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FLIGHT MANUAL

GROB G 109

This handbook must be carried on board of the motorglider at all times.

This Airplane Flight Manual is FAA approved for U.S. registered airplanes in accordance with the provisions of 14 CFR Section 21.29. and is required by FAA Type Certificate Data Sheet No. .....

Registration: .....VH-FFQ... Factory Serial Number: 6009...

Owner: .....

.....

.....

German edition of operating instructions are approved under § 12/2 LuftGerPO

Published March 1981 with modifications of 1. Oct. 1981

Approval of translation has been done by best knowledge and justment. In any case the original text in German language is authoritative.

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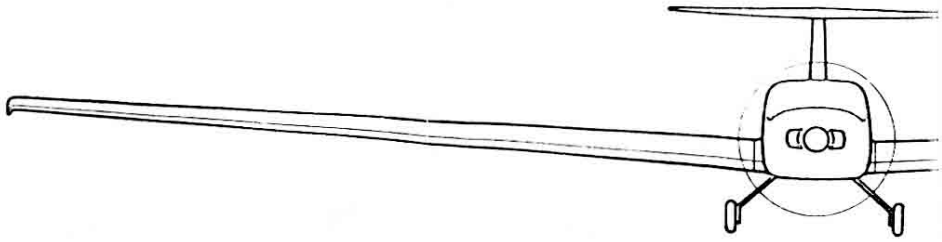
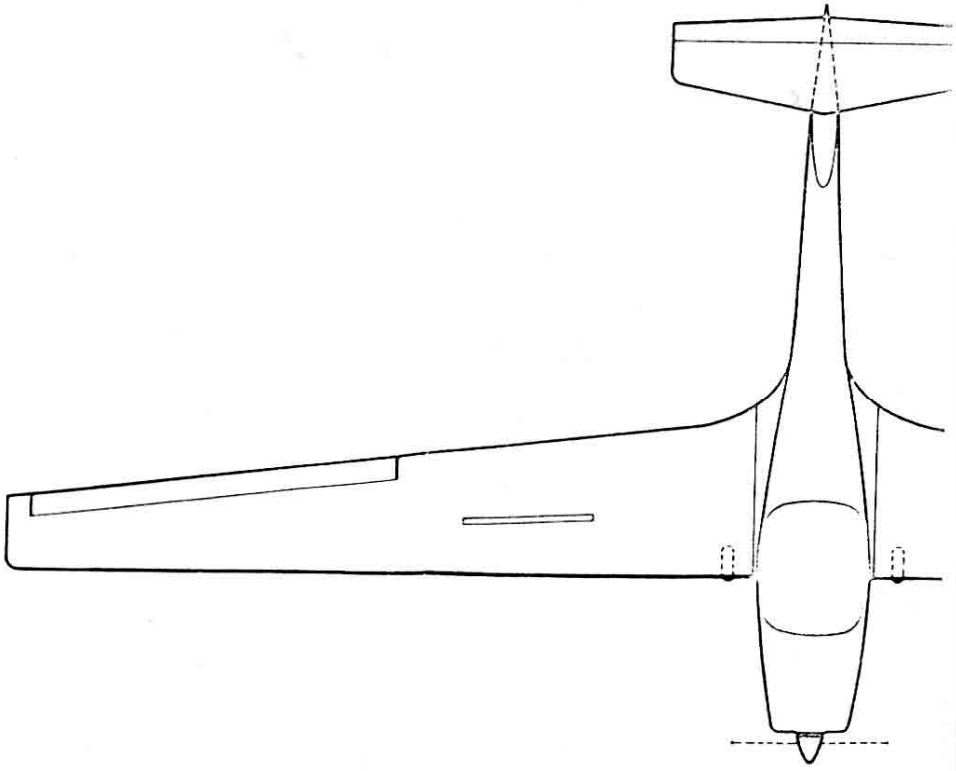
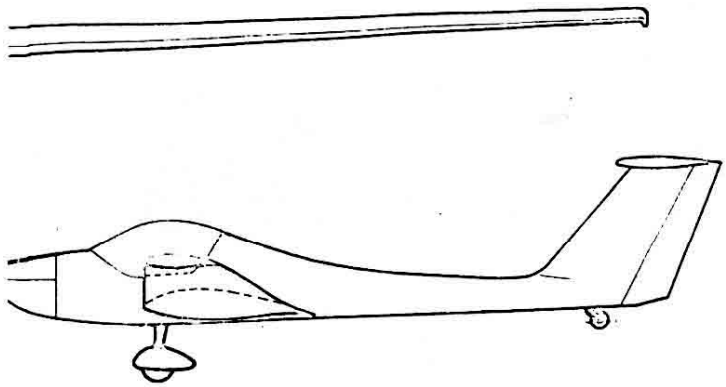
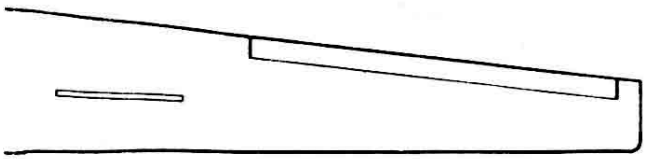




I. 3. Three-side view





GROB
G109

I. 4. Description

The G 109 is a two-seated motorglider with T-type stabilizer, fixed gear with fairings and air brakes extending out of the upper surface of the wings. The seats are arranged side-by-side.

This motorglider has been produced under the latest technology of industrial glas-fibre and carbon-fibre design.

It is designed for instruction-, training-, competition- and cross-country flights.

Technical datas:

Wing span:	16,6 m (54,45 ft.)
Length:	7,88m (25,85 ft.)
Height:	1,68m (5,51 ft.)
Wing ratio:	13,5
Wing area:	20,4 m^2 (219,6 sq.ft.)
Max. gross weight:	825 kg (1820 lbs.)
Max. wing load:	40,4 kg/m^2 (8,28 lbs/sq.ft)
Airfoil	E 572 (mod. E 603)
Engine:	Limbach L 2000 EB 1.A (59 KW/80 hp rated at 3400 RPM)
Propeller:	Hoffmann Ho-V62 R/L 160 T

12.5.81

II. Operating limitations

II. 1. Category of airworthiness:

U (Utility) according to JAR 22

Basis for type certification is the "Joint Airworthiness Requirements (JAR 22) Sailplanes and Powered Sailplanes", edition April 1, 1980

II. 2. Permitted operations:

The motorglider is certified for flights under VMC during daytime.

Flights under IMC and for known icing conditions, aerobatic inclusive intentional spinning and cloud flying are prohibited.

II. 3. Minimum equipment:

- 1 airspeed indicator (300 km/h, 162 kts)
- 1 altimeter
- 1 R.P.M. indicator with time counter
- 1 Oil pressure indicator
- 1 Oil temperatur indicator
- 1 Ammeter
- 1 Fuel quantity indicator
- 1 Magnetic compass
- 1 Cylinder head temperatur
- 2 4-belt seat harness
- Load placard
- Data placard
- Flight manual

II. 4. Engine limitations

II. 4.1 Type of engine: Limbach L 2000 EB 1.A

II. 4.2 RPM limitations (RPM indicator markings)

Maximum RPM (red line)	3400 RPM
Caution range (yellow arc)	3000-3400 RPM
Operating range (green arc)	700-3000 RPM

RPM with prop installed and aircraft not in motion:

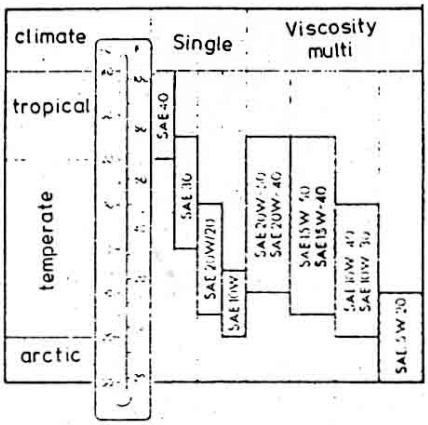
Hoffmann Ho-V62 R/L 160 T :

Takeoff setting:	2750 $\pm$ 100 RPM
Cruise setting:	2200 $\pm$ 100 RPM

II. 4.3 Lubrication

Do not use alloyed or unalloyed aviation oil!

Use only "SAE"-oil for combustion engines.



Capacity : min. 1,5 ltr., max. 2,5 ltr.

Note: The oil level indication at the dipstick is almost equal for flight or ground attitude. Filling to just below the upper mark is sufficient, too much oil will be drained through the vent lines and runs along the fuselage bottom.

Oil pressure:	Minimum (red line)	1 bar
	Operating range (green arc)	1 - 4 bar
	Maximum (red line)	4 bar

1.10.81

Oil temperatures:

Max. Oiltemperatur (red line)		120° C
Cautionary range (yellow arc)		100° - 120° C
Operating range (green arc)		50° - 100° C
Minimum temperatur (red line)		50° C
Optimum operation temperatur	ca.	80° C

II. 4.4 Fuel:

Gasoline AVGAS 100 LL or
Automobile fuel premium (MOGAS min. grade ROZ 96,0 Octane)
Fuel additives may not be used.

Fuel capacity: 80 ltr. (17,6 imp.gal., 21,1 u.s.gal.) 56 kg (123 l
usuable: 78 ltr. (17,2 imp.gal., 20,6 u.s.gal.)

Note: Due to the installation position of the quantity meter, fuel quantity indications on the ground or flight are almost identical. At the "empty"-indication 4 ltrs. (0,9 imp.gal., 1,1 u.s.gal.) of fuel are remaining.
"Full" is indicated between 74 and 80 ltrs. (16,3 - 17,6 imp.gal., 19,6 - 21,1 u.s.gal.) total fuel. So initially the fuel indicator needle will not move after starting when the tank is completely filled.

II. 4.5 Cylinder-head temperatur:

Max. Cylinder-head temperatur (red line):
250° C, sensed at the hottest cylinder

II. 5. Operating instructions for the variable pitch propeller

Series: Ho-V62-R/L 160 T with spinner
VP 30 - 81

The prop has three positions:
- start
- cruise
- feather

Number of blades:	two
Diameter:	160cm ±0,5cm (5 1/4 ft ± 0,2 in.)

