ALEXANDER SCHLEICHER SEGELFLUGZEUBAU

D - 6416 Poppenhausen / Wasserkuppe

Flight and Operations Manual

for the Sailplane Model

A S W 2 0

===========

July, 1977 Edition

This manual is always to be carried on board !

It belongs to the sailplane A S W 2 0

Serial No.	20058
Registration No.	BGA 2565
Owner :	....
	....
	....
Manufacturer :	Alexander Schleicher Segelflugzeugbau D-6416 Poppenhausen

This manual is the translation of the German original which is approved by the Federal Office of Civil Aeronautics of the Federal Republic of Germany (LBA). The translation has been done by best knowledge and judgement.

In any case the original text in German language is authoritative.

Contents

3. Appendix

Amendments to the Manual

No.	Title	Page	Date, Signature
[illegible]	PREVENT P.I.O.	[illegible]	2/1/88 [illegible]

1.1 Preface

The ASW 20 has been licensed according to the 'Airworthiness Requirements for Sailplanes and Powered Sailplanes' (LFSM), issued on November 1, 1975.

Contrary to earlier requirements (BVS and LFS), some major modifications have to be observed.

Please notice that the minimum safety factor is 1,5. The safety factor is the proportion of ultimate load against limit load.

This points to important consequences for the flight operations :

Breaking loads will be reached either by exceeding the permissible loads by 50% or by exceeding the permissible speeds by a $\sqrt{1.5}$ = 1.22 factor, in other words by only 22%. Therefore the stated placard speeds must be observed at all times.

One major difference is that the new regulation requires a speed limit for strong air turbulence. The new LFSM requirement considers a 15 m/s (3.000 feet per minute) up or down gust .

For easier understanding the following examples are given :

1. From a 5 m/s downdraft you enter a 10 m/s upcurrent (this is a + 15 m/s gust), or from a 10 m/s upcurrent you step into a 5 m/s downdraft (this is a - 15 m/s gust).
2. From the downdraft of a rotor of - 8 m/s you get into its upcurrent of + 7 m/s (this is a + 15 m/s gust).

This turbulence can be absorbed by the sailplane an long as the pilot does not charge it by additional loads due to unintended control deflections.

The airworthiness requirement does not include gust and manoeuvre loads simultaneously.

Gliding and meteorological literature show even stronger turbulence (in cumulo-nimbus clouds e.g.) so that max. speed for 'strong turbulence can be too high in extreme situations.

At manoeuvring speed full control deflections can be applied, but only 80% of the deflections are allowed for elevator and rudder simultaneously.

As mentioned above the requirement does not cover gusts and manoeuvre loads at the same time. Therefore aerobatic manoeuvres are not allowed in noticeable turbulence.

At redline speed the sailplane can absorb either + or - 7,5 m/s gusts (this is the transition from 3 m/s downdraft into 4,5 m/s lift), or one third of the possible deflections can be applied.

Again gust and manoeuvre loads cannot be absorbed simultaneously.

Airworthiness requirements are nothing more than a great amount of aviation experience gathered to the present time and are continuously developed by designers and aviation authorities in co-operation.

It is assumed that sailplanes are operated with good Judgement as in all areas of aviation.

A short chapter of aerodynamics for pilots of flapped sailplanes.

The introduction of so-called 'laminar' airfoils in the sailplane design - specially together with fibreglass structure - has resulted in great improvements of sailplanes during the last 20 years. For sailplanes with rigid profiles - that means without flaps - the profiles used provide moderate laminar effects for the whole angle of attack range, from thermalling up to high speed cruise at 150 to 180 km/h.

In order to reduce drag laminar airfoils have been developed for modern sailplanes, they extend the laminar boundary to a greater part of the wing surface. The disadvantage of this method in that the lower drag can only be achieved for a smaller range of angle of attack. By the flap movement, however, this range of low drag can be shifted up to the point where it in needed at the momentary flight condition.

Please notice that the angle of attack against the airflow is the determinative figure for the flap position and not the flying speed.

In order to calculate the speed to fly for a given angle of attack, the altitude, the load factor (g-load), and the wing loading of the sailplane must be known in addition.

The effect of the altitude may be neglected, since the airspeed indicator always shows an airspeed reduced to m.s.l.

Every pilot knows from his instruction time that the minimum speed goes up in steep turns or when loading the aircraft with ballast (fuel, flight instructor). In conformity to the same law as the minimum speed the speed ranges of the single flap settings do also shift by changement of the wing loading and/or the load factor.

The following table will show to you the coherencies. The data stated are based on performance measurements.

Flap Pos 4½

		+55°	+9°	0°	-6°	-11°
W/S lb.p.sq/ft	Load factor	Min. Speed (knots) Flap Pos. 5	Low Drag Speed Range [knots]			
			Flap Pos. 4	Flap Pos. 3	Flap Pos. 2	Flap Pos. 1
6.75	0 5	26	27 - 30	30 - 41	41 - 50	above 50
	1	36.5	38 - 42.5	42.5 - 58.5	58.5 - 71	above 71
	1.3	41.5	43 - 48.5	48.5 - 66.5	66.5 - 81	above 81
	2	51	53.5 - 68.5	68.5 - 82.5	82.5 - 101	above 101
8.85	0.5	29	31 - 34.5	34.5 - 47	47 - 57	above 57
	1	41.5	43 - 48.5	48.5 - 66.5	66.5 - 81.5	above 81.5
	13	47.5	49 - 55.5	55.5 - 75.5	75.5 - 92.5	above 92.5
	2	59	61 - 78	78 - 94.5	94.5 - 115	above 115

Flap Pos 4½

		+55°	+9°	0°	-6°	-11°
W/S (Kg/m^2)	Load factor	Min. Speed (kph) Flap Pos. 5	Low Drag Speed Range [knots]			
			Flap Pos. 4	Flap Pos. 3	Flap Pos. 2	Flap Pos. 1
33	0 5	48	50-56	56-76	76-93	above 93
	1	67.5	70-79	79-108	108-132	above132
	1.3	77	80-90	90-123	123-150	above 150
	2	95	99-127	127-153	153-187	above 187
43	0.5	54	57-64	64-87	87-106	above 106
	1	77	89-90	90-123	123-151	above 151
	13	88	91-103	103-140	140-171	above 171
	2	109	113-145	145-175	175-213	above 213

Now these above-mentioned coherencies should not confound the ASW 20-pilot nor make him give up because it is too complicated. There is a very simple method of estimating the correct flight attitude.

The flap has been designed such that the change in angle of attack produced by flap deflection just compensates for the difference in angle of attack which results from the new flight attitude. This means that the fuselage and tailplane always remain almost parallel to the airflow.

Since the glide angle is very flat for the whole speed range of the ASW 20, the relation of the ship to the horizon remains the same for load factor 1 (1g) provided that the flaps are used properly, A simple pitch indicator will move only in a small range, even in turns and other accelerated manoeuvres, and, therefore, is a good control instrument for the low drag angle of attack. (This is, however, not true for flap Position 5 or for extended air brakes because in this case you are intentionally leaving the aerodynamically optimum ranges in order to produce more drag).

The table also shows the control actions for some flight manoeuvres.

Principally, a flapped glider has two pitch controls : flaps and elevator. However, only one combination of both control settings results in optimum performance for a given flight attitude.

Case 1

Acceleration from thermalling to fast cruise :

According to the law that energy remains constant we can only pick up speed (kinetic energy) by giving away altitude (potential or static energy) with regard to the air around us. This is only possible by reducing our g-load (or load factor , below 1.

For thermalling our speed was 85 km/h and n = 1.3 (because of 40° bank) in flap position 4. Now we want to accelerate downwards (n = 0.5) and, pursuant to our table, therefore simultaneously must reduce bank and put the lever at least into No. 3 position, but as soon as our speed exceeds 92 km/h we must even put the flap lever into position No.2. If we now do not do anything else, the static stability of the sailplane will balance out at approximately 130 to 160.km/h and load factor 1. If we want to fly faster, we have to set flap position No.1.

The stick shows only little movement during the whole manoeuvre which manifest itself also by the fact that the trim hardly needs to be adjusted. With a conventional rigid profile wing the whole trim range would be needed for such a manoeuvre.

Case 2

Pull-up into a thermal from very high speed (wing loading 3 kp/m^2) :

From fast cruise of 200 km/h (1g) a pull-up into a thermal shall be done. This is impossible without increasing the load factor. Since turbulence is to be expected, a mild 1.3 g – pull-up should be initiated.

Looking at our table we find that flap position 1 still should be set for load factor 1.3 and 200 km/h.

