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Flight and Maintenance Manual



SF 28 A "TANDEM - F A L K E"

Serial-N° 5701 and up

LIMBACH SL 1700 EA / EA 1

maximum all-up weight 610 kg

February 1974 Edition

This handbook is to be kept on board

Serial no: 5719

Registration no: F-CFTD

Owner: PPBS, Aerodrome de la foret, 71600, PARAY LE MONIAL

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Revision status of manual

Serial N°.	Title	Pages affected	Date	Signature
1	Change of Fuel grade to AVGAS 100 LL	5, 8, 21	15.07.1974	signed by Nährlich
2	Connecting points for barograph, electric Oilpressure indication and fuses	28	15.07.1974	signed by Nährlich
3	Climb ratio	15	17.10.1975	signed by Friedel
4	Decreased max. continuous RPM	5, 6, 11, 15, 16, 18	24.09.1976	signed by Friedel
5	Increased max. Take off mass	3, 6, 15, 16, 32, 34	29.11.1976	signed by Friedel
6	Torque of the propeller flange screws	22	27.10.1983	signed by Nährlich
7	Instruction for rigging and de-rigging wings (mainspar)	3, 4, 8, 19, 20	26.10.1984	signed by Nährlich



The pilot is responsible for ensuring that the aircraft is operated in accordance with the Flight Manual.

1. Specifications and Limitations

1.1 Engine

Limbach SL 1700 EA I

Max. rpm	3550 U/min	
Take off power (max. 5 minutes)	3550 U/min	(60 PS)
Max. continuous rpm	2800 U/min	(49 PS)

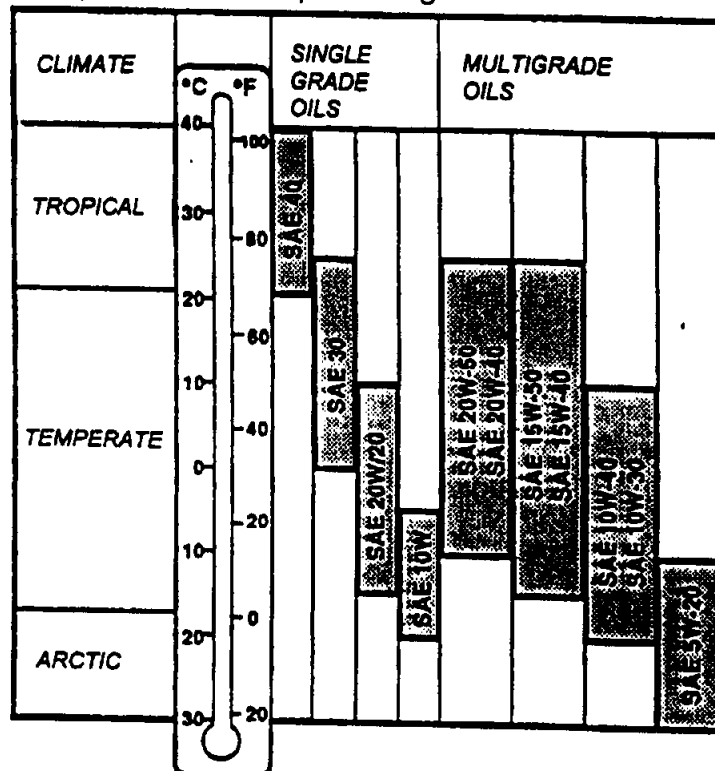
1.2 Fuel

AVGAS 100 LL or SUPER-PLUS auto gasoline ROZ 98)
see Limbach TM 50 and 53.1

Fuel tank capacity 40 litres (40 litres usable)

1.3 Lubricants (see LIMBACH TM 48)

Do not use detergent/ non-detergent aircraft engine oils.
Use good quality API SE oil for petrol engines



Oil capacity	2.5 litres (0.55 Imperial 0.66 US gallons)
Oil pressure range	1 - 4 bar (15-59 psi)
Min. oil pressure at 2500 rpm	1 bar (15 lbs/psi)
Minimum oil temp before take off	50 °C but 70 °C min if carburettor icing likely
Maximum oil temp .	120 °C
Crankcase oil capacity	2.5 litres (0.55 Imp.gal 0.66 US gallons)
Min. oil capacity	1.5 litres (0.33 Imp.gal 0,4 USgal) (lower mark)



1.4 Propeller

Two blade wooden variable-pitch propeller:
 Hoffmann HO - V62/ L 150 A or
 HO - V62R/ L 150 A

1.5 Engine instrumentation

Rev counter

Normal operating range	700 - 2800 rpm	(green arc)
Caution range	2800 - 3550 rpm	(yellow arc)
Max. revs	3550 rpm	(red line)
Static revs.	ca. 2600 - 2800 rpm	(white arc)

Engine hours counter (integral in rev counter)

This counts 2800 revolutions of the propeller as one minute of engine time and gives a five digit reading: the first three digits represent completed hours and the last two digits show values for 1/10 and 1/100 of an hour.

Oil Pressure Gauge

Operating range	1 -4 bar (14-59 psi)	(green sector)
Maximum oil pressure	4 bar (59 psi)	(red fine)

Oil temperature gauge

Operating range	50-120 °C	(green arc)
Minimum temperature	50 °C	(red line)
Maximum temperature	120 °C	(red line)

1.6 Ammeter

With a discharged battery the ammeter will give a positive (+) reading whilst the battery is recharged with the engine running.

With a number of extra heavy auxiliary loads or if the engine is stopped and assuming that there is a load on the battery, it will indicate battery discharge (-).

1.7 Airspeeds

Maximum airspeed	102 knots (118 mph) (190 km/h).
Maximum manoeuvring speed	84 knots (97 mph) (156 km/h)
Maximum airspeed with spoilers extended	102 knots (118 mph) (190km/h)

Airspeed indicator markings

Red line	102 knots (118 mph) (190 km/h)
Yellow sector	81-102 knots (93-118 mph) (150- 190 km/h) (Caution range)
Green sector	38- 81 knots (44-93 mph). (70- 150 km/h) (Normal operating)

1.8 Weights

approx. empty weight	882 lbs	(400 kg)
approx. max. permissible load including fuel	463 lbs	(210 kg)
max. permissible AUW (all up weight)	1344 lbs	(610 kg)
Max. weight of non-lifting components	992 lbs	(450 kg)

For an overview of actual weights measured see Maintenance Manual page

1.9 Centre of gravity at flying weights

<u>Aircraft attitude</u>	Wing chord rib 6 (2,02m = 79,52") from centre line (horizontal).
Datum point:	2.00m (78.74") in front of the leading edge of the root rib 0 (0.33 m = 12,99") from the centre line.
Forward limit of CG:	2.174m (85,59") aft of datum
Rearward limit of CG:	2.414m (95,04") aft of datum

1.10 Placards and warnings

In addition to the fireproof type plate and the usual placards, the following signs must be appropriately displayed:-

In the front seat:

1. Port side of cockpit by the levers: "Spoilers -full travel operates wheel brake"
2. On the right sidewall near the trimlever: "Nose down – Trim – tail down"
3. On the right sidewall: "Open – Cowlfap – closed"
4. On the instrument panel, by the controls: "Choke - pull for rich" "Ignition - on - off" "Fuel - off - on" "Master switch - on - off" "Starter" "Ventilation" "Cockpit heater- pull" "Throttle" "Carburettor heating" "Propeller pitch – change to feathered position only if engine is stopped" "Propeller brake"
5. Canopy release: "Canopy jettison:
 1. Propeller in operation position
 2. Open front canopy release.
 3. Open lateral canopy release
 4. throw clear to the back."
6. On the instrument panel: "Caution - Wet Wings - see Flight Manual" "No smoking" "Engine running - Cowling flap open"
7. "Pre-take-off checks": "canopy locked, seat belts securely fastened, trimmer set, spoilers closed and locked, full and free movement of controls, fuel cock open, fuel level, cowling flap open, propeller in operational position".

In the rear seat:

1. On the instrument panel: "Pre take off checks" see before point 7
2. On the right sidewall near by the trim lever. See before point 2
3. At the throttle: "Throttle"
4. Canopy emergency jettison: "1. open front canopy release. 2. Open rear canopy release 3. Open canopy and throw off to the back"
5. Near by the front canopy release: " front canopy release"
6. Left sidewall near by the spoiler lever: see above point 1
7. On the rear wall of the luggage locker: "Luggage - max. 10 kg (22 lbs)"

8. On the fuselage near the fuel tank filler cap:
"AVGAS 100 LL or SUPER-PLUS auto gas (ROZ 98)"
See Limbach SB 50 and 53.1
Fuel tank capacity: 40 litres" (: 8,80 Impgal / 10,56 USgal)
9. On the fuselage adjacent to the - mainwheel (fixed single wheel u/c)
"1.8 bar (25 psi)".
10. Above the tailwheel "2.5 bar (35 psi)"
11. By the oil filler: "Oil 2.5 l"

2. Operating Instructions

2.1 General

The Tandem- Falke is a self launching motor glider. It may be flown with an MGPPL (Motor Glider Private Pilot's Licence).

It is of course necessary for the pilot to have a thorough understanding of motor gliders and the operations of the engine. He must become thoroughly acquainted with the Flight Manual and the Operating Handbook and master the essential details of the airframe and engine.

