued joint (rear fuselage) should not be damaged.

3. Holes, cracks and tears, bubbles etc. in the wings, horizontal stabilizer and control surfaces skins where the damage does not exceed:

	average diameter	cracklength
Wings	100 mm (4 in.)	150 mm (6 in.)
Horiz. stabiliser	50 mm (2 in.)	80 mm (3 in.)
Rudder	50 mm (2 in.)	80 mm (3 in.)
Flaperon, Elevator	30 mm (1.2 in.)	50 mm (2 in.)

The above parts should not be damaged in the spar area.
When repairing control surface refer to sect. 5.6 page 13.

4. Replacement of bent fittings: Part numbers, see diagrams in the maintenance manual. Damaged fittings should not be repaired but replaced.

3. Tools and facilities required

Tools

- Accurate scale for the correct mixing of resin and hardener
- Containers and wood mixing sticks
- Brushes (short hair) to apply the resin
- Metal roller to press down the glass cloth and to force the air out to reduce the formation of bubbles
- Scissors to cut the fabric
- Adhesive tape
- Plastic film for a tempering tent
- Hot air blower
- Abrasive paper - various grades
- Knife
- Saw to cut tough plastic
- Rubber hand gloves
- Accurate thermometer up to 60°C (140° F)

Facilities

To insure proper curing, the room temperature during repair work and at least 12 hours afterwards should be maintained at 21°C (70° F). After that the repaired parts are to be tempered. Therefore you may construct a tempering tent, using plastic film or Styrofoam plates.

4. Material list for FRP repairs

Resinsystems for repairs

Resin	- Bakelite Rütapox L 20 with	
Hardener	- Bakelite Rütapox SL 50	
	- mixing ratio	100:30 by weight
or resin	- MGS L 160 with	
hardener	- H 163	
	mixing ratio	100:28 by weight
or resin	- MGS L 285 with	
hardener	- H 286	
	- mixing ratio	100:38 by weight

The repaired areas must be tempered for 20 hours at a min. of 54°C (129°F) before the next take-off.

Fibre glass fabric

Interglas No.	US-No.	Weave	Weight (g/m²)
90 070	1610	Linen	80
92 110	-.-	Twill	163
92 125	-.-	Twill	280
92 130	-.-	Linen	390
92 140	-.-	Twill	390
92 145	180-150	unidirectional	220

All fabrics - finish I 550 or FK 144

Fibre Glass Rovings

Gevetex EC-10-2400 K 92 with Silan finish

Carbonfibre fabric

Weight	Weave	Manufacturer/Type
appr. 285g/m²	Atlas	Interglas 98160, C.Cramer C 475
appr. 245g/m²	Linen	Sigri 8049, Interglas 98150 C. Cramer C 460
appr.245g/m²	Twill	Sigri KDK 8043, Interglas 98151 C. Cramer C 462
appr.205g/m²	Linen	Sigri 8003, Interglas 98140 C. Cramer C 450
appr.205g/m²	Twill	Sigri KDK 8042, Interglas 98141 C. Cramer C 452
appr.120g/m²	unidi- rectional Linnen	Interglas 04387

Carbonfibre tape Sigri KDU 1009 7.5 cm (3 in) wide

Carbonfibre rovings TOHO or TENAX HTA 24000

Diolenfabric (as core in the flaperons)
C. Cramer style 14 K (158 g/m²)

Aramidfibre fabric (fuselage):

Twill 220 g/m² C. Cramer Style 333 or
Interglas 98631

Aramidfibre fabric (elevator):

Linen 115 g/m² C. Cramer Style 145
or style 148

Foam

Diab	Divinycell H 60	colour green
Röhm GmbH	Rohacell 51	colour white
	Rohacell 71	colour white,

(only for the shear web of the wing spar).

Paint (Gelcoat)
Lesonal UP Schwabbellack 0369066
mixing ratio: 100:2
with 0720510 hardener.

Up to 10 % thinner 0630260 can be used.

or MGS T35
mixing ratio: 100:2-3 with hardener SF 2

Up to 10 % thinner SF can be used.

or PUR paint if such paint was optionally applied.

Glue for Plexiglas

To attach the canopy:

glue	Casco Nobel	1805	Foss Than 2K
hardener	Casco Nobel	1821	Curing Agent

mixing ratio 3 : 1 by weight
or 2 : 1 by volume
thickened with Aerosil.

To repair cracks in the canopy:

Röhm Acrifix 92 which hardens by exposure to light.

Filler

For gluing, the resin-hardener mix should be thickened with chopped cotton fibres FL l f. (add enough so that the resin no longer flows). The surfaces to be glued should be wetted with non-thickened resin + hardener before.

