MAY 1959

ZUGVOGEL III and IIIA OPERATOR'S HANDBOOK

List of Contents

1.0 GENERAL

Sailplanes of the types 'Zugvogel-I', Zugvogel-II', and Zugvogel-III' belong to the small number of industrially produced performance gliders with laminar flow wings, which can be purchased and maintained at reasonable cost. A number of characteristics make them suitable for present day requirements, whether in club or competition use. These include robust construction, ease and speed of rigging, and pleasant and vice-free flying characteristics. Also, not least, their outstanding performance, especially at high speeds.

The wings of the prototype 'Zugvogel-I' had a relatively pronounced forward sweep. This was decided on to improve safety by restraining the tendency of the laminar profile wing to spin. As this, however, was kept within completely tolerable limits, subsequent aircraft were produced with only slight sweep.

In the 'Zugvogel-II' we did away entirely with the sweep. The straight wing is simpler at the wing root, from the point of view of both structure and assembly and can therefore be produced at a reasonably low cost. This mark also differes from the 'Zugvogel-I' principally in that it has a shorter nose, structurally simplified (cheaper) controls, plain bearings instead of hinged joints for the ailerons (giving minimal friction and control forces). It also has an open centre section with a removable cover (for easier rigging).

The 'Zugvogel-III' differs from the 'Zugvogel-II' in a 1 m increase of wing span to 17 m, and in a fin which is increased in height by 120 mm.

The stability of the 'Zugvogel-III' meets the specification laid down for sailplanes of German BVS category 2 in the German construction regulations. The safety load factor of the wing is 4 and the breaking load 8. In the case of the vital fittings the load factors are significantly higher. Aircraft of this category are not cleared in Germany for aerobatics, and cloud flying is completely forbidden.

The 'Zugvogel-I' first flew in June 1954, the 'Zugvogel-II' in October 1956, and the 'Zugvogel-III' in April 1957. Hanna Reitsch, in a 'Zugvogel-I', won the 1955 German national championships at Oerlinghausen, beating the world-champion Gerard Pierre of France in a 'Breguet-901'. In the 1956 world championships at Saint Yan, France, she was also the best German pilot, coming 8th out of 45 contestants. In July 1956 Peter Kurten achieved the longest post-war distance flight of 404 km from Oerlinghausen to Anklam, also in a 'Zugvogel-I'.

2.0 AIRCRAFT DATA

2.1 Principal Measurements, Flight and Loading Limitations

For airframe data, permitted centre of gravity and loading limits see the attached data sheets, pages (21/23 of this handbook). Take particular note of maximum permitted speeds. Do not exceed the permitted cockpit loading. This loading is calculated by subtracting the ready-to-fly empty weight from the maximum permitted weight. In connection with this, it should be ensured that the maximum weight of the non-lift parts does not exceed 474 lb (215 kg). Further information can be found in Worksheet 050 (3 pages), 'Weight Determination of Sailplanes', obtainable from Deutschen Versuchsanstalt fur Luftfarht, Prufstelle fur Luftfahrtgerat, Essen/Ruhr, Steeler Straße 65 (German Aviation Research Institute, Department of Aircraft Regulations). The maximum permitted speed stated in the test report is registered on the flight limitations placard. This should be fixed in the cockpit where it can be easily read.

2.2 Centre of Gravity

If a centre of gravity weighing is carried out it is recommended that Worksheet 051 (6 pages) should be obtained. This is entitled 'Aircraft Centre of Gravity and its Determination'. It is available from the same source as in paragraph 2.1.

Centre of gravity determination is also written up in 'Weights, Weighing and Centre of Gravity Determination' by Oscar Pflaumer, in the technical publication 'Der Adler' (No 5/1954), and in 'Thermik', (No's 10 and 11/194). If the measured unladen weight lies within the limits given in the manufacturer's data sheet, then the weight limitations given in the loading limitations placard are also valid. A centre of gravity weighing is essential when the sailplane is fitted with extra ancillary equipment (eg. blind flying aids, radio and oxygen system).