2.2 Daily inspection

Before commencing the day's flying or after unfolding the wings or rigging the aircraft, it is necessary to inspect the airframe, the engine and the propeller for airworthiness. The following checks should be made:

2.2.1 Airframe

- ✓ During the inspection everything should be checked carefully (no cracks or deformations), with particular attention paid to safety pins, pulleys and cables, as well as play in the controls.
- ✓ See AD 82-134/ SB653-42 1 Main rigging points. Check the four wing attachment points. Check that the main bolt is fully home and secured, and check that the two rear wing attachment points are secured. (see page 18)
- ✓ Check that the aileron controls in the fuselage are connected and secured. See AD 94-001/2 enclosure 1 and AD 93-001/3 enclosure 2
- ✓ Check that the spoiler controls in the fuselage are connected.
- ✓ Check the controls from the cockpit for full and free movement and that the starboard column is secure.
- ✓ Check rudder pedals and nosewheel steering if applicable.
- ✓ Check pulleys, fairleads and cables for wear and kinking.
- ✓ Check operation of spoilers from the cockpit.
- ✓ Check correct operation and effectiveness of the brake.
- ✓ Check the instruments and radio.
- ✓ There is a facility for draining the pitot remove the drain plug behind the mainwheel. Check especially after exposure to rein and road transport and drain as necessary.
- ✓ Check that the safety belts and their fittings are in proper condition and secure.
- ✓ Any luggage should be secured by the straps provided.
- ✓ Check for foreign objects.
- ✓ Check the canopy, canopy lock, canopy jettison system and direct vision window.
- ✓ Check the spar/fuselage fairings cover plates on the underside, both sides of the fuselage.
- ✓ Check that both outriggers are in good condition and correctly attached (only applies in the case of single mainwheel undercarriage).

- ✓ Check both pushrods at the aileron.
- ✓ Check that both ailerons are attached and secured.
- ✓ Tailplane - check that the front connection is tight and secured.
- ✓ Check that the elevator is connected to the pushrod in the fuselage and secured.
- ✓ Check the trimmer on the elevator.
- ✓ Rudder - check rudder bearings, fixing and cable attachments, and security. After rigging check that the rudder moves in the correct sense.
- ✓ Check the tailwheel assembly bearings and axle for full and free movement (also nosewheel if applicable).
- ✓ Check the condition and tyre pressure of mainwheel(s), tailwheel (or nosewheel) and outrigger wheels if fitted.
- ✓ Check the underside of the fuselage for damage or oil (hot exhaust).
- ✓ Check the general condition of the ply, fabric and paint finish of the aircraft for damage.

2.2.2 Engine (see also Engine Handbook)

1. Check the engine thoroughly for missing or loose nuts, bolts, screws etc. Check fuses, cooling ducts, ignition leads and V-belt for condition and beware of chafing.
2. Check that the following operate freely: throttle, choke, engine cooling flap, propeller brake, heating, ventilation and carburettor heating.
3. Check the oil level and top up if necessary. The oil level should be checked after every hour or
5. Check the fuel tank level
6. Open the fuel drain valve briefly
7. Check the engine bay for foreign bodies.

2.2.3 Propeller (see also Propeller Handbook)

1. Examine the propeller for indentations, spikes and other damage. The propeller should be cleaned frequently to remove any accretion of insects and grass. All bolts must be tight.
3. Check the spinner for cracks and ensure that the bolts are tight.

2.3.1 Starting the engine (see also Engine Handbook)

Before starting, ensure that someone is standing to the left at the front of the machine to make sure that no-one is near the propeller. All club members and also any spectators must be instructed regarding the dangers of rotating propellers: contact with a rotating propeller can be fatal. Close the canopy before starting. Before pressing the starter the pilot calls from the cockpit "Clear prop" and the observer confirms by repeating "Clear prop" that the area around the propeller is clear. Then, and only then, proceed to start the engine.

Starting procedure:

Apply parking brake

Open engine cooling vent

Open fuel cock

Pull choke if engine is cold

Move the throttle approximately 2 cm from the tick over position

Master switch on

Switch off any sensitive electrical equipment (radio etc.)

Ignition on----- Is the propeller clear?

Press starter button

As soon as the engine starts release the starter button, push in the choke and set the throttle so that the engine ticks over at about 1.000 rpm. The oil pressure should increase within 10 seconds.

When cold the engine will usually start within 2 - 3 seconds. Then return the choke immediately or the engine will flood and stop. If the motor fails to start after two attempts, push in the choke, open the throttle completely or almost completely and try starting again. If the engine does not start after five more attempts it is probably flooded. Ignition off, full throttle, choke closed. Turn over the engine by hand backwards about eight to a dozen times. Then try starting again with full throttle, reducing the throttle setting as soon as the engine starts. A warm engine is best started with the choke pushed in and with the throttle at a tickover setting.

The engine can also be started by turning the propeller, the pilot remaining in the cockpit of course. The same comments apply with regard to choke and throttle as when starting using the electric starter. Never hand start without chocks in front of the mainwheel. Take up a good, firm position, facing the propeller call "Switch off" to the person in the cockpit who checks that the ignition switch is really in the "off " position before answering "off". Pull the propeller past the ignition point once or twice. The impulse click of the magneto will be heard. Ensure that your hands are clear of the propeller when it starts.

After confirmation from the cockpit that it is off first pull the propeller over several times. "Ignition on" followed by shouted confirmation from the cockpit of "on". Continue as for starting with electric starter.

2.3.2 Warming up, static rpm check (see also Engine Manual)

Warm up the engine by first running it at 1,000 rpm for about two minutes then at 1,500 rpm for five to 10 minutes (depending upon the ambient temperature) until the oil temperature reaches its operating point of 50 °C. The temperature gauge is relatively slow to respond so that at an indicated 50 °C the engine is already sufficiently hot. If the take-off point is some distance away, the engine may be warmed up whilst taxiing. As soon as the operating temperature is reached, apply the brake, hold the control column fully back and run up the engine. Gradually open the throttle, check oil pressure and temperature and run for about 20 - 30 seconds at 2600 – 2800 rpm, then check the carburettor heating. The revs should reduce by approximately 150 rpm when carburettor heating is applied. (Do not start with carburettor heating pulled). Then turn off carburettor heating and return to tickover.

2.3.3 Taxiing

The "Tandem-Falke" can taxi unaided and is steered on the ground with the tailwheel, with a turning circle of 12 - 15 m (40 – 50 ft). The mainwheel brakes will stop the motor glider effectively.

2.4 Take off and climb

(Caution: See also 2.12 Wet wings - warning).

Pre-flight check list (see placard in the cockpit).

Trim neutral, spoilers closed and locked, control column central (do not push the column forwards).

Take off run on the ground normally 655 – 985 ft .

Apply full throttle.

Check engine revs, allow ground speed to increase to 38- 40 knots (43-57 mph) (70- 75 km/h), then climb 46 – 49 knots (53 – 56 mph) (85-90km/h) with the airspeed not less than 49-54 knots (56- 62 mph) (90-100 km/h) with rpm at 2800 rpm. Continue climbing to about 650-1000 ft such that the airfield is within reach in case of engine failure. After reaching about 150 – 250 ft the engine revs may be reduced. Check that the oil pressure and oil temperature are in the green sector. The limits must not be exceeded.

Ensure that the airspeed when climbing is sufficient to cool the engine, so preferably keep the airspeed a little higher, especially in hot weather.

During a prolonged climb in hot weather, monitor the oil temperature carefully: if it approaches the upper limit then fly faster and reduce engine revs. i.e. accept a shallower climb on reduced power.

2.5 Level Flight

The minimum airspeed for level flight is 43 knots (50mph) (80 km/h) Best cruising speed is about 70- 81knots (81- 93mph) (130- 150 km/h) at 2.600- 2800 rpm. Maximum cruising speed 81 knots (93 mph) (150 km/h) at 2.800 rpm.

2.6 Landing

The aircraft can be landed with the engine either running or stopped. Approach at about 43- 46 knots (50- 53 mph) (80- 85 km/h), flying a normal gliding type circuit. Control the glide path with the spoilers. As the spoilers are effective it is not usually necessary to slip the aircraft. With spoilers extended the rate of sink at 43 knots (50 mph) (80 km/h) is approximately 3,0 to 3.5 m/s (590 to 690 ft/min). At minimum touch down speed is 35 knots (40 mph) (65 km/h) the Tandem-Falke touches down with the tailwheel then with the mainwheel (in the case of the nosewheel version first with the mainwheels then with the nosewheel). The landing run of about 300 feet can be reduced effectively using the mainwheel brakes.

2.7 Stopping and starting the engine In flight

Before switching off allow the engine to cool down by gliding on tick-over or flying level with the engine throttle back for a minute or two then return the throttle to tick-over, switch off all sensitive electronic equipment and finally switch off the ignition. Reduce airspeed to no more than 41-43 knots (47-50 mph) (75-80km/h) to reduce windmilling so that the propeller brake may be applied if desired in the final stages. If the engine has not been allowed to cool there may be a tendency for it to continue firing spasmodically. If this occurs, apply full throttle, during the last stage of the engine turning. Should it be necessary, the propeller can be aligned horizontally with quick blips on the starter.

Before restarting in the air open the cowling flap, switch off all sensitive electronic equipment, switch on the ignition,

fly at about 43-49 knots (50-56 mph) (80-90km/h).

Set choke and throttle settings for hot or cold engine as on the ground. The engine is very easy to start if the pilot is familiar with its operation.

If the engine is cold do not use full throttle until the oil temperature reading has returned to the green sector. At airspeeds of about 70-80 knots (81-93 mph) (130-150 km/h) a quick blip on the starter will start the propeller turning and the engine will start immediately (depending on engine temperature). Choke in, about one third throttle, ignition on. Height loss is in the order of 500 - 600 feet.

2.8 Flying with the engine stopped

The aircraft handles very well at 38-49 knots (44- 56 mph) (70-90km/h) with a sink rate of about 1.0 m/s (200 ft/min) in straight flight.