Instructions for the 50h-inspections are contained in the operating- and maintenance manual Ho-V62.

With running engine the prop can be adjusted from "start" to "cruise" and vice versa. The prop must be feathered with dead engine or idling.

To change from "start" to"cruise" the engine RPM must be higher than 1800 RPM.
RPM must be reduced to below 1300 RPM to adjust the prop from "cruise" to "start".

When releasing the prop from "feather" with dead engine it is automatically positioned to "start".

Adjusting the prop from "start" to "Cruise" and vice versa is handled by pulling the prop control knob on the center console. The prop can be feathered by pulling the handle above the prop control knob and rotating it by 90° clockwise to lock the prop in the desired position.

II. 6. Airspeed limitations and load factors limits

Maximum allowable airspeed (calm air):

V_{NE} = 240 km/h 130 kts 149 mph

Maximum allowable airspeed (rough air):

V_B = 185 km/h 100 kts 115 mph

Maneuvering speed:

V_A = 185 km/h 100 kts 115 mph

Maximum speed with airbrakes extended:

V_{LE} = 240 km/h 130 kts 149 mph

Stallspeed with airbrakes extended:

V_{S1} = 87 km/h 47 kts 54 mph

Stallspeed with airbrakes retracted:

V_{S0} = 76 km/h 41 kts 47 mph

All speeds are calibrated airspeed (V_{CAS}).

Calibrated airspeed is indicated airspeed corrected for position error (CAS = IAS + V_i).
Note the difference between indicated and calibrated airspeed at low speeds (see figure pg. 15),

The following accelerations may not be exceeded:
(airbrakes retracted, symetrical maneuvers)

at maneuvering speed	+ 5,3	- 2,65
at maximum allowable speed	+ 4,0	- 1,5

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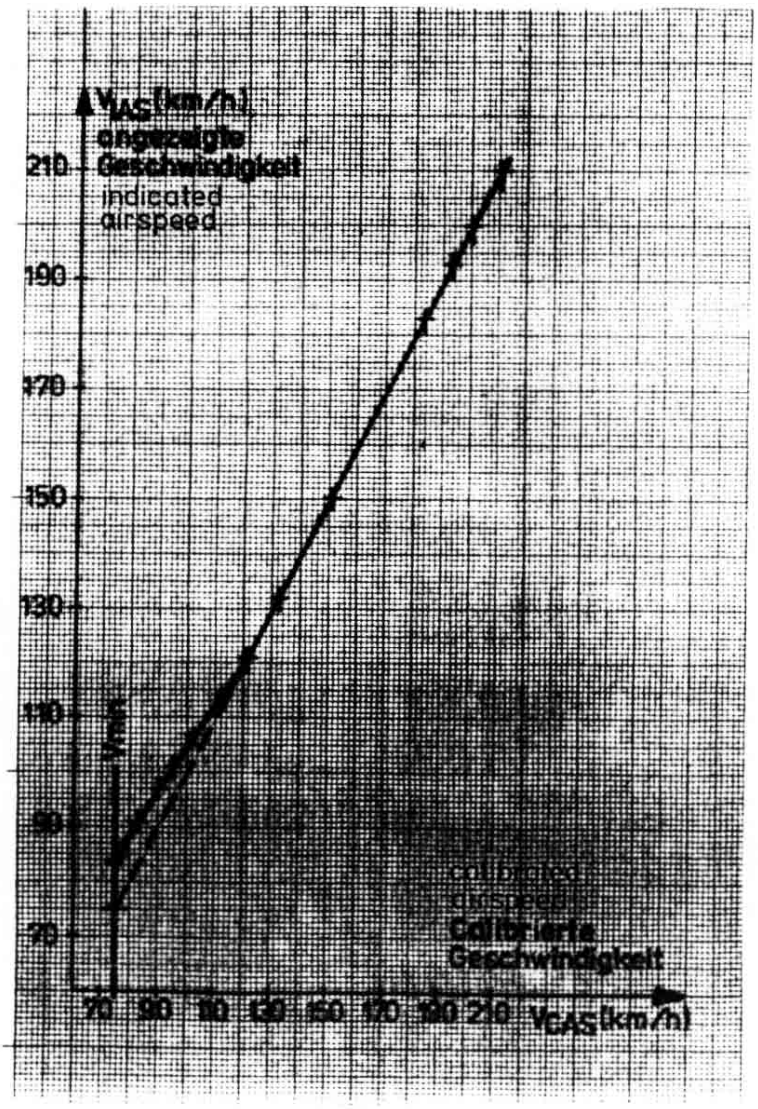
Rough air is defined as turbulence that can be expected in wave rotors, thunderstorms, whirlwinds and when crossing mountain ridges.

Maneuvering speed is the highest speed at which full deflection of controls is considered in calculations. At the maximum allowable airspeed only 1/3 of the full deflection is considered. Please note, that with increasing altitude true airspeed increases versus indicated airspeed.

Use following table to find V_{NE} at various altitudes:

Altitude (m):	V_{NE} (IAS) km/h:
0-2000 (0-6000 ft)	240 (130 kts)
3000 (10 000 ft)	225 (122 kts)
4000 (13 000 ft)	214 (115 kts)
5000 (16 500 ft)	203 (110 kts)
6000 (20 000 ft)	192 (104 kts)

Diagram of indicated airspeeds (airspeed indicator calibration line).
This figure shows airspeed indicator errors due to the position of the pitot pressure port.
Pitot pressure source: Pitot tube under the right wing
Static pressure source: fuselage sides in front of the cockpit.



1.3.81

Airspeed indicator markings:

Red line (maximum allowable airspeed):		
240 km/h	130 kts	149 mph
yellow arc (caution range):		
185-240 km/h	100-130 kts	115-149 mph
green arc (normal range):		
95-185 km/h	51-100 kts	59-115 mph
yellow triangle (approach speed):		
115 km/h	62 kts	71 mph
blue line (best climb; prop in "start"):		
95 km/h	51 kts	59 mph

II. 7. **Crew** : 2 persons
Minimum crew : 1 person (min. weight: 70 kg/155 lbs)

Caution: **Solo-flights may only be conducted from the left seat!**

II. 8. **Weights**

Empty weight	ca. 580 kg (1280 lbs.)
Max. gross weight	825 kg (1820 lbs.)
Max. weight of non-lifting parts	640 kg (1410 lbs,)
Max. wing load	40,4 kg/m^2 (8,28 lbs/sqft)

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II. 9. Center of gravity at takeoff weight

The approved range of center of gravity positions during flight is

380 mm (15,0 in.) to 465 mm (18,3 in.)

behind the datum line, equivalent to

29,5 % to 36 %

of the M.A.C of 1,29 m (50,8 inches)

The datum line (DL) is the front edge of the wing at the wing root.

Aircraft attitude: The top of the fuselage horizontal 500 mm (20 in.) in front of the vertical stabilizer.
(See page 25)

Date of weighing carried out by:	Record of fitting-out. Date:	Empty weight kg (lbs)	Empty C of G (mm behind datum)	Empty weight momentum m/kg	Max. Payload	Signature
20.11.81	20.11.81	585 kg	481 mm	281,4	240 kg	
7.5.82	7.5.82	607½ kg	494 mm	300.1	217 kg	

The empty weight momentum is neccessary to calculate the CG for flight (load table).

1.3.81

II. 10. Load table

Load on both seats (Pilot and other occupant including parachutes).

Solo-flights:

min. 70 kg (155 lbs.)

max. 110 kg (242 lbs.)

- now baggage in the baggage compartement, only on the second seat fastened.
- fuel quantity in accordance with the diagram at page 19a. (See also examples pg. 24 and 24a)

Two-seated:

max. 220 kg (485 lbs.) / 2 x 110 kg (2 x 242 lbs.)

- baggage in the baggage compartement in accordance with the diagram at page 19a.

The maximum takeoff weight of 825 kg (1820 lbs.) may not be exceeded. Fuel quantity and baggage have to be reduced accordingly (see examples pg. 24 and 24a)

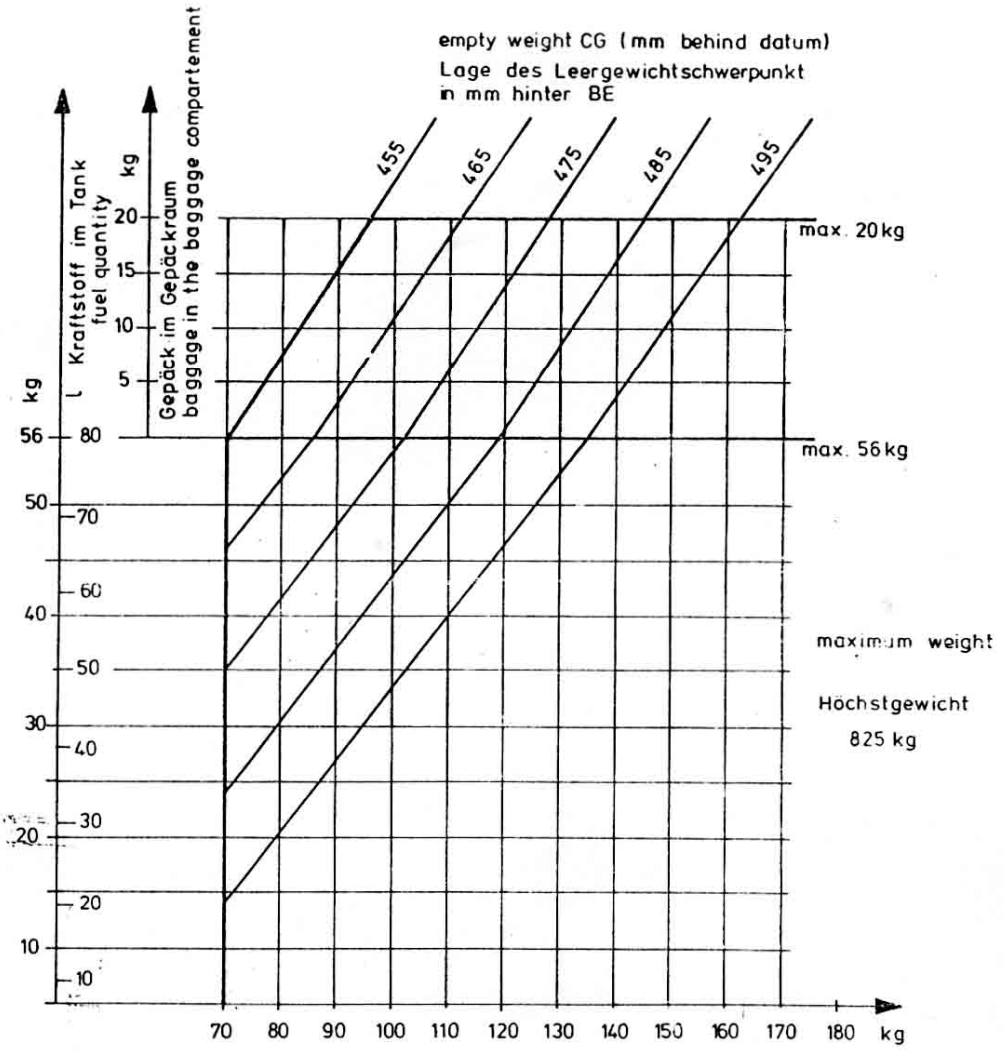
Fuel max. 56 kg (123 lbs.) = 80 ltr (17,6 impgal.) (21,1 us.gal)