2.3 Weak Link

2.3.1 Winch Launch

For winch launching a weak link No II is required. To protect against launch failure because of weak link breakage, we recommend the safety connector developed by Messrs Tost Aviation (131b) Munchen 15, Thalkirchner Straße 62. This is fitted with a No II or III weak link with parallel slots.

2.3.2 Aerotow

A weak link No I is required for aerotow. We also recommend that in this case the above-mentioned safety connector is used, but with a No I or No II weak link connected in parallel.

2.4 Performance

The values of the attached polar curves (page 23) have been calculated.

Stalling speed is around 33 kt at an average flying weight of 728 lb (330 kg) and increases to 34.5 kt at maximum flying weight.

On the occasion of the 1956 world championships at St Yan, comparisons of flying performance were made between a production model of the 'Breguet-901' and a 'Zugvogel-1'. These showed the 'Zugvogel-1' to perform less well at speeds of less than 43 kt, equally well up to 65 kt, and then increasingly better over 65 kt.

3.0 RIGGING INSTRUCTIONS

3.1 Rigging

Before assembling the aircraft, clean and grease all metal fittings. Rigging then begins with the port wing. One man holds the fuselage on the starboard side and three other helpers bring the wing to the correct position at the fuselage. Next, with the wing-tip held slightly forward , the front mounting pin on the fuselage is engaged in the corresponding fitting on the wing. Then, by moving the wing-tip backwards, the rear wing mounting is engaged on the rear fuselage pin. By slightly moving the wing, the rigging-aid pin can be easily pushed home.

When fitting the starboard wing, the same procedure is used as with the port wing. With slight backwards pressure maintained on the wing-tip, it can be raised or lowered so that the wing-root main pin can be inserted. While doing this, do not tilt the wing and fuselage. The best way is for one man to climb into the seat and direct the two wing-tip helpers until the holes in the main spar fittings coincide. The main pin can now be inserted by being gently turned under hand pressure only. Make sure that the main pin is fully home so that the hole for the safety pin is clear. It is possible that the main pin will have to be slightly turned to achieve this. The safety pin can then be fitted and secured, and the handle unscrewed from the main pin.

The aileron and airbrake control rods can now be connected with wing nuts and these secured with safety pins. Finally, the panel is screwed down over the centre section.

The tailplane is fitted last. This job is best done by two people. The two pins on the underside of the tailplane are located in the two sockets on the fuselage. Then the forward fitting is attached to the fuselage with a hexagonal nut, using a box spanner which is part of the main pin handle. The nut is secured with rigging wire. Connecting the elevator rod to the elevator crank is achieved by means of a bolt, washer, wing nut and safety pin.

3.2 Daily Inspection

Carrying out the daily inspection is particularly important. Many accidents have happened because it has either not been done, or has been done carelessly. The daily inspection must be carried out whenever the aircraft is rigged and on every flying day before the first launch. It is best if on each flying day an experienced glider pilot or ground engineer carefully runs through the following check list point by point.

a. Is the main pin fully home and secured ? Are the parallel parts projecting at least 1 to 2 mm ?

b. Are the aileron and airbrake controls connected and secured ?

c. Is the tailplane properly rigged and secured ?

d. Is the elevator connected and secured ?

e. Check the function of all controls : are movements in the correct sense ? is there full and free movement ?

f. Check operation of airbrakes. Do they lock properly ?

g. Check for unacceptable play in all control surfaces. Are all control surface hinges properly secured ?

h. Check the operation of the aerotow and belly hooks. If necessary, clean and grease them.

i. Is the canopy catch in working order ?

j. Check the tension in the rudder cables and adjust if necessary : replace weak return springs. Are the turnbuckles secured ? Inspect the cables for wear, especially at pulleys and fairleads.

k. Are the required instruments fitted (ASI and altimeter) ? Check the ASI.

l. If the aircraft is to be flown without a parachute, is the seat-back well fitted with a large enough hard cushion of at least 16 cm thickness ?

m. Are the access doors on the underside of the wing and at the rear of the fuselage by the elevator connection securely fitted ?

n. Are the belts and their fittings in order ?

o. Is the tyre pressure (of the dolly) properly inflated (2.5 to 3.0 atu - 35 to 42 psi) ? Check the operation of the dolly.

p. Check for foreign objects, especially in the fuselage. Pay attention to free movement of the controls.

q. Check for damage. Have fuselage tubes been bent through hard landings ? Is there any rust ? Check for cracks in the ply and tears in the fabric.