Close the cowling flap to reduce drag when the engine is off. The Tandem-Falke, being a low wing monoplane, has to be flown cleanly. When skidding or flying at 38 knots (44 mph) (70 km/h) or less than the airflow breaks away from the wing/fuselage fillet area and performance is lost. When gliding and especially when turning, fly the aircraft as cleanly as possible and avoid skidding in turns. The traditional solution of a length of string mounted on a 10 cm (4") piano wire mast, about 20 cm (8") ahead of the canopy in front of each seat, is still a highly cost-effective aid to accurate flying. With a little practice the pilot will be flying accurately and climbing well in thermals even when compared with pure gliders.

2.9 Propeller pitch change

The Tandem-Falke has a variable pitch Propeller. For gliding with engine stopped, propeller is to feather. This possible by pulling the pitch change lever. The snatch rests in one position.

Feathering of Propeller is only possible with engine stopped.

Before restarting the engine unfeather the propeller at the best at a speed of 54 knots (62 mph) (100 km/h). Move the pitch change lever 30° left or right and push the lever complete forward.

2.10 Slow flying and stall characteristics

At maximum flying weight the stalling speed is about 33 knots (37 mph) (60 km/h) with the engine running or stationary. At this speed the airflow over the wing roots begins to break away; ailerons and rudder are still fully effective. With a forward CG position the Tandem-Falke simply lowers it's nose if the control column is pulled right back. Needless to say, in rough air conditions stalling with middle or rearward C.G. positions will cause a wing to drop. With rearward CG positions in rough air it is possible that to fly on, fully stalled in still air conditions with the control column right back whilst retaining full aileron and rudder effectiveness. In both CG positions immediate recovery is effected by easing the control column gently forward. If this occurs a stalled condition is still recognisable. If stalled in a 30° turn with rearward C.G., the Tandem-Falke gradually drops the outer wing such that normal flying speed may be regained when both wings are level. Stalling characteristics are the same engine on or engine off.

2.11 Spinning

Except with rearward CG positions it is very difficult, if not impossible, to make the Tandem-Falke spin. If no corrective action, such as releasing the backward control column pressure is taken, the incipient spin becomes a spiral dive, from which a transition to normal flight is easy. Use of spoilers is recommended in the spiral dive. Even with middle and rearward CG positions a continuous spin is impossible. A spin may be induced by gradually easing back the control column and crossing the controls.

A spin can of course be corrected in the normal manner, this taking about half a turn. When rotation stops pull out of the resulting dive gently and do not hesitate to use the spoilers to prevent the speed building up excessively.

2.12 Wet wings - warning

The Tandem-Falke wing has a glider airfoil which is sensitive to rain. Drops of rain on the wings disturb the air flow and reduce the lift. Whereas minimum airspeed with dry wings is about 33 knots (37 mph) (60 km/h) with wet wings it is 41-43 knots (47-50 mph) (75-80 km/h). Wet wings change stalling characteristics. Whereas the Falke is positively docile with dry wings it will drop a wing when wet. When flying in rain keep the airspeed above 49 knots (56 mph) (90 km/h). Do not attempt to take-off at less than 43 knots (50 mph) (80 km/h). Fly at about 54 knots (62 mph) (100 km/h) when climbing and on the approach. Avoid steep turns and other manoeuvres involving high G-forces. If there is snow or ice on the wing it must be cleaned off completely before take-off. Do not forget the tailplane.

Carburettor icing can occur when humidity is high (especially near clouds) and where the air temperature is between -10 °C and +18 °C. The pilot will recognise the rough engine note and reduce rpm. Carburettor heating control should be pulled immediately.

Carburettor icing can also occur when the engine is idling for long periods whilst gliding. Pull carburettor heat from the start but remember to cancel carburettor heat when you require full engine performance again.

Operation of the carburettor heater (when there is no icing in the carburettor) results in a small drop in revs.

In warm dry air carburettor heat should be fully off (pushed fully home).

2.13 Operating without the outrigger wheels (single wheel undercarriage)

The Tandem-Falke can also be operated without the outrigger wheels fitted. Taxiing is possible with a wing tip holder. Take-off is then like a normal glider launch – someone runs with the wing until the pilot has aileron control. After touchdown the Falke can be held level with the ailerons virtually until the aircraft stops.

2.14 Safety factors and engine reliability

It should always be borne in mind that the motor glider engine is not designed to such stringent specifications as that of a light aircraft (e.g. single ignition system instead of dual); it is simpler and cheaper. This must be taken into account when flying, by observing safety heights and flying in such a way that suitable fields are always at hand should it be necessary to land out.

2.15 Attachment points for parachute static release

In the front seat:

These are to be found marked red on the tubular member above the backrest.

In the rear seat:

At the triangle of the lower seat belt attaching points (red marked)

2.16 Emergency canopy release

Front seat:

1. Propeller in normal operation position.
2. Open front canopy release.
3. Open left hand canopy release, open canopy and push them backwards.

Rear Seat:

1. Open the front canopy release by the red t-handle on the right hand canopy side.
2. Open left hand side canopy release, open canopy and push them back.



2.17 Type conversion

Before flying the Tandem-Falke study the Manuals for the motor glider, the engine and the propeller. Complete a few type conversion flights with someone who is thoroughly acquainted with the aircraft.

A good number of solo flights should be completed before taking off with a passenger. Glider pilots without previous experience of light aircraft should particularly study the servicing and maintenance of the engine and propeller, and also the take-off procedure.

3. Performance data

3.1 Take-off performance

These performance figures have been obtained from type test results and can be reproduced provided that the motor glider and engine are in good condition and that the pilot is of average ability and skill.

Maximum all up weight (AUW): 610 kg (1344 lbs)

Level airfield with short well kept grass. Wings dry, wing surface clean. No wind. Air pressure standard for height of airfield above sea level.

Lift-off speed: approx. 38 knots (44 mph) (70 km/h).

Climb speed: approx. 49 knots (56 mph) (90 km/h)

	Elevation MSL		OAT °C							
			-15°C		0°C		+15°C		+30°C	
	m	ft	m	ft	m	ft	m	ft	m	ft
Take off roll distance (m) ft	0	0	178	584	188	617	199	653	209	685
	250	820	184	603	194	636	205	672	215	705
	500	1640	189	620	200	656	211	692	221	725
	750	2460	194	636	206	676	217	702	228	748
	1000	3280	200	656	213	699	224	735	236	774
Distance req. to clear 15 m (49ft) obstacle	0	0	311	1020	341	1118	371	1217	401	1315
	250	820	327	1072	356	1168	386	1266	415	1361
	500	1640	342	1121	372	1220	402	1318	431	1235
	750	2460	356	1168	388	1273	419	1374	450	1476
	1000	3280	372	1220	406	1332	438	1255	471	1545

3.2 Rate of climb

Maximum all up weight at sea level

Rate of climb: 2.2m/s (433 ft/min)

3.3 Airspeed at max. continuous power

$V_H = 81$ knots (93 mph) (150 km/h)

Speed on approach: 49 knots (56 mph) (90 km/h)

Touchdown speed: 38 knots (44 mph) (70 km/h)

3.4 Max. approved altitude

round about 4600 m at 0.5 m (100 ft/min) climb ratio

3.5 Aerobatic and cloud flying

Simple aerobatics and cloud flying are prohibited



3.6 Range and endurance (zero wind conditions)

RPM	Fuel consumption ltr./ hour	Duration	Airspeed	Endurance
2700	10,0	4 ⁿ 00	70 knots (129 km/h) (80 mph)	520 km 281 miles
2800	12,0	3 ⁿ 00	78 knots (145 km/h) (90 mph)	480 km 259 miles

NB. Endurance and range do not allow for any fuel reserve

3.7 Gliding performance

Engine off, cowling flap closed:

Min sink rate: 0,92 m/s (181 ft/min) at 38 knots (44 mph) (70 km /h)

Glide ratio 1 : 26 at 51 knots (59 mph) (95 km/h)

4. Centre of gravity and weight limits

It is the responsibility of the pilot (P1) to see that the weight limits are not exceeded.

4.1 Empty weight centre of gravity

Make sure that the empty weight CG is still within the permitted limits after repairs, respray or the installation of new equipment etc. Add balance weights if necessary. This work has to have the approval of an authorised inspector.

Centre of gravity limits for various empty weights are stated in page 18 of the Maintenance Manual.

Aircraft attitude Wing chord rib 6 (2,02m = 79,52") from centre line (horizontal).

Datum point: 2.00 m (78.72") in front of the leading edge of the root rib 0 (0.33 m = 12,99") from the centre line.

If the empty weight C.G. position is within the limits prescribed then the centre of gravity in flight will be within the permitted limits

In flight the centre of gravity has a considerable influence on the handling qualities of the aircraft. For this reason it is of vital importance that the prescribed CG limits are scrupulously observed.

The following limits of CG flying weights have been tested and approved:

The centre of gravity for all flying weights must be within the limits

Forward C.G. in flight 2.174 m (85.59") and

Aft C.G. in flight 2.414 m (95.04")

aft of the datum point.

4.2 Weight placard

Cockpit weight limits (including parachute(s), both seats combined)

Max: 242 lb (110 kg) on each seat

Min.: 121 lb (55 kg) on the front seat

Luggage: 22 lb (10 kg) max.

It is important to ensure that the cockpit load (including fuel and possible luggage) does not exceed the maximum cockpit load. Allow 0.73 kg per litre of fuel (1.611bs), i.e. a full 40 litre tank represents 29,2 kg (64 lbs).



5 Minimum equipment

In the front seat:

- 1 Airspeed indicator (ASI) (up to 108 knots/124 mph /200 km/h)
- 2 Altimeter
- 3 Magnetic compass
- 4 Rev counter
- 5 Oil temperature gauge
- 6 Oil pressure gauge
- 7 Ammeter
- 8 Fuel gauge
- 9 two four-element safety harnesses
- 10 two back support cushions, to be used in the absence of parachutes.
- 11 Flight Manual, approved by the LBA, to be carried on board

In the rear seat:

- 1 Two four-element safety harnesses
- 2 two back support cushions, to be used in the absence of parachutes.