Baggage max. 20 kg (44 lbs.) incl. Oxygen-bottle

Caution: Pilot's weight of less than 70 kg (155 lbs.) must be raised by using trim ballast secured on the seat. "Trim-Cushions" attached to the lapbelt can be ordered from the manufacturer of the aircraft.

During solo-flights oxygen-bottles in the baggage compartement must be compensated by trim ballast in the second seat.

(Calculation see pg. 20)



1 Pilot einschl. Gepäck im zweiten Sitz oder 2 Piloten
1 pilot inclusive baggage in the second seat or 2 pilots

The limits of payload in the diagram are calculated according to the following procedure for flight CG and in accordance with range of empty weight CG at page 26a.

SAY 2 PERSONS @ 75 KG = 150
SAY LUGGAGE 14 KG = 14
164

Intermediate values of diagramm page 19a must be interpolated.

Calculation of CG for flight (x_F)

The sum of momentums divided by the total weight equals the actual CG for the given load conditions.

Empty weight x CG (empty) (latest figure from table pg. 18)	= emptyweight momentum
.....kg (lbs) x .....m(in.)	= .....mkg (lbs in.)
weight of crew x crew factor (inclusive baggage in the 2. seat)	= crew momentum
.....kg (lbs) x 0,09 m (3,6 in.)	= .....mkg (lbs in.)
weight of fuel x fuel factor	= fuel momentum
.....kg (lbs) x 1,035 m (41 in.)	= .....mkg (lbs in.)
weight of baggage x baggage factor (during two-seated flights)	= baggage momentum
.....kg (lbs) x 0,97 m (39 in.)	= .....mkg (lbs in.)
+.....kg (lbs)	+.....mkg (lbs in.)
(Totalweight) (G)	(Total momentum) (M)

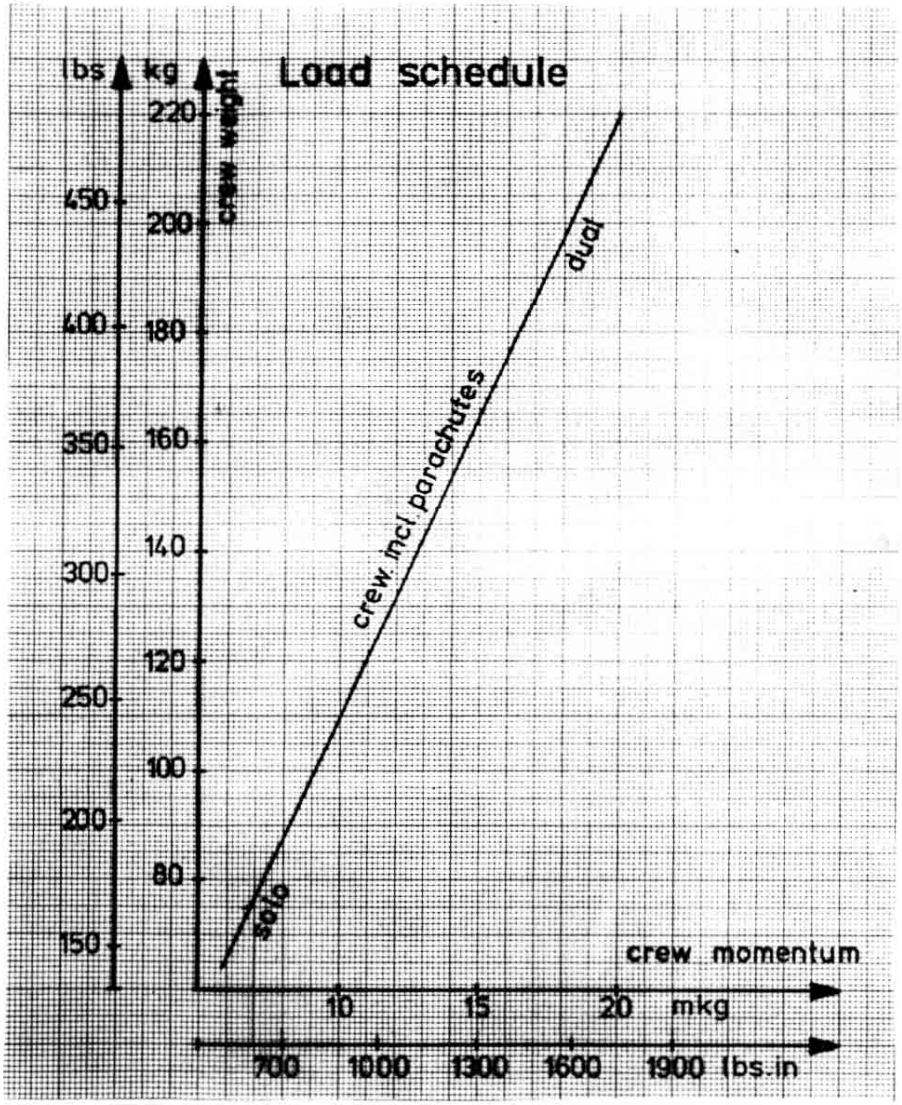
$$\text{CG of flight} = \frac{\text{total momentum}}{\text{total weight}} \qquad \left(x_F = \frac{M}{G}\right)$$

The approved range of center of gravity see page 17.

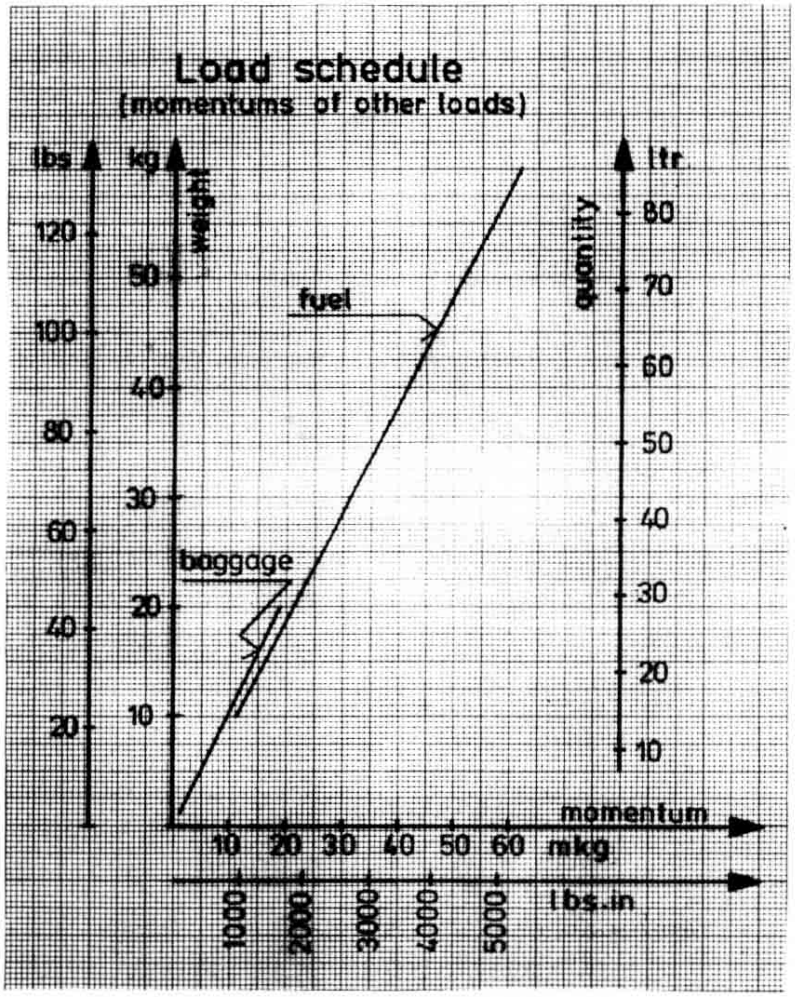
The individual momentums can be figured out from the two load schedules (page 21 and 22). The total momentum must not exceed the approved range of the CG schedule (page 23).

