FLIGHT MANUAL
for
SAILPLANE PIK-20

SERIAL NO: **REGISTRATION**

This sailplane must be operated in compliance with this manual

THIS MANUAL MUST BE KEPT IN THE SAILPLANE AT ALL TIMES

This manual applies for individual sailplanes where airworthiness directives M9 and M10 have been implemented

English translation based on Finnish Manual approval 18.1.1980 on OH-469

Finnish Transport Safety Agency

Edition 1

LOG OF REVISIONS

Any revision of the present manual must be recorded in the following table. The new or amended text in the revised page will be indicated by a black vertical line in the left-hand margin, and the Revision No. and date will be shown on the bottom of the page.

Rev. No.	Revised Pages	Description of Revision	Date	Signed

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Kisällinkatu 8
SF-15170 Lahti 17

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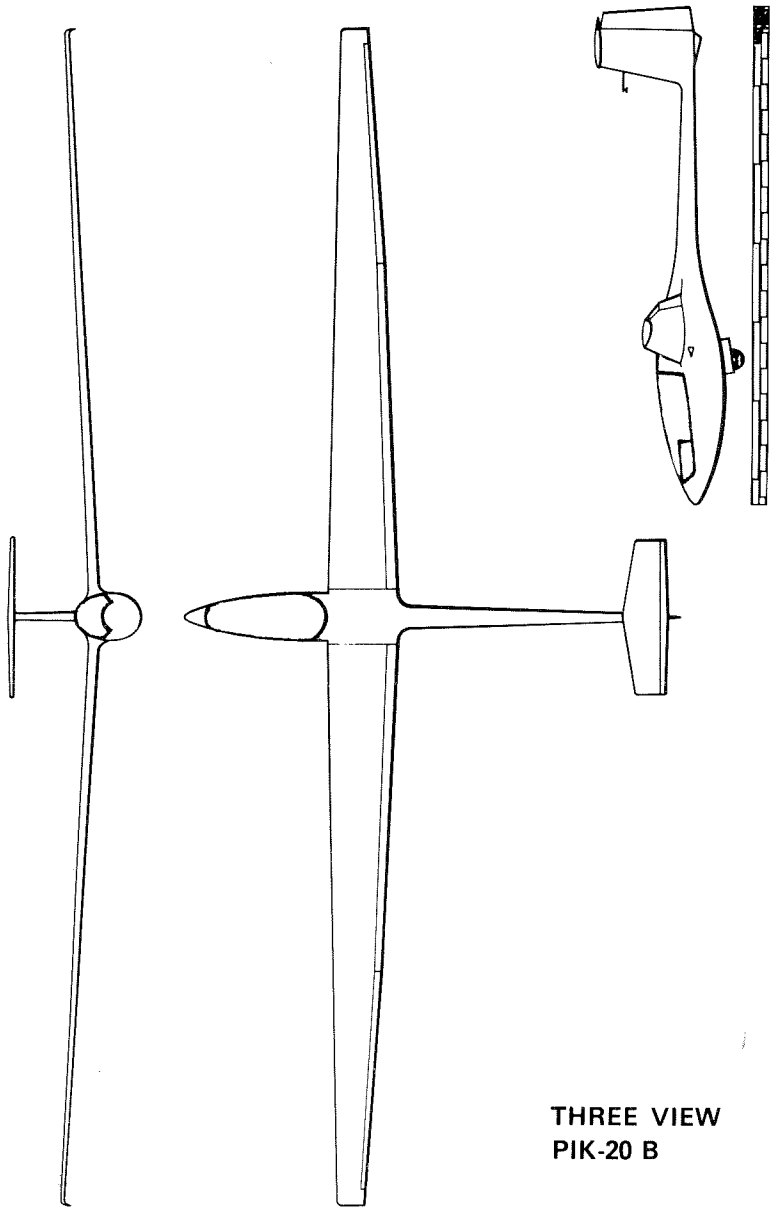

THREE VIEW
PIK-20 B

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1. TECHNICAL DATA

1.1. Main technical data

— Span	15 m (49.2 ft)
— Lenght	6.43 m (21.10 ft)
— Height	1.34 m (4.40 ft)

1.2. Wing

— Wing area	10.0 m² (107.5 sqft)
— Aspect ratio	22.5
— Dihedral angle	3°
— Sweep-back angle (quarterchord line)	0°
— Angle of incidence	1°
— Root chord	0.90 m (2.95 ft)
— Mean chord	0.65 m (2.13 ft)
— Tip chord	0.36 m (1.18 ft)
— Mean aerodynamic chord (MAC)	0.70 m (2.30 ft)
— Root profile	FX 67-K-170
— Tip profile	FX 67-K-150
— Aileron area	2 x 0.24 m² (2 x 2.61 sqft)
— Aileron movements	Up 21°—24°±2°
	Down 17°—21°±2°
— Flaps-airbrakes area	2 x 0.55 m² (2 x 5.99 sqft)
— Flaps-airbrakes movements	Up 8°±1°
	Down 80° +10° —5°
— Ailerons move with flaps	Up 8°±1°
	Down 8°±1°

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1.3. Horizontal stabilizer and elevator

— Area	1.00 m² (10.76 sqft)
— Span	2.0 m (6.56 ft)
— Aspect ratio	4.0
— Angle of incidence	—2°
— Profile	FX 71-L-150/20
— Elevator movements	Up and down 20°±1°

1.4. Vertical stabilizer and rudder

— Area	1.02 m² (10.98 sqft)
— Profile	FX 71-L-150/30
— Rudder movements	Right and left 27° ±2°

1.5. Fuselage

— Height	0.86 m (2.62 ft)
— Width	0.60 m (1.97 ft)
— Main wheel	5.00-5
— Tail wheel	200 x 50 mm (7.87 x 1.96 in)

1.6. Weights and loads

— Empty weight	about 240 kg (529 lbs)
— Gross weight	450 kg (992 lbs)
— Maximum water ballast	140 kg (309 lbs)
— Wing loading	32 . . 45 kg/m²
	(6.55 . . . 9.21 lbs/sqft)

2. SAILPLANE DESCRIPTION

2.1. General description

The PIK-20 is designed according to OSTIV — Airworthiness Requirements For Sailplanes 1971, single seat Standard Class Sailplane for training and limited acrobatics (Utility Category).

The whole sailplane is made of epoxy resin laminates. The shoulder configuration wing and the control surfaces are of rigid sandwich structure, PVC-foam between epoxy laminates.

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The fuselage is made of epoxy laminates stiffened with eight ribs and by the cockpit with a double bottom.

The retractable main landing wheel is equipped with brake.

The tail wheel is located under the vertical stabilizer in a housing.

The trailing-edge flaps-airbrakes may be used for three purposes:

1. To improve performance while thermalling and gliding.
2. At all speeds as air brakes except for more than 45° (see Airspeed Limits).
3. During landing as landing flaps.

The "T"-configuration tail unit has conventional elevator and rudder surfaces.

2.2. Flight control and flap system

The primary flight control surfaces (ailerons, elevator and rudder) are controlled by a conventional control stick and rudder pedal arrangement.

The elevator trim is controlled by a green knob located on the left side console. It is connected to the elevator control system by a spring.

The trailing-edge flaps blue control wheel is located to the left of the pilot's seat. The wheel provides detent positions for all values between −8° and 80° of flap deflection.

The wheel also moves the aileron neutral position between angles −8° . . . +8°, this means that the ailerons follow the flaps to +8° and then the connection opens. This is done by means of a slide under the flap drive rack under the wheel. The slide is connected to the differential lever of the aileron drive mechanism, where geared segments move.

2.3. Landing gear system

The retractable main landing gear is operated by means of a grey lever located on the right side of the cockpit. In the forward position the gear is down — rear position the gear is up. Remember to put the handle in the forward position before landing.

The wheel brake handle is attached to the control stick.

2.4. Other controls

The yellow tow coupling release knob is located on the lower left side of the instrument panel. The tow coupling hook is located below the fuselage in front of the landing gear.

The canopy is hinged to the right side of the cockpit and can be opened by pulling the red knob on the left side of the cockpit. Jettising in an emergency occurs by pulling the abovementioned knob together with the red jettisoning knob on the right side of the cockpit and lifting the cockpit. The grey coloured pedal adjustment knob is located in front of the control stick on the right, below the instrument panel.

Adjustment of the seat back occurs by loosening four screws located on the lower part of the seat back.

The water ballast draining knob is located on the right side of the cockpit. The forward position is open — the rear position closed.

3. LIMITATIONS

3.1. Airspeed limits (I.A.S.)

Never exceed (V_{NE})	262 km/h 163 mph 142 kts
Gusty conditions (V_B)	242 km/h 150 mph 131 kts
Maneuvering (V_A)	185 km/h 115 mph 100 kts
On aero tow (V_T)	185 km/h 115 mph 100 kts
On winch tow (V_W)	125 km/h 77 mph 67 kts
Flaps-airbrakes deflected,	
— 45° or less	262 km/h 163 mph 142 kts
Flaps-airbrakes deflected,	
— more than 45°	200 km/h 124 mph 108 kts
All acrobatic maneuvers must be accomplished with speeds less than (See 4.1.3 and 5.7)	185 km/h 115 mph 100 kts

3.2. Flight load factors

— Maximum positive	+ 5.3
— Maximum negative	— 2.65
— Maximum positive flaps-aribrakes deflected more than 45°	+ 4.0

3.3. Operating limits

- VFR day (See Service Manual, part 6 for equipment)
- Cloud flying, provided that the following instruments installed: Airspeed indicator, altimeter, compass, turn and slip indicator, variometer.
- Approved acrobatics:
  Looping, stall turn, steep turn, lazy eight, chandelle and spin.
- During acrobatic maneuvers the flaps-airbrakes must not be deflected more than 45°.
- No snapped figures approved.
- Accelerometer mandatory for acrobatics.
- Acrobatic maneuvers with water ballast are prohibited.