For training additional:

- Airspeed indicator (ASI) (up to 108 knots/ 124 mph/ 200 km/h)
- Altimeter

6. Cold weather flying and risk of carburetor icing

Especially when flying in the winter it is important to check that the oil temperature does not drop below 70 °C whilst the engine is running. The carburetor and intake are warmed by the hot recirculating engine oil. By installing a cylinder head thermometer (optional extra) the supply of cooling air to the engine can be accurately regulated by controlling the cowl flap. The cylinder head temperature must be monitored carefully: under no circumstances must the temperature be allowed to exceed the maximum of 250 °C.

7 Multi pitch propeller

7. 1. General

The information given on page before is applicable to motor gliders fitted with the HO - V 62 /L 150 A propeller. This propeller has two settings: power & glide. The power setting is designed for best possible take-off and climb performance. If the motor glider is fitted with the HO - V 62 R/ L 150 A propeller, there is a third pitch setting: cruise. This propeller should be operated according to the following procedures:

7.2. Take-off and climb

For take-off and climb always select CLIMB pitch setting (see pre-flight check list) as the Take-off run is extended by approx. 50% if CRUISE setting is used. It is not possible to change the pitch setting during take-off. Once in the cockpit it is essential to check before take-off that the pitch setting is correct as the difference between CLIMB and CRUISE is not easily recognized from outside the aircraft and it is not possible to change the setting during take-off. When the pitch setting is changed from fully feathered (GLIDE) the CLIMB setting is engaged automatically. Always do this before take-off. Static revs of 2600 - 2800 rpm (white sector on rev counter) provide a check that the CLIMB setting has been engaged.

7.3 Selecting cruise pitch

In flight cruise pitch may be selected, through only with the engine running:

- 1) Lift limit catch
- 2) Reduce air speed to 43 knots (50 mph) (80 km/h)
- 3) Regulate engine revs to 2000 rpm
- 4) Pull the pitch control lever to the stop and immediately push forward as far as it will go.

For a given throttle setting, there is a perceptible drop in engine revs of about 300 rpm indicating that CRUISE pitch has been engaged.

7.4 Selecting CLIMB Pitch

During powered flight the propeller pitch can be changed from CRUISE to CLIMB:

- 1) Lift limit catch
- 2) Reduce air speed to 43 knots (50 mph) (80 km/h)
- 3) Reduce engine revs to 1000 rpm
- 4) Pull the pitch control lever to the stop and then forwards again as far as it will go.

For a given throttle setting, there is a perceptible increase in revs of about 300 rpm indicating that CLIMB pitch has been engaged. A more reliable method is to engage CLIMB via the fully feathered position (GLIDE) when the engine is stopped.

7.6 Range and endurance at cruise pitch

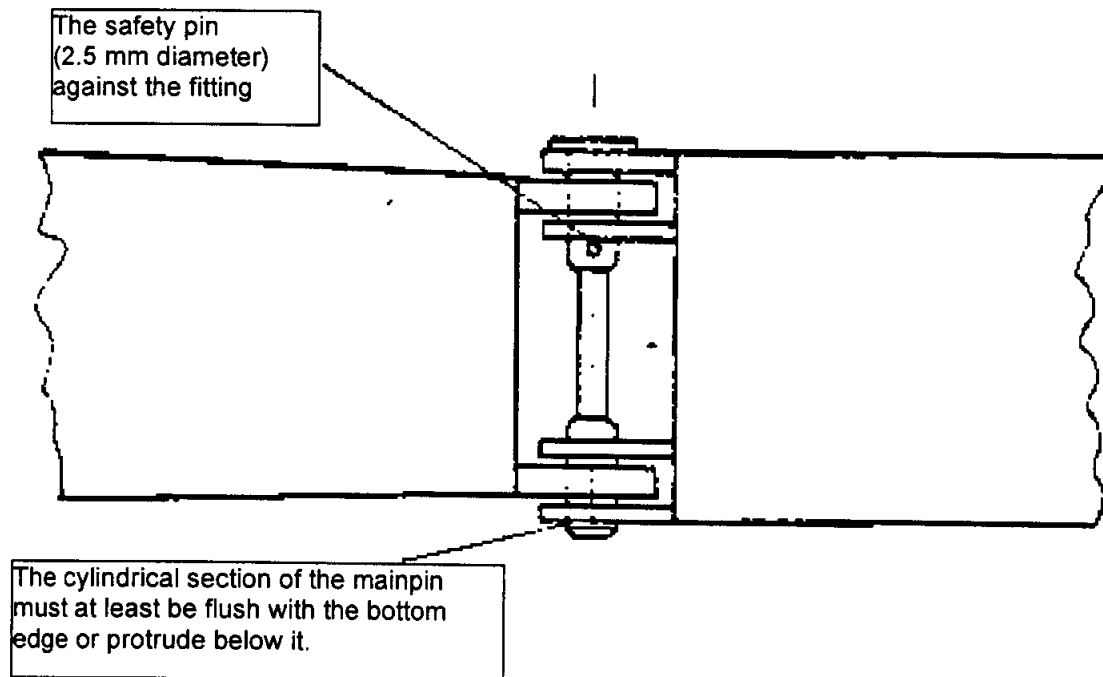
Range & endurance (Zero wind conditions)							40 ltr Fuel tank (8,80 imp.gal., 10,57 USgal)			
rpm	Fuel consumption			Airspeed			Duration range			
	litre	Imp.gal	USgal	knots	mph	Km/h	Hrs	min	km	miles
2400	10,0	2,20	2,64	70	81	130	4	00	520	280
2600	12,0	2,64	3,17	78	90	145	3	20	480	259
2750	13,0	2,86	3,44	84	96	155	3	00	470	292

NB. Endurance and range do not allow for any fuel reserve

X Instructions for rigging and de-rigging wings (mainspar) X

When rigging and de-rigging it is **essential to ensure** that the spar fittings of the port wing (yoke) are not subjected to vertical distortion. Never force the mainpin into place (e.g. never drive it in with a hammer) but gently insert it with the weight taken off the wing tips.

When the mainpin has been inserted, check that it is correctly seated. Check carefully, using a mirror and torch if necessary, that the mainpin is fully inserted into the bottom arm of the lower yoke. The cylindrical section of the mainpin must at least be flush with the bottom edge of the yoke, or protrude below it (see drawing) below). When checking, the mainpin must be pulled upwards (with the weight taken off the wingtips) such that the 2.5mm safety pin is up against the upper fitting.



MAINTENANCE MANUAL

1 Rigging and De-rigging

If the Falke is to be rigged and de-rigged often it is worthwhile obtaining support wheels for the fuselage so that the fuselage can be moved easily and if necessary even for short journeys on public roads. Every Falke fuselage has attachment points for fuselage support wheels. Simple supports without wheels are also available for parking the fuselage. (Not applicable in the case of the two wheel undercarriage version.)

Rigging

Before rigging, always clean and grease all fittings, especially after an open trailer journey:

- 1) Clean & grease front wing fittings (2 points)
- 2) Clean & grease rear wing fittings (2 points)
- 3) Clean & grease mainpin
- 4) Clean & grease tailplane fittings (3 points)
- 5) Clean & grease the pins at the wing folding point (if applicable) 3 pins per wing
- 6) Clean and grease the aileron drive at the wing fold position (if applicable).

It is best to begin with the port wing. A helper holds the fuselage on the starboard side, three further helpers offer up the port wing. Feed the spar through the fuselage carefully, being careful to avoid rudder cables, elevator pushrod and harness straps. Engage the rear fitting on to the lug on the fuselage. Bring the wing tip forwards to engage the root rib fitting on the forward lug on the fuselage. The procedure for fitting the starboard wing is the same. Be careful to ensure that the fuselage is held vertical and not at an angle.

Bring the starboard wing tip forwards, correcting the height of the tips to allow the main spar fittings to slide into each other. It works best if one person climbs into the fuselage and gives instructions to the helpers at the tips, until the fittings are in line and the mainpin can be pushed home. The mainpin is secured under the upper part of the main spar fittings with the large safety pin provided.

See page 19 of this manual

The outrigger wheels (marked left and right) are pushed into the fittings under the wings and screwed tight (not applicable for two wheel undercarriage version). The two aileron connections are made inside the fuselage and secured by safety pins and the spoiler control cables are connected by the two carabiners. Then the wing root/fuselage undersurface plates are added. Install and tighten the rear seat with D-ZUS fasteners. Now fit the tailplane, preferably with two people to handle it. With the elevator in the up position the tailplane is offered up to the fixed lugs on the fuselage. Then the front tailplane fitting is screwed down onto the fuselage with the castellated nut which is secured with a safety pin. Fix the tailplane fairing (if applicable) is hooked under the fin and fixed with two patent fasteners. The elevator horn and pushrod are connected by a pin and secured with a safety pin. Fix the front tailplane fairing. Finally connect the Bowden cable to the fittings on the elevator and trimmer, having first moved the cockpit trimmer lever fully forwards. After rigging, the aircraft will require a full Daily Inspection (Flight Manual).

1.2 De-rigging

The de-rigging procedure is simply the reverse of the rigging procedure. Start by removing the tailplane. Before attempting to remove the wings do ensure that controls (ailerons and spoilers) have been disconnected and that the underwing/ fuselage fairing plates have been removed. Let the wing tip helpers take the weight off the main pin by gently raising the tips before withdrawing it. Then the wing tip holders ease gently tailwards to disengage the forward lug before moving the whole wing forward to free it from the rear lug. During this operation avoid tilting the wings and fuselage and do not bring the wing tips too far back.