3.3 Derigging

Derigging the 'Zugvogel-III' is carried out in the opposite sequence to rigging. First the tailplane is removed. Before taking off the wings, remove the centre section cover and undo the aileron and airbrake connections. With two helpers lifting the wing tips so as to release the pressure on the main pin, this can be removed by lifting and gently turning using the handle. Once the pin is out be careful not to tilt fuselage or wings. The starboard wing is removed first while the port wing remains attached to the fuselage by the rigging-aid pin. The wing-tip is first moved slightly forwards so that the rear pin is released from its fitting. Take care not to move the wing-tip too far forward otherwise the front pin will be jammed in its housing, making the wing difficult to remove. Take care that, when disengaging the front mounting too energetic a push on the wing's leading edge does not move the wing backwards so that the main spar fittings hit the airbrake

actuators and perhaps distort them. If necessary, use a screwdriver between forward pin and wing fitting to gently lever the wing off backwards. After taking out the rigging-aid pin, the port wing can be removed in the same way.

3.4 Storage

If the 'Zugvogel-III' is to be stored derigged, it is particularly important to see that the wing is supported at the correct distances. One support goes under the wing root, the second somewhere between airbrake and elevator. When the wing is stored vertically these supports are also necessary otherwise warping of the trailing edge will inevitably result. When storing the tailplane it is necessary to ensure that the supports are placed beneath ribs otherwise it can easily be distorted.

4.0 OPERATING INSTRUCTIONS

4.1 General

In-flight handling of the 'Zugvogel-III' does not pose any difficulty. It is of course clear that an aerodynamically advanced aircraft must be flown in a correspondingly sensitive and competent manner. A certain degree of flying experience is therefore assumed.

4.2 Airspeed Indicator Readings

All instruments are affected by so-called 'built-in errors'. These false readings occur because the pitot is situated in airflow which is disturbed by the fuselage. The errors in the case of the 'Zugvogel-III' are given in the following table:

	knots									
Indicated airspeed IAS	33	38	43	49	54	65	76	86	97	108
True airspeed TAS	31.4	37	42.5	49	55	67	79	90	102	114

All airspeeds given in this handbook are IAS. New airspeed indicators will be delivered from the manufacturers with a calibration curve which accurately indicates speed in an undisturbed airstream. All ASI's should occasionally be recalibrated.

4.3 Launching

Winch launching is possible from either the skid or the wheel dolly. Launching from the dolly is more pleasant because of the shorter ground run (greater angle of attack and less friction). Dropping the dolly should always be done carefully. In order to avoid damage it should not be dropped from too great a height. On the other hand, neither should it be dropped from so low that it can rebound and damage the fuselage or tailplane. It is important not to drop the dolly in horizontal flight and even more that it is not dropped when climbing. It is best done at a height of 6 to 10 ft, so that after release the climb can be initiated. The release lever is in front of the seat to the left. (Warning : lever for dolly; knob for release hooks). Too hard a pull is always dangerous as this first leads to a leap off the ground and secondly, in an instant, the alteration of altitude at insufficient climbing speed brings the rear of the fuselage and the tailplane back near the ground. For the first launches one should particularly concentrate on dropping the dolly and above all, when pulling the release lever, keeping the stick steady. On training flights, dropping the dolly can sometimes be dispensed with as the aircraft can be landed on it without difficulty.