To glue foam pieces into place when repairing sandwich sections and to fill in irregularities and gaps etc. around the repair, Microballoons BJO - 0930 can be used mixed with the resin-hardener. Application and mixing is the same as for the cotton flocks.

Sources for material

All materials can be obtained from the DG Factory.

5. Instructions for FRP repairs

5.1 Only materials listed in sect. 3 should be used.

5.2 Only damage defined in sect. 2 should be repaired.

5.3 **Repair method for fibre reinforced plastics**
see sect. 2 and 3

5.3.1 Cut out damaged area, roughen the surrounding area for the overlap required see sect. 6.

5.3.2 Repairs should be made such that bonding is **wet over dry**. Specific details concerning handling and using fibre reinforced plastics can be obtained from various publications ie. "Petite Plane Patch Primer."

The use of Carbonfibre is the same as for glasfibre, except that the carbonfibres should not be kinked and only the specified resins are used see sect. 4.

All repairs should be tempered for 20 hours at 54°C (129°F) before the next take off.

5.3.3 **Repairs of a FRP shell**

Prepare the repair area as specified above. Scarf the shell so that the individual layers of fabric can be seen like plywood layers. Remove the gelcoat for at least 20 mm (.8 in.) around the damaged area.

New lay-up as shown on the sketch.

outside

5.3.4 Repairing the outer skin of a sandwich panel

Cut out the damaged area, remove the gelcoat over the overlap area +10 mm (0.4 in.) around the damaged area. Fill the damaged foam area with resin thickened with microballoons (microballoons-resin), let harden. Sand down. With a round headed hammer tap the outer skin around the hole so that the foam is somewhat compressed, therefore heat this area to ca. 60°C (140°F). Apply the new cloth.

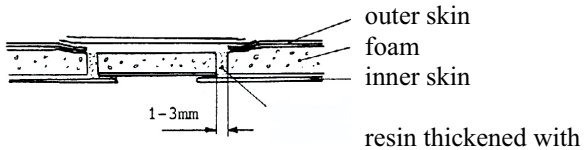
5.3.5 Repair of outer and inner skin of a sandwich panel

See sect. 5.3.4. Additionally remove as much foam as is needed so that the entire damage to the inner skin can be seen plus enough undamaged inner skin as is required for overlapping. If the inner skin still holds together, sand properly and lay up the new cloth over it. Insert a suitable cut piece of foam, 1-2 mm (0.04 to 0.08 in.) thinner than the original, glued in with microballoons-resin.

Should the inner skin be so damaged that the above process cannot be use, the inner skin fabric should be applied to the foam first and left to harden before inserting into the repair area. Microballoons-resin should once again be used.

For lay up of the fabric to the foam, a layer of microballoons-resin should be applied first to eliminate the formation of airbubbles.

Apply the outer layers as in sect. 5.3.4.



5.3.6 Special hints for processing aramidfibres

The difficulties processing aramidfibre starts already when cutting the fabric. Only with very sharp tools (toothed scissors) cutting the material is possible.

Sanding the fibres is not possible without formation of fluff or fuzz. Only wet sanding is feasible. After sanding, the area must be dried with a fan heater.

Aramidfibre has the tendency to take up humidity. So dry storage and drying the fibres prior to processing is necessary.

Aramid must be protected against UV-rays before and after processing.

An aramid repaired area must be protected by a paint with UV-protection.

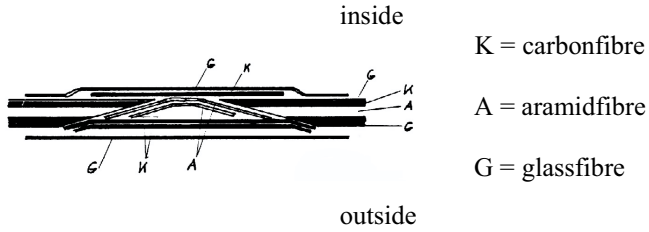
The paints indicated on page 7 feature this UV protection (titandioxide - white pigments).

Thin aramidlayers can't be scarfed. Only overlapping is possible.

5.3.7 Repair of the carbonfibre - aramidfibre – hybrid fuselage - shell

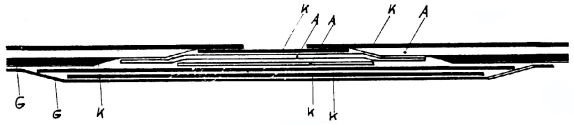
With this construction the repair method see 5.3.3 is not applicable.

A Repair areas which are accessible from the inside (Cockpit).



B Repair areas which are not accessible from the inside (fuselage boom):

inside



outside

K=carbonfibre / A=aramidfibre / G=glassfibre

Thickening of the shell in the repair area can not be avoided.