The pull-up is initiated by slightly pulling the stick. At about 183 km/h flap position 2 is set. The sailplane meanwhile climbs so rapidly that no further pulling is necessary and a straight climb at load factor 1 is following. Flap position 2 can be maintained down to 130 km/h, then flap position 3 is set.

To finish the climb, we are shortly setting flap position 2 which is reducing the load factor to about 0.5, then bank is applied and simultaneously the flap lever is shifted to position 4. The stick position is again the same during the whole manoeuvre and the trim needs only slight adjustment.

- In a flapped sailplane the flap handle is the more active pitch control whereas the stick is more or less a correcting control.

- The flap handle directly controls the wing lift and is, therefore, much more sensitive than a conventional elevator which through rotation of the aircraft changes the angle of attack, and thus relatively slowly changes the lift.

- At high speed flight of above approximately 180 km/h the pitch is merely controlled by elevator movement, since flap position 1 covers more than the angle of attack range which is necessary.

For low altitude flights (approach, slope soaring, finish gate low passes) and when thermalling together with other sailplanes you absolutely have to leave off the operation of the flap handle because of the sudden altitude changes which are hardly to calculate.

1.2. Operating Handles, Placards and Nomenclatures

Stick with wheel-brake lever and transmitter button (optional).

Rudder pedal with longitudinal adjustment.

Rudder pedal adjustment : grey knob RH of control stick

To move pedals back :
Take load off pedals and pull back. Release control knob suddenly and put slight pressure on pedals to adjust them.

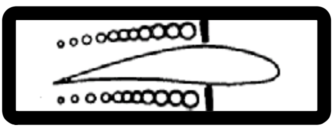
To move pedals forward :
Pull knob and simultaneously push pedals forward. Release control knob suddenly and lock in place by putting slight pressure on pedals.

Flap control : Black lever on upper LH cockpit wall.

Marking of the essential flap positions by numbers 1, 2, 3, 4, and 5 below the flap lever.

Flap lever in high position

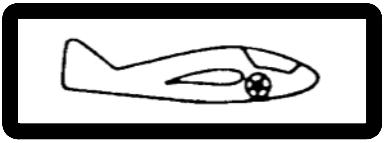
Flap lever in landing position



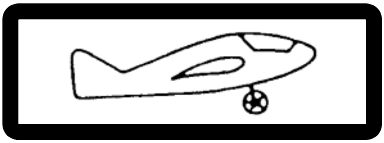
Air brakes (spoilers) Blue lever on LH cockpit wall. Extending of air brakes by pulling lever backwards.

Trim noseheavy:
press together the green trim knob (left cockpit wall) and push forwards.

Trim tailheavy:
press together the green trim knob and push backwards.



Landing gear retracted :
Black handle on lower LH cockpit wall pulled back.

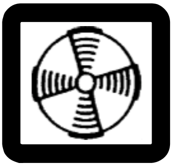


Landing gear extended

Tow release :
Yellow knob LH of stick

Open canopy :
Move white knobs LH and RH on upper side of canopy frame forward.

To jettison canopy:
Pull red handle above instrument panel; the normal canopy locking mechanism must be opened before !!!



Ventilation :

Light blue knob above LH area of instrument panel. Knob pulled = Open

Additional ventilation : Intake in sliding window

Water ballast :

Dark blue lever LH and RE on upper cockpit wall. To open valve move lever forward.

Note : LH lever for left wing tank, RH lever for right wing tank.

<u>Anchoring point for parachute static line :</u>

Red ring on main bulkhead

Serial number and Type Plate:

A . Schleicher
6416 Poppenhausen

Muster : AS - W 20
Werk Nr. 20 XXX
Kennz :
Made in West Germany

loading of baggage compartment

**Loading of baggage max.
Compartment 15kp [33lb]**

Data Placard and loading scheme:

Segleflugzeugbau A. Schleicher Poppenhausen

Type: *S. No.*

Data plate

Permission For:

Winch Launch	up to	
Aero tow	up to	
Max. speed	up to	
Maneuvering speed	up to	
Max. speed for flap pos.	1	
Max. speed for flap pos.	2	
Max. speed for flap pos.	3	
Max. speed for flap pos.	4	
Max. speed for flap pos.	5	
Gear down	up to	

Weight and Balance

single	max.		min.	
dual				

Max. permisible all up weight	

1.3.

Operation Values and Limitations

Maximum indicated airspeeds

(equivalent airspeeds are about 5 % higher, see page 49)

(below 3000 a m.s.l. / 9000 feet m.s.l.*)

For flap position 1	265 km/h	143 knots
For flap position 2	200 km/h	108 knots
For flap Position 3	200 km/h	108 knots
For flap position 4	160 km/h	86 knots
For flap position 5 (lan-	120 km/h	65 knots
In rough air **	180 km/h	97 knots
With full control deflec-tions (manoeuvre speed)	175 km/h	94 knots
For winch and auto tow	120 km/h	65 knots
For aerotow	175 km/h	94 knots
For extending landing gear	175 km/h	94 knots

For this purpose the following coloured calibration markings appear on the airspeed indicator :

	km/h	Knots
Red line at	265	143
Green range between	90 - 180	48,5 - 97
Yellow range between	180 - 265	97 - 143
White range between	85 - 200	46 - 108
White marking WK5 at	120	65
WK4 at	160	86
WK2 & 3 at	200	108

The yellow at 90 km/h shows the recommended approach speed for landing.

* Please note : The in-flight flutter tests are done at about 2,500 m to 3,500 m m.s.l.

Since the airspeed indicator reads too low values at increasing altitude, the critical flutter speed , however, is more or less determined by true airspeed for light aircraft, the following speed limits are valid for high altitude flights

Altitude		Max. Speed (indicated)	
meter m.s.l.	feet m.s.l	km/h	Knots
0-3,000	0-10.000	265	143
5,000	16,400	240	130
7,000	23,00	215	115
9,000	29,500	195	105
11,000	36,000	170	92
13,000	42,600	145	78

If the above limited values are not exceeded, the true airspeed will be constantly 315 km/h above 3000 m / 10000 feet m.s.l. and thus is high enough to face the strongest wind in wave flight.

** Please note : Rough air, according to airworthiness requirements, is turbulence found in wave rotors, thunderstorm clouds, dust devils and when skimming mountain crests. An experienced pilot will know that he must be aware of even stronger turbulence in thunderstorms or in alpine regions.

Weights (masses)

Empty weight with min. equipment	~ 255kg / 565lbs.
Max. all-up weight	454kg / 1000lbs.
Max. weight of non lift producing	235kg/ 518lbs.
Components.	
Permissible water ballast	max. 120kg / 265lbs
(depending on cockpit load)	or 32 USGals.

See table on page 20.

Weak link in towing line

600 kg (1320 lbs) for auto / winch and aerotow

In Flight Centre of Gravity

Datum point is the leading edge of the wing root rib (without the fillet of the wing - fuselage fairing).

The horizontal reference line is the centre line of the fuselage tail cone or a 1000 : 45 wedge template levelled out on the top side of the fuselage aft portion (see the page "Rigging Data" in the appendix).

In flight centre of gravity range is from 240 mm (9.45 inch) to 360 mm (14,17 inch) behind datum.

Cloud flying

The sailplane is suited for cloud flying.

Flights under icing conditions are not recommended, specially if the glider has been wet before climbing through the icing level. Experiences have shown that in the area of the rather narrow control gaps, any rain or condensation drops dry off relatively slowly and turn to ice when climbing above the freezing level. Therefore, one has to face a stiffening of the controls, leading to blocked controls in extreme cases.

Isolated climbs above the freezing level with a dry sailplane did not lead to any stiffening of the controls, even though the leading edges of wings and control surfaces showed severe icing.

Flights with water ballast above freezing level should be avoided because of the risk of icing-up of the tank ventilation.

Therefore one has to face stiffening of the controls which is leading to blocked controls in extreme cases.

After one climb above the freezing level with a dry sailplane no stiffening of the controls is to be expected even if the leading edges of wings and control surfaces show severe icing

With water ballast flights above freezing level should be avoided because of the risk of icing-up of the tank ventilation

Aerobatics

The 16,59 m span version of the ASW 20 L. is not approved for aerobatics. For aerobatic manoeuvres with the 15 m span version see page 32.

Seating position:

1. Do not use soft seat or back cushions which are thicker than 2 cm.
2. The backrest must be adjusted such that the pilot is seated with his head just below the canopy and as far forward as possible. When the stick is in the normal position (trim 10 mm off the front edge of the slotted gate), the upper arm should rest against the body while the elbow rests an the upper thigh. Such a comfortable seating position is preventive against PIO (pilot induced oscillations).