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3.4. Weight and C.G. limits

— Empty Weight	about 240 kg (529 lbs)
— Maximum gross weight	450 kg (990 lbs)
— Maximum water ballast	140 kg (309 lbs)
— Pilot and parachute	55 . . . 110 kg (120 . . . 240 lbs)
— C.G. limits aft datum minimum	2.085 m (82.08 ins)
maximum	2.225 m (87.59 ins)
	(20 . . . 40 % MAC)

Datum: Vertical plane 1.90 m (= 74.80 ins) forward of wing leading edge at wing root rib.
Leveling means: Slope of rear top surface of fuselage 1000:28.

3.5. Rated load in aero and winch tow 500 kg (1100 lbs)

4. MARKINGS

4.1. Placards

4.1.1. In full view of the pilot

Maximum airspeed

In calm weather (V_{NE})	262 km/h 163 mph 142 kts
In turbulent weather (V_B)	242 km/h 150 mph 131 kts
Maneuvering (V_A)	185 km/h 115 mph 100 kts
On aero tow (V_T)	185 km/h 115 mph 100 kts
On winch tow (V_W)	125 km/h 77 mph 67 kts
Flaps-airbrakes deflected 45° or less	262 km/h 163 mph 142 kts
Flaps-airbrakes deflected more than 45°	200 km/h 124 mph 108 kts

Weights
Gross weight 450 kg including water ballast.
If the pilot's weight with the parachute is below 75 kg ballast weights must be installed in the nose (see Flight Manual and Weight and Balance Data Sheet).

4.1.2. In full view of the pilot

Preflight check

- Tail dolly removed
- Parachute secured
- Seat and pedals adjusted
- Safety belts secured
- Canopy locked
- Altimeter set
- Flaps-airbrakes in take-off position (8° up)
- Trim set for take-off
- Tow rope coupled on
- Controls free

Before landing

- Water ballast drained
- Landing gear down
- Flaps as desired

4.1.3. In full view of the pilot

Operating limitations

- This sailplane must be operated in compliance with the operating limitations as stated in the form of markings, placards and in the Flight Manual.
- Cloud flying is only permitted when the following instuments are installed: Airspeed indicator, altimeter, magnetic compass, turn and slip indicator and variometer.
- Approved acrobatic maneuvers, maximum entry speeds and maximum load factors:

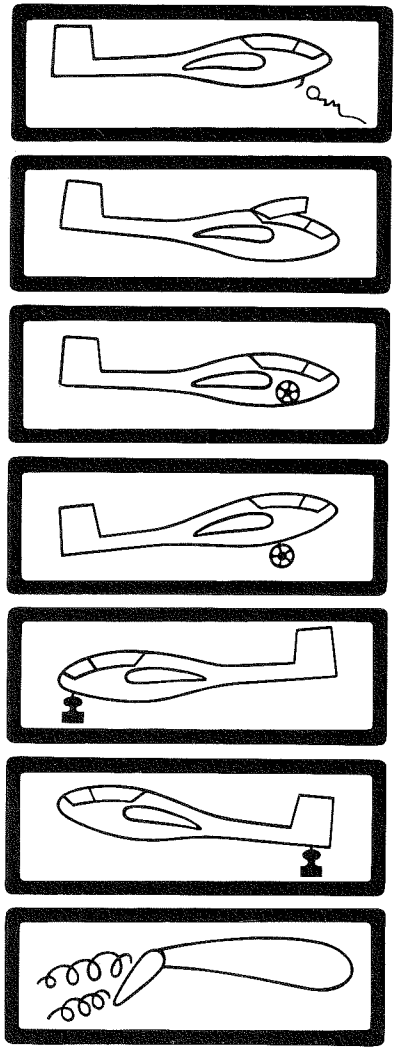
Maneuver	Maximum entry speed
Steep turn	185 km/h 115 mph 100 kts
Looping	185 km/h 115 mph 100 kts
Lazy eight	185 km/h 115 mph 100 kts
Chandelle	185 km/h 115 mph 100 kts
Stall turn	185 km/h 115 mph 100 kts
Spin	Use slow deceleration
Stall (Except Whip Stalls)	Use slow deceleration
Maximum load factors	+ 5.3 — 2.65
Maximum positive load factor, flaps-airbrakes deflected more than 45°	+ 4.0

Acrobatic maneuvers prohibited with flaps-airbrakes deflected more than 45°.

All acrobatic maneuvers including spins must be accomplished in accordance with the approved PIK-20 Flight Manual.
Accelerometer must be installed.

- Night flying prohibited.

4.2. Symbols of the Controls



Tow release

Canopy Lock and Jettison Control

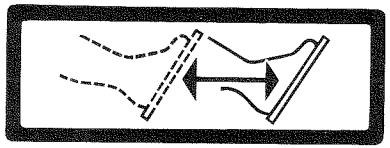
Landing Gear up

Landing Gear down

Trim control — Nose down

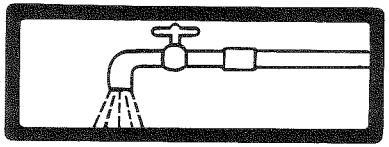
Trim control — Nose up

Flaps-airbrakes



Pedal adjustment

Cabin ventilation



Water ballast

4.3. Other markings

- Adjacent to tow coupling RATED LOAD 500 kg (1100 lbs)
- Above the main wheel 2.5 Aty (35 psi)
- Above the tail wheel 2.0 Aty (28 psi)
- Adjacent to static pressure entry on fuselage skin STATIC PRESSURE KEEP CLEAR
- Adjacent to oxygen control valve (if installed) DURATION TABLE
- On fuselage nose (inside) BALLAST

4.4. Flight Instrument Markings

4.4.1. Air Speed Indicator

— Maximum; Red radial	262 km/h	163 mph	142 kts
— Caution range; Yellow arc	242 . . . 262 km/h	150...163 mph	131...142 kts
— Normal range; Green arc	74 . . . 242 km/h	46...150 mph	40...131 kts
— Flap operating range; White arc	74...200 km/h	46...124 mph	40—108 kts

4.4.2. Accelerometer

- Maximum positive; Red radial + 5.3
- Maximum negative; Red radial — 2.65

5. NORMAL PROCEDURES

5.1. Preflight inspection

- Tail dolly removed
- Barograph on (if installed)
- Loading and ballast checked
- Parachute secured
- Seat and pedals adjusted
- Safety belts secured
- Canopy locked
- Altimeter set
- Flaps-airbrakes in take-off position (8° up)
- Trim set for take-off
- Tow rope coupled on
- Controls free

5.2. Take-off on winch launch

- Trim in front position with mean C.G.
- Flaps-airbrakes max 5° down
- Recommended airspeed 110 . . . 125 km/h 68 . . . 77 mph 59 . . . 67 kts
- Maximum airspeed 125 km/h 77 mph 67 kts
- During climb after 100 m (300 ft) altitude flaps-airbrakes can be taken 15° down

Note: If flaps-airbrakes are deflected more than 5° the airplane takes off too rapidly and controllability decreases.

5.3. Take-off on aerotow

- Trim in neutral position with mean C.G.
- Recommended airspeed 120 . . . 130 km/h 75 . . . 81 mph 65 . . . 70 kts
- Maximum airspeed 185 km/h 115 mph 100 kts

5.4. Flight

— At a safe altitude retract landing gear

— At weight 320 . . . 450 kg (705 lbs . . . 990 lbs)

Gliding speed	90 . . . 105 km/h 56 . . . 64 mph 49 . . . 57 kts
Best lift/drag ratio	39.5 . . . 42,0
Minimum sink rate at	73 . . . 89 km/h = 0.58 . . . 0.69 m/s (114 . . . 126 ft/min)
Stall speed flaps-airbrakes,	
— down 10°	67 . . . 81 km/h 42 . . . 49 mph 36 . . . 44 kts
Stall speed flaps-airbrakes	
— down 90°	60 . . . 72 km/h 37 . . . 44 mph 32 . . . 39 kts

— In stall the nose drops smoothly without natural warning: inadvertent spins don't occur.

Note: At speeds over 185 km/h (115 mph, 100 kts) full control movements are not acceptable. As the speed is increased to V_{NE} from V_A the control movement shall be decreased to 1/3 of maximum movement. The elevator control force is low and that is why it must be used carefully to avoid excessive g-loads.

5.5. Landing

— Water ballast drained
Landing gear extended

— Approach speed about 90 km/h (56 mph, 49 kts)

— Flaps-airbrakes down as desired, in the final down 60—90°. Before touchdown the flaps-airbrakes can be retracted to shorten the ground roll.

— On the ground wheel brake as desired.

Note: To avoid confusion it is recommended to keep the flaps-airbrakes handle on the upper sector, by using full rotations.

5.6. Cloud flying

— IFR instruments on and monitored

— Air speed within green range

— At air speed exceeding 200 km/h (124 mph, 108 kts) extend flaps-airbrakes

— Observe icing

5.7. Acrobatics

During acrobatic maneuvers the flaps-airbrakes must not be deflected more than 45°.

