F L I G H T and S E R V I C E M A N U A L

"G L A S F L Ü G E L 304 CZ - 17"

Issue March 2000

This manual should always be carried in the sailplane

It belongs to sailplane " GLASFLÜGEL 304 CZ - 17"

Serial No.: ~~70~~-17 33

Registration: ~~OK-4662~~ G-DAWZ

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The pages 10 - 34 are approved by
the Czech Civil Aviation Authority

This Sailplane Flight Manual Constitutes an FAA Approved Flight Manual for US registered sailplanes , in accordance with FAR 21.29

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REPAIR & MAINTENANCE MANUAL

Amendment to Manual

No.	Description	Page	Date	Signature
1.	Mandatory Bulletin No.:304CZ17-02a)	31	December 04 2000	Pekař
2.	Mandatory Bulletin No.:304CZ17-04a)	50	September 06 2002	Pekař
3.	Mandatory Bulletin No.:304CZ17-04a)-change1	50	December 03 2002	Pekař

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1. GENERAL INFORMATION

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The "GLASFLÜGEL 304 CZ - 17" is a single seat 49 ft. 2,5 in. (15 m) flapped sailplane in GLASFLÜGEL All Fiberglass Construction (GRP).

WING

The two-piece wing is cantilever and double trapezoidal It is constructed as a GRP-Foam-Sandwich shell with spar caps of parallel glass fibers, extruded by a method developed by Hütter and Hänle, and shear webs of reinforced GRP-Foam-Sandwich. The trailing edge airbrakes are a combination of spoilers and flaps. The ailerons have internal drive.
Removable winglets reinforced by the carbon fibre .
Removable wing extentions - wing span 57,18 ft(17,43 m).
Two water ballast bags carry a total of 25,3 gal (115 liters).

FUSELAGE

The fuselage tapers behind the wing, the faired-in one piece canopy is hinged forward.
The fuselage shell is of GRP single skin construction, therefore capable of large energy absorption. The fuselage shell is supported by GRP profile frames.
The pilot is seated in a semi-reclining position.
The landing gear is retractable.
A C.G. release is fitted as standard, and an Aerotow nose release can be fitted on request.

HORIZONTAL TAILPLANE

The horizontal tailplane has a stabilizer and elevators. Trimming is by means of a leaf spring on the control column, adjusted by a touch-button on the handgrip of the control column. The stabilizer is of GRP-Foam-Sandwich construction.

FIN and RUDDER

The fin is similar to the stabilizer of GRP-Foam-Sandwich Shell construction, also the rudder, which features internal drive.

COCKPIT INTERIOR

Head-rest, back-rest and rudder pedals are adjustable in flight. A seat cushion with inflatable knee supports is standard equipment. When the canopy is opened the instrument carrier pivots upward and renders possible a comfortable and unrestricted getting in and out. The canopy is ventilated by slots in the instrument panel support, fresh air for the pilot is provided by butterfly outlets right and left of the instrument panel. If necessary the sliding window (DV) in the canopy may be used for ventilation, too.
Battery box, barograph tray and a water ballast system are installed.

DIMENSIONS

Wing 15 m	span	49 ft. 2,5 in.	(15,00 m)
configuration :	area	106,35 sq. ft.	(9,88 m^2)
	aspect ratio	22,78	(22,78)
Wing 17.43 m	span	57,18 ft.	(17,43 m)
configuration :	area	114,99 sq. ft.	(10,683 m^2)
	aspect ratio	28,439	(28,439)
Horizontal Tail :	span	6 ft. 10,5 in.	(2,10 m)
	area	10,66 sq. ft.	(0,99 m^2)
	aspect ratio	4,42	(4,42)
Fin and Rudder :	span	3 ft. 9 in.	(1,15 m)
	area	9,59 sq. ft.	(0,89 m^2)
	aspect ratio	1,49	(1,49)
Fuselage :	length	21 ft. 2 in.	(6,45 m)
	width	2 ft. 0,5 in.	(0,62 m)
	height	4 ft. 5,5 in.	(1,36 m)
	(Cockpit :	2 ft. 8,5 in.	0,83 m)

INTENTIONALLY LEAVE BANK

2. OPERATING LIMITS

2.OPERATING LIMITS

2.1 AIR SPEEDS (IAS)

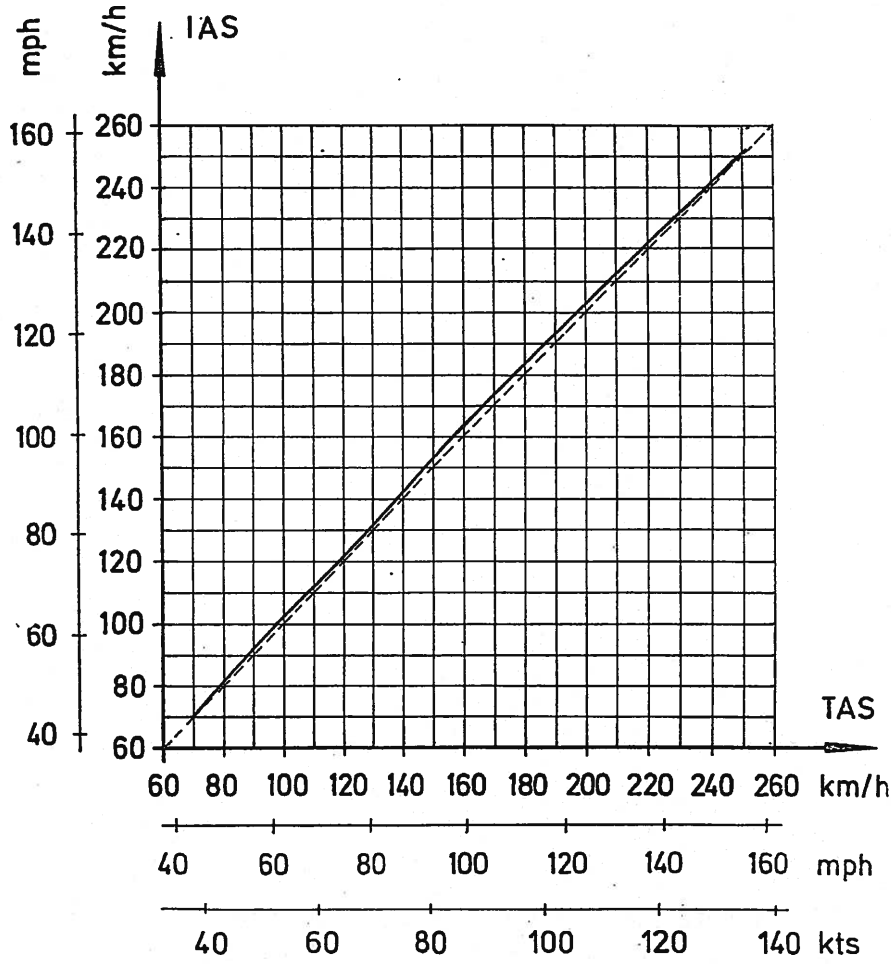
Operating limits - 15 m & 17,43 m wing span

Never exceeding speed with flaps at 0,-1,-2	V_{NE}	135 kts	155 mph	250 km/h
Maximum speed with flaps at +1,+2,L	V_{FE}	97 kts	111 mph	180 km/h
Maximum speed in rough air	V_{RA}	97 kts	111 mph	180 km/h
Manoeuvering speed	V_A	97 kts	111 mph	180 km/h
Maximum speed on Aerotow	V_T	81 kts	93 mph	150 km/h
Maximum speed on Auto or Winch tow	V_W	81 kts	93 mph	150 km/h

Please note that as altitude increases the True Air Speed (TAS) is higher than the Indicated Air Speed (IAS) registrated by the air speed indicator.
This has no influence on the strength or load factors of the sailplane, however, for reasons of flutter safety, the following Indicated Air Speeds should not be exceeded.

	Span 15 m		
Height	IAS	IAS	IAS
ft	kts	mph	km/h
Up to 13000	135	155	250
13000	135	155	250
16000	130	149	240
19500	122	140	226
22900	115	133	214
26000	109	125	202
29500	103	119	191
32700	97	111	179
39300	86	99	159

Air Speed Indicator (ASI) position error (at MSL)



2.2 AIRWORTHINESS CATEGORY

"U" (Utility)

Based on the Airworthiness Requirements LFSM full control movements of rudder and aileron can be used up to the manoeuvering speed V_A. At higher speeds it is possible to overstress the sailplane structurally, therefore full movements are not permitted above 97kts, (111mph, 180km/h).

At the maximum permissable speed V_{NE} = 135kts, (155mph, 250km/h), a maximum of 1/3rd of the full movement is permissable.
For the elevator, the permissable deflection is considerably smaller. It must be limited in accordance to the limits of the load factor (see below) which must not be exceeded.
This sailplane can under normal weather conditions be safely flown up to V_{NE} = 135kts, (155mph, 250 km/h).

In extreme turbulence, as encountered for instance in wave rotors, thunder clouds, visible up-currents, or when flying over mountain ranges, a speed of V_B = 97kts, (111mph, 180km/h) should not be exceeded.

2.3 LOAD FACTORS

The following load factors should not be exceeded:

at 97kts, (111mph, 180km/h)	+ 5.3/ - 2.65	Airbrakes closed.
at 135kts, (155mph, 250km/h)	+ 4.0/ - 1.5	
Airbrakes extended	+ 3.5	

The safety factor is then 1.5 .

2.4 CLOUD FLYING

is approved with corresponding equipment.

2.5 WEIGHTS

Maximum permitted weight (mass)	992 lbs (450kg)
Maximum permitted weight (mass) of non lift carrying parts (i.e. all parts including cockpit--loading and load of. luggage compartment, either wing and water ballast)	529 lbs (240 kg)

Maximum weight of water ballast (lbs) to the following table :

Empty weight		Cockpit load											
		kg	Lbs	kg	Lbs	kg	Lbs	kg	Lbs	kg	Lbs	kg	Lbs
Lbs	kg	65	143	70	154	80	176	90	198	100	220	110	242
507	230	253,5		253,5		253,5		253,5		253,5		242,5	
529	240	253,5		253,5		253,5		253,5		242,5		220,5	
551	250	253,5		253,5		253,5		242,5		220,5		198,4	
573	260	253,5		253,5		242,5		220,5		198,4		176,4*	
595	270	253,5		242,5		220,5		198,4		176,4*		154,3*	
617	280	231,5		220,5		198,4		176,4*		154,3*		132,3*	

* Attention: With this load in the cockpit, check if the weight of the non-lift-carrying parts has not been exceeded. The luggage compartment may hold a max. load of 22 lbs, (10 kg),including all installed equipment,. but must be considered when establishing maximum water ballast.

2.6 CENTER OF GRAVITY (C.G.) POSITIONS

The permissable CG positions (flight) are between 7.8 in.and 12.52 in, (200mm and 318mm.), behind reference point (corresponds to 24,5% - 41.7% mean chord).

Where pilots with parachutes do not reach the placarded minimum cockpit load the appropriate amount of lead ballast must be carried. One kg of lead ballast (2,2 lbs) in the ballast box will compensate for 2,4 kg (5,3 lbs). Maximum lead ballast capacity of the ballast box is 6 kg (13,2 lbs).

Suitable lead ballast plates are available from HPH spol. s r.o. .

Weighing date	11.25.03 mm.dd.yy				
Carried out by	Jensen				
Equipment list date	11.25.03 mm.dd.yy				
C.G. position behind reference	532 mm				
Minimum loading in cockpit	70 kg				
Maximum loading in cockpit	115.7 kg				
Empty Weight	264.3 kg				

2.7 WEAK-LINKS

Releases	Bugkupplung "E-72" or "E-75" or "E-85" , Sonderkupplung "SH-72"
Winch tow	6400 N (1433 lbs, 650 kg)
Aerotow	6400 N (1433 lbs,.650 kg)

2.8 MINIMUM EQUIPMENT

- Air Speed Indicator with range from 27kts, (31mph, 50km/h) to 146kts, (168mph, 270km/h) with the following colour coding:

White arc	42-97 kts	48-111 mph	78-180 km/h
Green arc	51-97 kts	58-111 mph	94-180 km/h
Yellow arc	97-135 kts	111-155 mph	180-250 km/h
Red radial and placard	135 kts 13000 ft	155 mph 13000 ft	250 km/h 4000 m
Red radial and placard	113 kts 24000 ft	130 mph 24000 ft	210 km/h 7300 m
Red radial and placard	92 kts 36000 ft	106 mph 36000 ft	170 km/h 10950 m
Yellow arrow at	46 kts	53 mph	85 km/h

- Altimeter
- 4- piece safety harness
- Manual parachute, automatic parachute, otherwise back-cushion (compressed approx. 39,3 inch (10cm) thick)
- Placards in cockpit as per Master Equipment List (8.3)
- Flight Manual

for CLOUD FLYING in addition to the minimum equipment:

- Variometer
- Compass
- Turn & Bank Indicator

Experience so far has shown that the installed Air Speed Indicator System is suitable for cloud flying. The installed minimum equipment must be of an approved type.

Take note, the instrument panel weight should not exceed 10 kg, 22lbs.

2.9 AEROBATICS

With corresponding equipment, the "GLASFLÜGEL 304 CZ - 17" is approved for aerobatics in the 15 m configuration only :

Inside loop

Spin

Stall Turn (Hammerhead)

Lazy eight

It is recommended to install a recording "G" meter in addition to the equipment listed under 2.8 .

WARNING

Aerobatics are only approved without water ballast (max. weight 380kg, 8381bs.)and without wing extensions (max. wing span 15 m).

2.10 SURFACE FINISH

Please note that the surface of all parts which are exposed to sun-radiation must be coloured white, except of the areas for the registration and anti-collision markings .

Colours other than white will increase the heat build-up in the GRP, so that insufficient strength will result.

3. EMERGENCY

3. EMERGENCY

3.1 TERMINATING OF SPINS

Should the sailplane unintentionally enter into a spin, the back pressure on the elevator must be released, the flaps must be set to a negative position and the rotation stopped by applying opposite rudder.
It is important to release the back pressure on the elevator to prevent the sailplane changing into an opposite rotation spin when applying opposite rudder. The negative flap setting deminishes additional rotation during terminating of spin.

3.2 INCIDENTS

Take-Off's on not mowed grass surfaces should be avoided for aerotow and winch tow.
Should a wingtip be caught in long grass, release at once, delaying this may result in a ground-loop.
In the early take-off phase of a winch launch, the cable chute may open if the chute is of a too large a type, or if the climb is too shallow.
In this instance, release and land straight ahead. A speed of 46-49kts *),(53-56mph, 85-90km/h), should be maintained after release at low height in straight and level flight; and in a turn, should be increased according to the angle of bank. With this, the unintentional and unnoticed stalled flight will be avoided.
Should you detect a slight vibration, with "spongy" controls and the air speed indicator varying between 35 and 46 kts, (40-53 mph, 65- 85 km/h), the sailplane is in stalled flight. Move the control stick forward at once.