Extreme Pilot Sizes

Tall pilots may fly without the adjustable seat rest, however, they have to use a stiff cushion that levels the edge of the tow hook fairing and the box of the wheel.

Prior to the first start the sailplane must be put. on stands and - with a pilot sitting in the cockpit - it has to be checked that the parachute does not press so hard against the cockpit rear wall that the landing gear can only be pulled up by severe forces. If this is the case, the rear wall must be reinforced by a piece of wood from the outside.

Tall pilots should also use gym shoes with heels as low as possible so that they can use the most forward pedal position. Small pilots should check prior to start if they can apply full rudder deflections and if they cannot fall off the pedals with their feet. If necessary, a board with a support for the heels can be installed on the pedals.

Do not use soft (lead or sand) seat cushions. We recommend to use only trim weights in the fuselage nose and seat cushions made from a foam which cannot be compressed (Styrofoam, Conticeil or safety foam like Dunlopillo etc.).

Limit Load Factors

Span	16,59m	15,00m
Max. positive load factor + 5.3 Max. negative load factor - 2.65	165km/h 89kn.	175km/h 94kn.
Reducing proportionally with airspeed to		
Max. positive load factor + 4.0 Max. negative load factor - 1.5	250km/h 135kn.	265km/h 143kn.

1.4. Weight and Balance Information

Payload in cockpit (pilot plus parachute) :

minimum 70 kg (154 lbs)

maximum 115 kg (253 lbs)

For possible exceptions see page 31

If the useful load is below the minimum, the shortfall below the minimum payload must be made good by the addition of trim weights in the fuselage nose (this is available as an optional extra, see page 22).

We recommend that inexperienced pilots and/or pilots who fly this model for the first time, do not make their first flights with the rearmost C.G. position, i.e. they should not go for a just still acceptable minimum payload, but should stay approx. 10 - 15 kg above the minimum useful load in the pilot seat.

Light pilots should fix about 4 trim discs more than the actually required minimum.

Loading of Water Ballast

(only for 15 m span version)

The maximum all up flying weight of 454 kg (1000 lbs.) must not be exceeded. For the determination of the proper amount of water ballast the following table may be used :

The loading of the baggage compartment has no significant effect on the CG location. It must not, however, be loaded by more than 15 kg (331 lbs). Hard objects weighing more than 1 kg (2.21 lbs) should be carefully secured in the baggage area in order to prevent accidents.

Loading of Water Ballast :

The maximum all up flying weight of 454 kg (1000 lbs.) must not be exceeded. For the determination of the proper amount of water ballast the following table may be used :

Payload [lb] for Pilot + Parachute

Empty Weight [lb]

see page 31

	150	175	200	225	250
525	full	full	full	30	27
550	full	full	30	27	24
575	full	30	27	24	+
600	30	27	24	+	+
625	27	24	+	+	+

Water Ballast in US Gallons

\+ *These weight combinations exceed max. permissible weight of non lift producing components.*

Payload [kp] for Pilot + Parachute

Empty Weight [kp]

see page 31

	65	75	85	85	105	115
240	voll	voll	voll	voll	109	99
250	voll	voll	voll	109	99	89
260	voll	voll	109	99	89	79
270	voll	109	99	89	79	+
280	109	99	89	79	+	+

As an option the ASW 20 can be equipped with a pin in front of the rudder pedals which allows the installation of interchangeable trim weights.

These trim weights are recommended if the sailplane is flown by several pilots of more than 20 kg (45 lbs.) difference in weight.

By the installation of a permanent lead trim weigh in the tail above the tail skid the glider is trimmed in such a way that the heaviest pilot gets an in flight C, of G. of about 0,3 m behind datum. This is causing, of course, an increase of the minimum permissible cockpit payload so that a light-weight pilot cannot fly the sailplane without additional ballast.

In order to avoid the taking along of heavy and unwieldy lead cushions a light-weight pilot shall install trim-discs at the bolt in front of the pedals

The lead discs weigh 1 kg (2.2 lbs.) each. Since the weights are installed so far forward in the sailplane, they have 2.5 times the effectivity.

of the same mass in the seat.

If 1 kg is installed in front of the pedals, the minimum cockpit payload is by 2.5 kg (5.51 lbs.) lower; if 2 kg (4.4 lbs.) are installed, the payload is by 5 kg (11.02 lbs.) lower, and so on

Remark (Important !) :

1. Only 7 weights, i.e. 7 kg, are allowed to be installed at the fittings.
2. The nut must be properly fixed and checked for every take - off. It must be safetied with a safety pin.
3. If the minimum cockpit payload trimmed by the ballast weights is exceeded by more than 30kg (66 lbs.), i.e. if a heavier pilot wants to fly again, the trim weights have to be removed.

The inner cockpit wall at the right hand side must show the following placard :

Minimum Cockpit Load without Trim Weight kg (lb.) *1 Trim Disc is equivalent to 2,5 kp (5lb) Cockpit Load*
Check Weight and proper fixing to Trim Discs prior to Start.

1.5. Minimum Equipment

Airspeed indicator with 50 to 300 km/h range
(25 to 160 knots, 30 to 190 mph),

Lap and shoulder straps,

Parachute or back-cushion at least 6 cm thick (2.5 inches) when compressed,

Altimeter.

Additional minimum equipment for cloud flying :
Turn and bank indicator,
Compass,
Transceiver (Federal Republic of Germany only)

Experience to date has shown the pitot pressure system for the airspeed indicator satisfactory for cloud flying.

If the compass cannot properly be compensated on the instrument panel, it should be mounted either above the control stick or on the right cockpit wall in the area above the map pocket.

Instruments which weigh more than 1.000 grams (2.2 lbs.) should not be mounted solely with the 4 instrument screws, but should be braced against one or possibly several of the rubber buffers.

It is strongly advised to use only instrument panels made from fibreglass. Panels made from other materials might, in the case of crash landings, lead to serious injuries.

An equipment list of approved or suitable instruments for the minimum equipment can be found in the annex of this manual (see page 47a and 47b).

1.6. Emergency Procedures

Recovery from spins according to (German) standard procedure

(1) Apply opposite rudder, i.e. against the direction of rotation of the spin.
(2) Short pause.
(3) Ease the control column forward, until the rotation ceases and sound airflow is established again.
(4) Centralise rudder and allow sailplane to dive out.

Remarks :

1. Recovery from spin can be easier achieved, if the flaps are set in negative position (handle forward). Extending the airbrakes (spoilers) slows down rotation speed, but needs more height for recovery and, therefore, is less recommended.

2. If the ASW 20 recovers itself from spin, it starts a spiral-like sideslip with high increase in speed. Recovery from this flight attitude is done by usual control movements (opposite rudder and reducing bank by use of ailerons; approx. half travel of controls is needed).

Emergency Bailout

(1) Open (white) canopy locks.
(2) Pull red canopy emergency release knob and push canopy upwards.
(3) Open safety harnesses.
(4) Try to push yourself away from the sailplane. Watch the tailplane !

Jammed Elevator Control Circuit

A jammed flap control system will convert the ASW into a 'rigid profile' sailplane. However, not every pilot will remember that he still has pitch control by use of flaps even though the elevator control circuit is jammed. Thus he probably still can improve his situation for an emergency bailout or even avoid bailout entirely.

1.7. In Flight Information

Instructions for rigging and derigging are given on pages 32 to 34.
After rigging it is advisable to check all controls, dive brakes, wheel brake, and tire pressure.
Even when the sailplanes is hangared it must be preflighted by checking all controls. According to experience hangared sailplanes are subject to hangar switching damages and are endangered by small animals.

Winch Launch

Maximum winch launch speed is 120 km/h (65 knots 75 mph). Recommended flap setting is No.3 (0°)When the trim lever is in the centre or in slight back position, the sailplane lifts off by itself and takes to a moderate climb. When safety height is reached, slight back pressure can be applied.

The landing gear can only be retracted after the tow.

Winch tows with water ballast are only recommended with more than 10 knots headwind.

There is a strict warning :
No tailwind tows on low powered winches !

Aerotow

Maximum aerotow speed is 175 km/h (94 knots, 109 mph). Tested lengths for manila or nylon tow-ropes are within the 25 - 60 m (80 to 200 feet) range. For tows behind 180 hp or even stronger tow planes the tow-rope should be at least 40 m (130 feet) long.

For take-off roll flap position No. 2 (-6°) is recommended. After about 50 km/h (25 knots) have been gained, flap position No.3 (0°) or even No 4 (+9°) is applied for earlier lift-off.

Pilots with little experience on flapped sailplanes should use flap position No.3 for the whole tow.