1.3 Fuelling up etc.

The engine runs on normal filling station four star petrol (unleaded) RON 98 or AVGAS 100 LL. Before fuelling up at a fuel pump there must be an earth connection between the petrol pump and the fuselage metal structure. Use a chamois leather filter when fuelling up. Absolute cleanliness is essential. If fuelling up in rain protect the filler to prevent ingress of rain. No smoking or naked flame near the open tank or when the filler cap is off. Use only the original vented filler cap. (The filler cap is labelled "Patent blau" or "mit Lüftung").

The oil level is to be checked every one or two engine hours and after every long flight. The oil should be topped up to the upper dipstick mark. The oil filler position is accessible after removal of the engine cowling and is marked yellow.

1.4 Wheel brake

The wheel brake on the single mainwheel is a drum brake. The brake is connected to the spoiler lever and is applied in the final part of spoiler extension.

1.5 Transporting the motor glider

The Falke can be transported on a special trailer. The supports for the wings must not be less than 5,3 metres apart. Otherwise the overhanging wing section can be damaged by road transport loads and when travelling off road. The propeller should be in its gliding position and mounted on the trailer such that it cannot rotate in the slipstream whilst being towed. If the aircraft is being towed on an open trailer without waterproof covers, ensure that water cannot enter the spoiler gap, pushrod openings, fuselage etc. If the wings do get wet en route dry them out immediately in a warm environment with the leading edge uppermost.

When moving the rigged motor glider across the airfield it is important to ensure that the control column is held fast by the harness straps to prevent the elevator bouncing.

1.6 Supports

The Falke can be chocked at the stub tubes provided for the purpose (marked with a triangle) and in the older version at the steps or using the threaded holes provided in the side of the fuselage (the thread is M10). On no account is the Super Falke to be chocked up on the fairing tubes in the undercarriage area. The tail end of the fuselage may be supported only on the underside of the fuselage at the appropriate fitting or at the triangular cable deflector in front of the tailwheel, but not of course under the wooden stringer. If the aircraft is to be left de-rigged, ensure that the wing halves are supported correctly as described.

1.7 Propeller change

If the propeller is damaged, the crank shaft or the hub may have been damaged so the engine manufacturer will need to dismantle the engine and check it.

1.7.1 Variable pitch propeller

The multi-pitch propeller is bolted through the propeller flange to the intermediate flange (on the engine side) and secured by six self-locking nuts with washers. The intermediate flange is retained on the propeller shaft by a central nut and may only be removed by the engine manufacturer. To remove the propeller, remove the six wire-locked nuts and withdraw the propeller from the intermediate flange.

Re-assembly torque setting for these nuts is $32\frac{1}{2}$ – 34 ft lbs. The propeller tips have a maximum permitted play of 3 mm (.125 in). When the propeller is not fully feathered the ball bearings of the propeller pitch lever must not be in contact with the swash plate. The clearance between the bearings and the swash plate must be identical end the bearings must be symmetrical to the rotating axis of the propeller.

2. Maintenance

2.1 General

Reliability results from an aircraft being clean and well kept. This applies especially to the engine and propeller. The level of attention required will vary according to usage and weather conditions.

At all inspection- and maintenance works pay attention to all the screws.

If you can open screws only hard, please check the thread, if necessary renew the screw.

2.2 Periodic Inspection and Maintenance

2.2.1 Daily Inspection

The normal Daily Inspection is of course required after work on it and before the start of flying. For details of the Daily Inspection see the Flight Manual.

Pitot- system:

It is possible to drain the pitot-system. After a flight in rain drain the system.

Propeller check:

Check that all nuts are tightened correct.

When the propeller is not fully feathered the ball bearings of the propeller pitch lever must not be in contact with the swash plate. The clearance between the bearings and the swash plate must be identical and the bearings must be symmetrical to the rotating axis of the propeller.

2.2.2 Engine Inspection

(see also Engine Handbook).

The engine is to be serviced and checked after the Engine Handbook. In addition the engine must be checked and serviced after every 50 engine hours. This work must be carried out in accordance with the Inspection and Maintenance List and recorded in the manufacturer's Motor Glider Log Book supplied with the aircraft. Following inspections must be carried out all 50 hours of operation:

1. Inspection of the engine exhaust for cracks
2. At variable pitch propeller remove the spinner dome; inspect and lubricate all moving parts beyond.
3. Drain fuel tank; therefore open the drain screw under the fuselage near the fuel tank. Screw on the drain screw and secure it with wire. Be sure, that this drain screw is closed very well.

Battery Servicing

At least every month check the electrolyte level and top up with distilled water as necessary. The correct level is individual cells with a battery hydrometer.

Specific gravity of electrolyte at 20°C (68°F)	State of battery charge
1.28 kg/ litre	Fully charged
1.19 - 1,21 kg/ litre	Half discharged
1,09 - 1,14kg/ litre	discharged

If necessary charge the battery (charge rate 1.5 amps). If the battery is not in use it must be given a top up charge every month and every three months it must be discharged and then recharged.

Keep the battery clean and dry. Lightly grease the terminals with a non-acid, acid-resistant oil or grease, e.g. Vaseline. Oil and grease should not come into contact with the moulded top of the battery. Check the battery vents which are intended to duct any inflammable battery gases safely out into the slipstream.

Airframe inspection:

Begin all maintenance work with a check according the pre-flight inspection. Lubrication of the control system and control surface bearings is to be carried out in accordance with the lubrication chart in the Appendix.

The control system bearings are to be cleaned externally and lubricated with oil. To the lower rudder bearing particular attention must be paid since depending on the condition of the airfield it may get dirty.

All ball-bearings are greased by the manufacturer and do not require any particular maintenance; however, if they get dirty, clean and lubricate with ball-bearing grease or vaseline. The tension on the rudder pedals is produced by the return springs at the pedals. If the cables get loose, the springs are to be replaced.

If the aircraft becomes wet, it should be dried by means of a chamois. The best paint suffers from the influence of weather. The life of the paint and the quality of the finish can be improved considerably by careful service and care. Take care for a good ventilation of the hangar. The installation of the instruments is to be inspected occasionally. Especially check the tubing for signs of aging and for safety of connections to nipples.

2.2.3 Annual Inspection and Overhaul

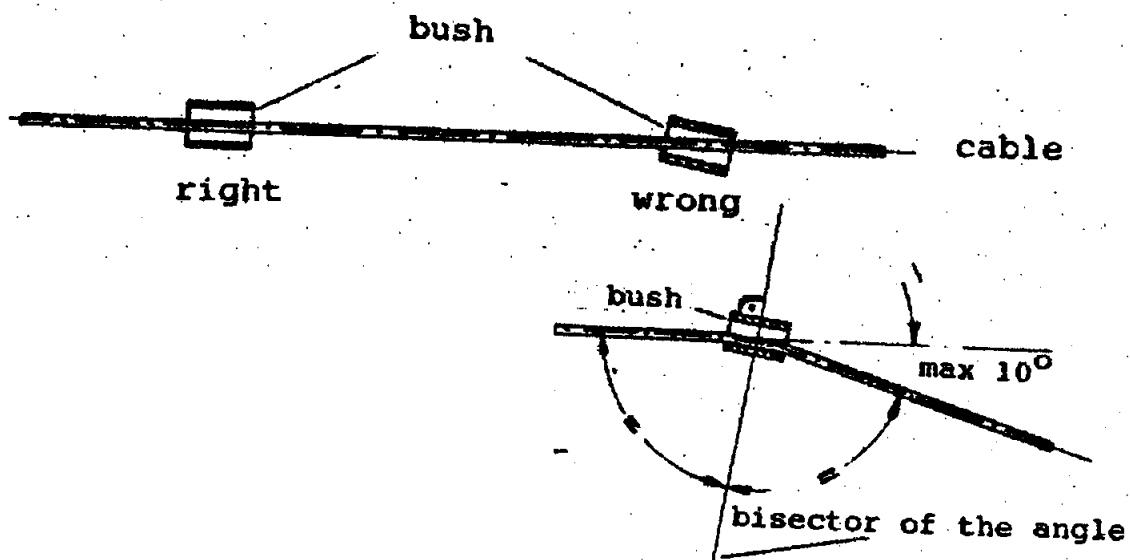
As is the case with gliders and light aircraft, a motor glider requires annual inspection for the renewal of its Certificate of Airworthiness. This must be carried out at the appropriate time by an authorized inspector. The whole aircraft must be thoroughly overhauled either before or at this annual inspection.

During this overhaul the work attached to the inspection at 100 hrs and also the additional work detailed on the lubrication chart must be carried out.

Fabric and paintwork defects are to be made good.

The bearings in the control circuits are to be checked and replaced if worn. All control circuits are to be checked for adjustment and the control surface deflections are to be checked.

Pay particular attention to the cables and the cable runs. Frayed cables (finger check painful but effective) are to be replaced, using only cable to specification LN 9374 or equivalent. Worn pulleys and control cable guide bushes are to be replaced. The bushes must sit tightly in their fittings: a missing bush causes rapid cable wear. Bushes on a straight run of cable must be aligned with the cable.



Cable guide bushes through which the cable is deflected must be set at 90° to the angle bisecting the two cable runs.

The maximum angle of cable deflection through a cable guide is 10°.

Keep cables with sliding contact clean and free from dirt. Oil, but do not grease. Check also at each overhaul that there are no slight kinks or wear in the free lengths of cable.

Apart from cleaning and greasing the undercarriage assembly, renew the brake linings.

The Engine Handbook should be consulted regarding any necessary overhaul work on the engine.

Check carefully the cowling, exhaust system, cabin heating, carburettor heating and ducts, since vibration can cause fractures in them.