In other respects the 'Zugvogel-III' behaves quite normally on winch launch. There is no marked tendency to nose up and break the cable. When launching, only the port wing should be held and run with. In this way a launch failure can more easily be avoided in the event of

the wing-tip holder involuntarily holding it back the wing-tip because of an unexpected snatch on the cable, than if he were holding the starboard tip. The climb is made with the stick neutral or lightly pulled back. Do not exceed the permitted speed of 54 kt ! The position of the hook (Tost safety hook) is such that the cable will release of itself before the winch is overflown. Three pulls on the release knob in front of and to the left of the seat go without saying once the cable connecting links have been heard to fall off. Winch launches are only to be carried out with the belly hook and not with the nose hook

Aerotow launch is done with the nose hook. The release knob is to the left of the instrument panel. The launch is carried out behind a low-powered aircraft (less than 140 HP), and it is essential to use the dolly. Special attention should also be paid to jettisoning the dolly. The aircraft is first allowed to gain speed and then, at an altitude of 6 to 10 ft, the dolly is dropped while at the same time the nose is pulled up. The release lever is forward of the seat to the left. After release push the stick forward again slightly. Aerotow speed should not be less than 43 kt.

When using the safety connector recommended in paragraph 2.3, the weak link can quickly be checked where it is attached to the tow rope. This will show if a blade of the link is cracked or if it has been in use for too long with parallel slotted blades.

During the first launches in the 'Zugvogel-III' large movements of the elevator should be avoided and when dropping the dolly one should fly using small movements of the stick. Avoid excessive movements which may cause the aircraft to touch down again.

4.4 Flight

By comparison with other sailplanes in general use at present there is an unaccustomed lack of wind noise in the 'Zugvogel-III'. During the first few launches more attention should be paid to the ASI and the horizon. Minimum speed in straight flight is 33 kt IAS 728 lbs (330 kg) and 35 kt at 805 lbs (365 kg). Normal flying speed is about 20 % above this at 41 kt to 43 kt. Until after the 'Zugvogel-III' has been test flown the higher speed should be used. (Best glide angle is achieved at 43 kt). For ASI checking the IAS is always tested at slow speed and then the normal flying speed is established from this.

At stalling speed in still air the 'Zugvogel-III' is generally stable. However, there is a tendency for a wing to drop, expecially in gusty conditions and this should always be avoided. Recovery from a wing dropping can be made immediately and without difficulty by slight movements of the ailerons and rudder. Warning of reaching critical speed is given by a noticeable change in the noise of the airflow over the canopy. Occasionally it appears as a slight vibration in the tail.

A spin can be induced by crossing the controls in straight flight at the stall or when turning at stalling speed. It can be corrected after about a quarter turn by applying the normal control movements. Full opposite rudder, ailerons centralised and forward movement of the stick (don't overdo the latter).

The 'Zugvogel-III' shows relatively little tendency to go into a spiral dive. This is evidenced in that in a 45°banked turn hardly any opposite aileron is needed.

In common with all aerodynamically high-performance sailplanes with reasonable wing loadings, the 'Zugvogel-III' has a high speed capability. Moreover, it has a very effective elevator. When flying at high speeds it is therefore particularly advisable to use gentle control movements.

4.5 Landing

Landing is very simple with or without airbrakes. Using no airbrake gives a good glide angle.Use of air brake enables such good glide angle control that even landing in small fields is no problem. The 'Zugvogel-III' also sideslips well. Sideslip can be used for extra glide angle control when landing but in most cases use of the airbrakes should be sufficient.

The airbrakes operate smoothly. Their operation produces a little tail-heaviness so slight forward stick pressure should be applied. After being unlocked the airbrakes can be sucked out by air pressure, particularly at speeds of 54 kt and over. In order to avoid sudden opening the handle should be firmly held once the brakes are unlocked and they should be extended slowly. Touchdown with airbrakes open presents no problem.

4.6 Sensitivity to Rain

All laminar profile wings are subject to a certain degree of sensitivity to rain. The effect is that performance drops off and minimum flying speed increases by about 20 %. Moreover the tendency to drop a wing increases. Under rainy conditions this should be taken into account and normal flying speeds increased by 5 to 8 kt, especially at low altitude. In this connection, as also mentioned later (paragraph 5.1, page 18), note that various polishes promote the formation of large drops of water which cause an early detachment of the laminar flow.

4.7 Transport

When moving on an airfield, expecially when towing the glider behind a car on uneven ground, make sure that the stick is secured with the seat belts so as to stop the elevator banging about.

When the glider is transported in a trailer the aileron rods should be fixed to the wing roots and the elevator rod to the fuselage framework with string or rubber bands so as to prevent them from banging about. Ailerons and rudder should also be secured by simply made devices. Drive carefully over the airfield.