*) With water ballast these speeds increase up to 15 %.

3.3 CANOPY JETTISON

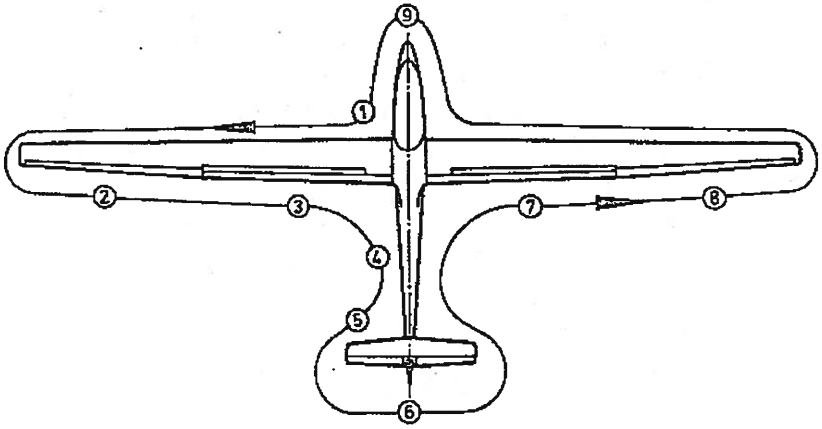
Grasp (from below) the red grips (right and left of the canopy frame) for canopy jettison. Pull them back and push the canopy upward.

INTENTIONALLY LEAVE BANK

4. NORMAL OPERATION

4. NORMAL OPERATION

4.1 DAILY INSPECTION:



When inspecting the sailplane check for cracks in surface finish, blisters or uneven surface, and if in doubt, check with authorized, specialized personnel.

1. a) Open the cockpit, check if the main pin is installed and locked.
   b) Visual cockpit control inspection.
   c) Remove foreign material from fuselage.
   d) Check tyre pressure in main wheel (see page 43).
   e) Check function of tow release, condition and spacing of cable deflector plates.
2. Check ailerons for full and free movement.
3. a) Check airbrakes for free movement and flush fit.
   b) Check aileron and flap trailing edges for damage . Lightly shake ailerons and flaps on the trailing edge to detect unusually large play in the system.
   c) With flaps at - 2 position, check gasspring in the control system - to do this, press flap at root-end down into the neutral position, - then release - flaps should return to previous position.
   d) Check hinges for damage.

4. Check if the holes for static pressure on the fuselage shell are clear.
5. a) Check if the front stabilizer attachment bolt is engaged.
   b) Check for blocked pitot, gently blow into pitot check ASI registers.
   c) Fit compensator tube and check line. When blowing against tube, the connected variometer registers "climb"
   d) Check tyre pressure in tail wheel (see page 43).
6. a) Check elevator and rudder for free and full movement.
   b) Check elevator and rudder for damage, lightly shake by hand on trailing edge to check for unusually large play in system.
7. See under 3.
8. See under 2.
9. a) Check the function of the aerotow release.
   b) Check for blocked pitot, blow into pitot, ASI registers.

After a hard landing, or excessively high "G" loads, the bending frequency of the wings must be checked and the sailplane carefully examined for any indications of demage. Dismantle the sailplane and check surface finish for cracks. Look for white areas (that may indicate delamination) at the wing spar root ends, wing root rib fittings, landing gear attachments, tail fittings, and all areas of concentrated loads. Also inspect the central wing pin and tail attachments for distortion. If damage is found, the sailplane should be grounded until any repairs have been completed.

4.2 COCKPIT LAY-OUT

1. Instrument panel:

With the canopy removed (operate canopy jettison with canopy open and supported), instruments are readily accessible. The instrument panel shroud is attached to the canopy.

The instrument module itself is mounted to the nose bulkhead and pivots upward when opening the canopy.

2. Control Column:

The elevator is moved by a parallelogram system which prevents unintentional movements induced by gusts. The following are mounted on the control column:

a) Radio button: press to transmit.

b) Spring trim button: depress with the little finger and release in any selected control column position.

c) Trim lever: can be adjusted manually when trim button is depressed.

Forward rotation = nose heavy

Rearward rotation = tail heavy

3. Wheel brake:

Press heels on pedal control (if necessary pull back pedals (1-2 notches) before landing).

4. Tow Release:

The yellow grip under the Port side of the instrument panel is activating both releases.

5. Airbrakes:

Open: Unlock (inwards) blue lever on the Port cockpit side and pull towards the rear.

Close: Push lever forward and lock.

6. Flaps:

Unlock (outwards) grey lever on the Port cockpit side, and select flap setting.

This lever can only be operated if the airbrake lever is locked.

Flap settings:	
L	landing
+2	circling flight in wide thermals
+1	circling flight in narrow thermals, and when towing
0	best glide (51-62kts, 59-71mph, 95-115km/h)
-1	interthermal at normal speed (up to 81kts, 93mph, 150km/h)
-2	interthermal at high speed (above 81kts, 93mph, 150km/h)

7. Canopy Lock:

Closing: Pull canopy down on both white grips and pivot grips forward until flush.

Opening: Pull white grips (right and left of the canopy frame) and push canopy upward.

8. Landing gear:

to retract: Unlock black handle on the Starboard cockpit side and pull backwards, then lock.

to lower gear: Unlock, push black handle forward and lock.

9. Water ballast:

Small lever on the Starboard cockpit side.

Lever at rear position: Valves open

Lever in forward position: Valves close

10. Backrest with headrest

Release black "D" ring form notch on Starboard cockpit side.

Release weight on backrest and pull:

Backrest moves forward.

Headrest: Lift notched bar and adjust headrest.

Backrest and headrest may be adjusted during flight.

11. Rudder pedal adjustment:

By pulling the black "T" - grip under the instrument panel, the panel adjustment is unlocked.

Forward adjustment: Pull black "T"-grip while pushing pedals forward with heels, release grip and let pedals lock into position.

Rear adjustment: Pull pedals back with black grip.

12. Cockpit Ventilation

Blue knob on instrument panel: Pull to open - Push to close

Butterfly valves closed - all ventilation to canopy

Butterfly valves open - fresh air for the pilot and some to canopy

4.3 COCKPIT CHECK BEFORE TAKE-OFF

See placard in cockpit.

4.4 TAKE-OFF

Aerotow:

For aerotow, ropes of synthetic and natural fibers between 198 and 296ft. (30- 60 m), lengths have been tested.

If a nose hook is installed, we recommend to use this one.

Nevertheless the C.G. hook is approved for aerotow, too.

When commencing the take-off run, use wheel brake slightly to prevent rolling over tow rope.

Depending on the loading in the cockpit, the trim setting before take-off should be "normal" for forward to medium C.G., positions.

For medium to rear C.G. positions trim "nose heavy".

Flap setting during aerotow: + 1

With rear C.G. position, high take-off weight, or strong cross wind commence the take-off run with flap-setting - 2, until sufficient aileron control is available.

Then move flap setting back to take-off position + 1 (considerably below lift-off speed, in order to prevent "ballooning"). After lift-off at approx. 40-43 kts *), 47-50 mph, 75-80 km/h retrim to reduce elevator loads.

The normal towing speed is 54-65 kts *), 62-75 mph, 100-120 km/h, with a maximum of 81 kts, 93 mph, 150 km/h IAS.

The main landing gear can be retracted during tow.

Should the sailplane be unintentionally displaced laterally, it should be cautiously but immediately steered back to normal aerotow position.

Should the sailplane be displaced vertically into a too high tow position during high tow, with danger of over-shooting the tow aircraft, the airbrakes should be opened.

To release:

Pull release right through and repeat, ensure that the cable has released before turning away.

*) with water ballast these speeds increase up to 15 %.

Winch tow:

Winch tow must only be attempted on the C.G. release. Before take-off, the trim is set to "normal" for forward and medium C.G. positions, and "nose heavy" for medium to rear C.G. positions.

Flap setting for launching: + 1

When commencing the take-off run, use wheel brake slightly to prevent rolling over tow rope.

This sailplane shows normal behavior during winch tow and even with rear C.G. positions has only a minor tendency to enter into a steep climb after take-off. Depending on the trim-setting, a correction with the elevator may be necessary to prevent a steep climb in the early take-off phase.

After a safety height of approx. 150ft (50m) is reached, the sailplane can be brought into a steeper climb by more back pressure on the control column. If too much back pressure is applied and proposing occurs (elevator stall),release some of the back pressure.

Avoid rapid lift-off maneuvers or low towing speeds.

The high wing loading of this sailplane requires the pilot to abort the take-off and release, if the towing speed drops below 51 kts, 59 mph, 95 km/h, (with water ballast 59 kts, 68 mph, 110 km/h).

Winches with low performance, engines with RPM limitations and other restrictions, as well as tail wind, calm air, filled water tanks etc., require special attention before take-off, to ensure that the winch is providing enough power in reserve to maintain the safe towing speeds.

If possible, use small cable chutes to prevent deploying at flat climb angles.

The normal minimum towing speed is	57kts (65mph,105km/h)
with water ballast	65kts (75mph,120km/h)
Max. towing speed	81kts (93mph,150km/h)

At maximum towing height, the cable will back release automatically, however, you should not neglect to pull the release knob several times.

4.5 FREE FLIGHT:

At a safe height, experiment with the airbrakes and note loss of height at different speeds.

Make yourself familiar with the operation of the flaps. This sailplane has very well balanced flight characteristics and controls. The rate of roll from 45° bank at 1.4 x stalling speed and flap setting 0 is 3 to 3.5 sec. With the wing extentions the rate of roll is 4 to 4,5 sec .

On the other hand, it is possible to fly "hands off" in straight and level or circling flight without the sailplane changing its attitude or speed. All control movements require only very low operating forces.

4.6 SLOW SPEED FLIGHT, STALL

For familiarization with this sailplane, we recommended to do stalling tests at different flap settings, from a straight and level flight, and from banked flight (approx. 45° bank) at safe heights.

The following stalling speeds were measured:

A.U.W		772 lbs (350 kg)	882 lbs (400 kg)	992 lbs (450 kg)
		Stalling speed with closed airbrakes & winglets		
Flap setting	L	36 kts(41 mph,66 km/h)	38 kts(44 mph,71 km/h)	40 kts(42mph,75 km/h)
	0	38 kts(43 mph,70 km/h)	40 kts(47 mph,75 km/h)	43 kts(49 mph,79 km/h)
	-2	40 kts(46 mph,74 km/h)	43 kts(49 mph,79 km/h)	45 kts(52mph,84 km/h)
		Stalling speed with airbrakes extended		
	L	36 kts(42 mph,67 km/h)	39 kts(45 mph,72 km/h)	41 kts(47 mph,76km/h)

A.U.W		772 lbs (350 kg)	882 lbs (400 kg)	992 lbs (450 kg)
		Stalling speed with closed airbrakes & wing extentions		
Flap setting	L	33,5 kts(39 mph,62 km/h)	36 kts(41 mph,66 km/h)	38 kts(44 mph,71 km/h)
	0	36,7 kts(42 mph,68 km/h)	38 kts(43 mph,70 km/h)	40 kts(47 mph,75 km/h)
	-2	40 kts(46 mph,77 km/h)	40 kts(46 mph,74 km/h)	43 kts(49 mph,79 km/h)
		Stalling speed with airbrakes extended		
	L	36 kts(42 mph,67 km/h)	36 kts(42 mph,67 km/h)	39 kts(45 mph,72 km/h)

With closed airbrakes, a stall warning occurs in the form of a light shudder and vibration and twitching of the ASI needle just prior to the stalling speed. If the airbrakes are employed, the airframe vibrates noticeably at approx. 2kts, 3mph,5km/h, before the stalling speed is reached. If the control column is slowly pulled back further the glider stalls and pitches nose down or drops a wing. The back pressure on the control column should then be immediately released.

If the airbrakes are extended, the loss of height after wing drop may be approx. 150 ft (50m).

With medium and forward C.G. positions you can steer the glider by rudder and ailerons in a stalled flight. This situation shows up by "spongy" controls, increased sinking speed and oscillation of the ASI needle.

4.7 HIGH SPEED FLIGHT

During high speed flight, pay attention to the maximum permissable speeds for the corresponding flap settings. Speeds are colour coded in different colours on the ASI and are easily visible (see 2.8).

Full control deflections of aileron and rudder are allowable up to

V_A 97kts, (111mph, 180km/h), and at

V_{NE} = 135kts,(155mph, 250km/h), only 1/3rd of the full control movement is permissable.

Elevator deflections must be limited so, that the load factors indicated on page 12 are not exceeded.

During extreme turbulence, as it may occur for instance in wave rotors, thunderclouds, visible up-currents (stubble fire), or while crossing mountain ranges, the gust speed V_B 97kts, (111mph, 180km/h) should not be exceeded. The necessary control column travel, in particular at rear C.G. positions, from the stalling speed to the maximum speed is relatively small, however any speed changes will be noticed by a change in the control forces.

The airbrakes can be opened up to V_{NE} = 135kts, 155mph, 250 km/h, this however, should only be done in an emergency, or when unintentionally exceeding the maximum permissable speeds listed on page 8, as sudden decelerations of 2 "G" will occur.

For this reason, ensure that your harness is tight, and that you do not unintentionally move or jolt the control column while operating the airbrake lever.

Loose objects in the cockpit should be avoided.

Pay attention also to the fact, that recovery from dives with airbrakes employed, should be more gentle than with airbrakes deployed (see section 2.3 load factors).

CAUTION

BECAUSE OF THE QUICK ACCELERATION AT STEEPER ANGLES DO NOT RETRACT THE AIRBRAKES AT ABOVE 81 KTS,(93 MPH, 150 KM/H).IF THE AIRBRAKES ARE EMPLOYED AT HIGHER SPEEDS (ABOVE 81KTS, 93MPH, 150KM/H) THEY SHOULD BE OPENED CONSISTENTLY.

IN PARTICULAR, THE OPERATING LEVER SHOULD NOT BE HELD NEAR THE LOCKING POSITION (SLIGHTLY OPEN).

CAUTION

IF THE AIRBRAKE DRIVE MECHANISM IS WRONG ADJUSTED THAN THE KNOCKING OF THE AIRBRAKE SPOILER WITH HIGH FREQUENCY CAN OCCUR WITH SPEED APPROACHING TO V_{NE} . TO TERMINATE THIS SITUATION PULL OUT TO REDUCE SPEED BELOW 81 KTS,(93 MPH, 150 KM/H) OR OPEN THE AIRBRAKES CONSISTENTLY .