2.3 Non periodic inspections

The Tandem-Falke requires only a daily inspection (see page 10 of Flight Manual). After any unexpected incident such as a trailer accident, a heavy landing, or a field landing the motorglider should be checked thoroughly for damage. Check all vital fittings for paint cracks which might indicate that the aircraft has been overloaded.

2.4 Authorized repairs

The type sheet states: "Major repairs may only be undertaken by the manufacturer. In exceptional cases major repairs may be undertaken by suitably qualified bodies, but only with the express consent of the manufacturer."

Minor repairs may be carried out in consultation with an approved inspector.

2.5 Landing gear and brake

The Tandem-Falke has a single mainwheel undercarriage with Tyre 8.00 x 4, pressure: 26 lbs/sq. in.

Tailwheel: 210 x 65 mm tyre. pressure: 37 lbs/sq. in.

Outrigger wheels: 200 x 50 mm tyre. Pressure: 37 lbs/sq.in

The hub bearings of all wheels are sealed for life and require no maintenance.

3. Equipment

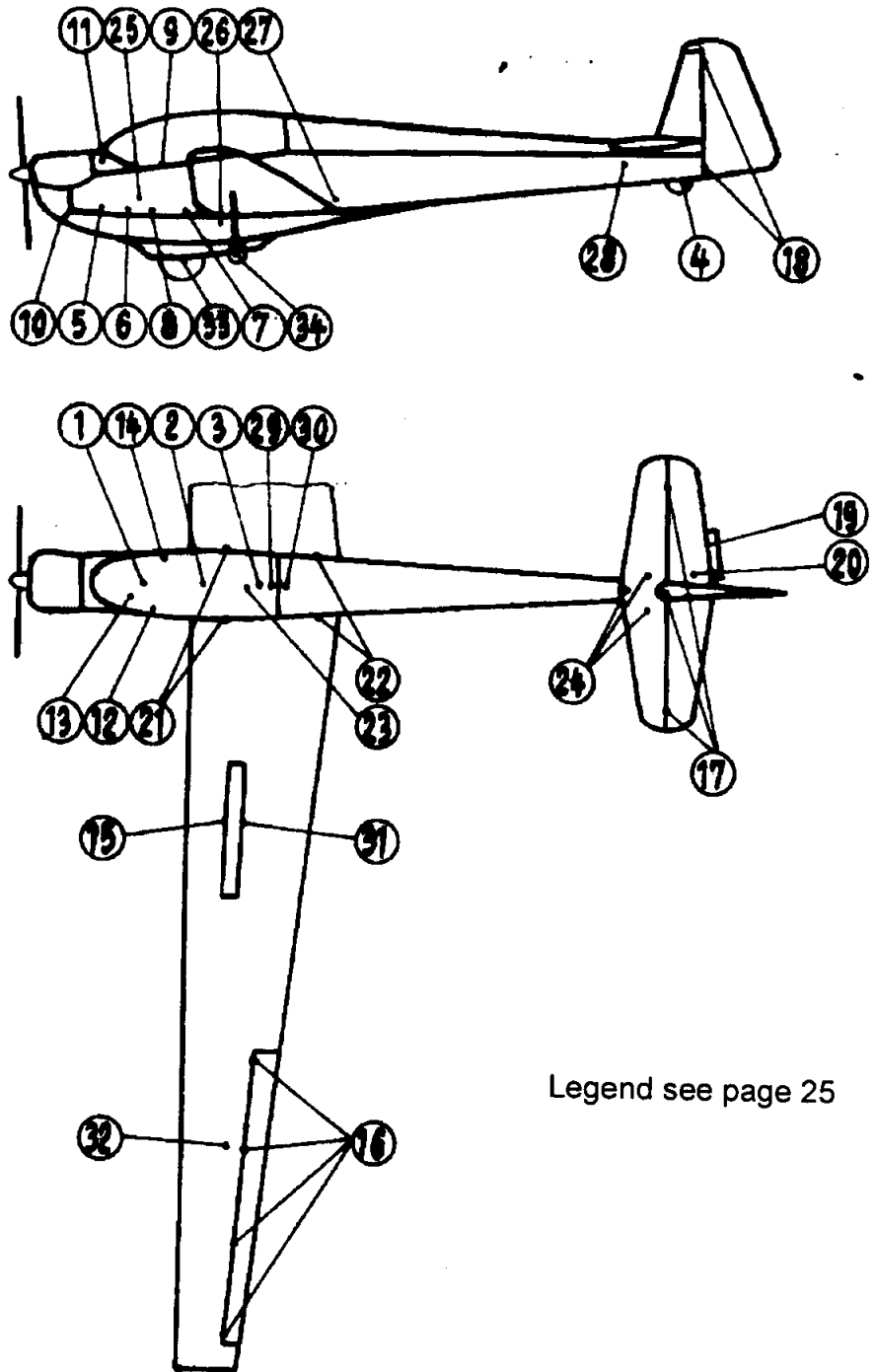
The minimum equipment is listed in the Flight Manual. A list of the equipment fitted will be found in the Tandem-Falke file which comes with the aircraft and also in the log book, as will also full details of dope and paint schemes. Operating manuals are delivered with the Tandem-Falke and all operation of the aircraft must be in accordance with them.

Seat and backrest cushions of the front seat should not be too wide.

Take care that the rudder pedals of the rear seat are clear of the seat cushions of the front seat.



Lubrication chart



Legend see page 25

Lubrication at annual inspection in addition to the above, the following items

are to be carried out all 200 landings, or 100 flight hours at a minimum before the annual inspection:

1. Control stick bearing in the front seat clean and grease
 2. Control stick bearing in the rear seat clean and grease
 3. Rear control bearing under the rear seat clean and grease
 4. Tail wheel pivot and axle; clean and grease
 5. Rudder pedal support front seat clean and grease
 6. Rudder adjustment front seat clean and grease
 7. Rudder support rear seat clean and grease
 8. Spoiler lever clean and oil (3x)
 9. Canopy lock and canopy supports clean and grease (5x)
 10. Cowlfap: Oil supports and Bowden cable
 11. Oil cabin ventilation
 12. Clean and grease throttle lever push rod (2x)
 13. Propeller pitch change push rod clean and grease
 14. Trimmer push rod clean and grease
 15. Oil spoiler hinges
 16. Oil aileron hinges (4x at each wing)
 17. Oil elevator hinges (3x)
 18. Oil rudder hinges (2x) cable connecting points (2x)
 19. oil trim flap hinges (3x)
 20. Clean and grease trimmer Bowden cable and trim flap lever.
- Following items: Clean and grease before each rigging of the motorglider.
21. two front wing to fuselage connecting bolts
 22. two rear wing to fuselage connecting points.
 23. Main pin clean and grease
 24. Elevator supports clean and grease (3x)

For the annual inspection following additional work are necessary:

1. Control stick bearing in the front seat clean and grease
2. Control stick bearing in the rear seat clean and grease
3. Rear control bearing under the rear seat clean and grease
25. Front push rod (aileron and elevator) of the controls clean and grease
26. Rear push rod (aileron and elevator) of the controls clean and grease
27. Short elevator push rod clean and grease
28. Long elevator push rod clean and grease
29. Aileron deflector lever inside the fuselage clean and grease
30. Pulleys of Spoiler cables clean and grease
31. Spoiler lever in the wings clean and grease
32. At the connecting point of the short aileron push rod clean and grease (5x)
33. Mainwheel bearings clean and grease (2x)
34. Outrigger wheels clean and grease axle and bearings
16. Remove ailerons, clean and grease hinges
17. Remove elevator, clean and grease hinges
18. Remove rudder, clean and grease