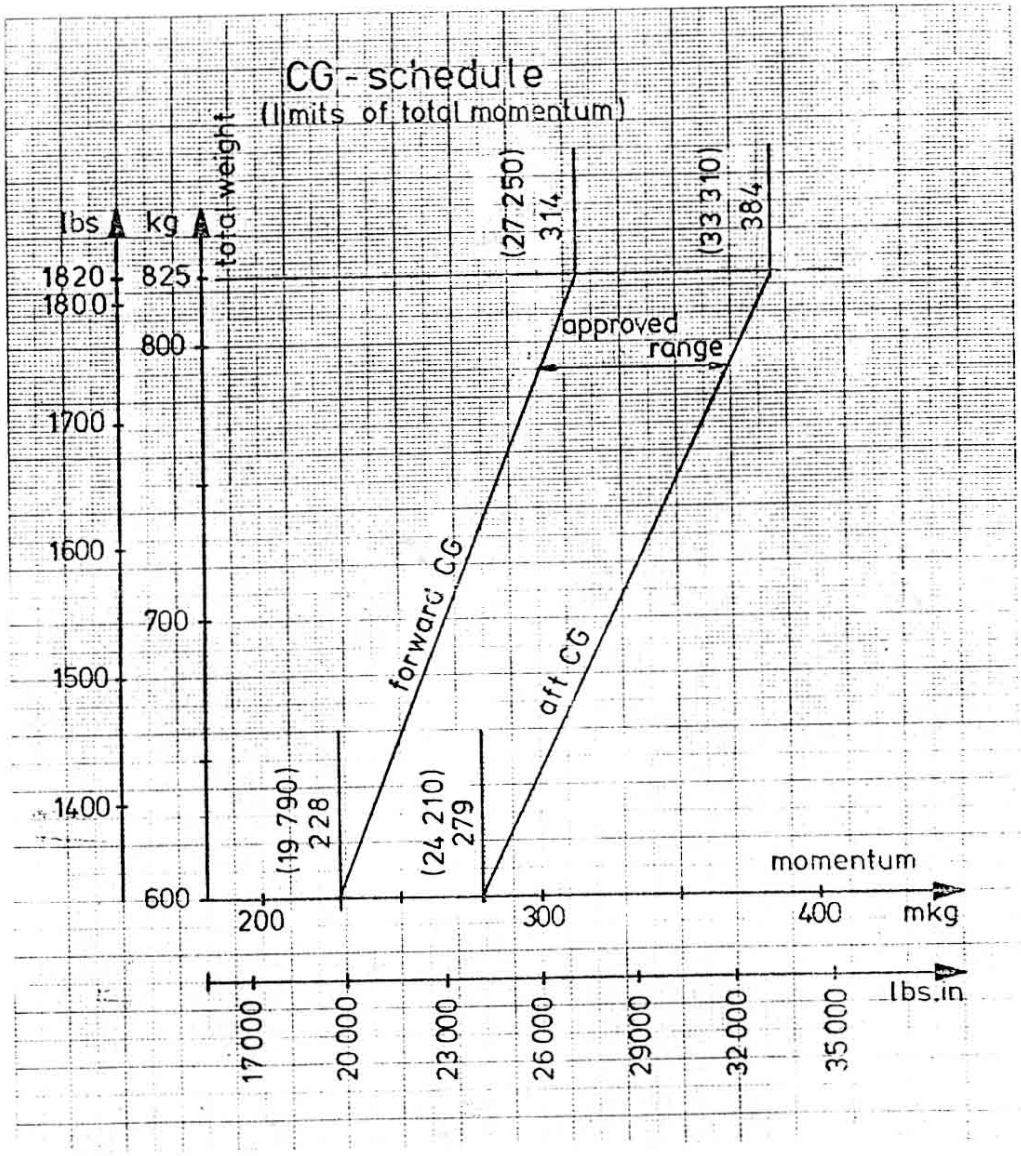
If this momentum exceeds the approved range, the load must be repacked or limited and weight-and-balance calculations must be repeated under the revised conditions. Max. gross weight may never be exceeded.

Note: The baggage factor during two-seated flights is the distance to the center of the baggage compertment. The baggage should be placed as far forward as possible.


Load schedule
lbs
kg
crew weight
450
400
350
300
250
200
150
220
200
180
160
140
120
100
80
dual
crew incl parachutes
solo
crew momentum
10
15
20
mkg
700
1000
1300
1600
1900
lbs.in

1.3.81


Load schedule
(momentums of other loads)
lbs
kg
weight
ltr
quantity
120
100
80
60
40
20
50
40
30
20
10
80
70
60
50
40
30
20
10
fuel
baggage
momentum
10 20 30 40 50 60 mkg
1000
2000
3000
4000
5000
lbs.in


CG-schedule
(limits of total momentum)
total weight
lbs
kg
1820
1800
1700
1600
1500
1400
825
800
700
600
(27 250)
314
(33 310)
384
approved range
forward CG
aft CG
(19 790)
228
(24 210)
279
momentum
200
300
400
mkg
lbs.in
17 000
20 000
23 000
26 000
29 000
32 000
35 000

Caution: Incorrect loading can deteriorate aircraft performance and flight characteristics and can cause hazardous flight conditions. The pilot -in-command is responsible for correct location of loads.

Note: The empty weight and the empty weight CG only differ very little on the standard aircraft; additional equipment however can cause noticable differences.

1. Example to the load table: given empty weight 600 kg (1320 lbs)
given empty weight CG 480 mm (18,9 in.) aft of DL

(Caution: The example dont correspond with your motorglider)

	weight kg (lbs)	distance m (inch)	momentum m kg (lbs. in.)
empty weight	600 (1320)	0,480 (18,9)	288,0 (24948)
Crew (2 pilots)	180 (400)	0,09 (3,6)	16,2 (1440)
baggage in the bag. compartment	10 (20)	0,97 (39,0)	9,7 (780)
fuel	35 (80)	1,035 (41,0)	36,2 (3280)
	825 (1820)		350,1 (30448)

CG for flight $\frac{350,1}{825}$ = 0,424 m ($\frac{30448}{1820}$ = 16,7 in)

CG-position is 424 mm (16,7 in) aft of datum line within approved range.

Fuel weight had to be reduced to 35 kg (80 lbs) not to exceed the maximum gross weight.

2. Example to the load table: given empty weight 610 kg (1345 lbs)
given empty weight CG 495 mm (19.5 in.) aft of DL

(Caution: The example dont correspond with your motorglider)

	weight kg (lbs)	distance m (inch)	momentum mkg (lbs in.)
empty weight	610 (1345)	0,495 (19.5)	302,0 (26227)
Crew (1 pilot)	80 (176)	0,09 (3.6)	7,2 (634)
baggage in the second seat	10 (20)	0,09 (3.6)	0,9 (72)
fuel	27 (59)	1,035 (41.0)	27,9 (2419)
	727 (1600)		338,0 (29352)

CG for flight $\frac{338,0}{727}$ = 0,465 m ($\frac{29352}{1600}$ = 18,3 in.)

CG-position is 465 mm (18,3 in.) aft of datum line at the rear limit of the approved range.

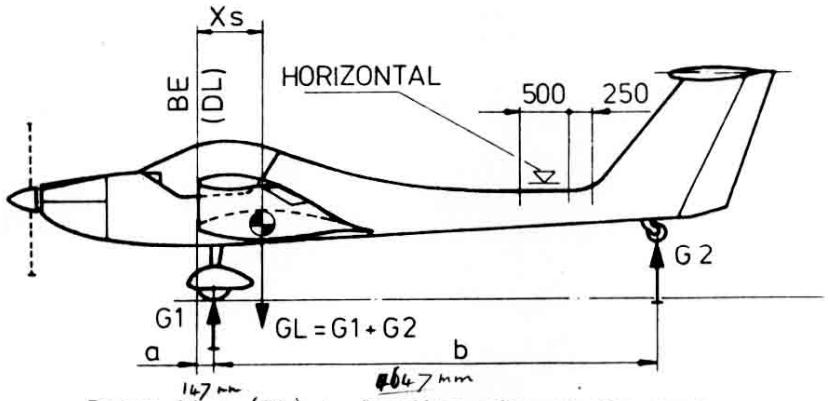
Fuel weight had to be reduced to 27 kg (59 lbs) not to exceed the approved CG range. Without the baggage of 10 kg (20 lbs) in the second seat you exceed the CG range and must reduce the fuel quantity once more.

II. 11. Center of gravity empty

Prior to determining the CG for flight, CG at empty weight has to be found out by weighing the aircraft. For this procedure the motorglider is placed on three scales (2 x mainwheel, 1 x tailwheel) and the tail is lifted so that the top of fuselage is level at 500 mm (20 in.) in front of the vertical stabilizer.

Note: When rolling onto the scales with the main-tires avoid friction in the scales due to the strain of the maingear that can cause erroneous results.

The datum line (DL) is situated at the wing leading edge at the wing root. The distances a and b are measured by using a plumbline. The empty weight is the sum of $G_{1\ R/H}$, $G_{1\ L/H}$ and G_2.



Datum line (DL) : Leading edge at the root.
Aircraft attitude: Level on top of the fuselage 500 mm (20 in.) in front of vertical stabilizer.

1.3.81

$$X_L = \frac{G_2 \times b}{G_L} + a$$

Weight on the mainwheel	R/H	$G_{1\ R/H}$	=	kg (lbs.)
Weight on the mainwheel	L/H	$G_{1\ L/H}$	=	kg (lbs.)
Weight on tailwheel		G_2	=	kg (lbs.)
Support point main gear		a	=	mm (in.)
Support point tailwheel		b	=	mm (in.)

Note: Determining empty weight and CG at empty weight must be conducted without additional balance weights (trim cushion.)

Use caution not to exceed the maximum weight of non-lifting parts when using maximum useful load.
The total weight of non-lifting parts contains the particular weight of fuselage, elevator and maximum useful load and may not exceed 640 kg (1410 lbs.). In other cases the useful load must be reduced correspondingly.

The center of gravity should be recalculated after repair, re-painting, installation of additional equipment but not later than 4 years after the last weighing.

The empty weight, emtyweight CG-position and maximum load should be recorded after each weighing on pg. 18 of Flight Manual by a competent individual.

The manufacturer adjust the empty weight CG within the below mentioned limits. You have to recheck these limits also if you change the equipment or during repairs.

See note at page 19a.