4.8 FLYING WITH WATER BALLAST

At average climbing speeds of less than 2.9kts (300 ft/min, 1.5m/sec), the use of water ballast is not of benefit.
This applies also for flights in tight thermals which require steep angles of bank.
Before water ballast is added, check the table in section 2.5 for the maximum weight of water ballast.
The capacity of the bags in the wings total 25,3 gal (115 litre).
Fill through the valves in the lower surface of the wings. Let the actuating lever in "close" position, fill left bag, disconnect the filler tube from the valve (it will be closed automatically), fill right bag by the same steps as the left .
Attention:

- Bags must not be pressurized, e.g. directly from the water hose.
- Both bags must be filled equally.
- Water ballast must not be carried at temperatures below 32°F, 0°C, because of freezing danger.

The water ballast should be jettisoned before landing.
Full bags jettisoning takes about 4 minutes.
Never store the sailplane with filled bags.
Always jettison the water and open the valves to vent the water bags.

4.9 CLOUD FLYING

During cloud flying flap setting L must not be used.
The spin should not be used as a safety escape as the sailplane may change over into a spiral dive.
It is rather recommended to open the airbrakes fully at IAS of 70 kts, 81mph, 130 km/h and load factors above 2 "G". At speeds above 81 kts, 93 mph, 150 km/h the airbrakes should not be closed, as this sailplane, owing to its very steep glide path, may exceed the max. permissable speed.
Please note the additional required equipment for cloud flying (2.8).

4.10 FLIGHTS AT BELOW ZERO 0°C (freezing point)

At temperatures below zero 0°C, as for instance during wave flights or during winter, it is possible that control friction increases. Ensure that all control elements are free of moisture to prevent freezing.
This, in particular, applies to the AIRBRAKES. Experience so far, recommends to apply vaseline over the full span of the spoiler contact surface to avoid freezing. Continuously operate controls and airbrakes at short intervals. During flights with water ballast, note the recommendation under 4.8.

4.11 AEROBATICS

INSIDE LOOPS:
Speeds for entry not under 97 kts, (112 mph, 180 km/h.).
Recommended is 108 kts,(124 mph, 200 km/h), and 97 kts,(112 mph, 180 km/h) , for recovery.

SPINS

Stationary spins are only possible at rear C.G. positions. With forward C.G. positions, this sailplane will enter a spiral dive. It should be terminated immediately by neutralizing all controls and recover.

To enter the spin, a dynamic stall has to be produced, and before nose drop, full rudder has to be applied into the direction of spin.

Entry speed: 32kts, (37mph, 60km/h)

Recovery speed: 81-97kts, (93-112mph, 150-180km/h)

The recovery from spin is achieved by neutralizing the elevator and applying rudder against the rotation. A negative flap setting reduces additional rotation.

STALL TURN (Hammerhead)

Entry speed not below: 97 kts, (112 mph, 180 km/h)

Recommended speed: 108 kts, (124 mph, 200 km/h)

Recovery speed between: 97-108 kts, (112-24 mph, 180-200 km/h)

After the entry, full rudder is applied at 71 kts, (81 mph, 130 km/h) at the end of the vertical climb.

LAZY EIGHT

Entry speed approx.: 97kts, 112mph, 180km/h

Following a climb between 30 and 45° a turn is initiated at 65kts, 75mph, 120km/h

Recovery speed: 97kts, 112mph, 180km/h

In steep turns, the following speeds, depending on load factor, and degree of bank, should not be less than:

Load factor	Angle of bank	Speed
+ 2,0	60°	59kts, (68mph, 110km/h)
+ 2,5	65°	67kts, (78mph, 125km/h)
+ 3,0	70°	73kts, (84mph, 135km/h)
+ 3,5	73°	81kts, (93mph, 150km/h)

Aerobatics should only be carried out without water ballast (max. weight 838 lbs. , 380kg).

4.12 LANDINGS

The rotating trailing edge surface is a combination of spoiler and flap, and a very effective landing device, which makes possible, steep, as well as relatively slow approaches.
Lift is not notably decreased or increased.

The normal flap position during landing is L.

For better aileron control during strong turbulence, the approach can be made with flap setting +1 or 0.
While pulling back the airbrake lever, up to a noticeable resistance, only the spoiler airbrake is extended, with which the approach can be controlled.
By pulling further back, the airbrakes (spoiler and flaps) are activated together.

For a landing weight of 838 lbs,(380 kg), with fully extended airbrakes, flaps at L and the landing gear extended, the normal approach speed is approx. 46-49 kts,(53-56 mph, 85-90 km/h).
The corresponding glide angle is then approx. 1:4.5 in 15 m configuration and 1:6,23 in configuration with wing extentions (wing span 17,43 m) . The minimum approach speed is 43 kts,(50 mph, 80 km/h).
Below this speed, the airbrakes should not be retracted suddenly.
Immediately before touch-down, the airbrakes should be always opened fully.

For a landing weight of 932 lbs,(450 kg), the approach speeds have to be increased 5.4 kts,(6.2 mph,. 10 km/h).

For steep approaches (e.g. in strong ground turbulence or when approaching over high obstacles) the airbrakes are fully extended, and the glide angle is controlled with the elevator.
Excessive height can thus be absorbed without increasing speed noticeably.

5. STORING , TRANSPORTATION , RIGGING

5.1 STORING, PARKING and GROUND TOWING

The sailplane should only be stored or parked in well ventilated areas. Closed trailers should be equipped with sufficiently large ventilation. Always store with empty water tanks.

Take note to store the sailplane without stresses. This is particularly important at elevated temperatures.
Because of their slim shape, it is particularly important to store the wings correctly. They should be stored with the L.E. pointing downwards and supported under the wing root spar at approx. 7,8 ft (2.4 m) from the wingtip, in a profile true wing sling.

Fuselage is correctly stored in a wide fuselage moulding in front of the C.G. release, and supported by the tail wheel.

The Tailplane is stored in two profile true slings, separated 5 -6.6 ft. ,(1.5-2m) and with the L.E. pointing downward.
Under no circumstances attach the tailplane into the trailer by using the tailplane main attachment fittings.

Sailplanes which stay rigged for the whole year or longer periods, should be attended to, so that rigging elements on the fuselage, wing and tailplane do not corrode.
Dust covers should be used and are highly recommended.
Avoid parking and ground handling without winglets properly attached . The aileron could be damaged during wing tip collision with the obstacle .

The sailplane should not be parked in the open with the canopy in the open position, as this may act as a concave mirror, and depending on direction of sun-radiation, constitutes a fire hazard.

A tail dolly should always be used for ground-handling this sailplane, to prevent unnecessary vibration of the tailplane, and stresses and wear to its attachment fittings.

When ground-handling, do not push at wingtips, but rather close to the fuselage.

5.2 RIGGING

1) Clean and grease pins and bearings.

2) In the cockpit, the flap lever is set at high speed, the brake lever in the medium position, and the water ballast lever set in the closed position.

3) Rig both winglets - engage the winglet pins into the wing tip bushes . Compress the lock pin on the lower winglet spar cap and push the winglet to the right position - the lock pin is locked in it's hole .

4) First rig Port wing with flaps in high speed position, temporarily lock with the main pin by engaging it only into the front spar fork bush.
Pay attention that the bellcranks on the root rib are in their neutral position and are actually engaging into the opposing socket fittings on the fuselage, connect the water ballast tank ventilation hose behind the rear canopy lock.

5) Rig Starboard wing with the same lever and flap settings as Port wing, and pull together with rigging tool.
Ensure correct engagement of control and connect the ventilation hose as with Port wing.

6) Momentarily remove main wing spar pine. When bushes line up push pin in and lock.

7) Check aileron and airbrake functions.

8) Push tailplane onto the rigging - drive pins and pull out front connection pin with tool, push tailplane L.E. down and push front connection pin fully into position, remove tool. Check that the elevator rigging-drive pins are actually correctly engaged into their opposing elevator fittings (move elevator) .

9) Derig both winglets (see 5.3.1 point 4)- engage the wingextension pins into the wing tip bushes . Compress the lock pin on the upper wingextension spar cap and push the wingextension to the right position - the lock pin is locked in it's hole .

10) Tape off gaps.

5.3.1 DE-RIGGING - 15 m CONFIGURATION

1) Pull front tailplane connection pin out, with the help of the tool, and lift up tailplane.
2) Lift wingtips and remove main pin, disconnect the ventilation hose.
3) With the help of the rigging tool, or by pulling on the wingtips, separate the wings from the fuselage.
4) Simultaneously unlock the lock pin of the winglet and apply the hand force to take the winglet out of the wingtip .

5.3.2 DE-RIGGING - 17,43 m CONFIGURATION

1) Pull front tailplane connection pin out, with the help of the tool, and lift up tailplane.
2) Simultaneously unlock the lock pin of the wingextension and apply the hand force to take the wingextension out of the wingtip .
3) Lift wingtips and remove main pin, disconnect the ventilation hose.
4) With the help of the rigging tool, or by pulling on the wingtips, separate the wings from the fuselage.

6.MAINTENANCE

6. MAINTENANCE

6.1 MANDATORY MAINTENANCE

After every 100 operating hours, and during every yearly inspection the rudder cables should be checked for damage and wear, and the gasspring installed in the control system, should be checked for proper function.
The cables should be checked in the areas of the S-shaped tube of the pedals in both the front and rear pedal adjusting positions.
The cable should be replaced if wear, twist, corrosion or other damage can be detected.
A wear up to 40% of the single outer wires is still permissable.
Material: Steel wire cable corresponding to MIL-C-5424,
B 3.2 LN 9389 of stainless steel or steel wire cable corresponding to MIL-W-1511A,B 3.2 LN 9374 of galvanized carbon steel, in conjunction with Nicopress clamps No. 28-3-M and tool 51-M-850 or 63-V-XPM or 64-CGMP, whereby always the M-groove should be used.
Only the correct tool should be used in conjunction with these clamps.
The works and inspection instructions corresponding to the tool should be adhered to.

The gasspring is accessable by removing the left inspection lid behind the left (port) front wing attachment tube.
The piston tube should be cleaned and should show no sign of damage.
In the event of oil leaks under piston tube seal, the gasspring must be replaced.

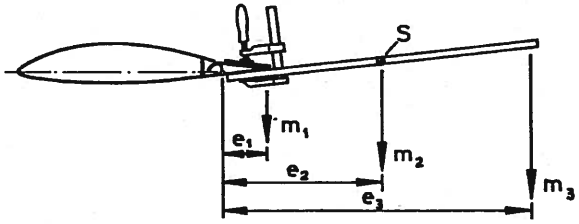
The expansion power of the spring must be checked on the rigged sailplane with the flaps set at -2.

A flap momentum of 17-19.2 lbsft. ,(23-26 Nm) must be absorbed before the flap moves down.

The momentum is applied via a 1 ft., 1 m long piece of wood, which is attached by a small jig clamp, to the lower surface of the Port flap root, by using weights or a spring scale, and is calculated as follows:

masses in lbs.,
lengths in ft $M = m_1e_1 + m_2e_2 + m_3e_3$ [lbs. ft.]

masses in kg,
lengths in m $M = 9{,}81 \cdot (m_1e_1 + m_2e_2 + m_3e_3)$ [Nm]



After every 200 operating hours, and during every yearly inspection the metal lip at the flap operating lever should be checked for wear. Lip should be replaced if wear is more than 1 mm.
The corresponding operating and maintenance instructions TOST-Flugzeuggerätebau, München, are applicable for the installed releases "Sonderkupplung SH-72", "Bugkupplung E-72" or "Bugkupplung E-75".
For the installed instruments, and other equipment, instructions of the corresponding manufacturers are applicable.

Supplier:

- HPH spol. s r.o., P.O.Box.112, Kutná Hora, CZ-284 01, CZECH REPUBLIC
  (clamps, cable, gasspring, main and tail wheel)
- TOST Flugzeuggerätebau, Thalkirchnerstr. 62, 8000 München 2 (Tow release and main wheel)

6.2 REGULAR MAINTENANCE

Within the framework of the yearly inspection, the following maintenance should be carried out.

The controls (see page 44-47 G.A.) are accessable as follows:

1) Aileron control system within the wing is accessable through pushrod openings in the false spar when the airbrakes are open and the ailerons dismantled.
2) Airbrake control system within the wing is accessable through the pushrod openings in the false spar.
3) Control systems in the fuselage are accessable after removal of the inspection cover on the underside of the fuselage, after removal of the wheel box cover behind the back-rest, the removal of the four inspection covers in the wheel box, the upper wheel box cover, and after removing the seat tray.
4) Elevator drive after removal of the tailplane.
5) Rudder drive after removal of the rudder.

After cleaning the whole aircraft, proceed as follows:

Check GRP outside surface condition for holes, tears, cracks, paint cracks, indents, delamination. If the outer layers of the sandwich are damaged, the inner layers should also be checked. Seek the help of an experienced person.

Check all metal parts for corrosion, and if necessary, clean up and preserve again (steel fittings, pushrods and levers should be primed with Zinchromite and conserved with Nitro-lacquer).
In control runs with excessive friction, the bearings and joints should be cleaned and lubricated.

The permissable friction in the elevator controls can be checked in flight.

From a trimmed speed of 65kts,(75mph, 120km/h), and gently freed controls, the sailplane should be returning within ± 8 kts,(± 9 mph, ± 15km/h) of the trimmed original speed.

Bearings and joints with excessive radial play should be replaced.

The automatic "link-up" connection for ailerons and airbrakes between wing and fuselage can be adjusted free of play on the adjusting bolts of the four socket fittings on the fuselage.

The play in the controls and airbrake drive should be checked according to 6.3.

All fittings which are attached to GRP should be checked for firm adhesion.

Check the condition of the FRP near the fittings for cracks and white areas of delamination.

Landing Gear: Clean brake drum, check brake linings and if necessary renew. Check and adjust bowden cable or brake lever, check side play of the wheel hub.

In addition, observe the instructions of TOST.

Ensure that the wheel axle and the two landing gear hinge-tubes are not bent, and that the fiberglass bearings on the wheel box are not damaged.

Check pressure of main- and tail wheel.