Following acrobatic maneuvers are approved with entry speeds listed below:

Maneuver	Recommended entry speed		
Steep turn	120 km/h	75 mph	65 kts
Looping	185 km/h	115 mph	100 kts
Stall turn	170 km/h	106 mph	92 kts
Lazy eight	170 km/h	106 mph	92 kts
Chandelle	185 km/h	115 mph	100 kts
Spin	Use slow deceleration		
Stall (except Whip Stalls)	Use slow deceleration		

Note: Max. entry speed for steep turn, looping, stall turn, lazy eight and chandelle is 185 km/h, 115 mph, 100 kts.

During acrobatic maneuvers monitor accelerometer.

The spin is possible at all C. of G. positions: however in the forward C. of G. position the sailplane enters spin with very great difficulty. The start of the spin is conventional for sailplanes: Pull control stick fully back and at the same time apply rudder control to the desired direction, then apply full aileron to the same direction. Without aileron control the spin stops after one or two turns. The spin stops by neutralizing the controls. The spin recovers rapidly by applying full rudder opposite to the direction of rotation. Do not push the control stick forward of the neutral position so as to avoid an extreme speed increase.

Drain the water ballast before acrobatic maneuvers.

6. WEIGHT AND BALANCE

The following information will enable you to fly your PIK-20 within the prescribed weight and center of gravity limitations. To calculate the weight and balance for your PIK-20, use the Sample Problem, Loading Graph and Center of Gravity Moment Envelope as follows:

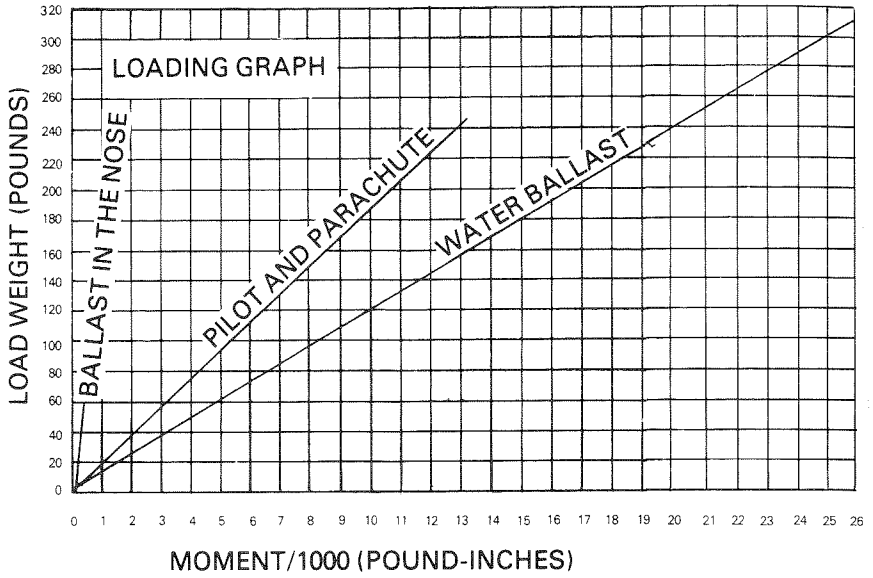
Take the licensed Empty Weight and Moment/1000 from the Weight and Balance Data Sheet (in Service Manual), and write them down in the proper columns. Add all additional weights and their corresponding moments/1000 (using the Loading Graph) of items to be carried on the flight. Plot the total weight and moment on the Center of Gravity Moment Envelope and if the intersection point is within the envelope, the loading is acceptable. If necessary use ballast in the nose (Usually if the pilot's weight with the parachute is below 75 kg/165 lbs ballast weights must be installed).

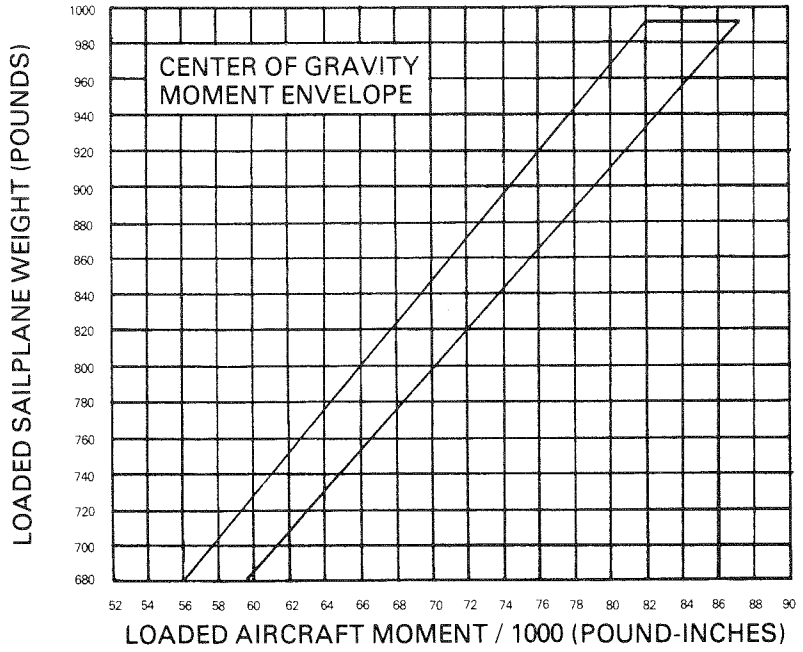
SAMPLE LOADING PROBLEM	SAMPLE SAILPLANE		YOUR SAILPLANE	
	Weight (lbs)	Moment (lb-ins/1000)	Weight (lbs)	Moment (lb-ins/1000)
1. Licensed Empty Weight x)	545	52.3		
2. Pilot and parachute	187	10.8		
3. Water ballast	132	11.1		
4. Ballast in the nose				
5. Equipment xx)				
TOTAL WEIGHT AND MOMENT	864	74.2		

In this sample case the point (864 lbs. at 74.2 lb.-ins./1000) falls within the Center of Gravity Envelope and the loading is acceptable.

x) See the Weight and Balance Data Sheet

xx) See the weights, arms and moments of the removable equipments at the end of the Service Manual.





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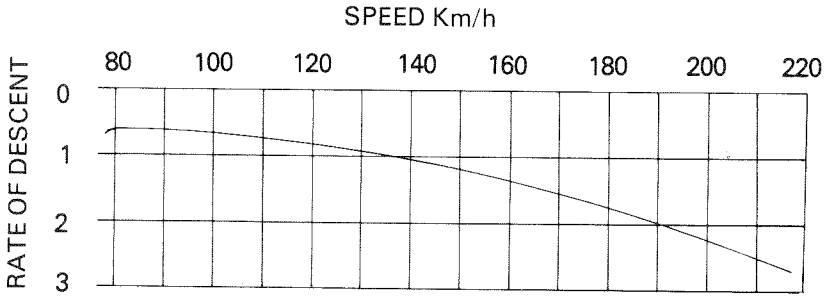
7. PERFORMANCE

At sea level	Weight 320 kg (705 lbs)	Weight 450 kg (992 lbs)
– Stall speed (flaps down 10°)	67 km/h 42 mph 36 kts	81 km/h 49 mph 44 kts
– Stall speed (flaps down 90°)	60 km/h 37 mph 32 kts	72 km/h 44 mph 39 kts
– minimum rate of descent at speed	0.58 m/s 114 fpm 73 km/h 45 mph 40 kts	0.63 m/s 133 fpm 89 km/h 54 mph 48 kts
– Maximum gliding ratio at speed	90 km/h 56 mph 49 kts	105 km/h 64 mph 57 kts



PERFORMANCE AT WEIGHT 450 kg (992 lbs)

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8. SPECIAL FLIGHT CONDITIONS AND EMERGENCY PROCEDURES

8.1. Flying in the rain and icing conditions

Raindrops, ice or frost on the sailplane's surfaces will considerably reduce its performance: Stall speed increases 5 to 10 percent and also rate of descent is greater than normal. This must be taken into consideration in particular during approach and landing.

8.2. Flying at high altitude

If you fly above 3500 m (11000 ft) altitude use oxygen.

8.3. Landing on uneven or soft ground

Landing on uneven or soft ground may be done with the landing gear extended or retracted depending on circumstances. Usually the sailplane is not damaged by landing on grass with the landing gear retracted.

8.4. Jettisoning of the canopy

To jettison the canopy pull the red locking control and the red knob on the right hand side of the cockpit and lift the canopy.

II SERVICE MANUAL

1. ASSEMBLY AND DISASSEMBLY

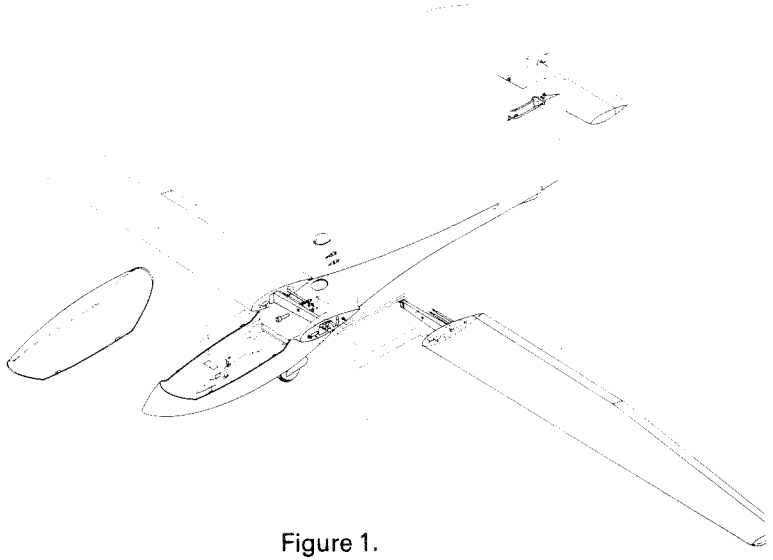

Figure 1.