Empty weight kg	Empty weight lbs	Approved position of CG aft of DL: Forward mm	Forward in.	aft mm	aft in.
580	1279	479	18,86	494	19,45
590	1301	477	18,78	494	19,45
600	1323	473	18,62	495	19,49
610	1345	467	18,39	495	19,49
620	1367	461	18,15	495	19,49
630	1389	455	17,91	495	19,49

AUSTRALIAN GROB 109s - BALLAST BARS

Minimum solo pilot weight without extra ballast is 70kg. In Australia GFA require that removable ballast be provided which can lower the pilot weight to 55kg. This is done by bolting 2 bars under the pilot's knees, each bar 8 kg.

This then allows:

Pilot weight	70kg	-	No ballast
	63kg	-	1 bar required
	55kg	-	2 bars required

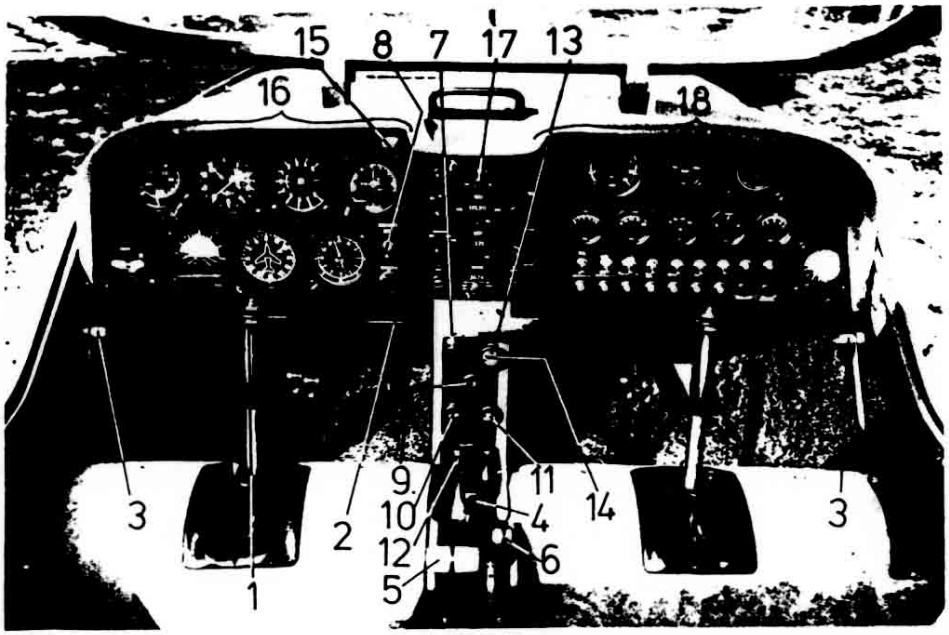
This ballast can be permanently mounted to imrpove the fuel and baggage carrying ability of the 109 solo.

For inclusion in weight and balance calculations:-

Bar weight	Arm (M)	Moment (Mkg)
8kg	- .300	- 2.400
16kg	- .300	- 4.800

III. Normal operating procedures

III. 1. Cockpit layout and controls



1	Control stick	9	Choke
2	Rudderpedals (with individual wheelbrakes)	10	Heating
		11	Carburator heat
3	Airbrakes (with wheelbrake)	12	Fuel shutoff switch
4	Parking brake	13	Prop feather handle
5	Throttle	14	Prop control knob
6	Elevator trim	15	Canopy emergency jettison
7	Master switch	16	Flight instruments
8	Ignition and starter	17	Radio and Avionics
		18	Engine instruments

Compass and canopy handle are not shown in this illustration. They are attaches to the canopy frame that can be locked with a key.

Ripcord attachment-points (red marked) are located behind back-rest on the left and right side close to the fuselage skin.

III. 2. Daily inspections

Prior to flight operations the following visual exterior checks have to be performed (see also pg. 29):

1. Engine
   - Check the propblades for cracks and dents and proper installation (radialplay up to 1° permitted
   - Remove cowling
   - Check oil quantity (min. 1,5 ltr, max. 2,5 ltr.)
   - Visual inspection of the engine
   - Install cowling

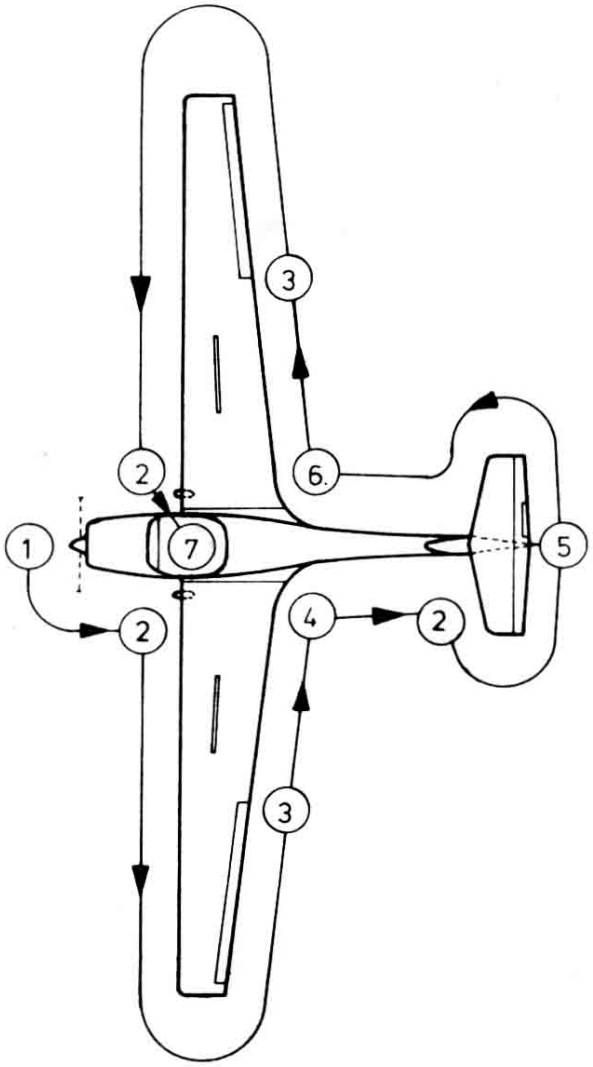
   Note: For further details refer to Prop and Engine manuals.

2. Gear
   - Tire pressurte (main- and tailwheel 2,5 bar (35,6 psi) ea.)
   - Check slipmarks, tirecondition and fairings

3. Wings
   - Condition
   - Attachment
   - Airbrakes
   - Pitot tube
   - Aileron play and freedom of movement

4. Tank and wing connections
   - Drain by pressing the drain valve located at the bottom of the fuselage
   - Check fuel quantity through tank filler neck
   - Safety catches (2) of the main wing fittings locked
   - Electrical connections check
   - Pitot pressure tube (only R/H) checked

   The last three steps are performed through the maintenance cover in the wing-fuselage fairing.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5. Tailunit
   - Proper installation
   - Securely locked
   - Control connections locked
   - Freedom of movement
   - Damage

6. Fuselage
   - Damage
   - Static pressure ports clean

7. Cockpit
   - Canopy and locking mechanism checked and, if necessary, cleaned
   - Safety catches (2) of the wing fittings checked through inspection windows behind the back rests.
   - Control rod linkages (4) checked through inspection holes in the bottom of the baggage compartment
   - FOD-check

III. 3. Preflight inspection

1. Daily inspection completed ?
2. Oil- and fuel quantity
   Oil level stick can be reached through maintenance cover in the engine cowling.
3. Weight and balance calculation
   (See load table at page 19)

III. 4. Before starting engine

1.	Canopy	- locked
2.	Rudder pedals-adjusted correctly (red knobs on each pedal must be pulled down to adjust)	
3.	Red knobs at the rudder pedals	- locked
4.	Ripcord (automatic parachutes only)	- attached
5.	Seat harness	- tight
6.	Parking brake	- set
7.	Radio and Nav.-equipment	- off
8.	Fuel shutoff switch	- open
9.	Controls	- free
10.	Airbrakes	- extend, than retract and locked
11.	Altimeter	- set

III. 5. Starting the engine

1.	Prop. position	- "start" (pull the prop control knob back by 10 cm (4 in.))
2.	Choke	- pull with cold engine
3.	Throttle	- advance (2 cm (1 in.) out of idle)
4.	Propeller	- free from persons and objects
5.	Main circuit breaker	- press
6.	Generator circuit breaker	- press
7.	Master switch	- on
8.	Auxiliary fuel pump	- on
9.	Electrical indications	- check (12 V Battery voltage)
10.	Ignition	- on
11.	Starter button	- press
12.	Radio and Nav.-equipment	- on after the engine is running

After the engine fires release starter button immediately and adjust throttle and choke so that the engine is running smoothly between 1000 and 1200 RPM.

Check the oilpressure; if no indication after 10 sec. shut off the engine.

Remark: The auxiliary fuel pump has to be switched on during take off, climb and landing.
During normal cruising the aux. fuel pump should be switched off.

If the engine does not fire after five starting procedures propably too much fuel was ingested and the spark plugs are wet.

Then:	1.	Ignition	- off
	2.	Choke	- in
	3.	Throttle	- full power
	4.	Rotate the prop about 10 times backwards manually	
	5.	Ignition	- on
	6.	Starter button	- press

After the engine is running reduce throttle to between 1000 and 1200 RPM.

When the engine is already warm prior starting, do not use choke and only a small amount of power.

III. 6. Warm-up and run-up

The engine should be running at 1000 to 1200 RPM for about 2 min. before accelerating to 1500 RPM for 5 to 10 min depending on outside airtemperature to get an oiltemperature of 50° C. The indication is relatively slow so that at the indicated temperature of 50° C sufficient operating temperature exists.