Main wheel:

All-up weight	[lbs.]	772	882	992	Tire size
	[kg]	350	400	450	
Pressure	[bar]	2.5	3.0	3.5	5.00-5
	[psi]	36	44	51	

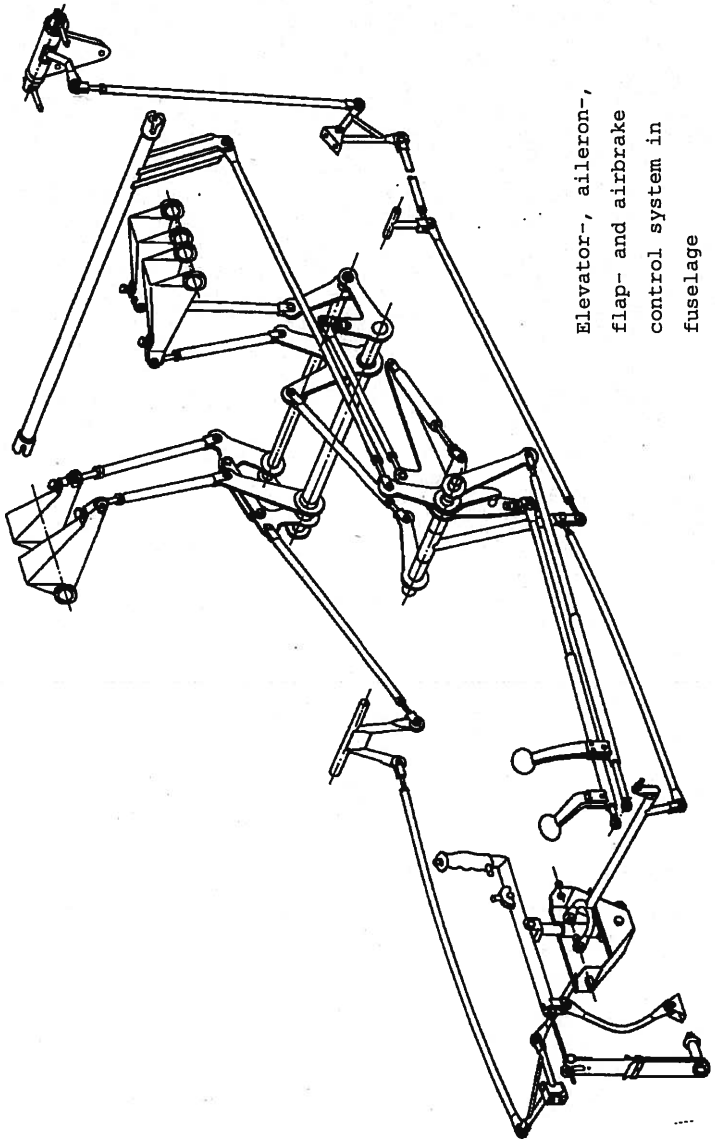
Tail wheel: p = 1.5bar,22p.s.i.

Check static and pitot inlets,lines, as well as line quick connectors for free flow and leak.

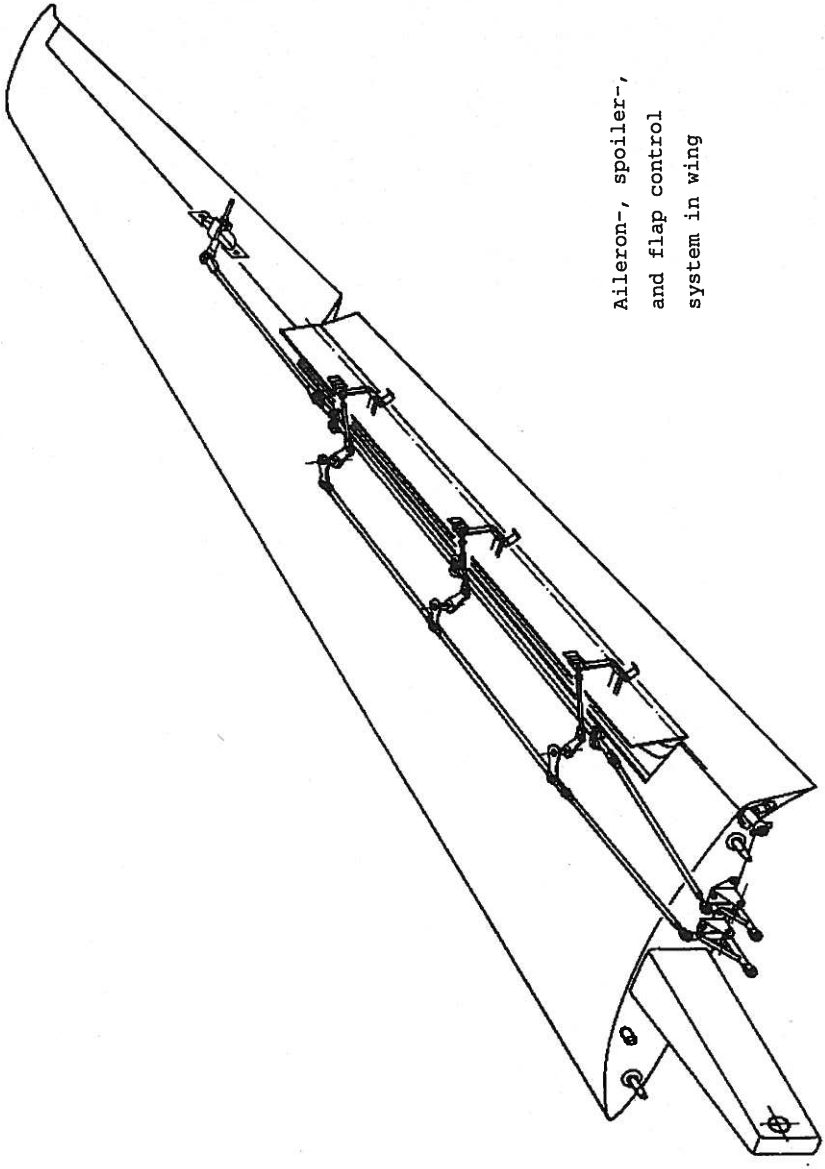
Ensure there are no loose instrument face glasses.

On the rigged aircraft, check control deflections and function of the control system and releases.

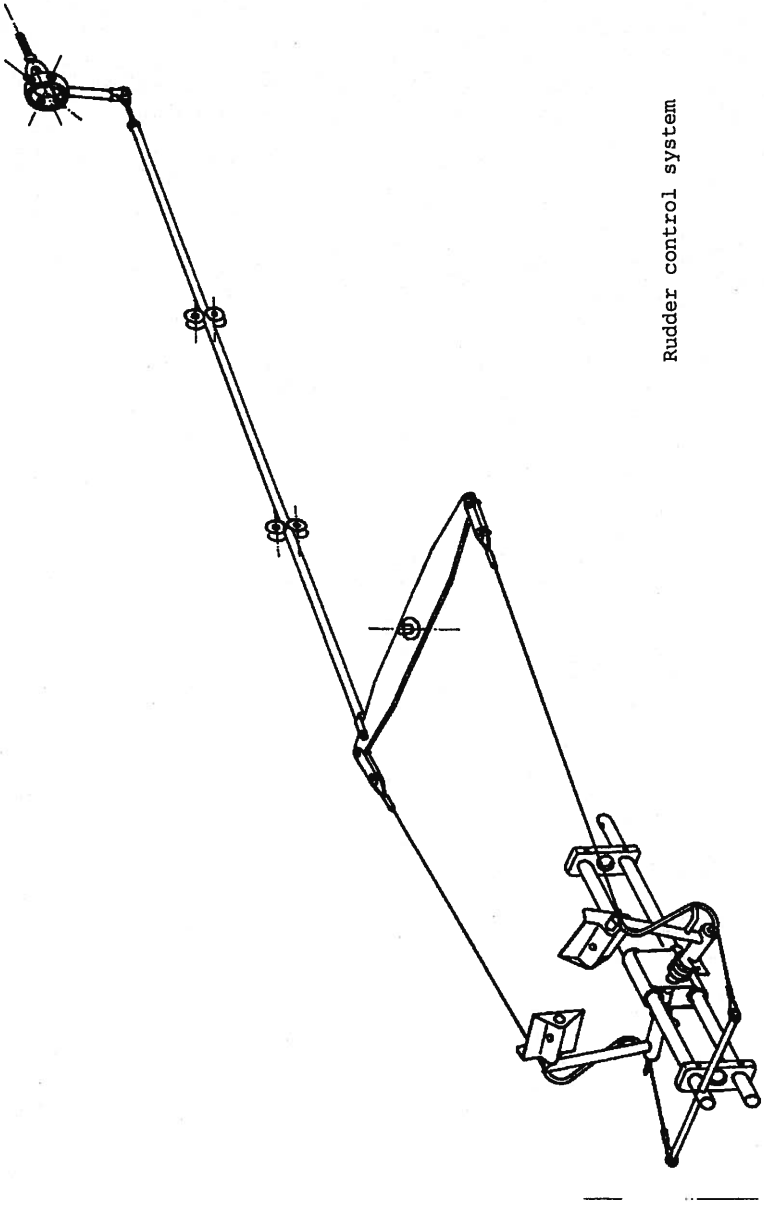
A gap of 4.5mm, 0.18in. minimum should be allowed between flaps and ailerons.



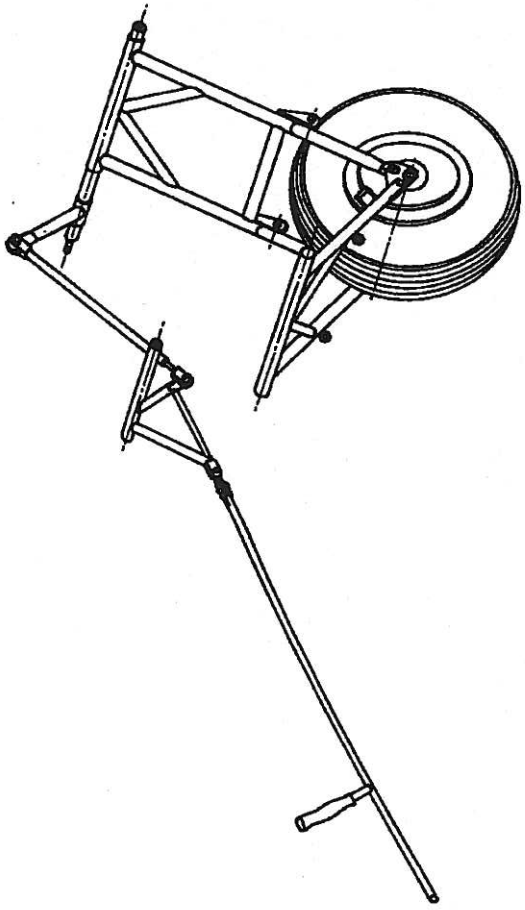
Elevator-, aileron-, flap- and airbrake control system in fuselage



Aileron-, spoiler-,
and flap control
system in wing



Rudder control system



Landing gear system

6.3 FREE PLAY IN THE CONTROL CIRCUITS

With fixed controls, the following free play on the control surface should not be exceeded:

Aileron:	±0.118 in (3mm), measured 5.354 in (136mm) behind control hinge line,
Elevator:	±0.079 in (2mm), measured 5.433 in (138mm) behind control hinge line
Rudder:	±0.197 in (5mm), measured 10.630 in (270mm) behind control hinge line
Flaps:	±0.118 in (3mm), measured 5,551 in (141mm) behind hinge line,
Airbrakes:	±0.079 in (2mm), measured 4,724 in (120mm) above surface hinge line, with full employed airbrakes.

6.4 FREE PLAY IN WING AND TAILPLANE ATTACHMENTS

Tangential play of ± 0,787 in (20 mm) at the wingtip is permissable. If this play is larger, washers of 0,00787 to 0,01181 in (0.2 to 0.3mm) thickness should be packed under the wing attachment bolts until the main spar rigging pin is firm.
To add the washers under the wing pins, the pins are removed and tightened with washers in place.
Take note not to damage the pins.

Main wing spar pin and bushes may have a maximum play of 0,002363in (0.06mm).

For the horizontal tailplane, a tangential play of ± 0,0591 in (1.5mm) and a play of ± 0,1575 in (4mm) around the longitudinal axis, both measured at the tailplane tip, is the maximum permissable.
The play at the forward stabilizer attachment point should not exceed 0,002362 in (0.06mm).

6.5 DAMAGE

Before take-off, and in particular after lengthy storage, an inspection should be carried out.
Check for small changes, such as holes, blisters or uneveness in the surface. This may be a signal that something is wrong.

It is best to consult an experienced person in GRP if stressed parts are in question.

Better still, to make available photographs of the damage to a specialized representative of the manufacturer, who will advise the correct procedure, therefore saving unnecessary repair attempts.

FRP parts are neither expensive nor difficult to repair, but a different technology, compared to sailplanes of other materials, is used.
One must know the procedure for the repairs.

Scratches and small cracks in the surface can be repaired by the owner.
Small repair kits with all necessary materials for minor repairs are available from HPH spol. s r.o.
After studying the "Repair Instructions" (9.1-9.4) for the "GLASFLÜGEL 304 CZ - 17 " these small repairs should not present great problems.

Major repairs must only be carried out by the manufacturer.

6.6 REMOVAL and RE-INSTALLATION of RELEASES

To remove the C.G. release, the hinge and adjusting cable (Port side) of the backrest has to be removed. Then remove the seat tray and wheel-box cover.
The release is now visible, and the bolted joint between release and the black link should be undone. After removal of the 8 bolts from the release bracket, which attaches the release to the fuselage and wheel-box, the release and the attachment brackets can now be pulled up.

Now remove the two bolts which hold together the release and release attachment brackets.
The re-installation is in opposite sequence, whereby attention should be paid that the correct bolts and pins are used, and that the earth cable is attached.
To dismantle the aerotow release, the rudder foot control is removed by removing the bolt at the rear end of the lower guide tube and pulling back the foot control. Thereafter, the bolts of the diaphragm are removed. The diaphragm which is sealed off with a sealant is then carefully pulled away with a hook.
If a trim ballast box is installed, the aerotow release is accessable by removing only this one.
After the release cable is detached only the 4 attachment bolts have to be removed and the release can be pulled back together with it's attachment brackets.
Release and attachment brackets are joined with two bolts.
When re-installing the release pay attention to the correct assembly of the pulley and attachment brackets. The recesses on the release for the rings should correspond with the recesses on the release brackets. Also take note of the different length bolts and the attachment of the earth cable.

6.7 CONTROL SURFACE MOMENT

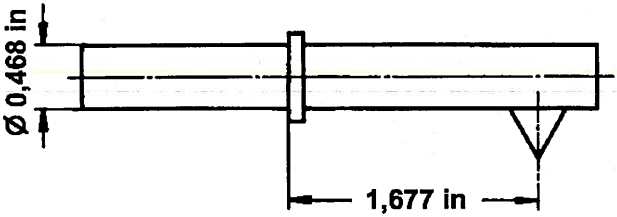
After repairs or new paintwork, the following control surface moments M = P x r should not be exceeded.