1.1. Preparation

Three or even two persons can easily assemble and disassemble the PIK-20. Before assembly remove the canopy and prepare the required tools, clean clothes, grease of mineral or synthetic basis, the wing assembly tool and a bit of steel wire for pulling out the locking pin of the horizontal stabilizer. Clean and grease all fitting surfaces, bolts, pins and control system connectors.

1.2. Wing assembly (Figure 2)

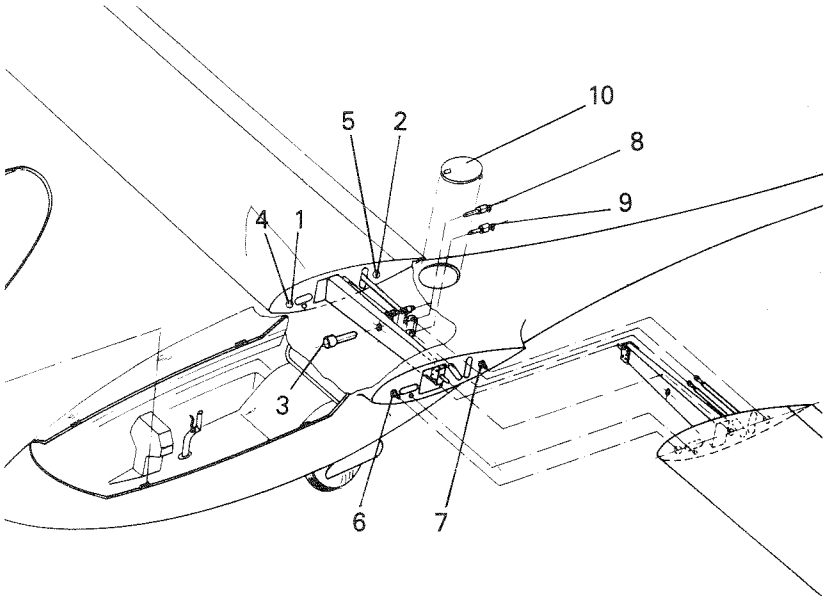

Figure 2

- Insert the right-hand wing ensuring that the fuselage bevel pins (1) and (2) are in the seats (4) and (5).
- Insert the left-hand wing in the same way and watch that the bevel pins (6) and (7) go correctly into their seats. Draw the wings together with the wing assembly tool and install the main wing pin and secure it using a Fokker-pin. It is necessary to upload the wing tips when using the assembly tool.
- Connect aileron and flap control rods by installation of pip-pins (8) and (9). Close the inspection opening (10) on the top of the fuselage.

1.3. Empennage assembly (Figure 3)

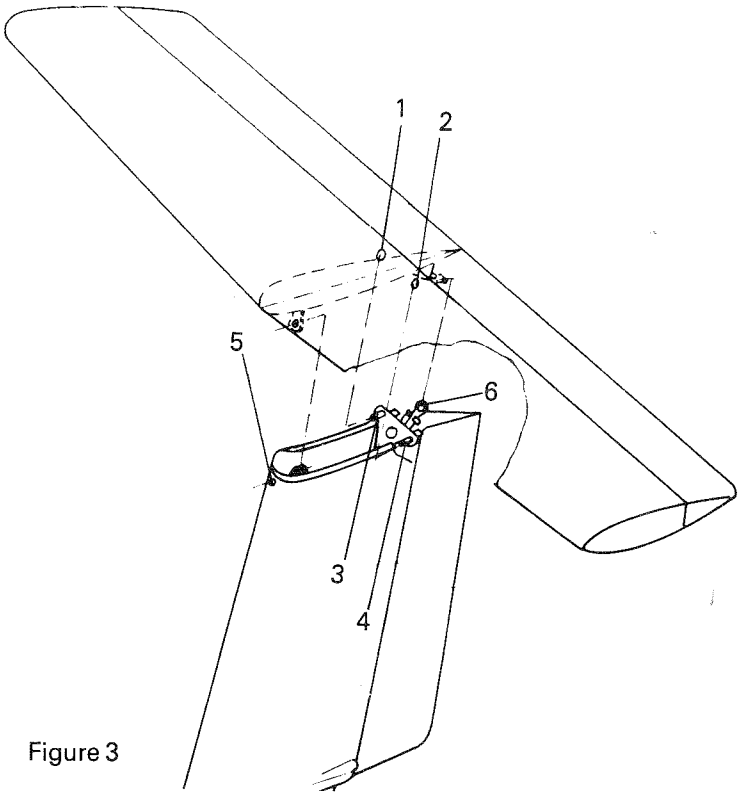

Figure 3

— Insert the horizontal stabilizer by lifting the leading edge up a little and by pushing the ball bearings (1) and (2) on to the pins (3) and (4) on the vertical stabilizer.
— Pull out the locking pin (5) with a tool (steel pin) and push the leading edge into place. Remove the tool and push the locking pin in. Ensure that the safety spring is engaged and secure the pin using a Fokker-pin.
— Deflect the elevator upwards and connect elevator control rod (6) and secure it using a Fokker-pin.

1.4. Disassembly

— The wings are removed in the reverse sequence to assembly. Reinstall all attachment bolts and control rod connection bolts in their holes and secure them.
— Remove the horizontal stabilizer in the reverse sequence to assembly.

2. PREFLIGHT CHECK

Following sailplane rigging, and before the first flight of the day carry out the following checks:

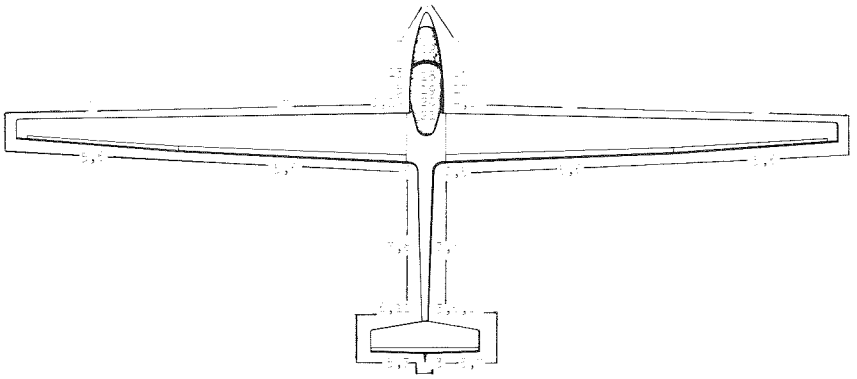

Figure 4

1. Main wing pin secured.
2. Pip-pins connecting ailerons and flaps-airbrakes secured.
3. Horizontal stabilizer attachment pins correct and locking pin all the way in and secured. Quick release for elevator control rod secured.
4. Tow coupling clean and functioning properly.
5. Ailerons, flaps-airbrakes, elevator and rudder correct, free and full travel.
6. Tapes over control-surface gaps for adherence (if fixed).
7. Wings, fuselage and empennage for damages to the skin, dents or cracks.
8. Static pressure vents free.
9. Pitot tube free.
10. Tyre pressure correct.
11. Tail dolly removed.
12. Ballast properly fastened.
13. Canopy clean and locking mechanism for condition.
14. Water ballast system for condition and proper functioning.
15. No foreign matter or loose particles in the cockpit.
16. Control stick and pedals free and full travel.
17. Flaps-airbrakes full travel.
18. Safety belts for condition.
19. Instruments for condition and correct indication.
20. Trim control for condition.
21. Documents in the sailplane.

3. TRANSPORTATION OF SAILPLANE

For transportation, the use of the special PIK-20 trailer is recommended. If the sailplane is being transported in another vehicle, the following should be checked:

- Depending on transportation van, the sailplane may be fixed and supported by the following elements: Wing spar root shanks; Bevel pins of the fuselage; Undercarriage wheel (take care of hatch covers) and tail wheel. Besides this wing, fuselage and horizontal stabilizer may be placed in appropriate holding clamps.
- Fix all control surfaces using gust locks.
- Lock aileron and flaps rods and attachments in the wing using cords or rubber belts.
- Take care of that no shifting, jamming or deformation can arise and avoid entry of dirt and water into the sailplane.
- On an open trailer, protect the canopy, the area of the horizontal stabilizer attachment and cover the pitot tube and static pressure vents.
- Ensure that all components cannot be shifted during transportation.

PIK-20 Service manual

4. CARE AND MAINTENANCE

The PIK-20 fiberglass sailplane requires minimal maintenance.

4.1. General care

The outside of the sailplane can be kept bright and smooth simply by washing with water and mild soap. Avoid abrasive or harsh detergents. Rinse with clean water and dry with terry-cloth towels or chamois. If you choose to wax your sailplane, use a good automotive-type wax, however, not one containing silicone.
The canopy surface may be cleaned and polished using the conventional plexiglass care products. Never clean with a dry cloth.

Note: Never use gasoline, benzine, alcohol, acetone, carbon tetrachloride, lacquer thinner or glass cleaner to clean plexiglass.

In hot sunshine it is recommended that the sailplane is protected with fabric.
Prior to hangaring, the water drain holes, shown in Figure 5 should be inspected for free outlets and cleaned if necessary.

4.2. Before assembly

Clean and grease points marked "X" in Figure 6.

4.3. Every week

Clean cabin and wheel box e.g. with vacuum cleaner.