Run-up the engine in prop position "start":

Parking brake	- pull
Elevator	- pull back and hold
Throttle	- slowly advance to full power
RPM	- 2750 ± 100
Oilpressure and-temperature	- observe
Throttle	- idle (after apprx. 25 sec)

Note: (Provided the engine is in good shape) but only 2200 ± 100 RPM are reached with full power the prop is at "cruise" position and must be set to "start" using the standard procedures

Carburator heat test (with warm exhaust)	- fix 1800 RPM
	- pull
	- diminish apprx. 100 RPM

(III. 5. and III. 6. also refer to Engine Manual)

III. 7. Taxiing

Due to coupling of rudder and tailwheel the aircraft handling on the ground is simple.
To achieve a very small turn radius the individual brake at the main gear is actuated in the direction of turn when full rudder is applied.
To decelerate the aircraft either parking brake on the console or airbrakes can be pulled. In the full aft range the airbrake handle operates both mainwheel-brakes simultaneously.
When maneuvering the aircraft manually on the ground the tailwheel disengages automatically and can be rotated by 360° .

III. 8. Before takeoff

Engine	- run-up (see III. 6.)
Throttle	- unobstructed
Airbrakes	- locked
Canopy	- locked
Trim	- neutral
Engine instruments	- checked
Parking brake	- released

Caution: It is always necessary to check for the open fuel shutoff switch. The engine will operate for appr. 2 min. with a closed switch. A hurried takeoff can end fatally without fuel.

III. 9. Takeoff and climb

Throttle	- advance smoothly
Lift-off	- at 85 Km/h (46 KIAS)
Climb speed	- maintain 95 km/h (51 KIAS)
Oiltemperature	- monitor (max. 120° C)

Note: If the oiltemperature exceeds 120° (250° F) continue flying at higher speeds for better cooling effect (130 km/h (70 Kts)). Maximum effective cross wind for takeoff and landing on wet and dry surfaches is 20 km/h (11 Kts)

Caution: Under extreme cross wind conditions heading control with full rudder also actuates the corresponding brake which extends the calculated ground run.
Lift off the tail-wheel soon to reduce the resistance.

III. 10. Horizontal flight and cruise

To change the prop position from "start" to "cruise" RPM must be adjusted to over 1800 RPM (best 2200). Then pull back the prop control knob momentarily for about 7 cm (3 in.). Afterwards a RPM-drop by appr. 500 RPM occurs without changing the throttle.

Note: When advancing the throttle to full power while the RPM exceeds 3000 ± 100 RPM indicates that the propeller is still in "start" setting and the procedure must be repeated.

Under high relativ humidity and outside airtemperatures of up to 25° C (72° F) carburator icing can occur indicated by rough-running engine or even engine failure. Whenever suspecting carburator icing immediately pull the carburator heat. While flying under weather conditions prone to carburator icing pull the carburator heat at

intervalls. A small RPM-drop of 100 to 200 RPM occurs and this is a safe indication that no icing exists in the carburator.

Note: Full deflection of controls is considered only up to 185 km/h (100 Kts) (maneuvering speed). At higher speeds the flight controls should be operated accordingly limited.

III. 11. Engine shutdown and restart in flight

The engine should be idling for appr. 2 min. and airspeed reduced to 100 km/h (54 Kts).
Prior to engine-shutoff turn off all electrical equipment (i.e. radions, VVi, Nav.) to avoid damage caused by excessive voltage peaks.
Turn off the ignition and then feather the wind-milling prop by pulling the feather handle back for about 17 cm (7 in.) and rotate it 90° clockwise. Now radio and electronic VVi can be switched on again.

Caution: The prop may only be feathered with engine dead or wind milling.

Note: During unpowered flight all unnecessary electrical equipment (i.e. position- and strobelights, electr. fuel pump, VOR, ADF, etc.) must be switched off to assure sufficient electrical power to restart the engine. Battery capacity has been designed for a 5-hours unpowered flight with operating radio and vertical velocity indicator.

After a 10-hours unpowered flight the wind milling RPM at speeds above 140 km/h (80 kts) is sufficient to airstart the engine without starter when turning on the ignition.

To airstart the engine the prop feather handle is unlocked rotated 90° counter-clockwise and pushed forward. The propeller is now adjusted to the starting position.

- Turn off all electrical equipment
- Maintain airspeed 120 km/h (65 Kts)
- Choke and throttle according to engine temperature
- Ignition on
- Starter button bush

Use caution not to apply high powersettings at low engine temperatures to avoid unnecessary damages. Use the same technique to warm-up as described in para III. 6.

III. 12. Descent

Reduce power and trim for 115 km/h (62 Kts), if necessary, use airbrakes. During longer descents under certain weather condition carburator icing can occur (see para.III. 10.). In this case pull carburator heat immediately.and close the heating of cabine for a better effectivity.

III. 13. Approach

1. Prop control knob	- "start"-position prior to final
2. Throttle	- idle or as necessary
3. Approachspeed	- maintain 115 km/h (62 Kts) yellow triangel on A/S indicator
4. Airbrakes	- as required (very effective even for very steep approaches)

Caution: Keep the airbrake lever firmly in your hand to control the glidepath. Fully extended brakes increase the stalling speed. Side slipes cannot be maintained continuously to control the glidepath.

III. 14. Landing

1. Airspeed	- reduce to minimum
2. Control stick	- smoothly pull back
3. Touchdown	- 3-point attitude
4. Airbrakes	- do not fully extend due to heavy breaking action.

- After touchdown keep the stick fully aft and reduce speed by operating the airbrakes in their extended position actuating the wheelbrakes.
- Maintain heading with rudder and the coupled tail-wheel

Maximum effective crosswind for takeoff and landing on wet and dry surfaces is 20 km/h (11Kts).

Note: Do not retract the airbrakes immediately after touchdown because unintentional floating will occur.

Engine shutdown:

1. Radios and navigation equipment	- off
2. Electrical switches	- off
3. Throttle	- idle (min. 2 min.)
4. Ignition	- off
5. Auxiliary fuel pump	- off
6. Master switch	- off
7. Main circuit breaker	- pull
8. Generator circuit breaker (if with reset button)	- pull
9. Parking brake	- set

Note: When parking the airplane outside for a longer period (over night for ex.) wheel chocks have to be used due to possible decrease in braking action of the hydraulically actuated brakes. (See also page 49).

III. 15. Soaring

When entering updrafts reduce throttle to idle. Shutoff the engine when reaching sufficient vertical velocity (see para. III. 11.) and circle while maintaining 95 km/h (51 Kts).

Best glide-ratio is 1:30 at 115 km/h (62 Kts)

The aircraft shows no tendency to flutter over the complete range of speed from minimum to red-line speed. At a 30°-dive with fully extended airbrakes maximum allowable airspeed will never be exceeded even at maximum grossweight.

III. 16. Landing with dead engine

Start the approach from sufficient height. On final control the glidepath with airbrakes, if necessary.

III. 17. Inspections after hard landings

After hard landings or other undue stress during flight the aircraft must be checked very thoroughly with wings and elevator removed. If any damage is observed consult authorized personnel or the manufacturer. Under no circumstances the aircraft may be flown until repairs have been completed.

After hard landing inspect the following:

- Wheels
- Gear struts and suspension
- Wing spar at the root for white spots in GRP
- Main wing fittings
- Bolts in the wing root

Special instructions after groundloops
Check for damage especially in the following areas:

- Gear suspension
- Rudder control rods
- Rudder actuator lever behind the tailwheel
- Main wing fittings
- Bolts in the wing roots

IV. Emergency procedures

IV. 1. Spin recovery

Intentional spinning is prohibited (see page 8).

Recover unintended spins with the following control movement.

1. Rudder full against spin direction.
2. Aileron full against spin direction.
3. Stick full forward.
4. Hold the controls in position until stop of rotation.
5. Recover smoothly from dive.

You need for 1 spin turn between 80 m (260 ft) and 100 m (330 ft) and have a sinkrate of 26 m/s (5000 ft/min) to 33 m/s (6500 ft/min).

During spin the ailerons want to move out of neutral position. The stick force in full nose down position may increase up to 20 daN (45 lbs).

IV. 2. Canopy jettison and emergency exit

The wide cabin quarantees the unobstructed emergency exit. Adhere to the following procedure:

If the engine is running: Throttle - idle
Ignition - off

If the prop is feathered: Prop feather handle
- released to "start"
(Otherwise it is sticking about 17 cm out in the cabin and may hinder the exit

Emergency jettison handle - pull to full extend
Canopy - push upwards
Seat harness - release

Stand up and leave airplane on either side. After 2 to 3 secs. grip ripcord handle and pull firmly to full extend.

IV. 3. Engine failure after takeoff

1. Fuel shutoff switch - close
2. Ignition - off
3. Land from glide

IV. 4. Other emergencies

a) Engine failure during flight
same as para. Iv. 3.
In addition, if applicable, declare emergency on the radio and squawk emergency

b) Engine fire during flight

Cabin heat	- close
Fuel shutoff switch	- close
Throttle	- full power
Ignition	- off when the engine stops

Land from glide

c) Flights through precipitation
There is a noticeable deterioration of flying characteristics by wet or lightly iced wings, which raises the stall speed about 10 km/h (6 kts). Increase take off and approach speed by 10 km/h (6 kts). You have the same effect with mosquitos at the nose of wing.

d) Stalls
When pitching down from straight-and-level flight or with bank:

stick	- forward to neutral
rudder	- opposite to rotation

e) Emergency landing
From sufficient height choose useable field, meadow etc.. Watch the winds. Approach to the desired landing site must be executed carefully and precisely. Flare and touchdown smoothly. Prior to touchdown stick full aft and brake moderately.
You must have sufficient height to be able to land immediatly without propeller working.
With sufficient engine power still available the landing site should be crossed at lower altitude to check for abstacles, ditches, fences etc.