Ruder :	Weight / Moment Without static balances	Weight / Moment With static balances
Elevator:	m = 1,5…1,8 kg M = 41…58 Ncm	
Sideruder:		m = 2,9…3,9 kg M = 0…30 Ncm
Aileron:		m = 3,0…3,8 kg M = 25…58 Ncm
Flap:	m = 3,3…4,2 kg M = 130…170 Ncm	

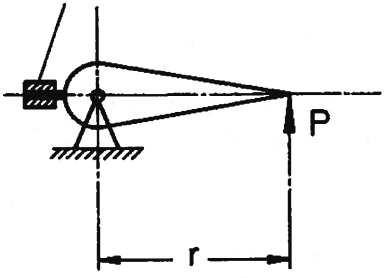
Should these values be exceeded, a mass ballast is to be attached to the control surfaces in front of the hinge line. This ballast should be distributed evenly over the whole length in the case of the elevator, and only in areas where ballast is attached already as in the case of the aileron and rudder. After installing additional lead strips, check that the control surface movement has not been restricted.

To measure the control surface moments, all control surfaces have to be removed. The two elevator halves are to be assembled with the U-shaped drive fitting, so that the moment for both the elevator halves including the drive fitting, is measured.

To measure the moment on the rudder, a jig is required which is fitted into the lower bore of the rudder against it's stop. The rudder is then bearing on it's upper hinge pin and on the wedge of the jig.



Mass - balast



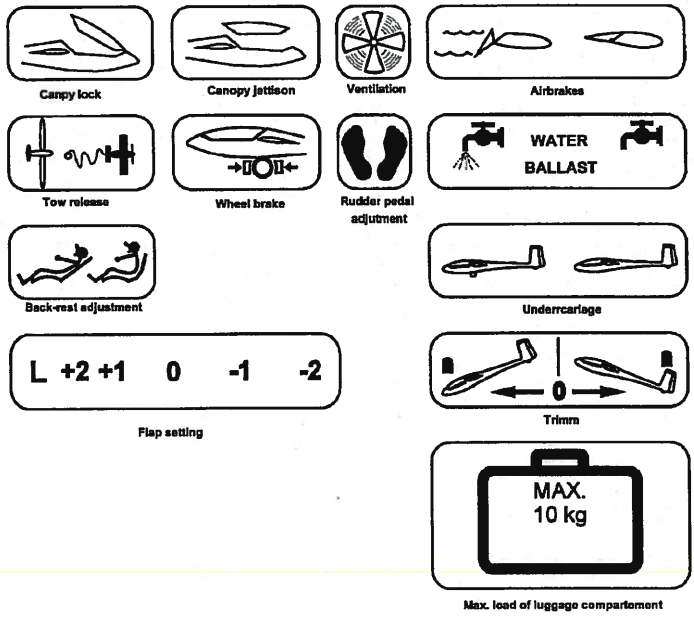
Establishing the control surface moment

M = P x r

Control surface balancing on hinge line

P is measured with the aid of a postal scale

6.8 SYMBOLS



6.9 MAINTENANCE OF THE SURFACE FINISH

Wash the surface only with clean water, sponge and chamois.

Never use petrol, alcohol or thinners.
Soap additives in water should not be used too often.
Polish as often as you wish, but take care not to heat up the surface when using a polishing machine, as otherwise the surface quality will suffer.
Exposure to moisture should be avoided, as with all other sailplanes.
Protect from intensive sun-radiation (heat), and unnecessary permanent load.
Please note that the surface of all parts which are exposed to sun-radiation must be coloured white.
Colours other than white will increase the heat build-up in the GRP, so that insufficient strength will result.

6.10 LIFE LIMITED COMPONENT SECTION

Approved life limited components installed in the glider (shown bellow) should be operated according to instructions of the corresponding manufacturer . Instructions are delivered with each new glider or component .

If the component is installed in another aircraft or if it is installed from another aircraft , then the number of takeoffs and the months of operating life already expired must be recorded by a qualified inspector in the log of the aircraft , which is the object of installation .

For installation and re-installation instruction of releases pay attention to the section 6.6 (page 49) of this Flight and Service Manual .

Life limited parts - GLASFLÜGEL 304 CZ - 17					
Manufacturer	Address	Product	Type	TC / issued by	TBO
Tost GmbH	Thalkirchner Strasse 62 D-80337 München	Nose tow release	E 72	60.230/1 / LBA	2000 takeoffs
		Nose tow release	E 75	60.230/1 / LBA	2000 takeoffs
		Nose tow release	E 85	60.230/1 / LBA	2000 takeoffs
		Special tow release	SH 72	60.230/3 / LBA	2000 takeoffs
		Safety tow release	Europa G 88	60.230/2 / LBA	2000 takeoffs
Gadringer Gurte GmbH	Postfach 1225 D-58012 Hagen	Seat belt	Bagu 5202	40.070/32 / LBA	12 years
		Shoulder harness	Schugu 2700	40.071/05 / LBA	

6.11 SERVICE LIFE

1. GENERAL

Additional test results of service strength of wing spars proved , that service life of sailplanes and powered sailplanes manufactured from glass fiber composite materials could be extended to 12000 flight hours , if the multistage test program for proof of airworthiness will be carried out for each sailplane (except of obligatory yearly inspections .

2. SERVICE TIME

If the sailplane reach the service life of 6000 hours , than the additional test inspection should be carried out according check out program stated by the manufacturer (see the point 4).

In the case of positive test result , respectively after repair of observed insufficiencies , than the service life could be increased for 2000 hours , than total of 8000 flight hours (1. step) .

The additional inspection will be repeated , if the sailplane reach 8000 flight hours .

In the case of positive test result , respectively after repair of observed insufficiencies , than the service life could be increased for total of 10000 flight hours (2. step) .

After reach of 10000 flight hours the additional test inspection should be carried out . If the test result is steady positive , respectively after repair of observed insufficiencies , than the service life could be increased for total of 12000 flight hours (3. step) .

For eventually service over 12000 flight hours the additional specifications will be stated by the manufacturer .

3. INSPECTIONS

Inspections could be carried out by the manufacturer or by the facility approved for this type of repair works .

4. CHECK OUT PROGRAM

If the inspection will not be carried out by the manufacturer , than the current Check out program should be required from the manufacturer : HPH spol. s r.o. , P.O. Box 112 , Kutná Hora 284 01 , CZECH REPUBLIC .

The day of inspection may not be more than three month later after the date stated on the front page of the Check out program .

5. INSPECTION RESULTS

The Inspection results should be written down in Check out program - each point of this program should be checked .

If the inspection will not be carried out by the manufacturer , than the carbon copy of filled up program should be sent to the manufacturer for evaluation .

6. OBLIGATORY INSPECTIONS

The additional test inspections have not influence for the obligatory periodical inspections , which should be carried out in proper periods .

7. C.G. DETERMINATION

7. C.G. DETERMINATION

To establish the C.G., the sailplane is rigged with closed canopy. The tailwheel is placed on a scale in such a way that the rear fuselage cone is angled 2.9° down towards the rear (wedge pattern 100:5.2 atop rear fuselage cone, and spirit level).

The tail weight is now established at m_2 with the wings horizontal. The distance a and b are now measured with the help of plumbs, or are referred to in the last weight record.

The empty weight of the sailplane is established through weighing m_1 - the main wheel weight . During weighting of m_1 must be the rear fuselage cone angled 2.9° down towards the rear (wedge pattern 100:5.2 atop rear fuselage cone, and spirit level) with the wings horizontal .

$m = m_1 + m_2$

C.G. empty :

$$X_{empty} = ((m_{2\,empty} \times b) / m_{empty}) + a$$

The aircraft is unoccupied without parachute but with total fixed equipment included .

C.G. in flight :

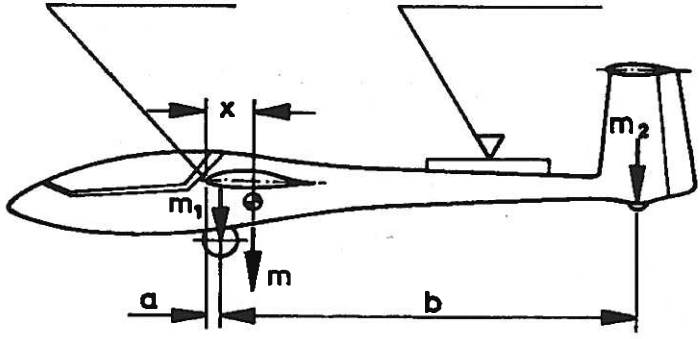
$$X_{flight} = ((m_{2\,flight} \times b)/(m_{empty} + m_{loading})) + a$$

The aircraft is weighted with loading (pilot, parachute and total removable equipment i.e. barograph, cushion, camera, etc.) .

Take note to correctly adjust pedals and backrest.

<u>reference</u>
wing root L.E. at
y = 16.7, in 425mm
out from
fuselage center line

<u>horizontal reference</u>
wedge pattern 100:5.2
atop fuselage cone
and sprit level.



The C.G. of the empty sailplane with normal loading between 154 and 2421bs. , (70 - 110kg) should fall into the shaded area of the following diagram.

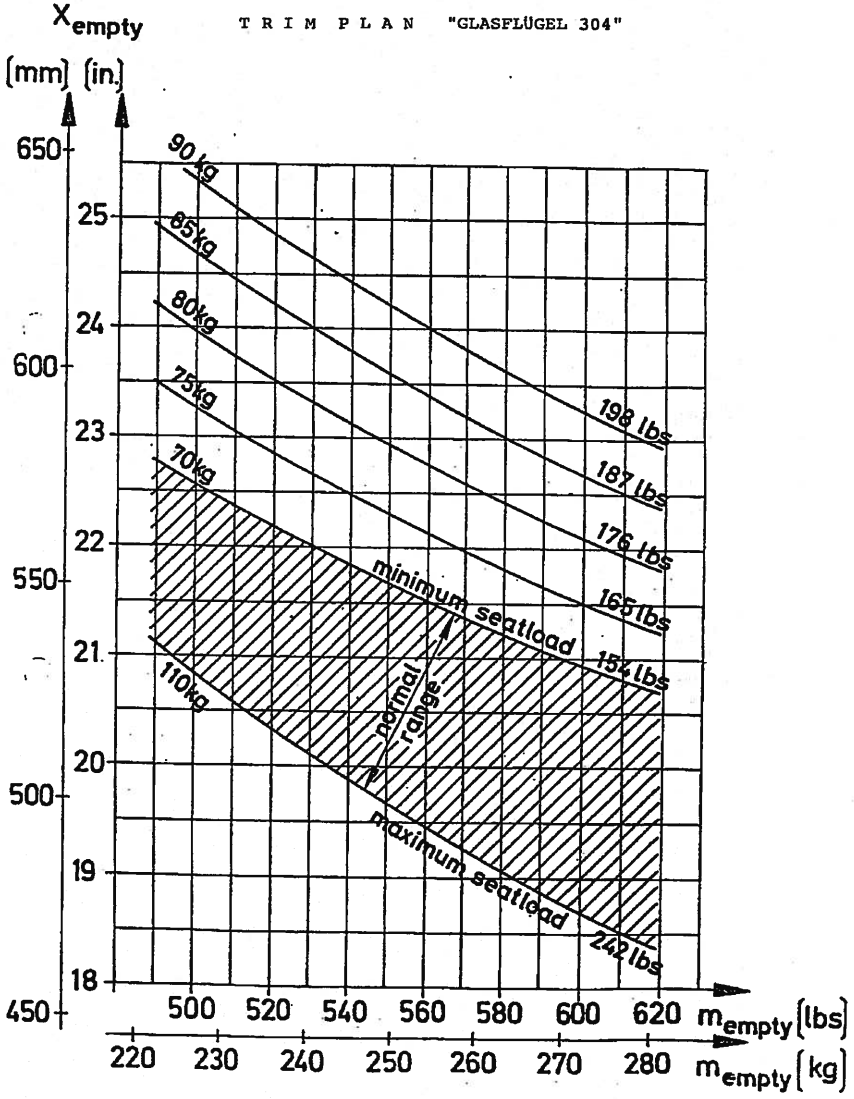
Should the sailplane, in particular cases, be trimmed so that the C.G. falls above or below the shaded area, and the maximum loading is lower than 242 1bs. ,(110kg) or the minimum loading is higher than 154lbs.,(70kg) *), these loading should be placarded in the cockpit (e.g. minimum loading on seat 176lbs.,(80kg)). This modification should be certified into the operating documents by an approved inspector.

The establishment of the empty C.G. is necessary after installation of additional equipment, after repairs, new surface finishing or other modifications which may change the weight of the sailplane. Weights and C.G. should be entered into operating documents by an approved inspector with reference to the equipment list.

For high performance and competition flying, it is recommended to establish the flight C.G. for the individual pilots, as performance of the sailplane deteriorates outside the optimum C.G. range.

The optimum C.G. range is between 11.0 and 12.79in. ,(280 - 325mm) behind reference point.

*) (depending on the empty weight).


X_{empty}
TRIM PLAN "GLASFLÜGEL 304"
(mm) (in.)
650
25
24
600
23
22
550
21
20
500
19
18
450
90 kg
85 kg
80 kg
75 kg
70 kg
110 kg
198 lbs
187 lbs
176 lbs
165 lbs
154 lbs
242 lbs
minimum seatload
maximum seatload
normal range
500 520 540 560 580 600 620 m_{empty} (lbs)
220 230 240 250 260 270 280 m_{empty} (kg)

8. MASTER EQUIPMENT LIST

8.1 INSTRUMENTS

1. Approved Airspeed Indicators

1.1 Original certification was carried out using a "Winter 6 FMS 4" airspeed indicator with a range of 0 - 270 km/h.

1.2 Any FAA-approved airspeed indicator for use in aircraft which has an effective range of at least 16 - 150 kts, 19 - 170 mph can be used. The approved maximum instrument error is ±2.5% (+3.75kts, +4.25mph).

The airspeed indicator must be marked as follows :

White arc	42-97 kts	48-111 mph	78-180 km/h
Green arc	51-97 kts	58-111 mph	94-180 km/h
Yellow arc	97-135 kts	111-155 mph	180-250 km/h
Red radial and placard	135 kts 13000 ft	155 mph 13000 ft	250 km/h 4000 m
Red radial and placard	113 kts 24000 ft	130 mph 24000 ft	210 km/h 7300 m
Red radial and placard	92 kts 36000 ft	106 mph 36000 ft	170 km/h 10950 m
Yellow arrow at	46 kts	53 mph	85 km/h

2. Approved Altimeters

2.1 Original certification was carried out using a "Winter 4 FGH 10" altimeter with a range of 0 - 1000 - 10000 meters.

2.2 Any FAA-approved insensitive or sensitive altimeter for use in aircraft with Millibar or Mercury scales can be used providing the instrument will measure altitudes up to at least 20000 feet.