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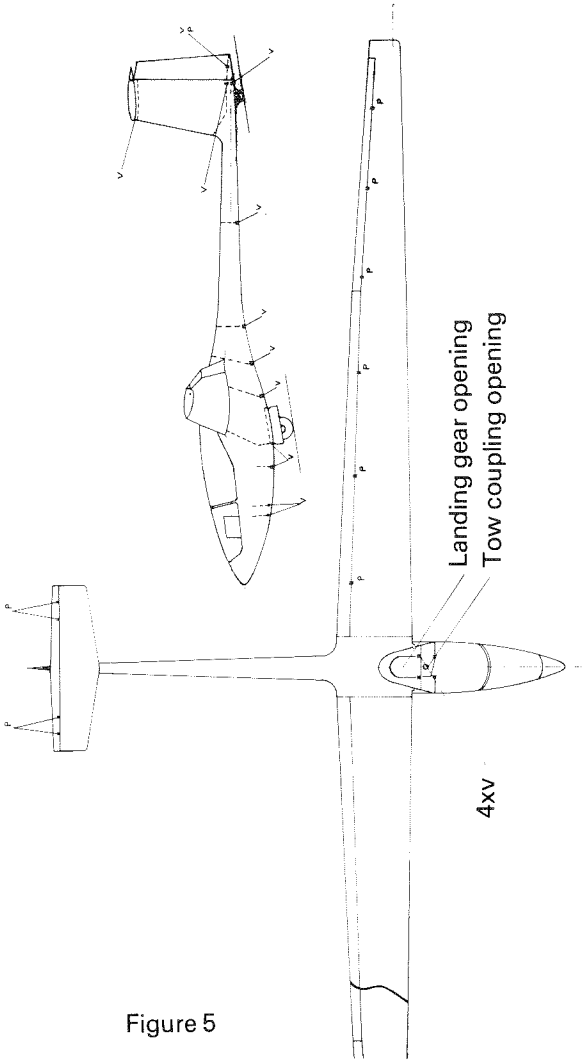

Figure 5

Water drain (v) and pressure relief (p) holes

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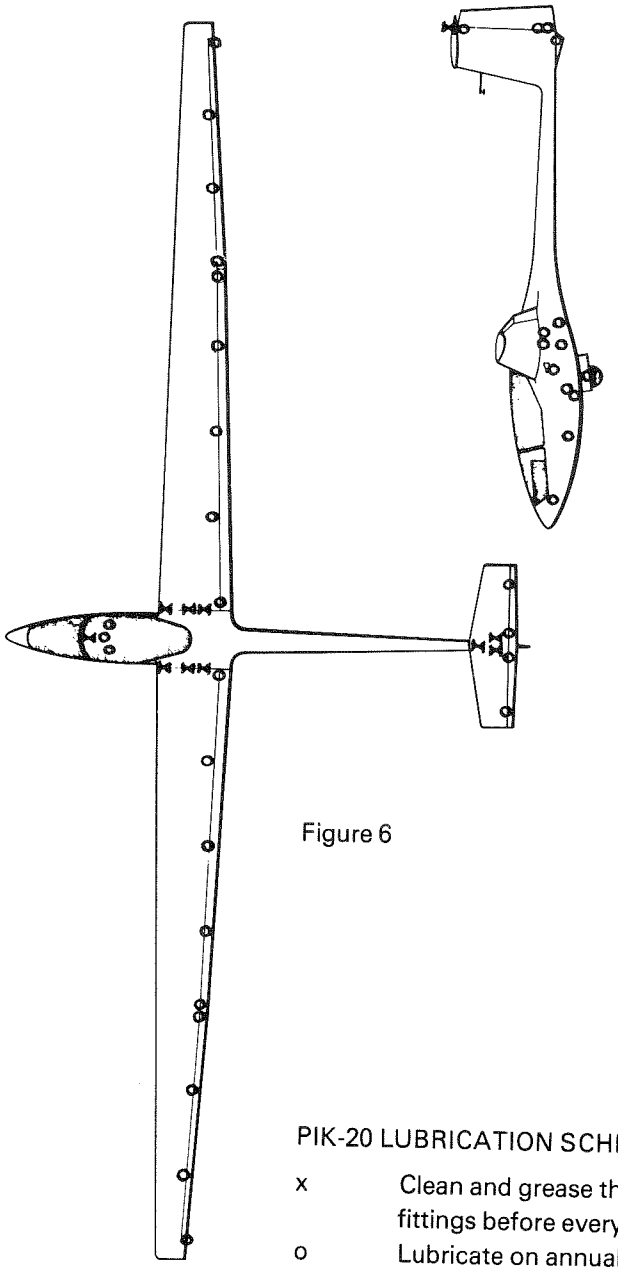

Figure 6

PIK-20 LUBRICATION SCHEME

x Clean and grease these fittings before every assembly

o Lubricate on annual inspection

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4.4. Annual inspection

- Inspect, clean and lubricate with oil the bearings and hinges marked "O" in Figure 6.
- Inspect the other bearings and rod endings and, if necessary, protect with litium-grease.
- Inspect the rudder cables.
- Inspect Bowden control cables of the tow release coupling, wheel brake, pedal adjustment, cabin ventilation and water tanks.
- Inspect and lubricate the tow release coupling(s).
- Inspect landing gear, wheel brake and gear doors.
- Inspect wing attachment points and tightness of attachment.
- Inspect horizontal stabilizer attachment points.
- Inspect and clean the pitot-static system.
- Check control surface deflections.
- Inspect water tanks.
- Inspect and lubricate the flap drive wheel and the differential lever inside the fuselage.

Note: If the sailplane is damaged, the structural repair schemes are given in "Repair Manual".

5. WEIGHING PROCEDURE

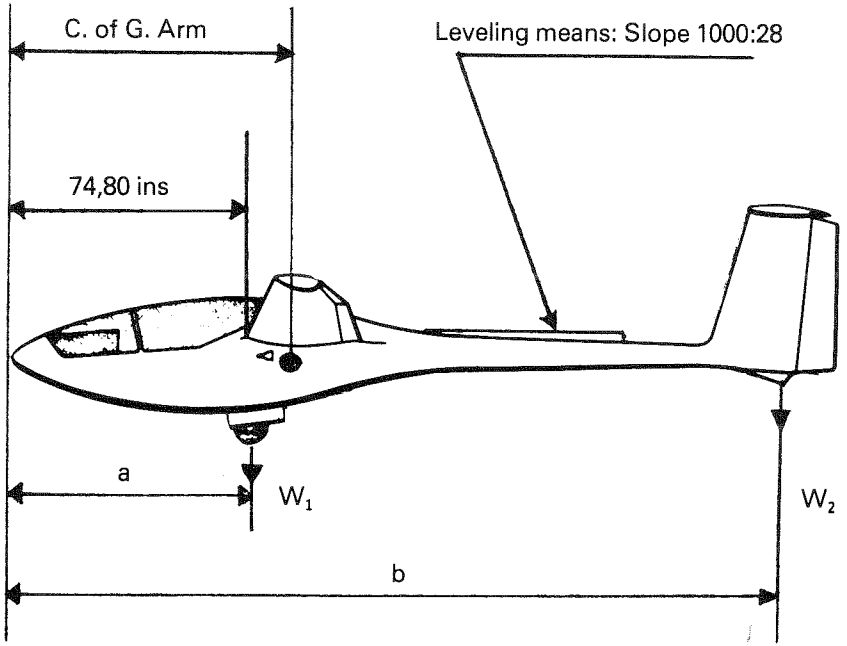
5.1. Preparation

- Ensure that all items marked in the sailplane equipment list are installed in their proper location in the sailplane.
- Remove dirt, moisture, foreign items such as rags and tools from the sailplane before weighing.
- Weigh the sailplane inside a closed building to prevent errors in scale readings due to wind.

5.2. Weighing

- Level sailplane (see diagram). Levelling means: Slope of top surface of rear fuselage between stations 140 ins and 180 ins 1000 to 28 tail down.

Datum: Vertical plane 1.90 m (74.80 ins) in front of leading edge of wing root rib.



— With the airplane level, record the weight shown on each scale. Deduct the tare, if any, from each reading.

Scale Position on Symbol	Scale Reading (lbs)	Tare (lbs)	Net Weight (lbs)
Main wheel (W_1)			
Tail wheel (W_2)			

Empty weight and moment	Net Weight (lbs)	Arm (ins)	Moment (lb.-ins./1000)
W_1		a = 79.6	
W_2		b = 229.2	
Licensed Empty Weight		C. of G.	

$$\text{C. of G.} = \frac{W_1 a + W_2 b}{W_1 + W_2}$$

6. EQUIPMENT

The following list shows equipment items which may be installed in the PIK-20. Items marked "X" are included in the Empty Weight recorded in Weight and Balance Data Sheet.

Item	Part	Weight (lbs)	Arm (ins.)	Moment (lb.-ins./1000)
	I Minimum Equipment (Standard USA)			
	Airspeed indicator Model:			
	Altimeter Model:			
	Compass Model:			
	Safety belts Model:			
	Seat cushion			
	Tow coupling Model:			
	II Optional Equipment			
	Variometer Model:			
	Compensating bottle			

Item	Part	Weight (lbs)	Arm (ins.)	Moment (lb.-ins./1000)
	Turn and bank indicator Model: Artificial horizon Model: Battery Model: Accelerometer Model: Clock Model: Radio Model: Oxygen Equipment Model: Water Ballast tanks Model:			

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PIK-20
REPAIR MANUAL

Approved:

EIRIAVION OY
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FOREWORD

The intention of this repair manual is to give basic advice needed for repairing structural damage to the PIK-20 sailplane made of glass fiber reinforced plastic (GFRP). Basic information about GFRP is not treated in this manual because the repair worker is assumed to have professional knowledge of repairing items of GFRP. Repairing sailplanes is not a proper field for practising GFRP laminating.