When building or buying a trailer it is important to see that the supports for the wing do not have too little distance between them. If for example the wing is supported at the wing-root rib then the second sup-

port should be at a distance of 4.5 to 4.8 m from the first. Otherwise, because of the weight of the overhanging tip the wing can break at the inboard end of the aileron.

In order to protect the surface, the 'Zuvogel-III' should never be transported in an open trailer. Moreover, when being transported, or standing in a hangar, the wings and fuselage nose including canopy should always be protected by cloth covers.

4.8 Repairs

Small repairs to the steel tube fuselage are not very difficult. Bent tubes can be cut out and replaced with new ones. However, welding should only be done by a qualified welder. Fabric near the weld (10 to 15 cm) has to be detached. The immediate area around the weld should be cooled with water or protected with a heat deflection plate. Keep fire extinguishers handy ! Although the wings are not of standard manufacture, repairs should present no difficulty.

Major repairs to the fuselage, the main spar (spar fracture) and main fittings should only be carried out by the manufacturers or by a workshop licensed for this work.

The tow hook assemblies should be sent with the log book to the manufacturers for major overhaul and after testing.

5.0 MAINTENANCE INSTRUCTIONS

5.1 Surface

It is a property of laminar flow wings that they only produce their best performance when their surface is smooth. It is essential that the laminar airflow is maintained to the greatest degree possible. Therefore the upper and lower surfaces of the wings forward of the main spar should be looked after carefully. Even slight dirtiness, be it only dust resulting from storage in a hangar, causes early detachment of the laminar boundary layer. Therefore cloth covers should always be used when the aircraft is hangared. Road transport in an open trailer should not be considered. Protective covers should also be put on when a closed trailer is used. Similarly careful treatment of the ply fuselage nose and perspex canopy is also recommended. A perspex polish is best for the canopy. Great care should be taken over choice of polish for the wings. Vehicle polishes certainly give an excellent finish but they are all more or less water repellent. That is to say, they can cause the formation of large water droplets on the surface which, as already mentioned, both reduce performance and increase the tendency to spin. We are sorry not to be able to suggest a really ideal polish and would be grateful for advice.

5.2 Controls

The controls generally run in ball bearings and are practically maintenance-free. If these bearings become severely contaminated they should be cleaned and relubricated with grease or Vaseline.

After 50 to 100 launches all control mechanisms and control surface hinges should be respectively oiled or lubricated by grease gun (see lubrication chart, page 24). At similar intervals the rudder cables, release hook and dolly cables should be cleaned and checked for broken strands. The rudder cables should be well lubricated where they pass through fairleads. Keep the fairleads free of grit and dirt. Graphite oil is preferable to grease. Do not forget the rudder cable fairleads in the rear of the fuselage. The fabric-covered inspection openings should be cut open every two years and then re-covered. If the fuselage fabric is renewed during a major repair the opportunity should be taken of completely renewing the rudder cables.

It is recommended that aileron deflection should occasionally be measured and compared with the figures in the data sheet. From time to time the ailerons should be removed and refitted.

5.3 Trimming

The elevator trim is adjusted to that the greater part of the trim tab deflection is downward and only a few millimeters is upwards. This is necessary because with the lower deflection force in slow flight, elevator effectiveness is less for a given angle than at high speeds.

Note: Centre of gravity outside the permissible range cannot be corrected by use of the trim tab, but only by weight distribution.

5.4 Miscellaneous

The daily inspection should include a careful inspection of the wheel dolly. It is more prone to dirt than any other part of the aircraft and therefore should always be kept clean. Checks its operation frequently.

Special attention should be paid to gaps. These should be particularly avoided and should be covered with tape whenever necessary.

Make a particular point of inspection after any hard landing etc. Most hidden damage to aircraft happens as the result of stresses of short duration and can appear unexpectedly in any component or place in the aircraft.

6.1 Data Sheet

Extract from Department of Aircraft Regulations Information Sheet Regulation No. L 214 NFP No 12/57.