3. Approved Variometers

3.1 Original certification was carried out using a "Winter 5 STV 5" variometer with a range of ± 5 m/sec.

3.2 Any FAA-approved variometer for use in aircraft which has a range of at least ± 1000 ft./min, ± 10 kts can be used for cloud flying.

4. Approved Magnetic Compasses

4.1 Original certification was carried out using a "Airpath C 2300" magnetic compass.

4.2 Any FAA-approved non stabilized type magnetic compass can be used.

5. Turn and Bank Indicators

5.1 Original certification was carried out using a "Gauting WZ-402/31" turn & bank indicator.

5.2 Any FAA-approved electric turn & bank indicator for use in aircraft can be used, providing the built-in battery or an additional one is suitable for its power supply.

8.2 SAFETY HARNESS

For the "GLASFLÜGEL 304 CZ - 17" a 4-piece harness is required. The following types are approved.

LAP STRAPS:	GADRINGER Bagu 5202 or IV - D or Bagu IV - E/2 or V - B/2
Attachment points:	On GRP loops through seat tray
	AUTOFLUG Bagu FAG-75-0
Attachment points:	On GRP loops through seat tray
SHOULDER STRAPS:	GADRINGER Schugu 2700 or II-C or II-C/V
Attachment points:	On forward wing attachment tube each between fuselage shell and wheel-box loop.
	AUTOFLUG Schugu FAG-74-O
Attachment points:	For right shoulder strap, on forward wing attachment tube between fuselage shell and loop on wheel box. For left shoulder strap, on forward wing attachment tube between the two loops on the wheel box.

8.3 COCKPIT PLACARDS

Placards giving the following informations must be installed in the cockpit in full view of the pilot:

Glasflügel 304 CZ

This glider must be operated in compliance with the operating limitations stated in the form of placards, markings & manuals.
WEAK LINK - Airplane/Auto/Winch Tow 1433 lb.

GLASFLÜGEL 304 CZ - 17 OPERATING LIMITS

Maximum permitted speed with flaps at 0,-1,-2				
Up to 13000 ft. , 4000 m MSL	V_{NE}	135 kts	155 mph	250 km/h
Up to 24000 ft. , 7300 m MSL	V_{NE}	113 kts	130 mph	210 km/h
Up to 36000 ft. , 10900 m MSL	V_{NE}	92 kts	106 mph	170 km/h
Maximum speed with flaps at +1,+2,L	V_{FE}	97 kts	111 mph	180 km/h
Maximum speed in strong turbulence	V_B	97 kts	111 mph	180 km/h
Manoeuvering speed	V_A	97 kts	111 mph	180 km/h
Maximum speed on Aerotow	V_T	81 kts	93 mph	150 km/h
Maximum speed on Auto or Winch tow	V_W	81 kts	93 mph	150 km/h
Maximum permissable A.U.W		992 lbs		450 kg
Maximum permissable A.U.W for aerobatics		838 lbs		380 kg
Maximum permissable weight of non-lift carrying parts		529 lbs		240 kg
Loading on seat		242 lbs		110 kg

Glasflügel 304 CZ

CLOUD FLYING: permitted only when the following instruments are installed
Airspeed indicator
Altimeter
Magnet compass
Turn and bank indicator
Variometer
NIGHT FLYING IS PROHIBITED

Glasflügel 304 CZ

The following acrobatic manoeuvers are approved and the limitations, minimum equipment and procedures for acrobatic flight are given in the ÚCL, January 1998, approved Airplane Flight Manual or later revisions:

SPIN :	Entry speed	V_{IN} =	32 kts.	(37 mph)	N_{max}= + 3g to 4g
Note : Height lose on spin 260-330 ft. (80-100 m) + pull out					
INSIDE LOOP :	Entry speed	V_{IN} =	108 kts.	(124 mph)	N_{max}= + 3g to 4g
STALL TURN :	Entry speed	V_{IN} =	108 kts.	(124 mph)	N_{max}= + 3g
	V vertical climb =		70 kts.	(81 mph)	
LAZY EIGHT :	Entry speed	V_{IN} =	97 kts.	(112 mph)	N_{max}= + 3,5g

Acrobatic maneuvers are only approved without water ballast and max. weight 838 LB(380 kg)
And without wing extentions .

Glasflügel 304 CZ

STORAGE COMPARTMENT
MAX. LOAD 22 LBS
INCLUDING ALL
INSTALLED EQUIPMENT

PRE-FLIGHT COCKPIT CHECK ***Glasflügel 304 CZ***

Parachute correctly fitted?
Safety harness correctly and firmly adjusted?
Backrest and pedals locked in comfortable position?
All controls and instruments within easy reach?
Airbrakes locked?
Control check?
Free, full and correct movements of controls?
Correct trim position?
Canopy locked?
Release check?
Towline on correct release - correct weak-link?
Set. flap!
Set Altimeter!

INTENTIONALLY LEAVE BANK

9. REPAIR INSTRUCTIONS

9. REPAIR INSTRUCTIONS

9.1 CHECKLIST

General ·

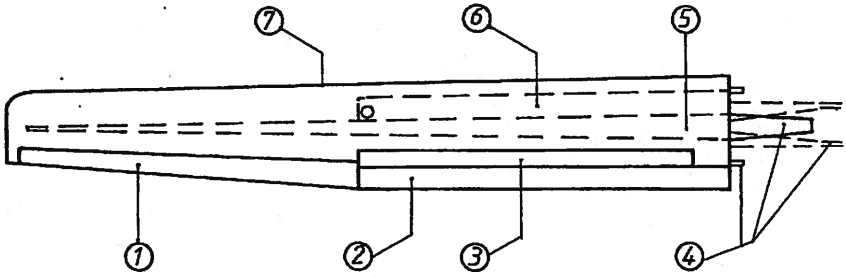
Check for proper positioning and fit of wings, tailplane and rudder.

Check the angularity of all axis.

Wing frequency must be identical to the latest inspection report.

For annual inspections the datum points and other requirements are obtained from chapter 6 "Maintenance".

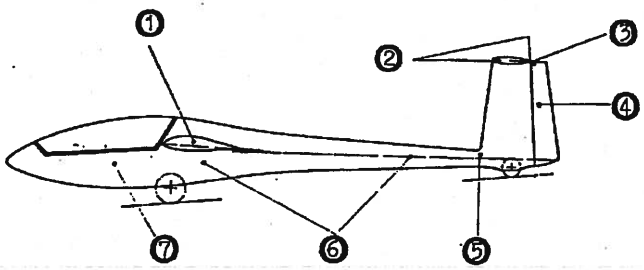
WINGS



1. Aileron 2. Flaps & 3. Dive Brakes		Full travel ? Rips, nicks, dents or cracks in surface ? Play in hinges `? Close well ?
4.	Main wing connection	Check for hairline cracks at spar root & root ribs, Check condition of pins, ball bearings, their housings and the main wing pin
5.	Main spar	Any cracks, ridges or dents ? Faultless lower and top surfaces ?
6.	Water ballast tanks	Check for proper fit of plugs and valves, check function
7.	Leading edge	Any hairline cracks ?

FUSELAGE

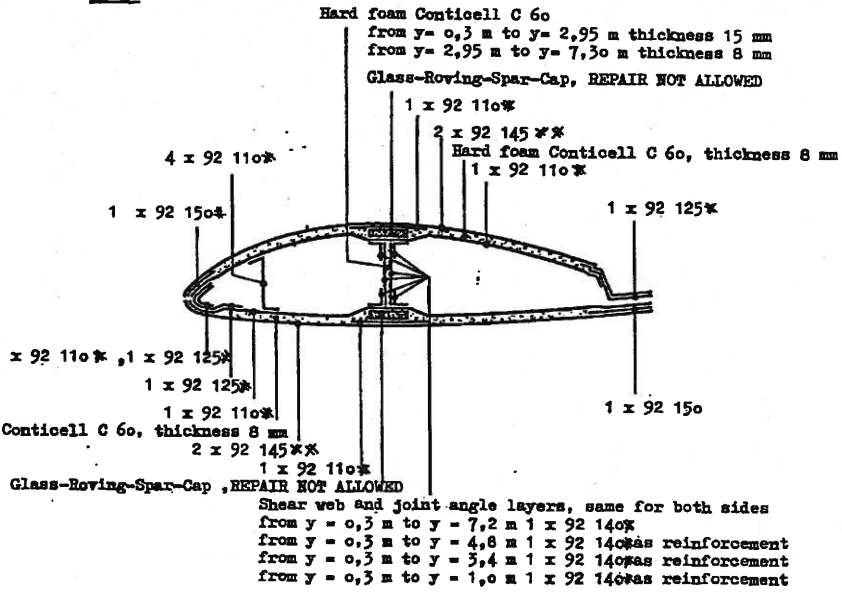
1	Fuselage/Wing-Connection :	Check for white or cracked areas, excessive play, loose bearings
2.	Horizontal Stabilizer-Connection :	Check for white or cracked areas around fittings, excessive play
3.	Elevator and	Check for excessive play, white spots near hinges
4.	Rudder :	



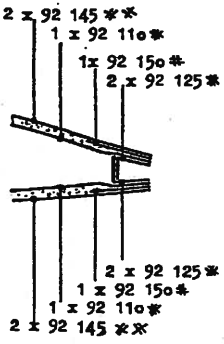
5.	Tailboom/Vertical-Stabilizer-Junction	Torsion test: Hold fuselage near front and push sidewise on fin. Twists easier than usual?
6.	Fuselage Skin :	Check these places especially! Check in-and outside for dents, rips, white areas or cracks in green fiberglass
7.	Cockpit :	Check seat belt loops: White areas near the attachment points to the fuselage skin`? Stick tunnel: Rips, cracks, white spots, firmly bond to fuselage skin?

9.2 STRUCTURE OF COMPONENTS

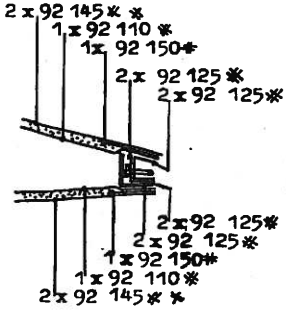
Wings:



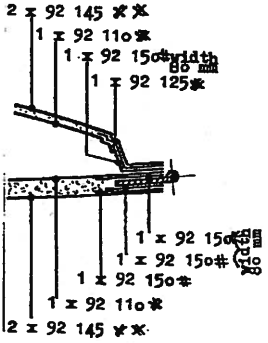
Section of Aileron area

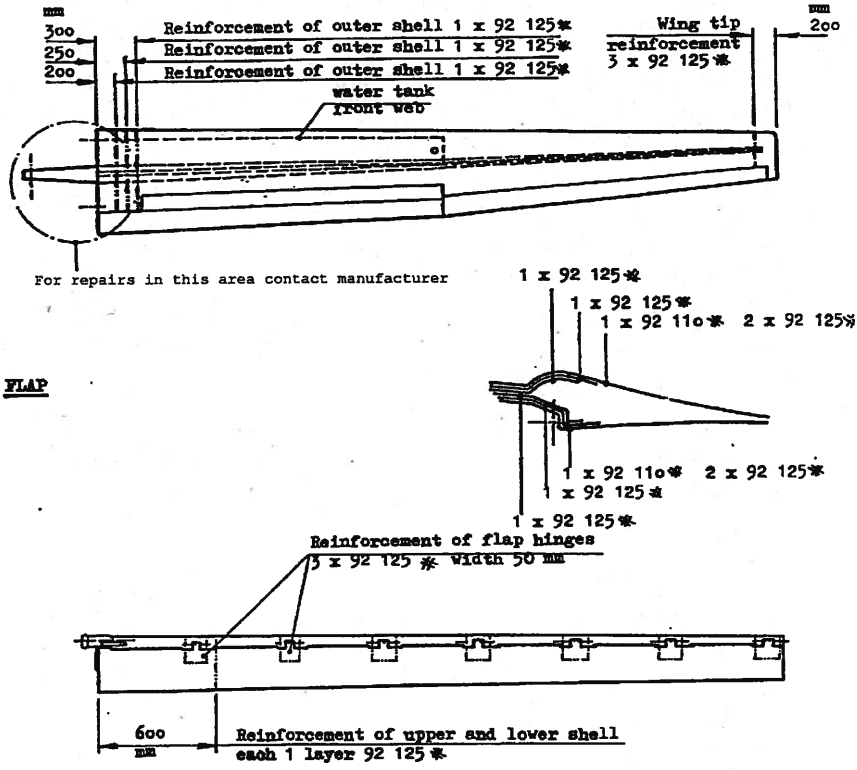


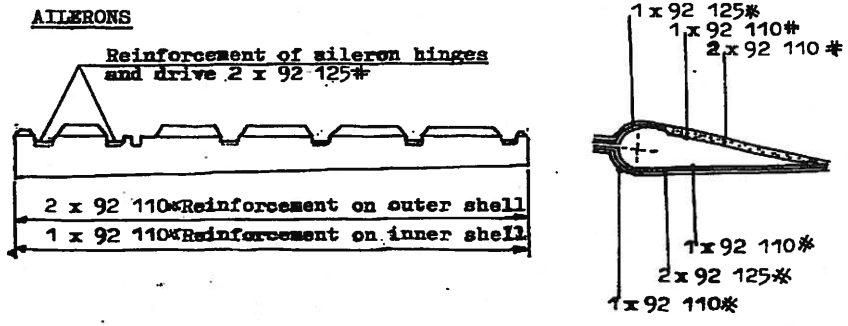
Section of Aileron hinge area



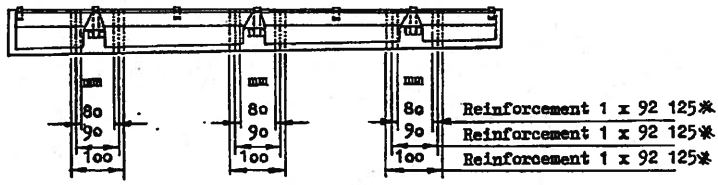
Section of Flap hinge area

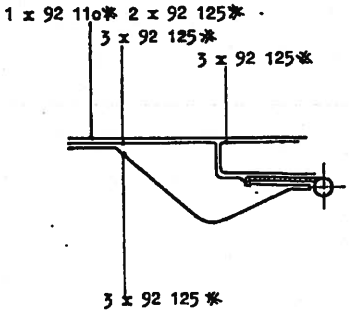


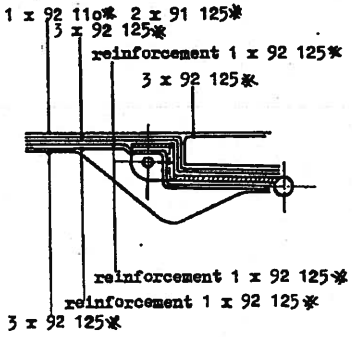

mm
300
250
200
Reinforcement of outer shell 1 x 92 125*
Reinforcement of outer shell 1 x 92 125*
Reinforcement of outer shell 1 x 92 125*
water tank front web
Wing tip reinforcement 3 x 92 125*
mm
200
For repairs in this area contact manufacturer
1 x 92 125*
1 x 92 125*
1 x 92 110*
2 x 92 125*
FLAP
1 x 92 110*
2 x 92 125*
1 x 92 125*
1 x 92 125*
Reinforcement of flap hinges
3 x 92 125 * width 50 mm
600
mm
Reinforcement of upper and lower shell
each 1 layer 92 125 *