Before starting the work, study carefully what kinds of material, supplies, tools and work methods are required. You will find the answers in this manual. To maintain the excellent performance figures of the sailplane the surface quality should be equal to the original one.

If there are doubts about repairing structural damage always contact the manufacturer to find out what can and what cannot be done.

The information given in this booklet applies to minor repairs, such as a hole in the bottom fuselage caused by a landing gear-up, a handling accident in hangar etc.

Major repairs must not be accomplished before contacting the manufacturer or their representative. Typical repairs that must be considered major are:

1. Damage to the wing spar
2. Damage to the wing root rib
3. Damage to the fuselage main bulkheads
4. A hole in the wing trailing edge that damages the rear spar of the wing
5. Damage to vertical stabilizer/fuselage fitting and bulkhead
6. Damage to horizontal stabilizer fitting
7. Damage to control surfaces that includes holes, cracks or other damage that reach 20 % of the chord into the structure
8. Holes, cracks or other damage in the wing that are larger than 15 cm (6 in) in diameter or 25 cm (10 in) in length

Additional information about repairing of laminates is given in FAA Advisory Circular AC 43.13 1A.

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PIK-20 Repair manual

1. REPAIRING IN GENERAL

During rough landings, ground loops or when exceeding permitted load factors during flight the largest calculated state of load might be exceeded. Damage arising in this way can be difficult to observe but it can cause the structure to become weaker so that the sailplane is durable in normal circumstances but not in situations with increased load. After these cases the sailplane must be properly examined because the lamination may be broken. In disintegration of GFRP laminates, part of the fibers break and one part becomes loose from the plastic bond. The lamination becomes partly or thoroughly white and opaque depending on how large the damage is. The structure must be repaired because of its incapacity for load in all situations. Repair the damaged place by laminating the necessary cloths on top of the structure or remove the damaged place and relaminate the whole area.

These kinds of breaks are also sensitive to humidity because water can permeate into the lamination along the fibers and the bond between plastic and fiber becomes weaker making the lamination less durable.

NOTE

After a rough landing or ground loop the area surrounding the main wing pin must be thoroughly examined for possible damage.

When starting the repair the quality of cloth used, the amount and the direction of fibers must all be known. To find this out sand the lamination with sandpaper or burn some plastic from a little piece which has been removed. In this way you can see the cloth directions clearly.

It is important to remember from which place and direction the piece of lamination has been removed. Paragraph 7 in this manual treats the structures used in most important surfaces and also the quality of cloth, amount and direction of laying.

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TOOLS

- Accurate balance for preparing the right mixture of resin
- Jars and sticks for mixing
- Brushes for spreading of resin
- Mohair roller for spreading of resin on large area
- Iron roller for damping fibers and eliminating air bubbles
- Scissors for cutting glass fiber cloth
- Tape
- Plastic film for high temperature tent
- Hot air blower (hair drier)
- Sandpapers of different degree of fineness
- Knife
- Hack-saw blades for cutting of reinforced plastic

2. REPAIRING OF REINFORCED PLASTIC LAMINATES

Cases of damage that can be self-repaired are usually one of the following three:
Broken monocoque structure
Broken surface of sandwich plate
Hole in sandwich plate

BROKEN MONOCOQUE STRUCTURE

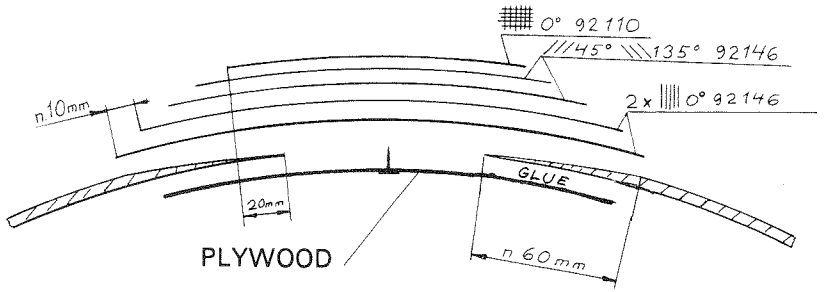

Figure 1

First determine how large the damage is by carefully sanding the surface paint up to where the lamination seems to be unbroken. Then remove the broken area and make a bevel approximately 60 mm at the edges of the opening. Avoid grease. Be sure to clean the area with pure acetone. Laminate each cloth with approximately 10 mm less overlap than the previous one. Laminating this way the last cloth should be 20 mm over the edges. The quality and direction of the cloths must always be the same as in the original lamination. Use an iron roller to eliminate air bubbles: in this way the cloths also become better wetted. During this period use some film (cellophane, or usual plastic film) to cover the area you are patching, and remove the air under the film using a trowel. This way you will get a smoother surface and there is less finishing to do. Remove the film when the resin has hardened. If the hole is big the area should be propped in some way in order to obtain good results when laminating. This can be done for instance by fastening a thin sheet of plywood with glue on the inner side. (See Figure 1). The sheet of plywood can be left there because being glued it will not get loose from the lamination.

If you cannot reach the hole from the inner side, make an oval hole and have a prop which can be layed on place through the oval hole. Before placing the prop set fastening pin or iron wire (See Figure 1). in the prop so that it can be fastened in place during lamination.

OUTER SURFACE OF SANDWICH PLATE IS BROKEN
(Wing, Vertical- and Horizontal control surfaces)

There are three cloths in the sandwich plate and for this purpose make a bevel approximately 40 mm. Remove broken PVC-foam and wash the area with pure acetone. Then fill the hole with mixture of microballoon resin. When the mixture has hardened, sand the area and remove dust and dirt (See Figure 2). Cut the pieces of cloth so that the first goes approximately 40 mm over the edge and the next one always 10 mm less than the previous one. You can now laminate the cloth in place. When the lamination has hardened the manner of proceeding is the same as in paragraph "Broken monocoque structure".

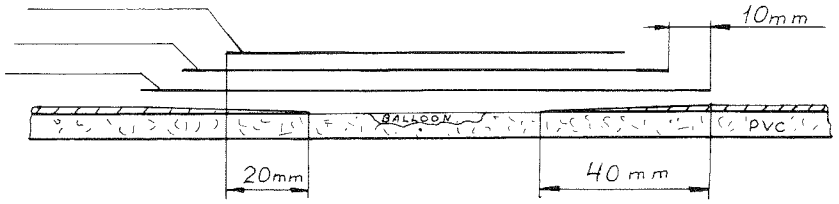

Figure 2

HOLE IN SANDWICH PLATE
(Wing, Vertical- and Horizontal control surfaces)

When there is a hole in the sandwich plate in such an area where laminating from the inner side is impossible, support the area in some way. First make the hole larger so that edges are solid. Remove enough PVC-foam so that a strip approximately 20 mm wide is left around the hole. (See Figure 3). Roughen the strip and make a bevel. After this the manner of proceeding is the same as in the paragraph "Broken monocoque structure". A thin sheet of plywood can be used for supporting. After this you can laminate (45° 92125) on the support and on the inner solid cloth. Let it harden. If the hole is small (100 mm) the manner of proceeding is the same as in the paragraph "Broken outer surface of sandwich plate". When the hole is larger make a PVC-plate to fit the curvature of the hole.

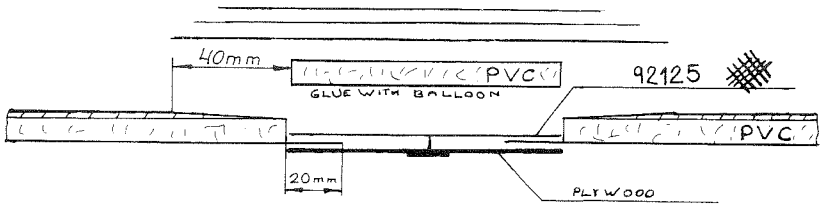

Figure 3

Fill the pores of PVC-foam with microballoon resin and glue it immediately on top of the inner cloth. Put a load on the piece to make it stick better in lamination.

When the glue has hardened sand the area smooth and make a bevel the same way as in the paragraph "Broken outer surface of sandwich plate". Fill the pores of PVC-plate and laminate the cloths immediately.

When the hole is larger first glue the inner laminate to the PVC-plate. To begin, the manner of proceeding is the same as in the previous case. Fill the pores of the PVC-plate with microballoon resin and fit the plate to suit the hole, then laminate the cloth of inner surface (45° 92125) immediately to PVC-plate. When this has hardened glue a sheet of plywood as a prop and draw a nail or iron wire through the plate and plywood. Then glue the PVC-plate on the area with microballoon resin (see Figure 4). Remember to wash the area with acetone and to roughen it before gluing. Use a load or iron wire to accomplish pressing. Do not use too much load because then the inner laminate can get loose from PVC-plate.

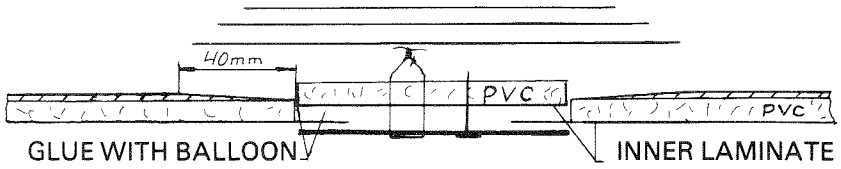

Figure 4

The third way to patch a hole in sandwich plate is to first prepare the patch and bond line together. Remove all broken parts of the hole and leave no inner laminate as edge. Shape the PVC-plate to the hole and glue the previously prepared piece of cloth laminate to the PVC-plate.