(The above mentioned information sheet can be obtained from the "Deutschen Versuchsanstalt fur Luftfahrt, Prufstelle fur Luftfahrtgerat, Essen, Steeler Straße 65).

Measurements

Span	17000 mm
Overall length	7100 mm
Wing area	14.48 m^2
Chord	1165 mm at rib Y
Aspect ratio	20 (datum pt chord Y 550 mm from centre of fuselage)

Weights

Prototype empty weight	540 lb (245 kg)
Max all-up weight	805 lb (365 kg)
Max weight of non-lift parts	474 lb (215 kg)

Centre of Gravity

Datum line	Chord at point Y
Datum point	Wing leading edge at chord Y, 145 mm fwd of leading edge
Mean chord	1 m = 852 mm

Empty Weight Centre of Gravity

Empty Weight	529 (240)	551 (250)	573 (260)	595 (270)	617 lb (280 kg)
Centre of Gravity	695	685	675	670	665 - 45 mm

In Flight Centre of Gravity

Max permitted forward 343 mm = 22 % l m

Max permitted rearward 513 mm = 42 % l m

Loading

132 lb to 220 lb (60 to 100 kg) in pilot's seat without special ballast.

Minimum weight to be achieved by ballasting seat.

Rigging Angles

Wing	Angle of incidence	- 4.5°at wing root rib
	Washout	0°
	Dihedral	2.5°at lower spar
	Sweep	0°at centre line of main spar
Tailplane	Angle of incidence	3.0°from chord at rib Y
	Dihedral	0°
	Datum point to elevator hinge line	4340 mm
	Datum point to rudder hinge line	4785 mm
	Wing oscillating frequency of prototype	154/min

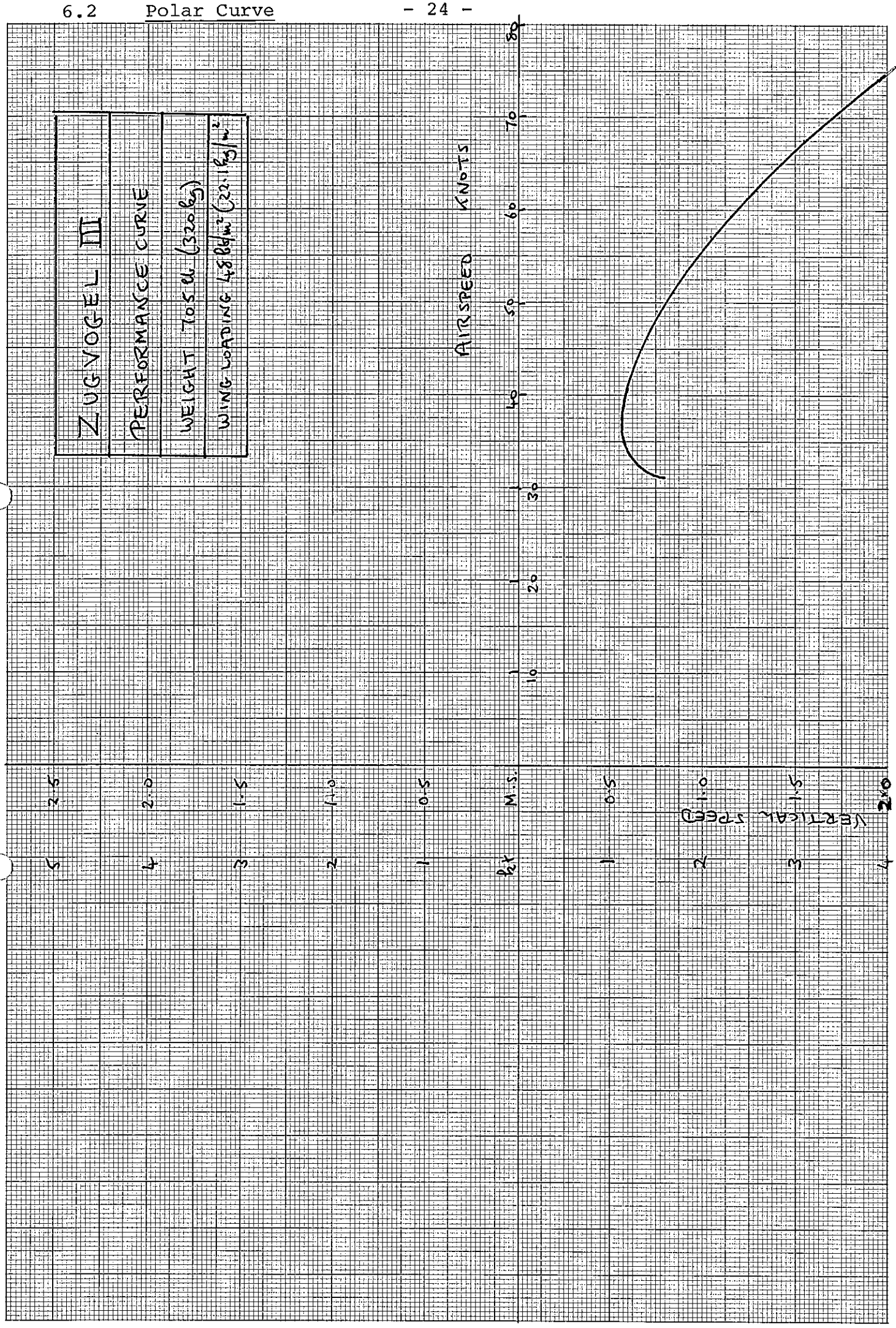
Minimum control deflection	Up mm	Down mm	Centre of mass from hinge line mm
Aileron	117 ± 5	41 ± 5	250
Elevator	135 ± 20	135 ± 20	400
Rudder	Min 320	Max 380	715