The pilot should try to keep the tailskid on the ground until take-off. This means several advantages. Lift-off will be at the earliest possible time. The landing gear gets lower loads. The direction stability during ground roll is considerably improved. During flight tests aerotows with stronger than 25 knots crosswinds were demonstrated.

After take-off an altitude of about 5 feet should be maintained in order to avoid pitch oscillation because of ground effect and turbulence behind the towplane. Retracting of the landing gear is only allowed after release, since the landing gear doors cover the towing hook.

Free Flight

Because of the possibility of loading the ship with water ballast, the all up weight varies in a wide range.

The following speeds are given for an all up weight of 350 kg (772 lbs). The speeds for maximum all up weight of 454 kg (1000 lbs.) are given in brackets.

Minimum speed in level zero bank flight is :

For flap position 4	70 km/h or 38 knots
	(80 km/h or 43 knots)
For flap position 3	72 km/h or 39 knots
	(82 km/h or 44 knots)
For flap position 2	73 km/h or 39,5 knots
	(83 km/h or 45 knots)
For flap position 1	76 km/h or 41 knots
-	(87 km/h or 47 knots)

For flap position 5 (flaps 55° down, ailerons -8° up) minimum speed in level flight is :

66 km/h or 35,5 knots

(75 km/h or 40,5 knots)

Extending of the airbrakes (spoilers) <u>increases</u> minimum speeds by approx. 7 km/h or 4 knots.

In bankings the minimum speeds age increased. An increase of 10% is valid for 30° bank, 20% are valid for 45° bank.

About the proper use of flap settings this manual has already informed you at length in the preface page 8.

Maximum approved wing loading is not always the most favourable, the type of flight rather has to be considered.

For long distance flights ballast is not necessary, since the optimisation of weak morning and evening thermals matters and not a slightly increased cruising speed.

For speed tasks the following wing loadings are proposed :

0 to 1 m/s (200 feet per min.), flying weight should be al low as possible (wing loading below 33 kg/m or 6,75 lbs. per sq.ft.)

1,5 m/s (300 feet per min.), flying weight about 360 kg or 800 lbs. (wing loading 35 kg/m^2 or 7.2 lbs. per sq.ft.)

If the rate of climb is higher than 2 m/s (400 feet per min.), the ASW 20 should fly with max. all up weight of 454 kg (1000 lbs.).

Dangerous Flight Attitudes

The ASW 20 has an extremely harmless stalling flight which is indicated by large stick movements without noticeable speed change. The aileron effectivity, too, is noticeably weaker when stalling speed is reached. In all configurations approach to stall speed can be noticed by alight tail buffeting.

Even in stalled flight attitude (the vario will read 1,5 to 2 m/s sink in calm air, that is 300 to 400 feet per min.) ailerons and rudder work in the usual manner, as long as only half control deflections are applied. Full control deflections result in light wing dropping, whereas full deflected controls in opposite directions with stick pulled completely back will cause rapid wing dropping.

Initiated from turning flight wing dropping is more rapid than from level flight.

The loss in altitude for wing dropping is about 20 m (60 feet). For flap position 5 (landing position) loss in altitude can be 50 m until recovery, since the airflow may separate from the horizontal tail surface, if the elevator remains in full up deflected position. For recovery move stick in less pulled back position, until elevator effectivity is regained.

Only at rear C. of G, positions (near minimum cockpit load) the ASW 20 will not maintain a stationary stall with the stick hard back, but starts 'porpoising'.

Full deflections of rudder and aileron will cause wing dropping, opposite rudder and aileron deflections will lead to a spin. Wing dropping as well as spinning are terminated with the (German) standard procedure (opposite rudder and elevator neutral, see page 22).

If no corrective measures are taken, the sailplane will terminate the sideskid or spin by itself and will pass into a spiral-like side slip. This side slip can also be terminated with opposite rudder, before the ship eventually changes to a spiraldive with the typical build-up of high speeds.

At forward C. of G, positions the ASW 20 spins very steeply and starts spiraldive after less than one turn, whereas at rear C. of G. positions the gliders pitch becomes steeper and steeper after an initial flat and slow turn (approx. 30 negative pitch) until the transition into spiral dive develops after 5 to 7 turns.

Rain drops, hoarfrost, and icing deteriorate the aerodynamic flow and will cause a change in flight characteristics. Therefore, a safety margin of 10 km/h, 5 knots or 7 mph should be added to the above speeds for level flight and circling. These speeds must be regarded as minimum speeds.

Again we point out that the ASW 20 spins easier and flatter with positive (down) flap settings (4 and 5) than with negative (up) flap settings (2 and 1).

Therefore, setting the flaps in negative position is a measure to prevent wing dropping and spins. Because of the involved altitude losses (about 15 m or 50 feet) this is impossible near the ground or when thermalling in gaggles. Here only a safety margin in extra speed compared to minimum speed is good airmanship.

<u>Landing</u>

Lower tae landing gear in time, at the latest in 100 m (300 feet) altitude, and put the flap lever in position No.4.

The approach normally should be made at about 90 km/h or 48,5 knots (yellow ∇ at airspeed indicator), this speed should be trimmed. For turbulent air a correspondingly faster speed must be flown. Only if the pilot is very sure that he can make the threshold of his airstrip, the flap lever is moved to position No.5 (flaps 55 down).

Because of the enormous aerodynamic twist of this flap configuration (flap down, ailerons up) the performance of the sailplane is bad in this flap setting. By extending of the airbrakes (spoilers) the performance can be further reduced (glide ratio 4 in 1 at 85 km/h or 46 knots) so that very steep approaches are possible with headwind.

- For strong headwinds flap setting No.5 is not recommended because of the danger of landing short off the field.
- Those pilots having no experience with flaps for landings should only use flap setting 4 for headwind landings !

Setting the flaps from position No.5 back to position No.4 is not recommended near the ground because of the danger of loss in altitude. This manoeuvre should only be done after plenty of training at a safe altitude and in a very careful manner.

In flap position No.4 sideslipping is very effective with the ASW 20. At low bank and high yaw angles the loss in performance is great.

In flap position No.5 such great yaw angles are impossible.

Because of the good landing qualities which can be achieved by flap setting 5 in combination with the variable effectivity of the spoilers sideslipping is restricted to extreme situations (approaches in rain, snow-showers or into the sun), since then the landing field can be observed more easily through the slide window.

Therefore, landing with sideslip should be practised occasionally under good conditions.

Water ballast must be dumped before landing !

Semi Aerobatics

Besides spinning (only with normal to rear C. of G, limits more than one turn is possible) the following aerobatics are approved :

Loops, Stall Turns, Lazy Eight, and Chandelle, as well as combinations of these manoeuvres. Negative load factors are not certified. The flap control is actuated according to the remarks in the preface (see page 8). The speed limits for the different flap settings must be carefully observed.

Loop

A starting speed in the lowest point of about 160 to 180 km/h, 85 to 95 knots, or 100 to 112 mph is recommended. Flap setting No.1.

Stall Turn

A stall turn is started with 190 to 210 km/h, 102 to 113 knots, or 118 to 130 mph. At about 100 km/h 54 knots, or 62 mph the turn is started by full application of the rudder and, if need be, supported by some opposite aileron deflection. Flap setting No.1.

Lazy Eight

This manoeuvre can be done up to 180 km/h, 100 kts or 112 mph in the crossing point. It is an excellent practice for control and airspace co-ordination which every pilot should exercise with flap setting No.2.

Chandelle

This manoeuvre is started like a stall turn, however, the transition to level flight must already be initiated at 110 km/h, 60 knots, or 70 mph, by applying full rudder and full contrary aileron deflections. The stick, too, must be remarkably pushed. Flap setting No-1.

Aerobatics are not approved with water ballast on board.

A warning seems to be necessary for aerobatics : Experiences with the ASW 15 and ASW 17 as well as the flight tests show that high g-loads can be much better absorbed by the pilot in the reclined position with legs higher up than in the older gliders or even in motor aircraft. The temporary installation of a g-meter is recommended in order to get a feeling for the load factors.

The rubber suspended instrument panel amplifies ground roll shocks by a factor of 1.5 whereas the low frequency g-loads in flight are read in correct manner.

1.8. Empty Weight Centre of Gravity Limits

After repairs, installations of additional equipment, repainting of the sailplane etc. special attention is to be given to the empty weight centre of gravity which must remain within the permissible limits.

Datum point and reference line are the same as stated in paragraph 1.3.

A diagram of the empty weight centre of gravity location range is given on page 44. If these limits are maintained, it is assured that also the in-flight C. of G. is within the permissible limits provided the load limitations have been properly observed.

The in-flight C. of G. has a great effect on the flight characteristics, it is, therefore, absolutely necessary to observe the prescribed limits.