AILERONS
Reinforcement of aileron hinges
and drive 2 x 92 125*
2 x 92 110*Reinforcement on outer shell
1 x 92 110*Reinforcement on inner shell
1 x 92 125*
1 x 92 110*
2 x 92 110*
1 x 92 110*
2 x 92 125*
1 x 92 110*

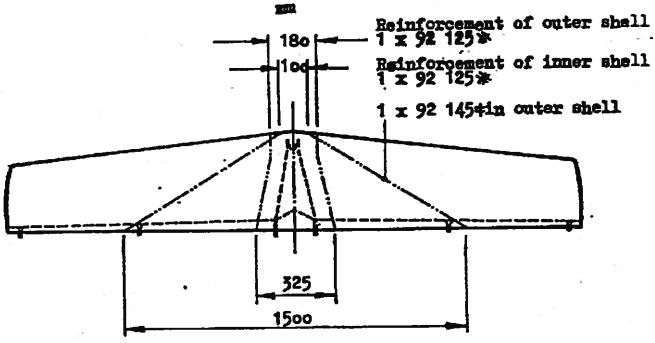
DIVE BRAKE

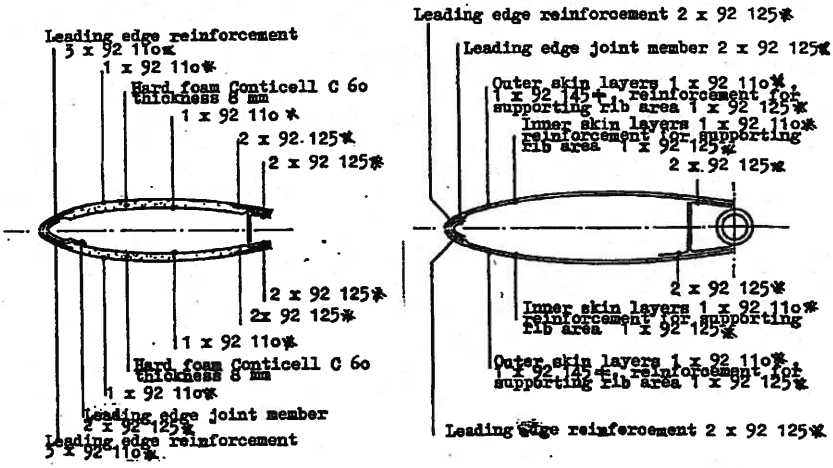




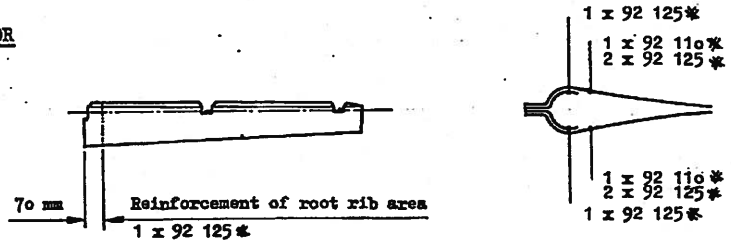


HORIZONTAL STABILIZER

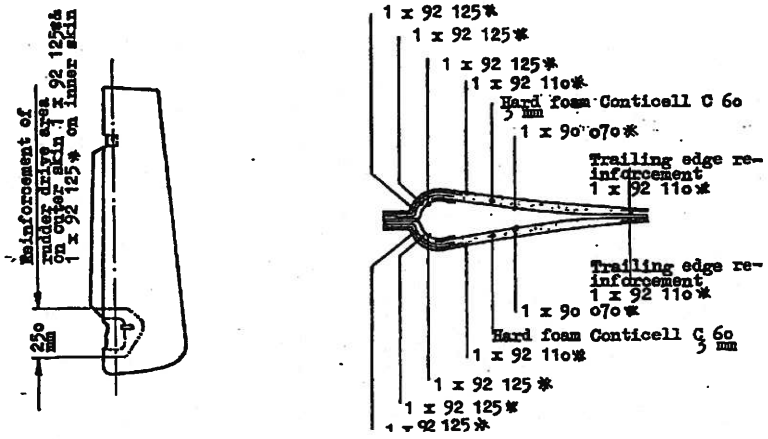


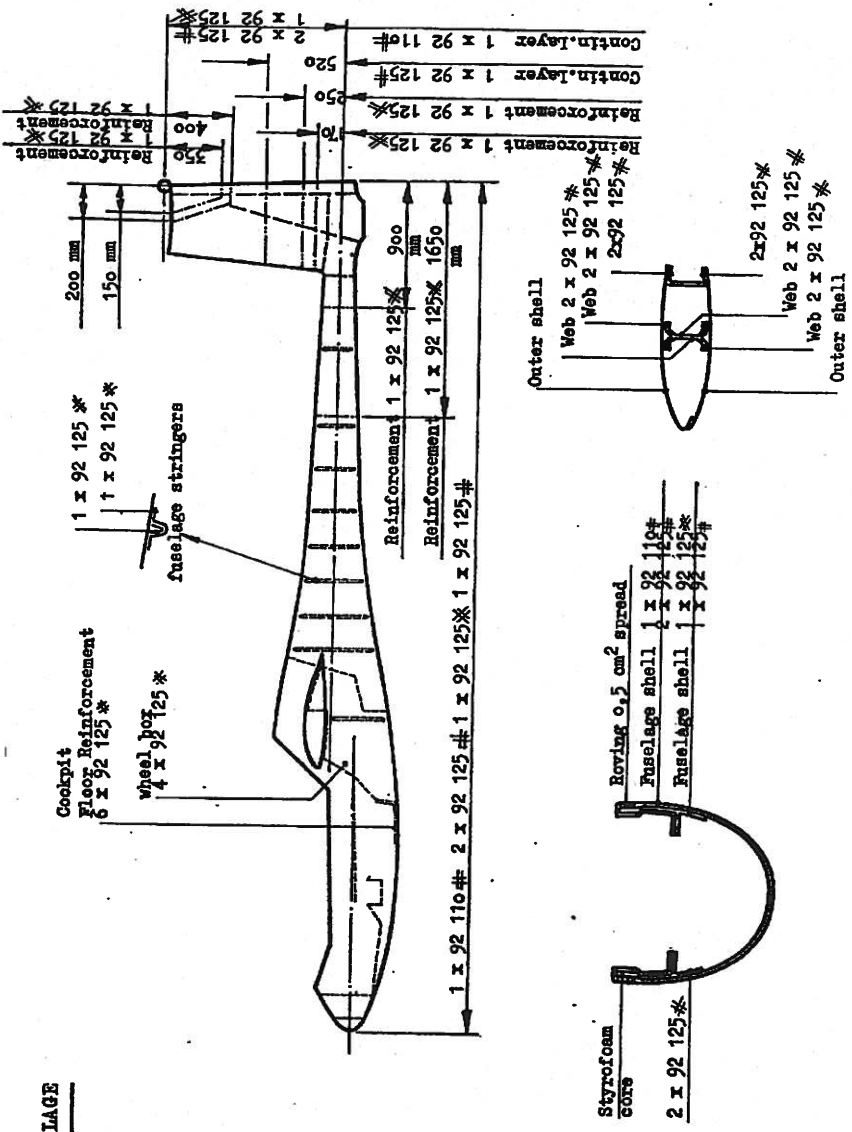


ELEVATOR



RUDDER




FUSELAGE
Cockpit
Floor Reinforcement
6 x 92 125 *
Wheel box
4 x 92 125 *
1 x 92 125 *
1 x 92 125 *
Fuselage stringers
200 mm
150 mm
1 x 92 110# 2 x 92 125# 1 x 92 125* 1 x 92 125#
Reinforcement 1 x 92 125* 900 mm
Reinforcement 1 x 92 125* 1650 mm
Reinforcement 1 x 92 125*
Reinforcement 1 x 92 125*
750
400
250
520
Contin.Layer 1 x 92 125#
Contin.Layer 1 x 92 110#
2 x 92 125#
1 x 92 125*
Reinforcement
1 x 92 125 *
Outer shell
Web 2 x 92 125 *
2x92 125 *
2x92 125*
Web 2 x 92 125 *
Outer shell
Roving 0,5 cm² spread
Fuselage shell 1 x 92 110#
Fuselage shell 1 x 92 125*
Styrofoam core
2 x 92 125*

9.3 MATERIALS

Resin: SHELL Epikote 162 (Glycidäther 162) MGS L 285

Hardener: BASF Laromin C 260 (Epikure 113) MGS L 286, 287

Mixture: 100 parts of weight of resin 38 parts of weight of hardener

Manufacturer:
Lackfabrik
Bäder GmbH
Postfach 25
7300 Esslingen

Manufacturer:
Martin G.Scheufler
Kunstharzproducte GmbH
Postfach 610238
D-70309, Stuttgart

GLASS CLOTH: Manufacturer:
INTERGLAS TEXTIL GMBH
Soeflinger Str. 246
7900 - Ulm/ Donau

Sailplane component	Weave	Weight g/m²	INTERGLAS No.
Fuselage	twill weave	161	92110
	twill weave	276	92125
Wings	Unidirectional	215	92145 skin
	twill weave	161	92110 skin
	twill weave	276	9212 spar root
	twill weave	390	9214 spar root
	plain weave	350	9215 spar root
Horizontal Stabilizer, Elevators & Rudder	Unidirectional	215	92145
	twill weave	161	92110
	twill weave	276	92125
Flaps	twill weave	161	92110
	twill weave	276	92125
Airbrakes	twill weave	161	92110
	twill weave	390	92140
Ailerons	twill weave &	161	92110
	twill weave	276	92125

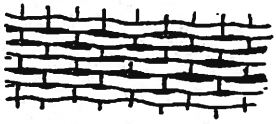
All glass cloths must have the following finish:

Volan - A - Finish or

Finish I 550

Rovings	VETROTEX EC 10-2400-K92 (80) or VETROTEX EC 9-756-K43 (80)
	Manufacturer: GEVETEX TEXTILGLAS GMBH Postfach 1205 4000 - Düsseldorf - 1
Hardfoam	CONTICELL 60 density: 60 kg/m3 thickness: 8 mm
	Manufacturer: CONTINENTAL AG Postfach 169 3000 - Hannover - 1
Gel coat	Up-VORGELAT (gel coat, white) No.0369100 UP-Hardener No.0720500(10%) or UP-Hardener No.0720510(2-3%) Thinner MONOSTYROL
	mixture. 100 weight-parts Vorgelat 10 or 2-3 weight-parts hardener thinner as desired
	Manufacturer: LESONAL - Werke Postfach 300709 7000- Stuttgart - 30
Fillers	MICROBALLOONS (brown)
	Manufacturer: Brenntag GmbH Postfach 320 4330 Miilheim/Ruhr
	SEILO 80 (putty, white)
	Manufacturer: Seitz & Kerler Postfach 145 8770 - Lohr/Main
	COTTON FLOCKS, type FL 1 f
	Manufacturer: Schwarzwälder Textil-Werke Postfach 12 7623 Schenkenzell

FIBERGLASS CLOTH

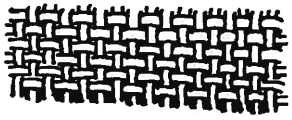


INTERGLAS 92145

Unidirectional weave
A special kind of plain weave. There are many fibbers in one direction, but only enough to hold things together in the other direction. Such cloth is used in the outer wing skin

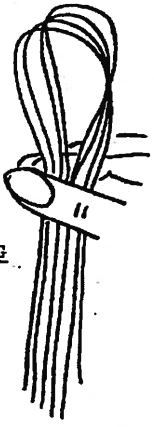
INTERGLAS 92110
92125
92140

Twill weave
This weave commonly has equal fiber content in warp and weft, but its special weave: over one, under two, makes it conform well to rounded places and compound curves.



INTERGLAS 92150

Plain weave
Over one, under one.
Warp and weft have about the same number of fibers and strength.
Used for most flat surfaces



ROVING

A T T E N T I O N !

You should NOT make any repair yourself.

1.) If the wing main spar is damaged.

2.) If main fittings in wings, fuselage or tailplane are torn out; or if around such fittings white overstressed areas are visible in the normally green fiberglass laminates.

3.) If parts are so torn up that - without the aid of original tools, jigs or moulds - you are not able to restore their exact shape or position.

4.) If it is unavoidable to remove undamaged laminated areas in order to carry out a repair.

5.) If you can't guarantee that your repair will be technically perfect and airworthy.

6.) If it's less expensive to purchase a replacement part.

7.) If areas with load bearing reinforcements are damaged as in most cases the number of glass layers shown on the following pages is not true.

9.4 BASIC TECHNIQUES and TOOLS

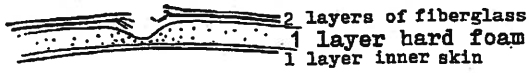
FIBERGLASS-HARDFOAM-SANDWICH SKIN:

(wings, horizontal and vertical stabilizer, rudder, ailerons and flaps)

In these components there is one layer of hard foam between the outer and inner skin.

Usually there are two kinds of damage:

A) Only the outer skin and the foam below is damaged while the inner skin is unhurt,

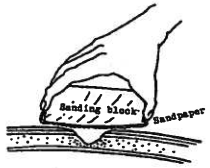


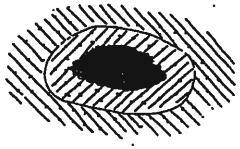
or

B) The damage affected the inner skin too

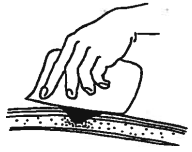
A) is of course easier to repair, so let's begin with it first:

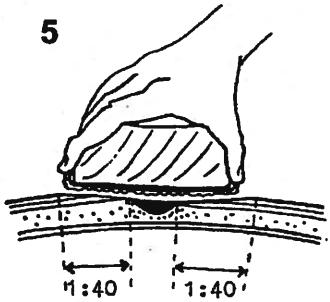
Grind off the afflicted area with 40 - 60 grit sandpaper, until the paint is removed .from the outer skin and the structure of the glass cloth is visible about 6 mm (1/4 in.) around the rim of the hole.