After touchdown:

throttle	- idle
ignition	- off

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V. Performance datas

V. 1. Takeoff distance

All figures based on ICAO-standard atmosphere

ground roll	285 m (935 ft.)
Takeoff distance (15m; 50 ft. obstacle)	496 m (1627 ft.)
Liftoff speed	85 km/h (46 Kts)
Airspeed when crossing 15 m; 50 ft. obstacle	98 km/h (53 Kts)

	Field elev. MSL		Outside airtemperature °C / °F							
	m	ft	-10°C	14°F	0°C	32°F	+15°C	59°F	+30°C	86°F
Ground-roll m/ft	0	0	219	719	244	801	285	935	335	1099
	200	660	231	758	257	843	300	984	354	1161
	400	1310	242	794	269	883	315	1033	374	1227
	600	1970	253	830	283	928	331	1086	390	1280
	800	2620	267	876	299	981	347	1138	414	1358
Takeoff distance 15 m(50ft) obstacle m/ft	0	0	388	1273	432	1417	496	1627	594	1949
	200	660	409	1342	455	1493	525	1722	626	2054
	400	1310	430	1411	476	1562	552	1811	661	2169
	600	1970	448	1470	501	1644	583	1913	691	2267
	800	2620	473	1552	529	1736	613	2011	732	2402

Atmospheric moisture reduces the engine effect and enlarges the takeoff distance

All figures are based on a maximum weight of 825 kg = 1820 lbs., in Zero wind and from a dry, level, hard surface. For operating on a dry, level, grass surface increase dfstances by 7% of the "ground roll" figure.

V. 2. Landing distance

All figures are based on ICAO-standard atmosphere

Landing roll	205 m (673 ft.)
Landing distance (50 ft. obstacle)	390 m (1280 ft.)
Approach speed	115 km/h (62 Kts.
Touchdown speed (depending on grossweight)	75 - 85 Km/h (41 - 46 Kts)

V. 3. Climb schedule

All figures based on ICAO-standard atmosphere

Vertical velocity with prop in "start" at MSL	2,7 m/s (530 fpm)
at optimum airspeed	95 km/h (51 Kts)
Vertical velocity with prop in "cruise" at MSL	2,1 m/s (410 fpm)
at optimum airspeed	120 km/h (65 Kts)
service ceiling	4400 m (14500 ft).

V. 4. Go-around performance

All figures based on ICAO-standard atmosphere

Vertical velocity (Airbrakes retracted)	2,4 m/s (470 fpm)
at approach speed	115 km/h (62 Kts)

V. 5. Cruise speeds

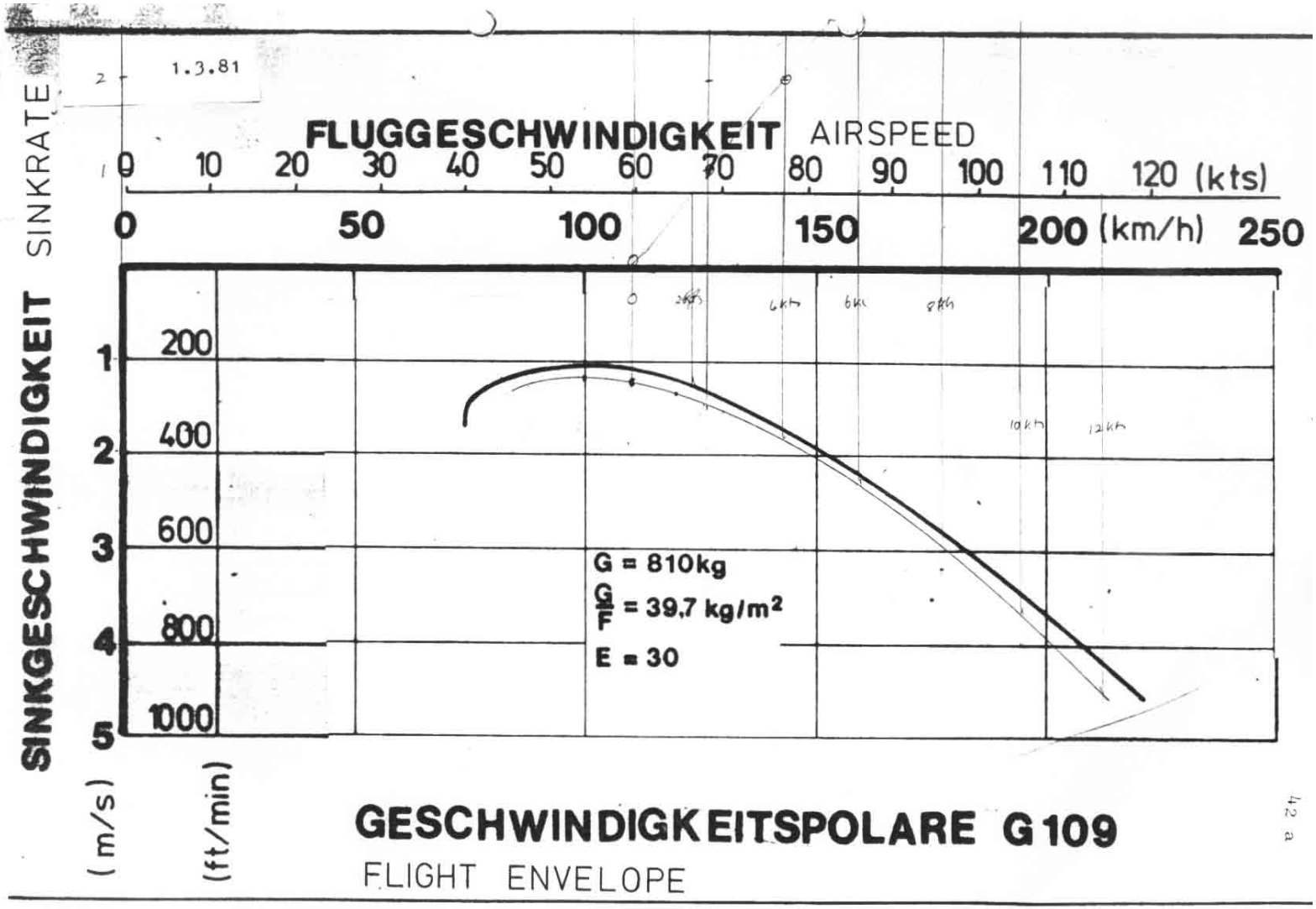
At maximum continous powersetting:

n_{Dmax} = 3000 RPM, horizontal flight: 190 km/h (103 Kts)

V. 6. Gliding performance

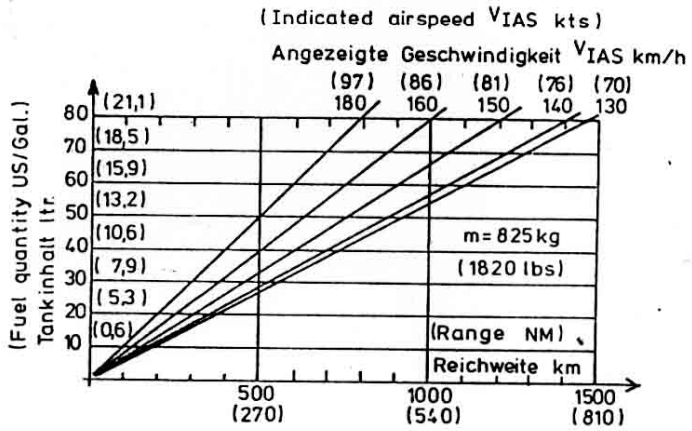
Grossweight	825 kg (1820 Ibs.)
Wing load	40,4 kg/m^2 (8,28 Ibs/in^2)
Glideratio	1:30
at airspeed	115 km/h (62 Kts)
minimum sinkrate	1,15 m/s (230 fpm)
at airspeed	95 km/h (51 Kts)

12.5.81


1.3.81
FLUGGESCHWINDIGKEIT AIRSPEED
0 10 20 30 40 50 60 70 80 90 100 110 120 (kts)
0 50 100 150 200 (km/h) 250
SINKGESCHWINDIGKEIT SINKRATE
200
400
600
800
1000
1
2
3
4
5
(m/s)
(ft/min)
G = 810kg
G/F = 39,7 kg/m²
E = 30
GESCHWINDIGKEITSPOLARE G 109
FLIGHT ENVELOPE

V. 7. Range

There is only little influence of the altitude to the range up to 1500 m (4920 ft.). The influence of the airspeed to the range is shown in the diagram. All datas shown are based on zero wind with no fuel reserve. Take off and climb are not considered.



Example: At 86 kts the range comes to 540 NM

V. 8. Fuel consumption

At 5000 ft MSL the following fuel flow exists:

Cruise	RPM	fuel flow
130 km/h (70 kts)	2100	7,5 ltr./h (1,6 imp. gal./h, 2,0 u.s.gal)
150 km/h (81 kts)	2550	12,5 ltr./h (2,7 imp. gal./h, 3,3 u.s.gal)
180 km/h (97 kts)	2850	19,0 ltr./h (4,2 imp. gal./h, 5,0 u.s.gal)
Full power	~3000	~20,0 ltr./h (4,4 imp. gal./h, 5,3 u.s.gal)

Note: All figures are based on good maintenance condition of the motorglider and its engine and average flying abilities of the pilot.

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V. 9. Stall speeds

Stall speeds are depending on useful load and condition of the aircraft.

All figures are based on max. grossweight 825 kg (1820 lbs)	
Unaccelerated level flight (full power)	82km/h (44KIAS)
30° - bank flight full power	87km/h (47KIAS)
Unaccelerated level flight (poweridle)	87km/h (47KIAS)
30° - bank flight (poweridle)	92km/h (50KIAS)
Unaccelerated level flight (power off, prop feathered)	87km/h (47KIAS)
30° - bank flight (power off, prop feathered)	92km/h (50KIAS)
Airbrakes fully extended	92km/h (50KIAS)

Stallspeeds are reduced at lower grossweights.

12.5.81

VI. Rigging and derigging

Due to the fact that the landing gear is mounted to the fuselage of the G 109, rigging and derigging can be executed by only 3 persons because wings and elevator can be removed without supporting the fuselage. Hangarspace is lowered to a minimum with the motorglider derigged.