The piece of laminate consists of two cloths (/// 45° 92146 + \\\ 135° 92145) which overlap the edge by approximately 40 mm (See Figure 5). Perform the lamination of the cloth on a table on top of plastic film or 2—3 layers of wax and one layer of PVA. After gluing, cut the pieces of laminate to a suitable size.

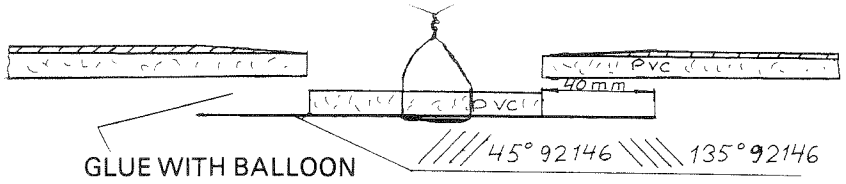

Figure 5

Roughen and wash the bond lines. Then glue the patch with microballoon resin. Make an oval for reaching the hole from the inner side. Use iron wire to accomplish pressing. When the resin has hardened continue the work as usual.

NOTE

Especially when you are gluing "blindly" use microballoon resin so that air is eliminated from the bond line. For this purpose make the bond line approximately 40 mm wide.

AILERONS

For strenghtening the surfaces in flaps and ailerons the PVC-plate used is 5 mm. Outer surface is of the same kind as the wing but there is no lamination on the inner surface.

Repairs are similar to the repairs of sandwich plate except that the inner surface is not made. The PVC-plate is glued with microballoon resin only at the edge.

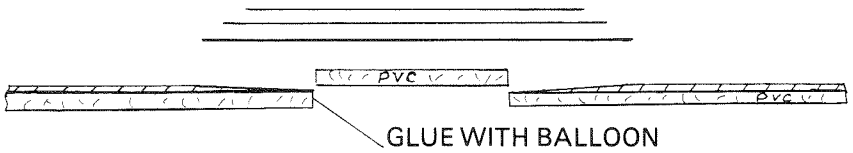

Figure 6

NOTE

When repairing the control surfaces it is important to prevent an increase in the weight. An increase in weight usually causes the center of gravity to shift. This means that the control surfaces should be massbalanced again.

FINISHING

Use sandpaper no. 100 to roughen and start finishing with sandpaper no. 300. Use microballoon resin as filler. It is easy to handle and grind. When repairing the wing use a metal plate to spread the microballoon. This way the solid area supports the work. Use water sandpaper (no. 400 — 600) to sand the filler. Use filler until the weave of the cloth cannot be seen after sanding. Then the surface of the cloth is ready for painting. When the paint has hardened start grinding with wet water sandpaper no. 600 and use grinding pastes afterwards. If you can still see the weave of the cloth another coat of paint is needed. For waxing the sailplane a normal car wax is good enough, not, however, one containing silicone.

NOTE

For painting the exterior surface use only INERTA 70 two-component paint. The hardener is an aliphatic isocyanate, thus the binder is fully resistant to ultra-violet light. Also the pigmentation is fully resistant to light. The following coloration standard measured with a Hunterlab D 25 D colordifference meter may be used:

Color	CIE chromaticity co-ordinates x and y, Luminance factor Y
TM 101 white	x = 0.336 y = 0.366 Y = 90.8
TM yellow	x = 0.501 y = 0.485 Y = 65.9
TM 292 red	x = 0.627 y = 0.324 Y = 9.9
Green	x = 0.343 y = 0.461 Y = 28.75

3. REPAIRING OF CRACKS IN PLEXIGLASS

Before starting the work, prevent the progression of the crack by stop-drilling (2 mm hole) the ends of the crack. Then open the crack and fill it with acryl glue starting from the bottom of the V. (See Figure 9). Use Tensol no. 7 for gluing. Fill the crack layer by layer and let the layers harden in between to prevent air bubbles because the glue shrinks while hardening. When the crack has been filled and the glue is hard grind the

patch smooth first with fine water sandpaper and afterwards with grinding pastes and liquids so that the bond line becomes transparent. To begin use water sandpaper no. 600 for eliminating scratches and defects of the surface if they are deep. Fasten the paper on a soft grinding tool which has curved edges. Do the grinding by gently rotating with help of the weight of the fingers. After this use grinding paste (''Perspex'' Polish no. 1) which is also good for starting to repair very small cracks. Spread the paste with a soft piece of cloth or grinding disc if a grinding

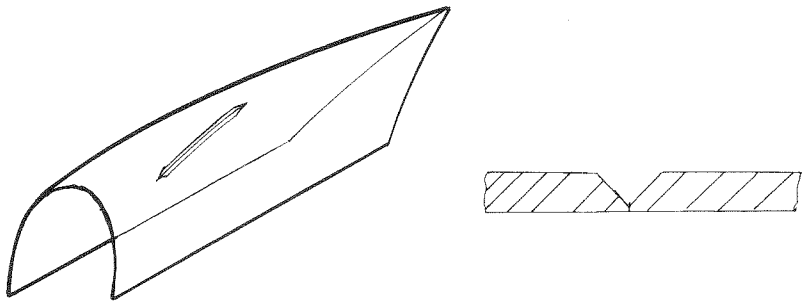

Figure 9

machine is available. Change the cloth every five minutes; the paste must not dry on the cloth. The grinding pressure must be very light. Remove the paste with a clean piece of cotton cloth, after this polish with polishing liquid (''Perspex'' Polish no. 2A). Use the same piece of cloth both for spreading and polishing. Take care that the piece of cloth is clean from dust and dirt during the work. Use ''Perspex'' Polish no. 3 to remove possible static electricity due to grinding and polishing. If necessary use water to make the Polish thinner and spread the Polish on the canopy with a soft, humid cloth. Use a clean, soft and dry cloth for rubbing the canopy shiny. You can also wash the canopy with a solution consisting of 10 % ''Perspex'' Polish no. 3 and 90 % water. Afterwards dry the canopy with a soft cloth. After washing the static electricity must be removed to avoid dust. Use warm water and soap for washing. The use of organic solutions (as solvents of paint and turpentine) is forbidden.

4. REPAIRING OF METAL PARTS

The steel parts of the sailplane are made of chrome molybdenum steel SAE 4130.

The steel plate has been in a soft condition and the tube normalized. If you use an inert gas welding system it is necessary to carry out annealing afterwards. This can be done, for instance, by warming the welding line and surrounding it with a gas flame. When you use a normal gas welding system annealing is not needed. The wing fitting parts, landing gear and flaps-airbrakes torque tube are normalized (100 kp/mm²). If these parts are welded they must be renormalized. Paint the repaired area with primer (for instance Herberts Standox Reaktionsgrund). The interior surface of the tubes are protected against rust (Dinitrol ML).

NOTE

Only a qualified welder may weld airplane parts.

The push rods are made of aluminum with rod ends. The rollers of the push rods leads are made of nylon. All the bolts are millimetric high strenght bolts. The bolts used in control system are of close tolerance and these are sold by the manufacturer. The fastening bolts are coated with zinc (for instance Bright Zinc F ZB). The fuselage pins and bolts are made of chrome molybdenum steel. If a bushing made of bronze wears it can be changed to a close tolerance bushing (AP 110). The rudder control cables are totally enclosed in a nylon tube.

The cable is 7 x 7 Ø 3/32'' MIL-1511 and it is approximately 6,40 m long.

NOTE

It is necessary to have two fastening bushings (swages) at the cable wire ends and their distance from one another must be approximately 8 mm (1/3 in).

5. INSPECTION OF WATER TANKS

The water tanks of the sailplane are made of plastic strenghtened with nylon so they are very strong. It is, however, good to inspect them every year at least. Loosen the tanks by sawing loose the fitting which comes out from main rib and take the tank out from the hole in the main rib. The easiest way of inspecting the tanks is to look for humid areas or chafed places when tanks are filled with water.

In case of leakages, patches for an air mattress or car wheel are suitable. Check durability of the patch before putting the tanks back.

Start installation by fastening a tube fitting (Ø 25 mm GF 21, 96, 04) with a tube tightener to the tank. Then push the tank into wing using a stick approximately 5 m long with a hook which fits the loop of the tank.

Notice during installation:

— no wrinkles allowed in the tank when it is on the bottom of the wing
— the seam towards trailing edge

When the tank is inside push the tube fitting into the hole in the main rib and lock the tank by gluing the fitting (Ø 25 GF 21, 64, 01) to the tube fitting.

Parts for water tanks are sold by the manufacturer.