A C. of G. location aft of the rear limit is dangerous because this adversely affects the stall and spin characteristics. Moreover the elevator becomes hypersensitive.

Excessive forward C. of G. location leads to a loss in the flight performance and prevents from flying in the maximum lift range which is very important in tight circling.

Permanent Trimweight Installed Above Tailskid

After repairs on the front fuselage, if a heavy instrumentation is installed, or if the sailplane is very often flown by heavy pilots, it is useful to install a lead trimweight in the tail. The weight of this lead ballast is determined by a weight and balance procedure. The basal surface of the cast lead should be 3,3 cm by 20 cm (1.3 inch by 7.9 inch) in order to get it through the opening of the fin spar. The lead is fixed to the fuselage by 2 bolts of 8 mm diameter. For its installation the rubber tailskid has to be removed.

Analogously to the resulting more tailheavy C, of G. position the minimum cockpit load is increased The new cockpit load is determined according to page 44 and to be registered on page 31.

Arms for C. of G, calculations : (X_P)

Lightweight pilot (65 kg or 143 lbs.)
X_S = 625 mm vor BP
X_S = -24,6 inch forward of datum

Heavy pilot (115 kg or 253,5 lbs.)
X_S = 550 mm vor BP
X_S = -21,65 inch forward of datum

Instruments in the instrument panel
X_S = 1250 mm vor BP
X_S = -49,2 inch forward of datum

Oxygen bottle (4 litre)
X_S = 80 mm hinter BP
X_S = +3,15 inch behind datum

1.9 Centre of Gravity at the Last Weighing

Date f Weight and Balance	Empty Weight Centre of Gravity	Payload in Cockpit inc. Parachute		Signature of Examiner
		Minimum	Maximum	

2.1. Rigging

All pins and fittings including the ball pip fittings are to be cleaned and lubricated.

Insert right wing (2 prong-spar end)from the side into the fuselage tunnel, then left wing from the opposite aide. Align the main fittings, push in the main pins and safety. Now the wing tips can be released.

Connect ailerons and dive brakes and double-check the connection by trying to pull the push-pull rods away from the ball fittings.

The horizontal tail, first, is only inserted into the vertical tunnel of the fin. Then the ball fitting at the elevator is connected. And now the horizontal tail is pushed back until the Allan bolt at the nose can be screwed in.

The taping of the wing-fuselage junction with a plastic Tape brings about a lot of performance with but small expenditure (1-2 points on the L/D).

The inspection hole of the fuselage above the wings must also be taped so that its cover plate is not sucked off at high air pressure loads. Do not tape the canopy gap, otherwise any emergency exit is jeopardised.

It is recommended to wax the taping area prior to taping so that the tape can be removed later on without pulling the lacquer finish off.

Loading of the water ballast

Water ballast must only be filled into the rigged glider.

On page 20 of the Flight Manual the max. permissible amount of water in determined.

Take care that both wings get the same amount of water. This may easily be verified by levelling the loaded glider.

If the loading of water is not symmetrical, one connects both exit pipes by means of a short tube and opens both valves. With level wings the ballast will become nearly symmetric. After the balancing the valves are re-closed and the connecting tube is removed.

Filling is done through the exit pipe near the landing doors by using a big funnel. The filling with pressure water is strongly prohibited, because the ventilation pipe is too narrow and the water pressure becomes too strong when the reservoir is full and will blow up the wing.

Each wing tank takes about 60 litres (15.8 USGal.). However, this maximum cannot be carried, since every lateral acceleration will press some water through the ventilation.

Therefore, you either fill the tanks full up and drop one gallon (open the valve approx.10 sec.) or fill each side from the first with only 15 gallons.

In flight the full ballast can be dropped in less than 2 minutes; this is equivalent to 1/4 USGal. per second

Remark :

With full tanks the wing cannot be laid down with the wing tip on the ground because then the higher wing is emptying through the ventilation pipe.

2.2. Checking

After rigging respectively prior to the first flight every day : Make sure that all assembly connections have been properly mounted and are safetied.

Check for foreign matters in the cockpit, check the controls for ease of operation.

It is advisable to inspect the entire aircraft from time to time. Many a bolt without safety and many a damaged area has been noticed this way. Especially with a newly developed aircraft such inspections are very important despite of the fact that the aircraft has been designed and built with care.

2.3. Derigging

First of all drop water ballast completely, disconnect the exit pipes. Derigging is done in inverted sequence like the rigging.

2.4. Road Transport

The Schleicher Company can supply drawings for a light weight trailer. It is important that the wings are sitting in well fitted saddles or are supported at the spar roots as near as possible to the wing root rib.

Good attachment points for the fuselage are : tail skid, wheel, wing attachment pins, and the instrument panel bulkhead.

If transported on an open trailer, the ASW 20 can be made water-proof to a certain extent by taping up aileron gaps, dive brakes, canopy, pitot head and static vents. For some variometers a taping up is not allowed (e.g. Pirol, Bohli).

Since we are dealing, however, with a sailplane of which the performance depends on the quality of its surface, the purchase of a light, waterproof cover or better yet of an enclosed light-coloured trailer is a good investment. It is important to keep the closed trailer well ventilated in order to avoid high temperature and high atmospheric moisture.

Road transport and parking of the sailplane with water ballast is prohibited.

2.5• Upkeep and Maintenance

Moisture is an enemy of fibreglass. Always take great care that no water remains in any corner. The upper dive brake boxes are not vented for performance reasons. They have to be kept dry with the aid of a sponge.

On the suspicion that water has soaked into different components, one should store them in a dry room and turn them over daily. Do not underestimate the amount of condensation which can got inside an airplane. Therefore, hangars and trailers should always be well ventilated (remove the instrument before a longer storage period).

If the glider is equipped with water tanks, special attention must be given to their maintenance. If the tanks are not needed for a longer period, they should be altogether removed. If they are in use, they should be removed and checked for leaks every month.

If water is found in the wing structure, the wing must be dried in the before-mentioned manner. Afterwards the tanks (which have to be also dry) can be reinstalled. To do this one is using the line in the wing nose which leads to a 30 mm hole in the wing tip.

With this line the water bag is placed tautly into the wing nose. The line is wound up and safetied so that it cannot interfere with any mechanism. The ventilation pipe should be placed on top of the water bag.

With some training it takes only half an hour to remove, inspect and reinstall the tanks. The time spent stands in no relation to the damages which the water can cause in the structure if it remains there over a longer period.

Excessive sun radiation is harmful for the finish therefore, the sailplane should never be exposed to sunlight any longer than necessary.

The maintenance of the finish with a good cleaning and polishing compound (silicon-free, if possible) prolongs the life of the lacquer and improves the surface, an important factor for good performance. The advantages of a fibreglass aircraft can only be fully utilised if the surfaces are smooth and free from imperfections, especially in the area of the wing and control leading edges as well as at the fuselage nose. The essential is not to have a light lustre but to remove all irregularities, such as dust particles, mud splashes, insects etc.;

Experiences of competition pilots show that roughness caused by insects can reduce the slow speed performance by some 15 % and high speed performance up to 30 %.

Cleaning of the Plexiglas Canopy

The Plexiglas canopy is best cleaned with a recommended Plexiglas cleaner, in an emergency soap and water will do. Use a soft cloth.

After landings on wet, muddy ground or in dusty fields the landing gear must be cleaned. For this purpose one removes the seat pan in order to get good access with a vacuum cleaner and to facilitate a thorough cleaning job.

The tyre pressure should be between 2,5 to 2,7 Bar (35 to 38 psi) for 790 lbs. all up weight. At maximum all up weight (when water ballast in used) 3,2 to 3,4 Bar (45.5 to 48 psi).

If the tyre pressure is too low, the tyre deforms to such a degree during landings that the landing gear doors will be destroyed.

The skidplate has to be removed in time or should be protected against excessive wear by welding several stellite beads on to it.

The rubber tailskid has been designed such that it will shear off under strong sideloads. It can be glued on again or repaired with contact cement. It is important to cover the gap from rubber skid to fuselage in order to prevent any peeling and catching of long grass.

The towing hooks are especially exposed to soil and dirt and require frequent cleaning and oiling. For this purpose remove the fibreglass seat pan.

Lubrication of the Bearings

Most ball bearings are, so far as possible, covered and, therefore, will normally require no special care for a longer period of time.

The control hinge bearings must be dismantled and re-lubricated at the annual inspection.

The control hinge bearings must be dismantled and re-lubricated at the annual inspection.

<u>The Pitot and Static Pressure Ports</u>

must be sealed off by taping for the transport on an open trailer provided that the instrument manufacturers allow this.