5.4 **Repairing small dents in a sandwich panel skin (no cracks in the gelcoat)**

Small dents can usually be removed by heating up to 60° to 70° C (140° - 158°F). Use a hot air blower to heat the area of the dent. The crushed foam will then spring back to its original form, so that the dent will hardly be seen. Final sanding with wet sandpaper grade 600 should finish the job. In more severe cases, one coat of gelcoat will remove all trace of the dent.

5.5 **Outer skin finish**

Repairs should be such that the area is exactly level or only slightly higher than the surrounding skin surfaces. Sand the hardened repair surface with dry grade 80 sandpaper. Fill with Polyesterfiller, let dry and sand with dry sandpaper. When the surface is smooth, sand the repair area and at least 5 cm (2 in.) of the surrounding gelcoat with wet sandpaper grade 400. Spray the repair area with 5 coats of gelcoat.
After the gelcoat has hardened, sand with grade 400, 600 and 800 wet sandpaper until the surface is smooth. Polish with a power buffer (electric drill or similar with cloth polishing wheel). Apply a block of wax onto the rotating polishing wheel and then polish the repaired area. Do not polish in only one direction, and do not polish one spot for too long so that overheating occurs, see sect. "general maintenance" in the maintenance manual.

5.6 After **repairing control surfaces**, the mass balance weights must be checked again with the values given in the maintenance manual. Should the maximum values be exceeded, then the parts have to be replaced.

5.7 **Fire protection of engine compartment**

The fire protection of the engine compartment is by means of a fire resistant paint which foams up in case of a fire and by additional heat-insulating fabric and metal foils.
In case of damage ask the DG factory for the working instruction “ Fire protection of engine compartment “ 8B-XM-RA60.

6. **Types of materials and overlap dimensions**

The following overlap dimensions are to be maintained. Use the materials given, see also pages 6 and 7.(Smaller reinforcements on high stressed areas are not given in the table below).

Part		overlap (cm)	(in.)	fabric type, etc. d= ± 45° l= ± 90°
Wing skin	outside	3	1.2	1 x 90070 l outside +1x245g/m² carbonfibre d
	core	/	/	H 60 - 6mm thick, 18m tip 3 mm thick
Wing skin	inside	3	1.2	1 x 285 g/m² carbonfibre d from root up to y = 2000 1x245g/m² carbonfibre d y = 2000 up to tip +1x carbonfibre 120 g/m² in flight direction in the waterballast tank compartment
Flaperons	outside	3	1.2	1 x 90070 l outside +1x245g/m² carbonfibre d
	core	/	/	1xDiolenfabric 158 g/m²l
	inside	2	.8	1x245g/m² carbonfibre d
Horizontal stabilizer				
	outside	2	.8	1x90070 d +1 x 92110 d
	core	/	/	H 60 - 5 mm thick
	inside	1	.4	1 x 90070 d +1 x 90070 d in the centre of the stabilizer up to y = 300
Elevator	outside	1	.4	Aramidfibre 115 g/m² l
		2	.8	Carbonfibre 245 g/m² d
	inside	1	.4	Aramidfibre 115 g/m² l

Part		overlap (cm)	(in.)	fabric type, etc. d = ± 45° l = ± 90°
Rudder	outside	1	.4	1 x 90070 d .
	Core	/	/	H 60 - 3 mm thick
	Inside	1	.4	1 x 90070 d
Fuselage boom				
	outside	2	.8	1x205g/m² carbonfibre d
	core	3	1.2	2x220g/m² aramidfibre l
	inside	2	.8	1x205g/m² carbonfibre d

Note: There are CFRP Rovings on the upper and lower side of the fuselage boom which have to be repaired in case of damage.

	30	12.	32 rovings HTA 24000 in each half of the fuselage
tape at both sides of the fuselage tube			
	3	1.2	1 carbonfibre tape KDU 1009 - 7.5 cm (3 in.) wide in each half of the fuselage
tape beside the cutout of the engine bay	10	4.	4 carbonfibre tapes KDU 1009 - 7.5 cm wide in each half of the fuselage
Forward fuselage belly up to wing suspension			
outside	4	1.6	1 x 92110 d +2x205g/m² carbonfibre d
core	3	1.2	2x220g/m² aramidfibre l
inside	2	.8	1x205g/m² carbonfibre d +1 x 92 110 l inside +glasfibre rovings in the canopy brink
fin outside	2	.8	2 x 92110 d
core	/	/	H 60 or Rohacell 51 3 mm thick
inside	1.5	.6	1 x 92 110 d
	2	.8	+1 x 92145 perpendicular to fuselage boom up to 290 mm above fuselage centreline