Electric Wiring Diagram

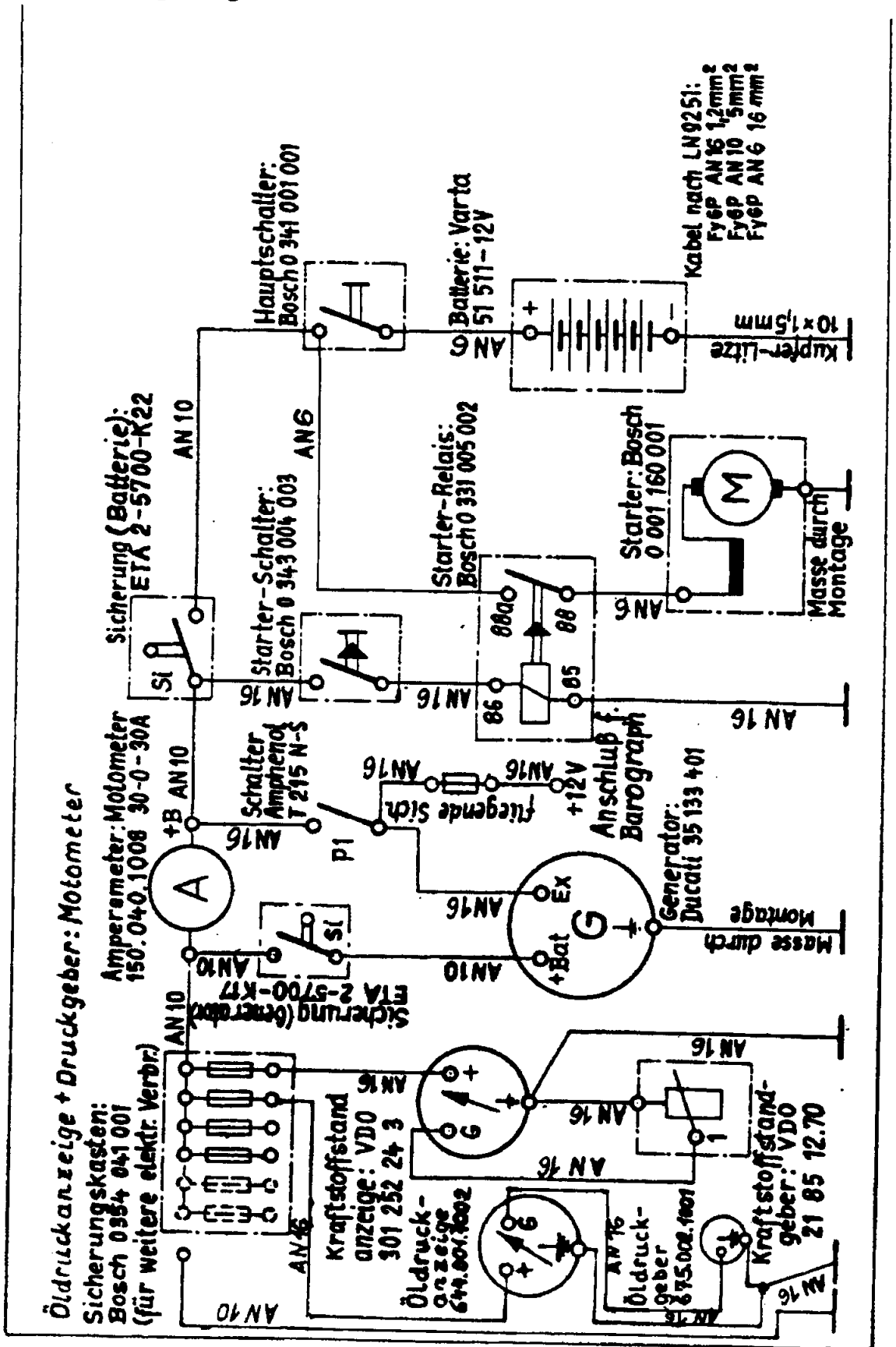
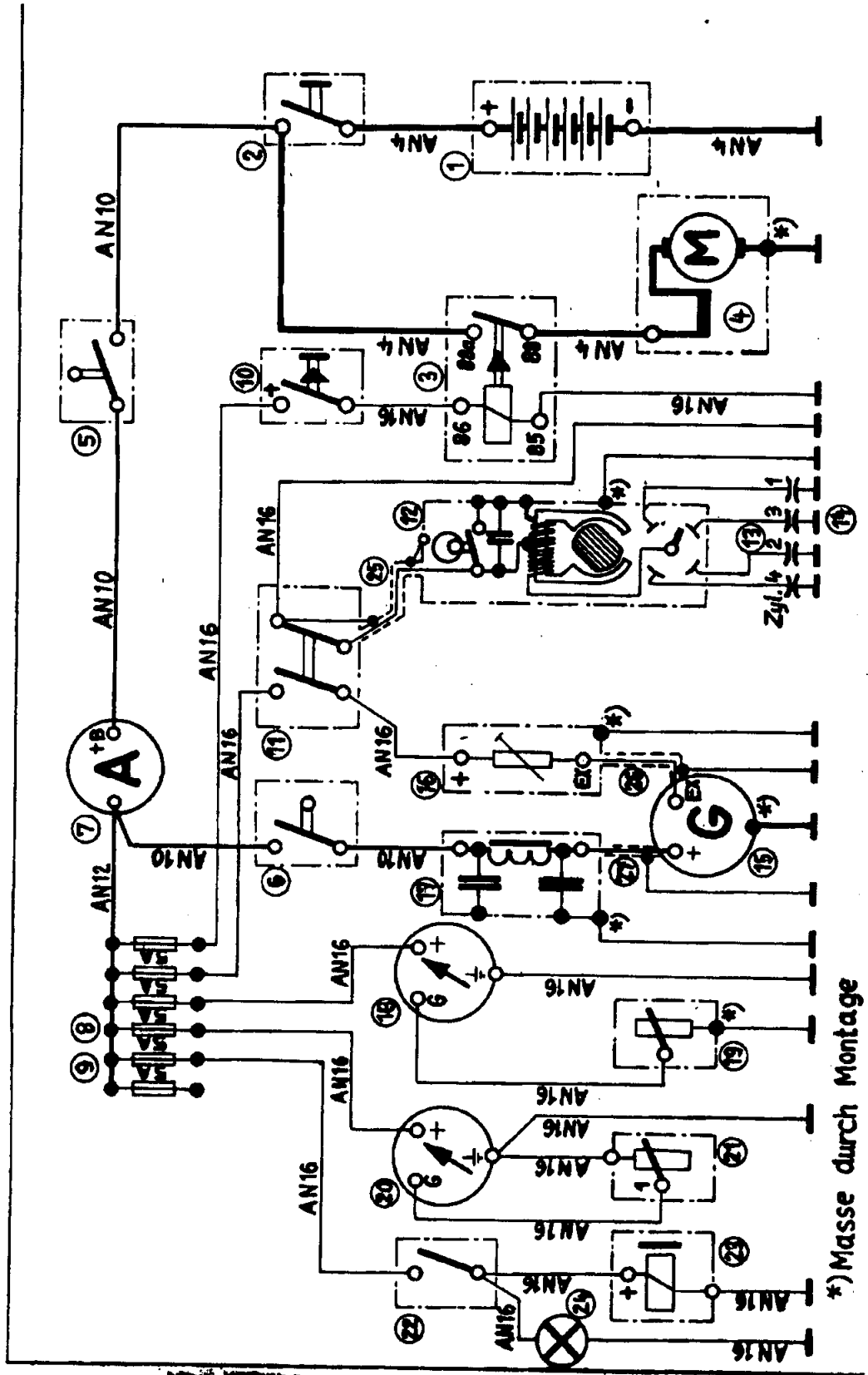


Diagram Details

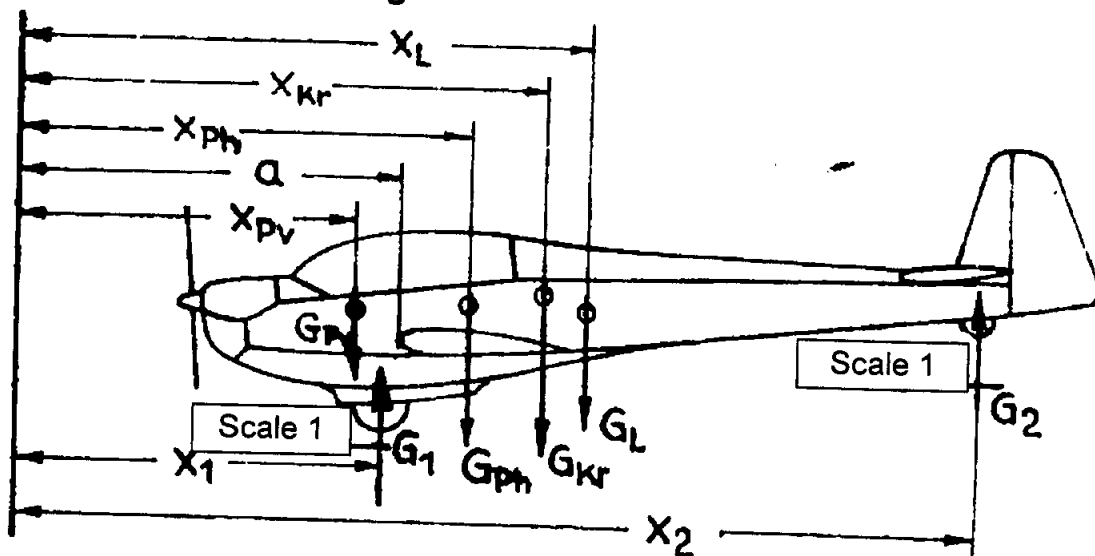
- 1 Battery: Berga or Varta 51511; 51612
- 2 Master switch: Bosch 0 341 001 001
- 3 Starter relay: Bosch 0 331 005 002 or
0 332 002 102; 0 333 006 004
- 4 Starter motor: Bosch 0 001 160.001
- 5 Safety cut out (Battery): ETA 2-5700-K12 25 A
- 6 Safety cut out (Generator): ETA 2.5700-K12 20 A
- 7 Ammeter: Motometer 150.040.1008; 615.052.1011
- 8, 9 Fuse holder Schurter FEP 031.1001
Fuse insert: (5 x 20 mm): Schurter FSF 034.15.
- 10 Starter switch: Bosch 0 343 004 003
- 11 Ignition switch: APR Schaltronic 6-646 N; Amphenol T 215 N - S
- 12 Magneto: Slick 4230 or Bendix S4 RN 21
- 13 Ignition harness: Slick High Temperature Harness
- 14 Spark plugs: Bosch WB 240 ERT 1
- 15 Generator Ducellier 7522
- 16 Regulator Wehrle DU506 14V or Ducellier 8347
- 17 Filter (Option): Hisonic Cessna S - 1629 - 1
- 18 Oil pressure gauge (option): Motometer 644.001.1002
- 19 Oil pressure sensor (option): Motometer 675.002.1001
- 20 Fuel gauge (option): VDO 301 252 24 3;
- 21 Fuel sensor (option) (For 55L tank): VDO 21 85
- 22 Switch (option): APR Schaltronic 6 - 631 N
- 23 Fuel pump (option): Hardi 8812 HZPR
- 24 Indicator light (orange) (option): Bosch 0 310 152 005 with lamp (12 V 2W):
Bosch/Osram 3898
- 25 Short circuit line: RG 58 C/U or 26
- 26 Screened cable 1.2 mm² LN 9252 FYGCP AN16
- 27 Screened cable: 5 mm² LN 9252 FYGCP AN10
LN 9251 Cable (according MIL-W-5086/2)
FYGP AN 12, 1,2 mm²
FYGP AN 12, 3 mm²
FYGP AN 10, 5 mm²
FYGP AN 4; 22 mm²



Electric Wiring Diagram



*) Masse durch Montage

Informations for balancing C.G.