<u>The Safety Harness</u> must be regularly checked for tears and corrosion spots.

If the safety harness installed is the asymmetric Autoflug type (Boberg), it must be checked that the short lap belt is installed on the right cockpit wall (in flight direction).

2.6. Overhaul

The tow coupling must be removed after every 2000 launches or every 3 years at the latest and has to be sent to the manufacturer for reconditioning. For the Tost combi-release some facilities are valid (see accompanying paper in the log-book). The rudder cables are to be renewed as soon as any wear spots are noticed.

2.7. Repairs

Smaller repairs on fibreglass components can be effected by the owner in accordance with the guidelines as set forth in the Repair Manual for the ASW 12, ASW 15, ASW 17, and the ASW 19.

All major repairs and overhauls have to be effected by the manufacturer. In case of doubt information and advise can be obtained from the Schleicher Company.

2.8. Notes for the Inspection

The inspection of control deflections and C. of G. weighing is done in the 15 m span version.

The dive brake boxes have no water drain.

It is very important to check the proper locking of the dive brakes from time to time. Every brake has its own dead point locking in the wing. There fore, it has to be checked whether the left and right dive brake do reliably and simultaneously lock.

For this purpose connect first one airbrake to the ball fitting in the fuselage and mark the dead point (locking point) on the dive brake lever nylon bearing in the cockpit. Do the same with the other airbrake.

Both dead points should be apart from each other no more than 5 mm (0.2 inch). Otherwise the mechanism must be adjusted (screws in the pipes behind the baggage compartment). Moreover there should be a surplus forward range of the dive brake lever of about 5 mm (0.2 inch).

The wing root-fuselage junction must be checked at least on the annual inspection for play or looseness between the fuselage pins and the wing root holes. Play in this junction results in a clac-clac noise when the rudder is deflected and can lead to awkward tailplane oscillations at high speeds.

The play is removed by putting thin metal washers under one or several pins. The pins are pushed out of the fitting tube by feeding a steel rod through the hole of the opposite pin and blowing the pin out with a hammer.

The pin should be replaced after the installation of the washer with but some blows of a 1 lb. hammer.

If the fitting is too wide, the pin can either be safetied by 4 mm Ø (1,6 inch) bolts and nuts or by treating the wide end of the pin slightly with a knurling tool in a lathe as it is used for making rough handles on metal rods.

On major repairs of the control surfaces there is slight danger that they become heavier and that the C. of C. of the control surface moves back.

This can lead to flutter. It is, therefore, recommended to make a light weight repair.

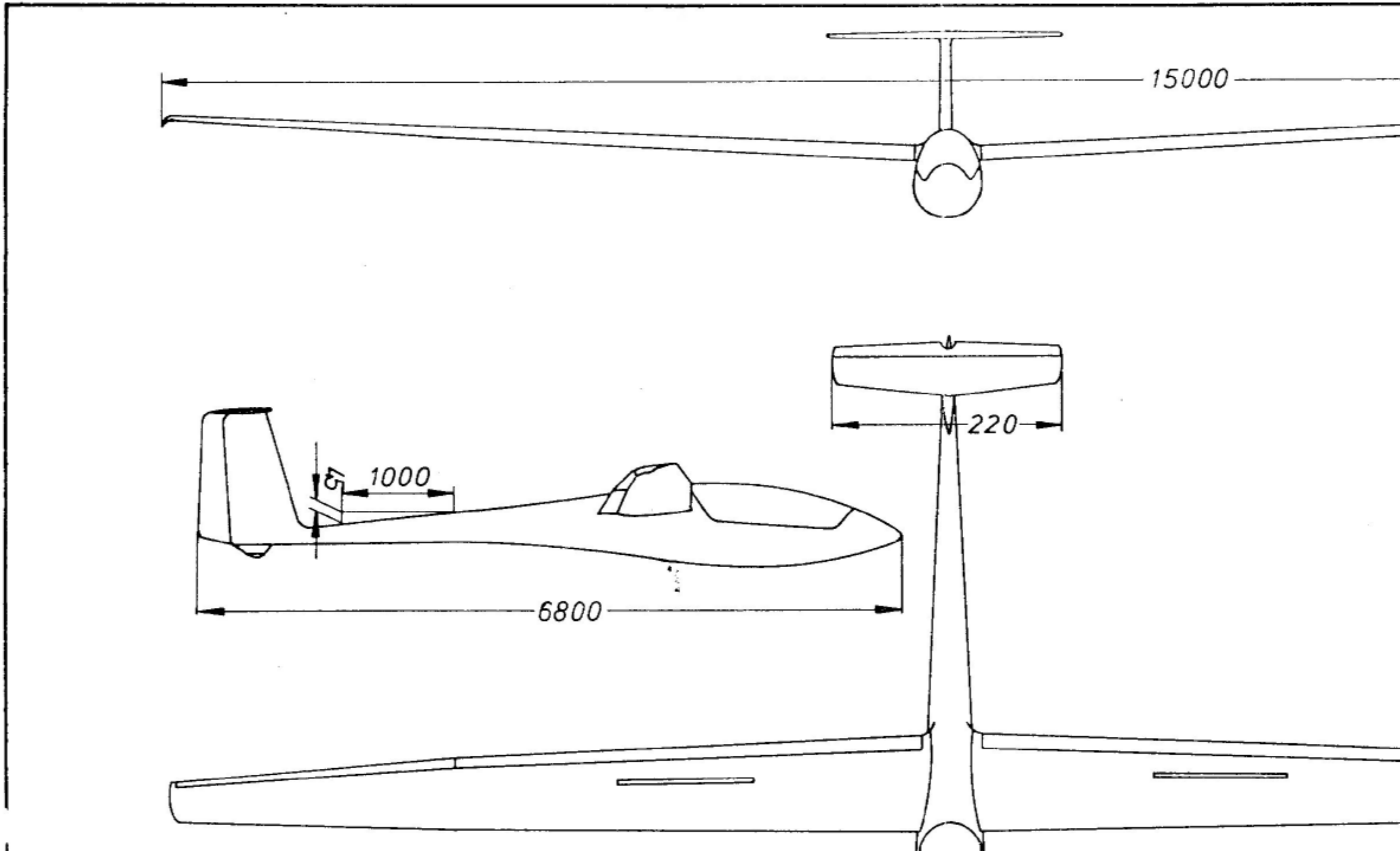
A table that shows all tolerable weights, static tailheavy moments, and play (backlash) of the control surfaces is given on page 46 in the appendix.

If these data are exceeded the manufacturer must be consulted.

After repairs of control surfaces or their painting with anti-collision colour, competition number, or with advertising etc., determinations of the static balance are absolutely necessary. For this see the drawing on page 45 in the appendix.