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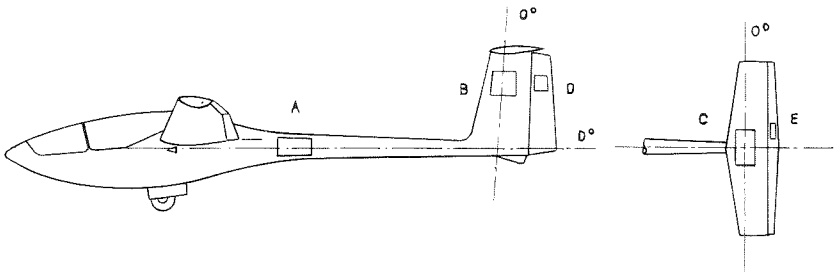
6. OTHER REPAIRS

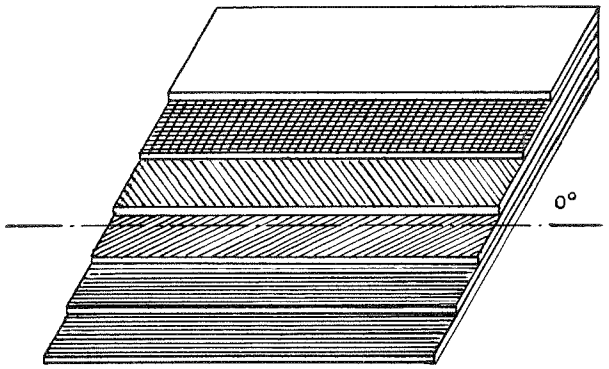
The repairs of instruments, radios and oxygen systems must be performed according to instructions of manufacturers or aviation authorities.

7. GLASS FIBER CLOTHS USED IN DIFFERENT PLACES



A FUSELAGE

Surface paint	
0°	90070
45°	92146
135°	92146
0°	92146
0°	92146



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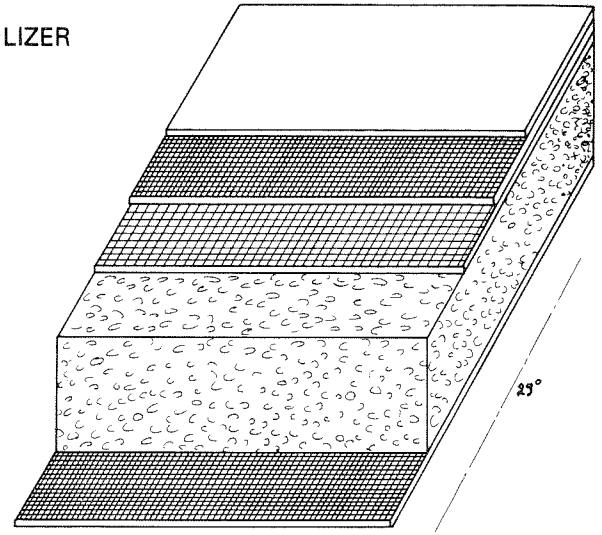
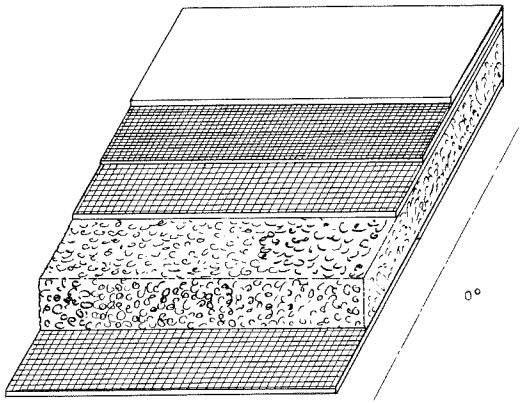
B VERTICAL STABILIZER

Surface paint
90° 92110
90° 92125
10 mm
Hard PVC-foam
Lynizel 4060
0° 92110



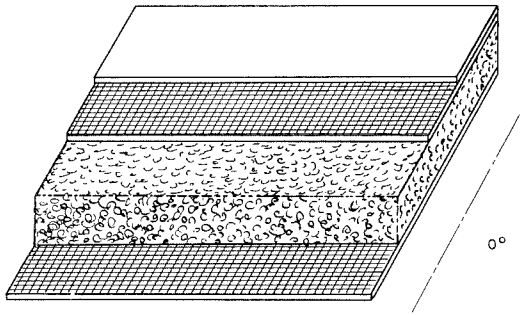
C STABILIZER

Surface paint
0° 90070
0° 92125
5 mm
Hard PVC-foam
Lynizel 4060
0° 92110



D RUDDER

Surface paint
0° 92110
5 mm
PVC-foam
Lynizel 4040
0° 92110



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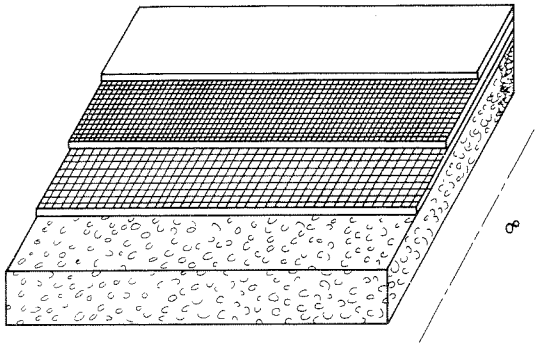
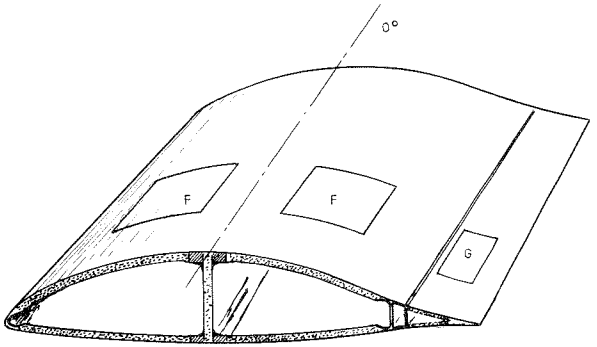
E ELEVATOR

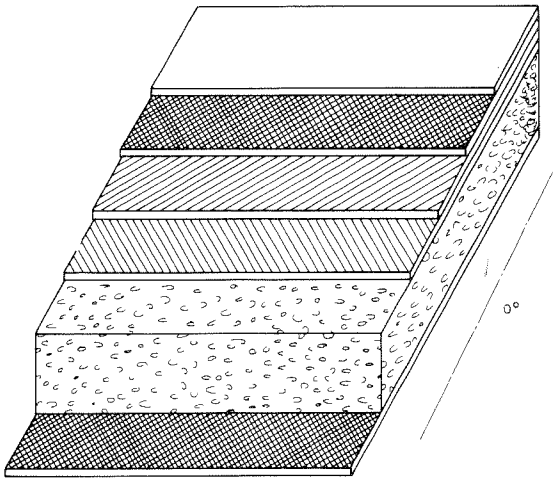
Surface paint
0° 92110
0° 92125
5 mm
PVC-foam
Lynizel 4040





F WING

Surface paint
45° 90070
45° 92145
135° 92145
10 mm
PVC-foam
Lynizel 4060
45° 92110



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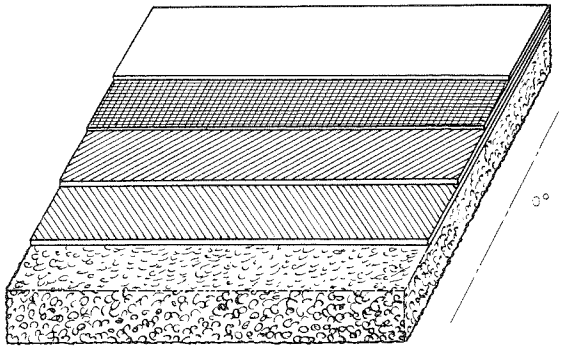
G FLAPS-AIRBRAKES AND AILERONS

Surface paint
0° 90070
45° 92145
135° 92145
In addition to this
flaps-airbrakes have
0° 92125
5 mm
PVC-foam
Lynizel 4040



8. RAW MATERIAL LIST FOR PLASTIC STRUCTURES

Plastic

Resin	Rütapox L 02
Hardener	Rütapox H 91/SG (91, SG 50, SG)
Mixture	(mass parts):
	34 H 91
	100 L 02 + 33 SG 50
	30 SG
Manufacturer:	Bakelite GmbH
	5868 Letmathe
	Gennaerstr. 2—4, Federal Republic of Germany

Glass fiber cloths

Manufacturer:	Interglas Gmbh, Federal Republic of Germany
Interglas no.	weight g/m²±5%
90070	80
92110	116
92125	280
92140	395
92145	215
92146	440

Finishing I 550

Rovings

RA 45T 448M 15
Manufacturer: Scandinavian Glasfiber, Sweden

Surface paint

Inerta 70	polyurethane surface paint
T-M shades:	101 white
	291 yellow
	292 red
Solvent:	9526
Mixture:	2 units by volume resin + 1 unit by volume hardener
Manufacturer:	Teknos Maalit Oy, Finland

Core material of sandwich plates

Hard PVC-foam
Conticell 60 (60 kg/m³)
Manufacturer: Continental Ag, Federal Republic of Germany

or

Lynizel 4060 (60 kg/m³) and 4040 (40 kg/m³)
Manufacturer: Indewek GmbH, Federal Republic of Germany

Fillers

Microballoon: Eccospheres
Manufacturer: Emerson & Cumings, Belgium

Chopped fibers EC 10-S
Manufacturer: Gevetex Textilglas GmbH, Federal Republic of Germany

Release agents

Wax QZ 11 3
Manufacturer: CIBA Ag, Switzerland

Polyvinylalcohol PVA Mould Release Agent No. 3
Manufacturer: Downland, England

Protecting ointments for hands

(Suitable for epoxy resins)
Arretil Q (before lamination)
Stokolan (after washing and lamination)
Manufacturer: Stockhausen Krefeld

Acryl plate

Finnacryl; 3 mm thick
Manufacturer: Lohjan Kalkkitehdas Oy, Finland

Repairing material for plexiglass

Acryl glue: "Tensol 7" and hardener
Manufacturer: ICI, England

Grinding and polishing material for acryl
"Perspex Polish No. 1"
" " No. 2A
" " No. 3
Manufacturer: ICI, England