Minimum Equipment

Four part seat belt, ASI, altimeter, loading limits, flight limitations placard, parachute or cushion in seat-well.

Limitations

Hand launch	Yes
Car and winch launch	54 kt
Weak link, car and winch launch	Min 1410 lb (640 kg), Max 1638 lk (742 kg)
Aerotow	76 kt
Gliding speed in smooth air	108 kt
Initial training	No
Training for emergencies	Yes
Cloud flying and aerobatics	No


ZUGVOGEL III
PERFORMANCE CURVE
WEIGHT 700 kg (1320 lbs)
WING LOADING 48 kg/m² (10.1 lbs/ft²)
AIRSPEED KNOTS
VERTICAL SPEED
M.S.
80
70
60
50
40
30
20
10
2.5
2.0
1.5
1.0
0.5
0
0.5
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3
2
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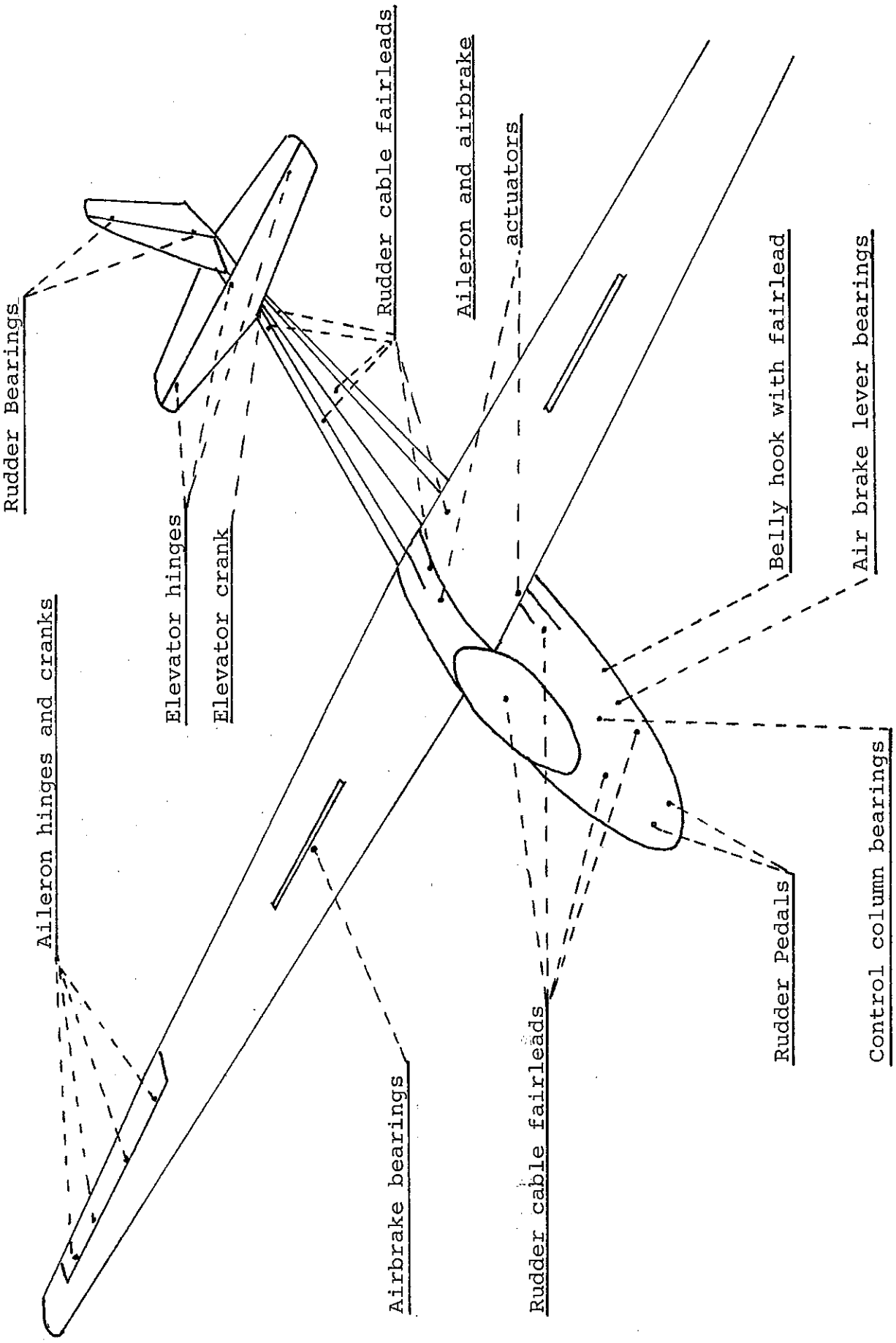
4

6.3 Lubrication Chart



6.4 Flight Limitations Placard

SCHEIBE FLUGZEUGBAU - GMBH DACHAU BEI MUNCHEN

Zugvogel - IIIA

Serial No : 1054 Year of construction: 1960

B G A No: 2560

Category of Certification: German BVS 2

Airspeed limits

Glide or dive :	Smooth air	108 kt
	Rough air	76 kt
Aerotow :		76 kt
Auto/winch launch :		54 kt
Airbrakes extended :		108 kt

Weak link :	No 11	1410 - 1634 lb
Empty weight :		571 lb
Maximum cockpit load :		234 lb
Maximum all-up weight :		805 lb
Mimimum cockpit load :		114 lb

NO AEROBATIC MANOEUVRES OR SPINS ALLOWED

CLOUD FLYING PROHIBITED

Maximum permitted loads on pulling out of dive and in tight turns :

- in still air	4 g
- in rough air	3 g

7.0 SUPPLEMENT

7.1 'Zugvogel-III-A'

For easier handling the 'Zuvogel-IIIA" is fitted with a fixed wheel instead of a wheel dolly. Launching with a fixed wheel is easier because the pilot no longer has to drop the dolly at the beginning of the launch.

When launching or during the ground run after landing, direction can be maintained by use of the rudder. After touch-down appropriate control movements can be initiated either to use the skid as a brake or to let the 'Zugvogel-IIIA' run on wheel and tailskid. The wheel axle has ball bearings and is practically maintenance free. Tyre pressure is 35 psi.

From Works No 1052

a. The wheel is braked by a type of hand-brake (steel strip operating on the tyre). The brake is operated by the airbrake lever and becomes effective when the airbrakes are fully open. Touchdown with the brake on is certainly possible but because of tyre wear is not recommended. When landing with airbrakes deployed the airbrake lever should not be hard against its stop. During the first few landings in the 'Zugvogel-IIIA' it is useful to become aquainted with the operation of the wheel brake and the amount of physical effort required.