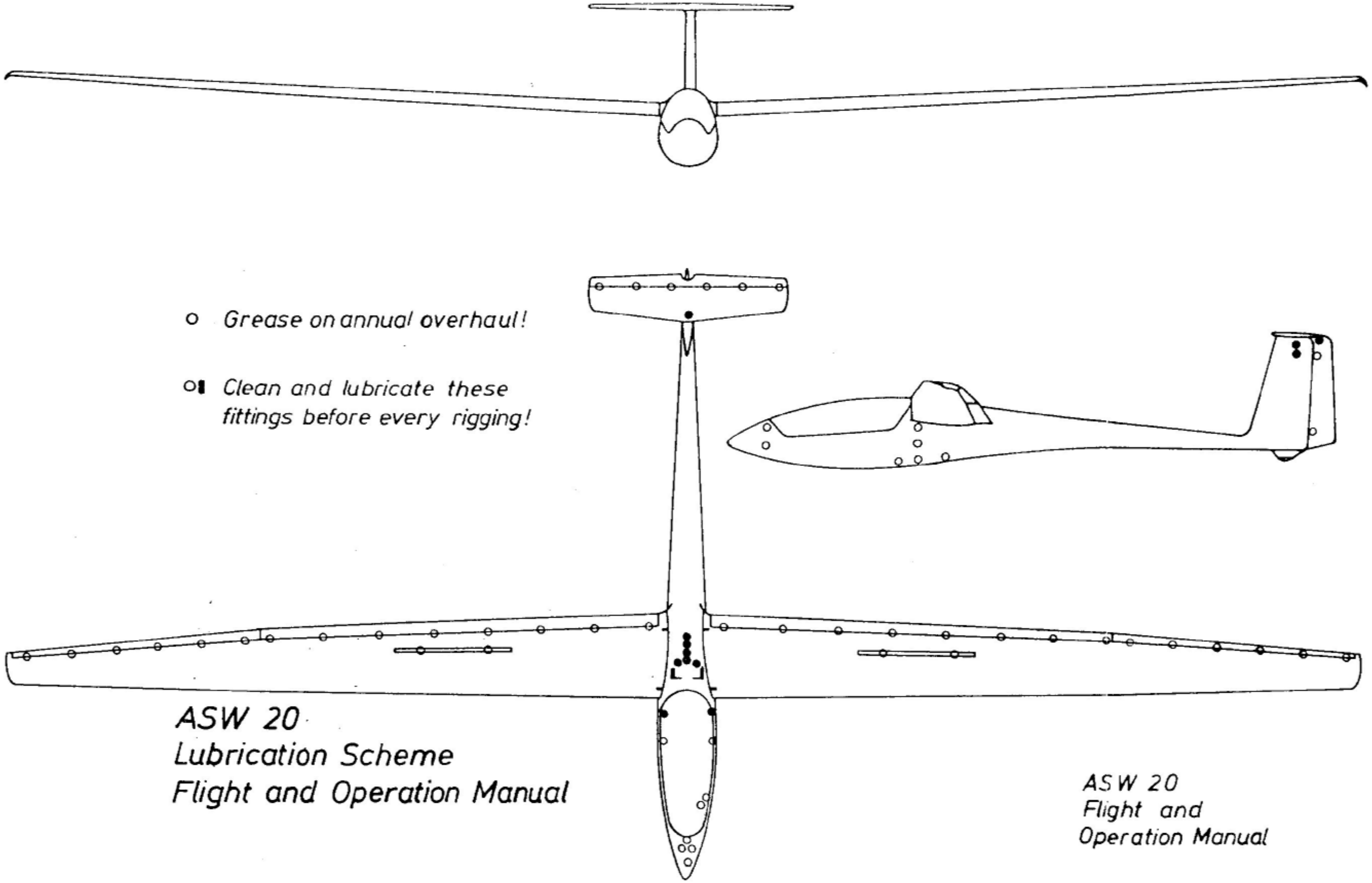
The strong springs in front of the pedal (5 kg, 11 lbs. tension unexpanded; c = 1.5 kg/cm, 8.4 lbs. per inch) must not be exchanged against weaker ones, since they are required for sufficient high rudder circuit frequency in order to prevent flutter.

Weak springs must be replaced by new ones.

