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REPAIR MANUAL

for the

SAILPLANE

DG – 300 ELAN

German Data Sheet No. 359

Manufacturer: ELAN Tovarna Sportnega Orodja,
YU-64 275 Begunje/Gor., Yugoslavia

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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 Flugzeugbau 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 below listed damage can be considered as minor damage repaired 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. stabilizer	50 mm	(2 in.)	80 mm (3 in.)
Rudder	50 mm	(2 in.)	80 mm (3 in.)

The above parts should not be damaged in the spar area.

4. Replacement of bend 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)
- Hygrometer

Facilities

To insure proper curing, the room temperature during repairwork 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.

The humidity should not be greater than 50%.

21°C = 75° F.

4. Material list for FRP repairs

Fuselage, rudder, ailerons, elevator and horizontal stabilizer:

resin - Shell Glycidäther 162 with
 hardener - BASF Laromin C 260
 mixing ratio 100:38 by weight
 or 2: 1 by volume

or resin - MGS L 160 with
 hardener - MGS H 160 A mixing ratio 100:28 by weight

or resin - MGS L 285 with
 hardener - MGS 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/m ²)
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

Fibre Glass Rovings

Gevetex EC-10-2400 K 92 with Silan finish

Foam

Continental	Conticell	C 60	colour brown
or Diab	Divinycell	H 60	colour brown
Röhm GmbH	Rohacell	51	colour white

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Wings

Resin systems

- 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 should be tempered for a min. of 20 hrs. at 54°C (129°F) before the aircraft is flown.

Fiberglass fabric and rovings

see above

Foam

Continental	Conticell	C 60	colour brown
or Diab	Divynycell	H 60	colour brown
Röhm GmbH	Rohacell	51	colour white
	Rohacell	71	colour white only for the shear web of the wingspar.

For all parts:

Paint

Lesonal PE Schwabbellack 0369066 Mix 100 : 2 with 0720510 hardener.
Up to 10% thinner 0630260 can be used.

Or MGS UP Vorgelat T 30, mixing ratio 100 : 2 with SF 2 hardener. Also up to 10% thinner SF can be used.

Filler

For glueing, the resin-hardener mix should be thickened with chopped cotton fibres FL 1 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, Microballoon BJO - 0930 can be used mixed with the resin-hardener. Application and mixing is the same as for the cotton flocks.

Glue for Plexiglas

To attach the canopy:

Röhm Acrifix 90 – mixing ratio 100 : 25 by weight with Katalysator 20, thickened with Aerosil.

To repair cracks in the canopy

Röhm Acrifix 92 which hardens by exposure to light.

All materials can be obtained from DG Flugzeugbau GmbH 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 glassfibre, 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 scetch.



outside

5.3.4 **Repairing the outer skin of a foam 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 (microballoon-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.

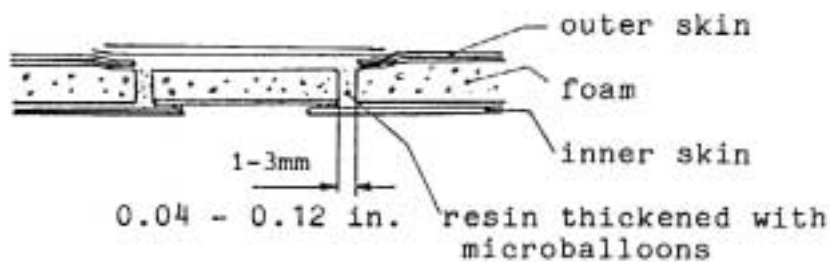
5.3.5 **Repair of outer and inner skin of a foam sandwich panel**

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 microballoon-resin.

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

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

Apply the outer layers as in sect. 5.3.4.



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 and 600 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.

6. Types of fabric and overlap dimensions

The following overlap dimensions are to be maintained.

Part	overlap		fabric type, etc. (see sect. 4 too)
	(cm)	(in.)	
wing skin outside	3	1.2	1 x 92110# outside + 1 x 92125#
inside	2	0.8	1 x 92130# + 1 x 92125# in the waterballast tank compartment
Horizontal stabilizer			
outside	2	0.8	1 x 92110# + 1 x 92125#
inside	1	0.4	1 x 92110#
Elevator	2	0.8	1 x 92110# + 2 x 92125#
Rudder and	1	0.4	1 x 90070#
outside inside			
Forward fuselage belly	6	2.4	1 x 92100# outside + 3 x 92125# + 7 x 92125#
Fuselage boom	5	2	1 x 92110# outside + 3 x 92125# + 3 x 92125#
Ailerons			
outside	2	0.8	1 x 92125#
inside	1	0.4	1 x 92110#