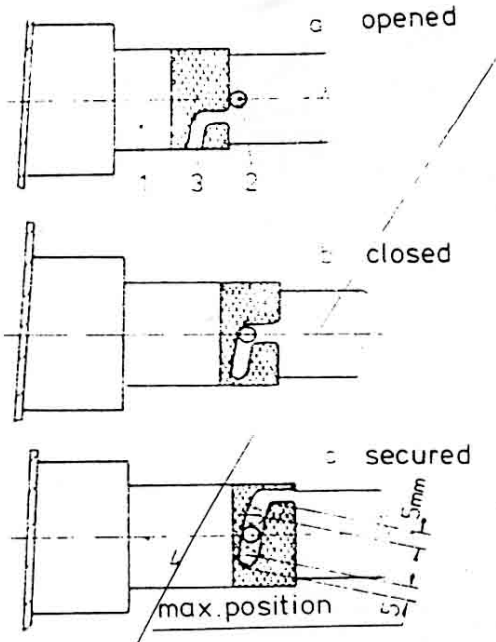
VI. 1. Rigging:

All main wing fittings can be reached easily after opening of the 4 maintenance covers (2 behind the backrests in the cabin, 2 outside in the wing-fuselage fairing). The 4 safety catches on the fittings and the airbrakes are unlocked prior to rigging.

Guide the right wing into the fuselage. Use caution not to damage the control rods inside the fuselage. The safety catches on the appropriate wing are now turned so that the guide pin on the wing-fittings--connection-rod can slip into the guide slot of the catches. Move the wing tips gently up and down, to and fro so that the safety catches move into the locked position. Support the right wing tip.

Next guide the left wing into the fuselage. Move the wing tip up or down so that the pin on the end of the spar stub is lined up with the appropriate bearing in the opposite wing root and slide it into place by circular motion of the wing tip.

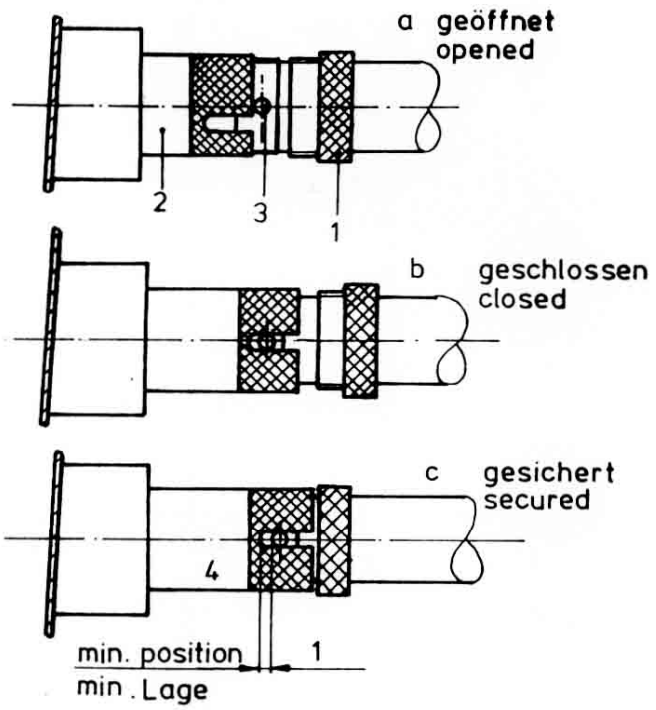
Afterward turn the safety catches of the left wing as well and lock them by moving the wings strongly to and fro.



The wing-fuselage linkage can be securely locked by turning the safety catches hand-tight so far that the guide pin moves through the sloping slot to a maximum extend but not reach the end of the angled slot. Moving the wings forward and aft facilitates this procedure.

Check: The red rings on the fuselage connection-rods must be covered by the rotated catches; the catches must be turned hand-tight.

In the closed but unsecured position (b) the wing bolt cannot be pulled out of the fittings.
At later serial numbers the safety catches are modified. Safety catches with sloping slots (bayonet-type) are replaced by threaded sockets with safety nuts.



To secure the fuselage-wing linkage in the closed position the safety nut (1) must be turned into the threaded socket (2) so that the socket is pull inboards against the red ring which is held by the guide pin (3).

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By moving the wings forward and aft strongly while turning the safety nut into the socket this linkage can be secured tight enough (4). The guide pin must not touch the end of the slot in the socket.

Check: The socket must cover the red ring.
The safety nuts must be turned hand-tight.

In the closed but unsecured position (b) the wing bolt cannot be pulled out of the fitting.

Cover the wing-fuselage joints with self-adhesive tape.

The aileron and airbrake connections is situated behind the spar.

The connecting rods in the fuselage are fitted with quick-lock linkages which must be coupled to its counterparts on the push rods of the wing

To check a secure coupling carefully observe the following:

After coupling the control push-rods by means of the "GROB" quick-lock fasteners confirm that the movable upper lid protrudes far enough so that the spring-looded safety-bolt is locked.

After sliding the upper movable lid across its counterpart of the wing's pushrods try to pull back the safety bolt without pushing it down against the load of the spring.
If it is not sliding backwards the coupling is secure.

Afterwards connect the L/H position lights and the antenna cable through the rear left-hand maintenance cover as well as position light cable and pitot pressure line through the R/H maintenance cover, if applicable.

Tailunit:

Before assembly is commenced the front cover must be opened and the rotating wing bolt pulled out to full extend.

The tailplane can now be positioned by two persons.

It can be rested on top of the fin with the elevator angled upwards so that the "Hotellier"-type quick connection of the trim rod can be linked to the ball on the trim-rudder horn as well as "GROB"-type quick lock fastener of the elevator pushrod to its counterpart on the elevator horn.

Afterwards the elevator unit can be rested completely on to the fin and pushed back onto the three attachment bolts. It is then necessary to tighten the wing bolt clockwise to secure the tailplane.

The assembly is completed when the bolt is sufficiently tight (hand-tight) to avoid play in any direction and the red arrows at the fin and elevator unit coincide.

The cover provides a safety measure to the locking bolt as it can only be closed with the bolt horizontal. If necessary the wing bolt must be turned a 1/4 turn to suit.

Then cover the slots between fin and tailplane and at the front cover with self-adhesive tape.

Derrigging is carried out in the opposite manner by turning the wing bolt counterclockwise and pulling it back to full extend.

<u>Checks after assembly:</u>

1. Four safety catches in the fuselage locked properly

2. Aileron and airbrake quick lock fasteners coupled securely as described before
3. Wheelbrakes and tire pressure checked
4. Check the tailplane mounted correctly and the elevator push rod and trim rod connected
5. Controlability check by two persons (1 moving the control stick, 1 seizing the appropriate control surface simultaneously)

VI. 2. Derigging

Derigging is carried out in the opposite manner and it does not matter which wing is removed first.

VI. 3. Parking

When the motorglider is parked outside, use the parking brake and chocks and close the canopy. To tie the airplane pull ropes through the wing tip skids and fix its on the ground.
For longer parking outside use a water-repellent cover over engine and canopy. Also lock the controls by using the seat harness.

VI. 4. Transport

For the transport of the motorglider on roads with a trailer we recommend the following: All parts must be carefully supported and secured so that cannot slide.

1. Fuselage

   The fuselage remains on its three wheels. To tie down the forward part the wing fittings can be used. To fixe the tail use a broad strong band.

2. Wings

   The minimum length for the spar support is 200 mm (8 in.) and should start at the root rib. The support must be covered with foam rubber or felt.

   The support below the aileron inboard and should be a shaped mounting block of a minimum length of 300 mm (12 in.) and a height of 400 mm (16 in.) and must be padded by felt.

3. Tailplane

   either horizontal on padded supports with its upper surface downwards and tied with bands or vertical supported on the leading edge downwards in shaped mounting blocks.

   Profile drawings are available for the construction of fuselage, wing and tailplane mounting blocks.

VI. 5. Simple maintenance

- Humidity

  The entire surface of the motorglider is coated with weather-resistant white polyester gelcoat. Although being not very susceptive against moisture it should be protected as much as possible against precipitation. Water that has entered the aircraft should dried out by storing that part in a dry place and frequently turning it around.

  After flights through rain dry the aircraft with a soft automobile leather.

  Although all metal parts of the motorglider, with the exception of wing and elevator mounts, are surface protected corrosion cannot be prevented under long lasting high humidity conditions.

  All unprotected metal surfaces should be regularly greased due to condensation.

- Sun light

  To prevent overtemperatures of the surface that may lead to structural damage all supporting structural parts must be coated with white paint.

- Maintenance of gelcoat

  The wax coat that was applied with a wobbling rotating disc is very resistant. A mild cleaning agent should be used for minor dirt (i.e. dust, grease, flies). More resistan dirt should be removed using only special silicone-free polishes (i.e."1 Z Spezialreiniger-DZ" Fa. W. Sauer & Co, D 5060 Bensberg, or "Reinigungspolish", Lesonal, Stuttgart).

VI. 6. Maintenance directions

At regular intervalls but not later than the annual inspection the following service schedule must be completed:

1. The entire aircraft must be checked for cracks, holes and bumps
2. All fittings in satisfactory condition (no play, scores or corrosion)
3. All metal parts no corrosion, if necessary re-condition and paint
4. No play in wing and tailplane to fuselage fittings
5. Control linkages (bearings, fittings, stops, hinges and control cable check for condition)
6. The flight controls including airbrakes must be submitted to an operational test; measure the control deflections
7. If controls do not move free throughout their range, search for the cause and correct it.
8. Condition of main- and tailwheel including tires and brakes
9. No obstructions in the pitot/static pressure ports, no leakage in the pitot/static system.
10. Condition and, if applicable, calibration of all instruments, radios and other electric equipment (i.e. transponder, Nav. equipment, storbelights etc.) Compare it with the appropriate equipment list.

11. The engine must be serviced and maintained according to Engine Manual.

12. The propeller must be serviced and maintained according to Propeller Manual.

For further details refer to Maintenance Manual.

VI. 7. Repair directions

For the execution of minor repairs refer to the attached Repair Instructions.

Major repair may only be handled by the manufacturer or authorized workshops. The GROB company will help in those cases and name a factory with the appropriate licence and experience.