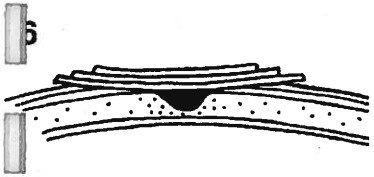


Fill the hole in the foam with epoxy putty which is made from normal epoxy mixed with microballoons '

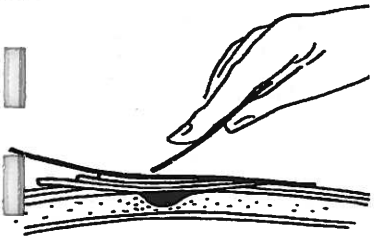




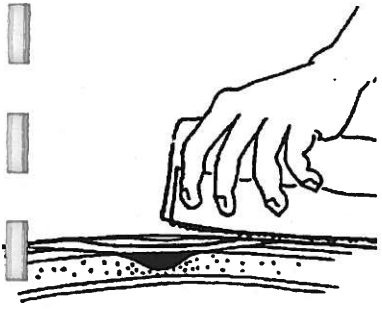
Grind off the excess resin flush with the sound foam.
Remove part of the outer skin so that the glass is exposed for about 25 mm around the rim. The exposed glass should be ground tapered so that it goes s from zero to full thickness (ratio 1:40). Note that it will be easy to unwittingly carve deep holes in the foam while attacking harder stuff. Do not touch area with (greasy) fingers!
Remove dust with clean brush.



Cut some glass cloth patches to cover the area - use the same kind and lay as original in that area (Exception: On wing skins, instead of 2 layers 92145, use 3 layers 92110. The 92145 weave can't be blended too well). Thoroughly wet the patches and the area with freshly mixed epoxy and lay them in place.
Saturate all with epoxy.



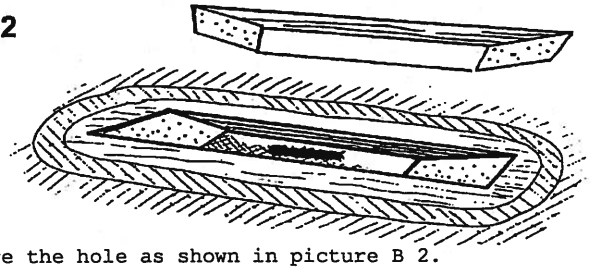
Cover the area with a film of polyethylene, etc., and squeeze and work the air bubbles out of the area. Be careful not to shift the glass - it will be nearly invisible if it is well wetted. Let harden.



When epoxy is surely hard, pull off the film and proceed to grind the area to shape, starting with coarse paper and finishing with 200 or even 400 grit, wet. Keep greasy fingers off. Epoxy putty can be used to fill tiny holes.

Now we consider case B), the awful hole through both the inner and outer skins. It will be necessary to rebuild the inner skin first. Suppose that one can't reach the area from behind, and that the hole in the inner skin is small.

B2



Prepare the hole as shown in picture B 2.

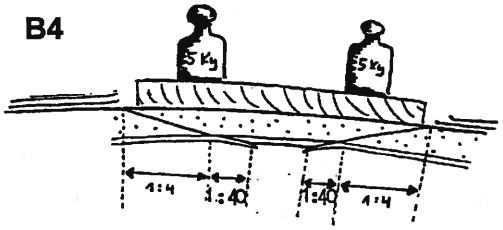
The inner surfaces of the support material are covered thoroughly with epoxy mixture

Then cover the bottom of the foam piece with glass cloth and saturated with epoxy

B3

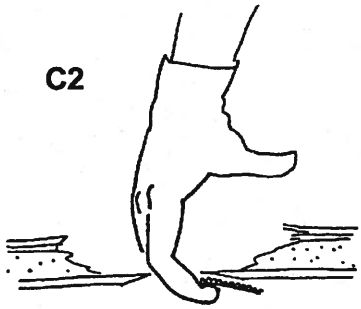
Cover the prepared area of the shell with epoxy and insert the fitted part. Apply light pressure with weights or sand bags.

B4



The next steps follow as explained in picture 5 and following.

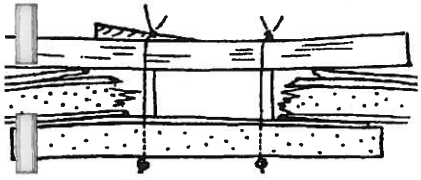
The support material, balsa or foam, should be replaced every time in the described kind. It might be easy to make a foam support material in a round shape, but it will be very hard to fit it precisely.
But the glass cloth should be cut with round corners.
No bird comes apart if you substitute a foam in a little damage not exactly in its special kind, but only in an equal strength.



For larger damage: prepare as shown in picture B 2, but the weaving must cover the slanted surfaces and extend beyond those slanted surfaces. These "ears" lie on the spliced edge of the outer FRP layer.
From there follow as shown in picture 6.

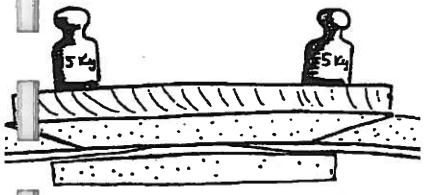
For holes big enough to admit a couple of fingers, or where the inner skin hangs down and flops around most disconcertedly, one must build a light platform under the inner skin to hold it in place while new fabric is glued to it.

Dress the inside surface of the inner skin to a clean, tapered surface, as shown in picture C 2. Gloves will protect the hands from sharp edges!



Cut out a platform piece of foam or other light material big enough to overlap the hole by about 50 mm (2 in.) all around. Sand off its top surface so that it is a fairly good fit to the ground surface of the inner skin. Then secure with wires or strings against the shell. The inserted part must fit shell contour exactly without distorting the contour.

Practice with a dry-run!



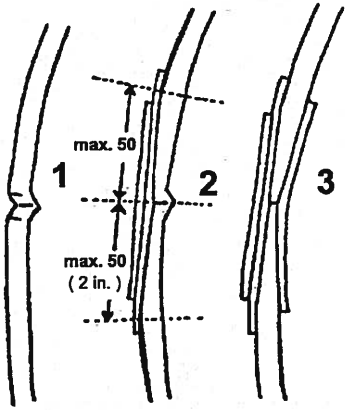
We cover the top side of this inserted piece with epoxy and glass cloth, so that it overlaps the splice of the inner FRP layer. After saturating exactly we tighten the wires or strings against the shell, and let it harden.

The re-established inner layer is now sanded off and one can lay in a piece of foam and proceed as shown in picture B 2 - 4 and continued as in picture 5.

This support platform remains forever inside and we must insure that it remains there in fact, and also does not interfere with any steering mechanism.

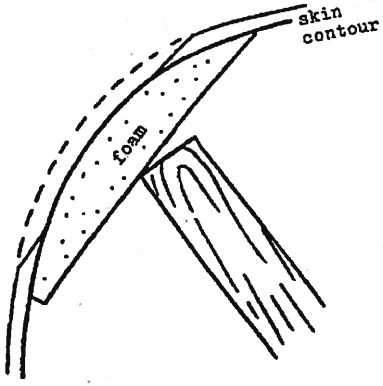
SOLID FIBERGLASS SKIN REPAIR

In contrast to the wing a fuselage shell consists only of fiberglass. This design provides spring flexibility. In case of a smaller damage do nothing but splice around the area, approximately 1 - 1.5 inches (20 - 30 mm). Observe the kind and direction of the glass cloth and replace accordingly.
The first layer of glass cloth is the largest, and each repeated layer should be 7 - 10 mm (0.5 in) smaller in circumference. Let it harden, sand it, paint it.

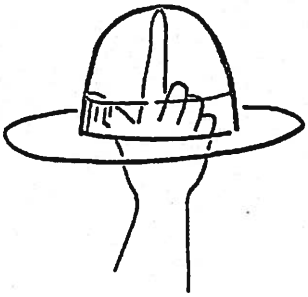


Rips in the shell or built-in parts are to be ground away (taper) on each side for a distance equal to the length of the rip, but at most about 50mm (2 in.) on each side of the rip, and also at each end. Lay on resin and properly oriented glass cloth. After this is hard, grind off the inside surface of the rip and lay on a single layer of fabric inside, as shown in the picture. Observe the kind and direction of the glass cloth and replace accordingly!

For larger damages it is difficult to establish the contour without a support.
Example 1: Fit a piece of foam, from the inside, so that it completely covers the open area and secure it with brace or other support. Remove the foam and splice the shell in a normal manner, cover the foam with a foil and insert it. Rebuild the shell as described earlier.
You can also work without the foil as long as the foam will not react to the epoxy. (Test a small piece!) Styrofoam has proven to work well.

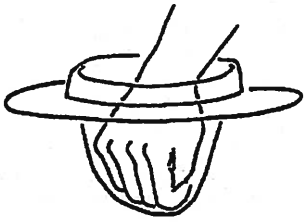


But certainly this manner requires more effort to clean the patch.



Example 2: You make a mould on the outside. This is not too hard to make

First wax the opposite symmetrical side of the airplane perfectly (hoping this area was not damaged too!), lay on one layer of saturated glass cloth of 300 or 400 weight (12 oz./sq yd), let it harden and sand it as desired without removing from the plane's contour! Then, after removing, bend it inside-out, like an old hat. Now the nicely ground surface, which used to be convex, has become concave. It can be waxed and used as a mould.



After preparing the damaged area as learned earlier under "little holes", wax the new mould and lay in the observed glass cloth. After saturating it with resin, stick the whole affair onto the damaged area in the right place. Hold it there very lightly, say with sticky tape. Heavy pressure will distort the shell contour or remove the wet fiberglass.
With small, curvaceous surfaces one may use modeling clay or typewriter cleaner or even Plaster of Paris to form a mould (but do not use silicones!) Remember that some of these moulding materials may contain grease which ruins the epoxy bond. So after removing the moulding material, clean the rebuilt area well with hot, soapy water and roughen it well after drying if you need to work with resin on this area.

Whenever it is possible, try to put one layer on the inside for safety reasons. Any separating material should be removed before inserting the inner layer. Wash with acetone and sand it.

PAINT JOB :

After sanding the area carefully, apply lacquer with a brush. (Do not spray paint because the outside periphery will get sticky.) After hardening first sand with fine sandpaper, then the main process of 220, 400 and 600 wet sandpaper. In areas where the FRP layers show through, repeat the procedure. At the end use a rotary polisher with sense - the area should not get too warm for protecting the lacquer.

For filling tiny holes, you can use epoxy putty, polyester putty etc. The putty should be spread out on the good dry surface; for this it is not practice to use wet abrasive paper for working on the putty.

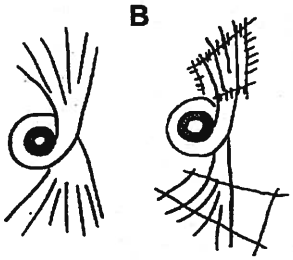
EXTRA EQUIPMENT

Attachment Point Reinforcement

A

If you have to attach something on the shell, the same rules apply as in wood construction. The area must be strengthened before cutting ' any holes or inserting screws.

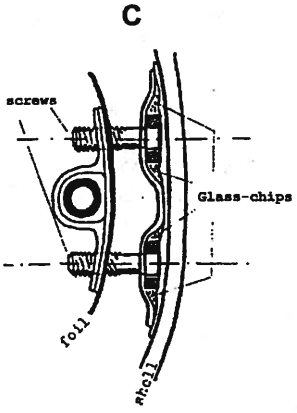
To accomplish this, roughen the place and put some layers of glass onto the area, each larger than the proceeding layer, and also changing the direction of the weave. The strengthening shall be in a realistic relation to the weight it must carry. A 1/8 inch diameter tubing does not need as much as an instrument weighing two pounds. In doubt you make some tests on a separate piece of wood or fiberglass.



B

A For loops, hooks, sockets, tubes: Sand the area, wrap the part with glass cloth around the tube and another layer lapping over to the skin, and let harden in position.

B Greater strength is achieved by wrapping the part with soaked strands of rovings. Spread the end out over the shell and secure it with an additional layer of cloth.



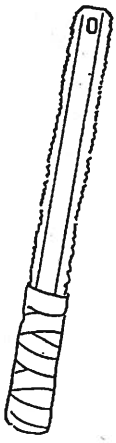
C

C You can also build a removable attach point:

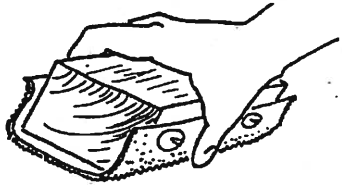
1. First cover the shell with foil and then proceed as described above. After hardening remove the bushing including all the glass.
2. Cover the back side of this attachment plate with foil and drill the necessary holes for the connection bolts through the plate and foil.
3. Sand the area where the attach points, should be located and cover it with the necessary layers of glass cloth.
4. Roughen the hexagons of the necessary screws with a file, the rougher the better. Protect the screws than against rust, by primer or by zinc or cadmium plating. Cover shank and thread of the screws with grease, but the head must remain clean.
5. Apply 2 to 3 layers of glass onto the prepared backside of the attachment plate, clear the holes of weaving and push the screws through so that the heads come to rest on the wet glass.

T O O L S

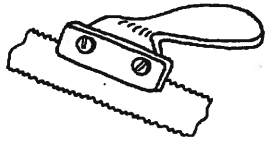
- In addition to the usual tools of an aircraft shop, especially recommended for fiberglass work:
- Clean vessels for resin, hardener, and mixing
- Brushes with small bristles; and one big brush
- Sharp scissors
- Sandpaper of various grits
- Abrasive paper 200, 300, 400, and 600 grits
- Sharp chisel
- A keyhole saw, a hacksaw blade with one end taped to make a handle



- Files, half-round, coarse
- Sanding block to hold sandpaper while using it



- Good special roughing tool: a piece of a hacksaw blade, fitted on a handle from fiberglass, or wood, or metal.



- Vinyl (PVC) plastic electrical tape, clear cellophane tape, old newspapers,
- Plastic sheeting, polyethylene
- Parting agents for epoxies. In emergency, try paste wax or clear shoe polish, also a candle, However, never use waxes containing silicones because one can never remove traces of them from the work, and silicones will prevent adhesion of resin or lacquer.

- Solvents: Acetone or MEK (methyl-ethyl-ketone), lacquer thinners, petroleum solvents, to clean the tools and remove traces of parting agents. Don't get them on the canopy!

- A small hand grinder makes the work easier.

- A disc sander with a 90° adapter is extremely useful for many works, but untrained people should use only small ones, - providing the danger of cutting holes very quickly!
- Grinding wheel for sharpening tools - fiberglass dulls them faster than wood!
- Balance or scale which is accurate to about one gram (0,05 ounce) a mail scale is not close enough in the most cases