To weigh the motor glider to establish the empty weight centre of gravity position, set up the aircraft on the scales such that the underside of the wing at Rib 6 (2.02 metres = 79,52 inches) from the centre line is horizontal. With the aircraft at this attitude a plumb line is dropped from the leading edge of the wing at Rib 0 (0.33 metres = 12,99 inches) from the centre line. Two metres (78.72 inches) in front of this point is the CG datum plane from which are measured X_1 and X_2 , the distance of the undercarriage axles. The wheels are supported on the scales which are used to determine weights G_1 , and G_2 .

The distance of the empty weight CG from the datum plane is determined by the formula:

$$X_L = \frac{G_1 \cdot X_1 + G_2 \cdot X_2 - G_{Kr} \cdot X_{Kr}}{G_1 + G_2 - G_{Kr}}$$

Use kg and cm for this calculation.

X_{pV} = Pilots moment front seat =	176cm (69,29 in)
X_{pH} = Pilots moment rear seat =	265 cm (104,33 in)
X_{Kr} = Fuel moment =	333 cm (131,10 in)
G_{Kr} = Weight of fuel: litres x 0.73 kg = weight in kg.	

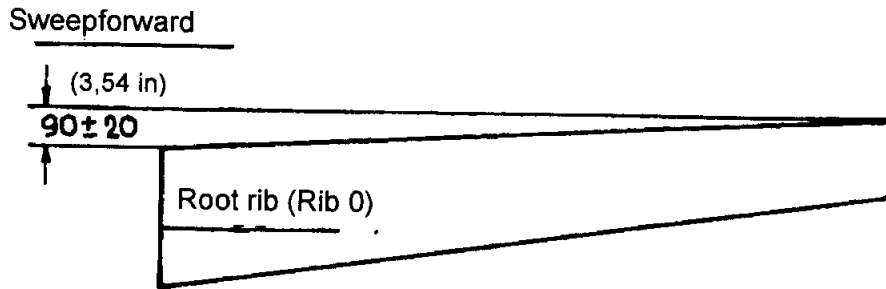
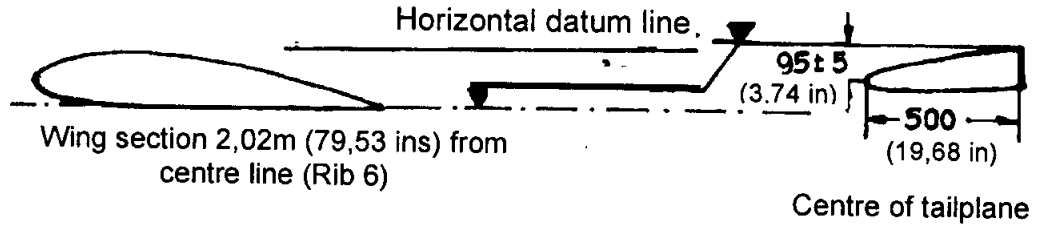
If the tank is empty then G_{Kr} and $G_{Kr} \cdot X_{Kr}$ are omitted.

Centre of gravity limits for various empty weights are stated in page 18 of the Maintenance Manual.

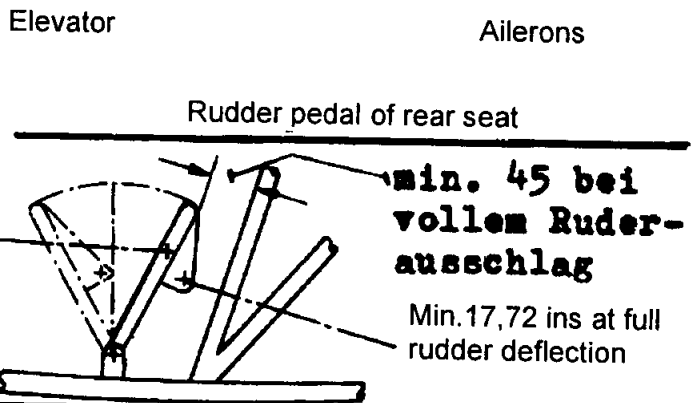
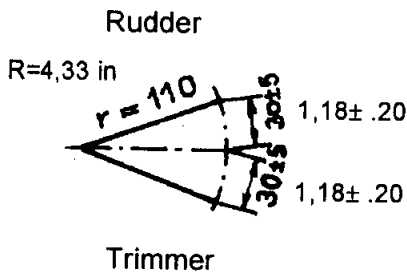
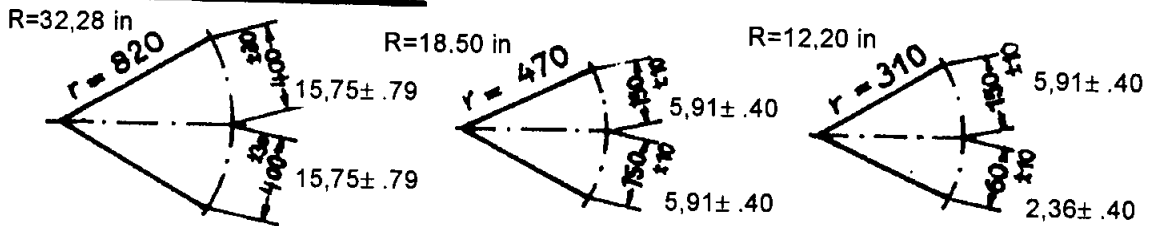
The values given in the diagram for X_L - CG apply to motor gliders with an empty tank as calculated from the above formula for X_L - CG and without outrigger wheels.



**Adjustment of control deflections-
Wing / Fuselage / Tailplane arrangement**



Control surface deflection

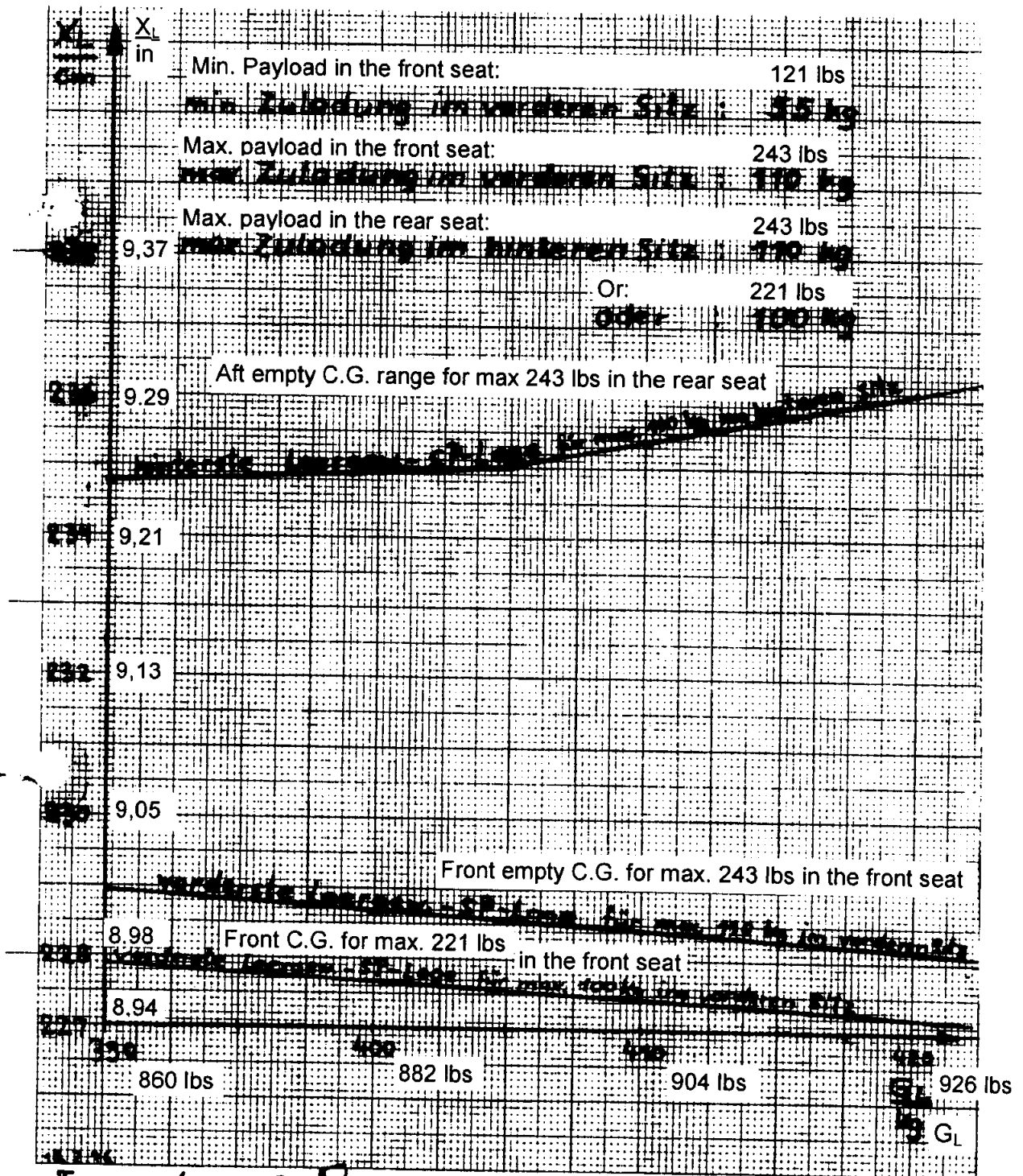




Date	Empty weight	Max. payload	Empty C.G.	Inspector



Empty weight C.G. ranges



F. 15.6.76. *[Signature]*