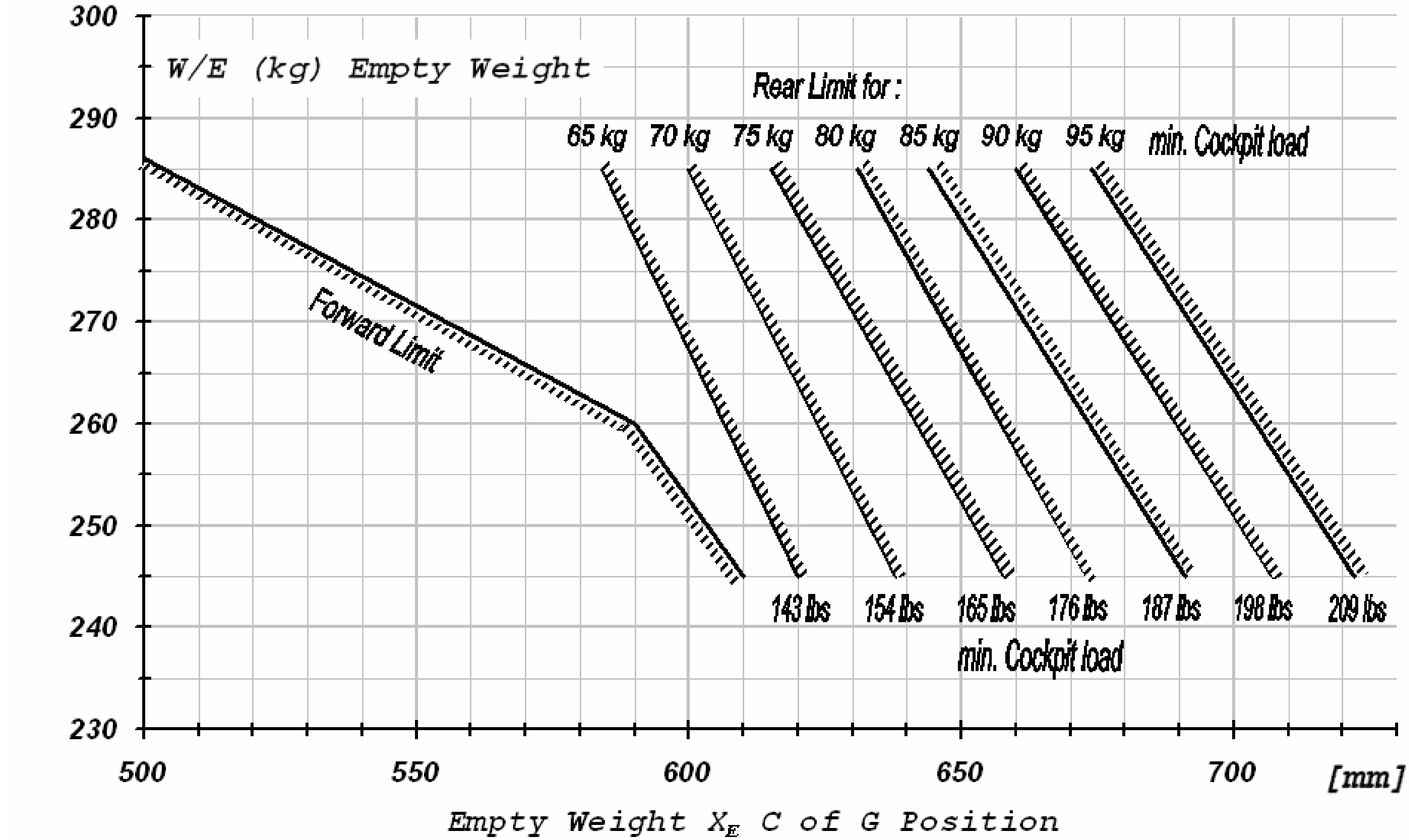

15000
220
1000
15
6800

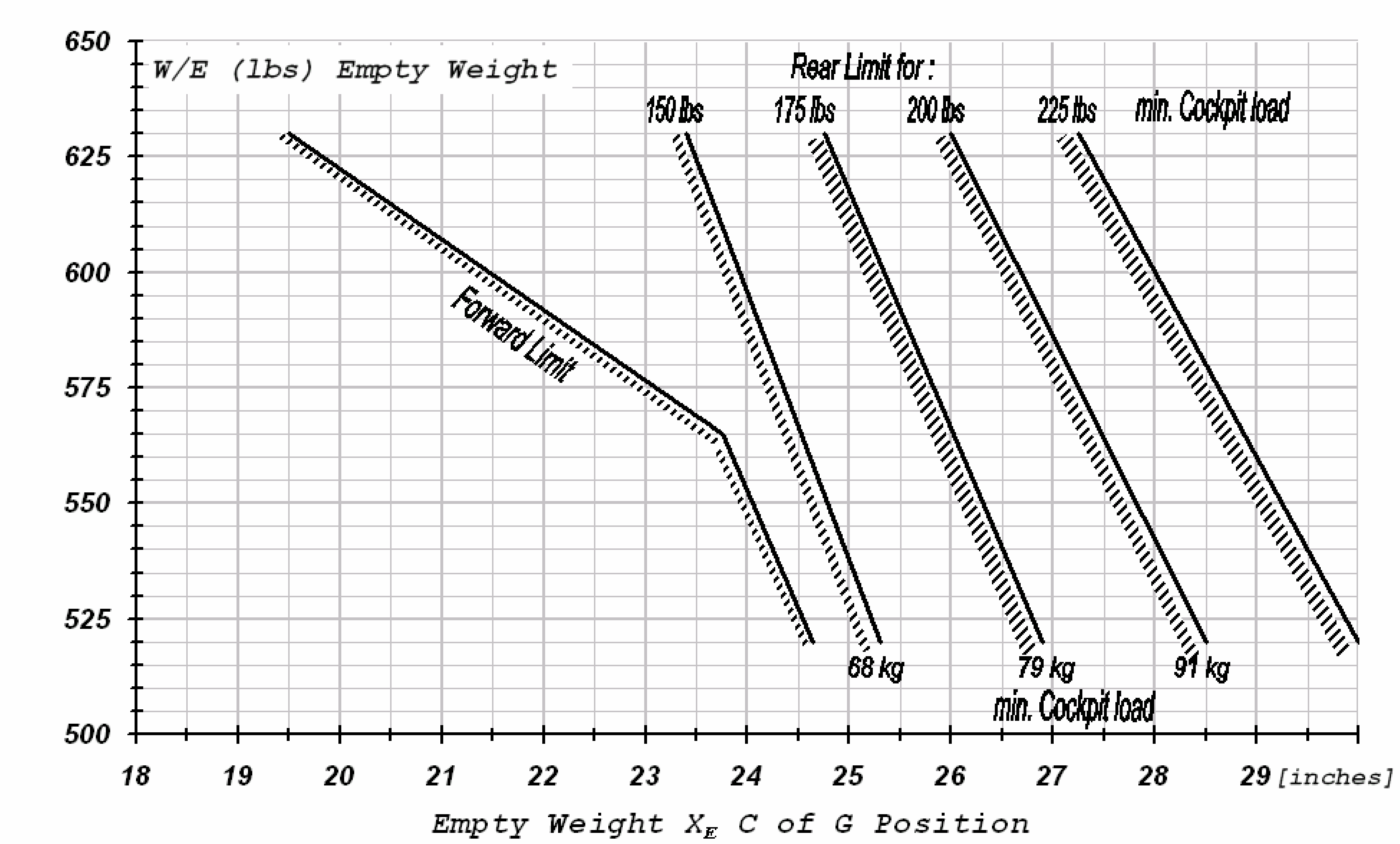
Flap Lever Position	Stick Position	right Wing Aileron	right Wing Flap	left Wing Flap	left Wing Aileron
(1) - 11°	right	-21° ± 2°	-17° ± 2°	-5,5° ± 2°	-1,5 ± 2°
	neutral	-11° ± 1°	-11° ± 1°	-11° ± 1°	-11° ± 1°
	left	-1,5° ± 2°	-5,5° ± 2°	-17° ± 2°	-21° ± 2°
(2) -6°	right	-21° ± 2°	-13 ± 2°	+0,5° ± 2°	+ 8° ± 2°
	neutral	- 6° ± 1°	- 6° ± 1°	- 6° ± 1°	- 6° ± 1°
	left	+ 8° ± 2°	+0,5° ± 2°	-13° ± 2°	-21° ± 2°
(3) 0°	right	-16° ± 2°	- 7° ± 2°	+6,5° ± 2°	+14° ± 2°
	neutral	0° ± 1°	0° ± 1°	0° ± 1°	0° ± 1°
	left	+14° ± 2°	+6,5° ± 2°	- 7° ± 2°	-16° ± 2°
(4) 9°	right	- 8° ± 2°	+ 2° ± 2°	+15° ± 2°	+20° ± 2°
	neutral	+7,5° ± 1°	+ 9° ± 1°	+ 9° ± 1°	+7,5° ± 1°
	left	+20° ± 2°	+15° ± 2°	+ 2° ± 2°	- 8° ± 2°
(5) flap +55° aileron -8°	right	-21° ± 3°	+50° ± 3°	+60° ± 3°	+40° ± 3°
	neutral	- 8° ± 1°	+55° ± 2°	+55° ± 2°	- 8° ± 1°
	left	+ 4° ± 3°	+60° ± 3°	+50° ± 3°	-21° ± 3°

\+ means down deflection
\- means up deflection



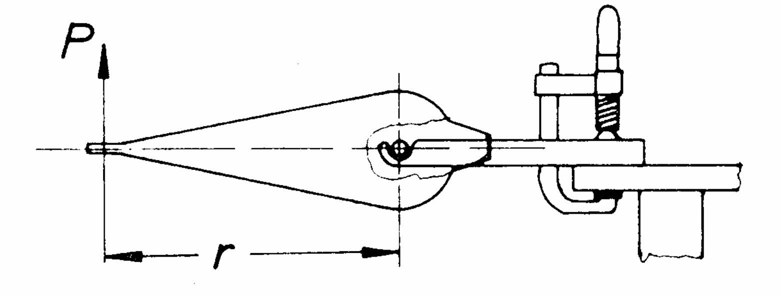
ASW 20
Lubrication Scheme
Flight and Operation Manual


300
290
280
270
260
250
240
230
W/E (kg) Empty Weight
Rear Limit for :
65 kg 70 kg 75 kg 80 kg 85 kg 90 kg 95 kg min. Cockpit load
Forward Limit
143 lbs 154 lbs 165 lbs 176 lbs 187 lbs 198 lbs 209 lbs
min. Cockpit load
500
550
600
650
700
[mm]
Empty Weight X_E C of G Position



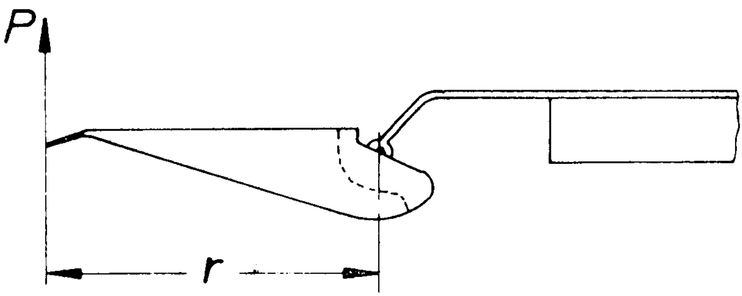
W/E (lbs) Empty Weight
650
625
600
575
550
525
500
Rear Limit for :
150 lbs
175 lbs
200 lbs
225 lbs
min. Cockpit load
Forward Limit
68 kg
79 kg
91 kg
min. Cockpit load
18
19
20
21
22
23
24
25
26
27
28
29 [inches]
Empty Weight X_E C of G Position

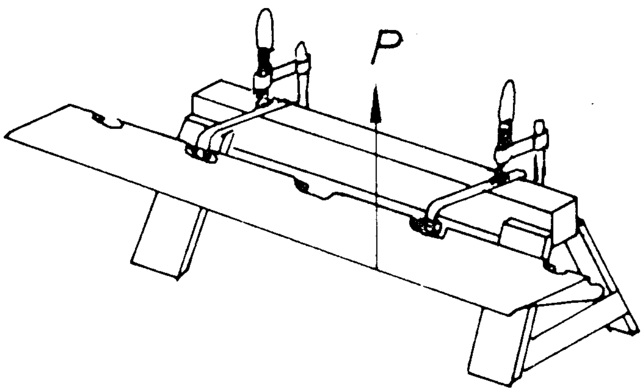
rudder chord level



M= P· r [kp cm] or (inch -pounds)
determination of P by use of spring balance or a letter – balance

upper aileron surface level





Tolerances in Weight and Tailheavy Static Balance for Control Surfaces and in Play (Backlash) of Control Circuits (Stick, Pedals or Flap Lever fixed).

	Weight Tolerance [kg]	Tolerances for tailh. Stat. Bal [cm kp]	Tolerable play	
			(backlash)	mm
Rudder	2,8 - 3,6	8,6 - 11,0	0,8°	4,5
Elevator	2,1 - 2,7	6,6 - 8,4	1,15°	3,0
Ailerons	2,2 - 2,6	2,8 - 3,5	1,25°	1,75
Flaps	5,1 - 6,5	12,3 - 15,7	1,1°	2,75

	Weight Tolerance [lbs]	Tolerances for tailh. Stat. Bal [inch lb]	Tolerable play	
			(backlash)	inch
Rudder	6,18 - 7,93	7,45 - 9,53	0,8°	0,18
Elevator	4,63 - 5,95	5,72 - 7,28	1,15°	0,12
Ailerons	4,85 - 5,73	2,43 - 3,03	1,25°	0,07
Flaps	11,23 - 14,32	10,65 - 13,60	1,1°	0,11

EQUIPMENT LIST Issue July 1977

Minimum Equipment

1. Airspeed Indicator

   a. Winter 6 FM 5.
      order/N: 651124 (km/h). 651224 (mph)
      651324 (knots)

   b. PZL PR-350

2. Altimeter

   a. Winter 4 HM 6
   b. Winter 4 FGH 10
   c. PZL W-12 S

3. Four-part Safety Harness

   a. Autoflug AFG 013305 consisting of : shoulder
      straps Schugu FAG - 7B – 1
      lap belt Bagu FAG - 7E – 1
      For left shoulder strap use the attachment point next to the fitting of parachute static line.

   b. Gadringer Sohugu II B (45 cm long)
      Bagu IV D

Additional Minimum Equipment for Cloud Flying

1. Turn and Bank Indicator

   a. Apparatebau Gauting WZ - 402/31

2. Compass

   a. Ludolph FK 5
   b. Ludolph FK 16
   c. PZL BS - 1
   d. PZL B 13/KJ

3. VHF - Transceiver (COM)

a. Dittel FSG 6 / 63

b. Dittel FSG 12

c. Dittel FSG 15

d. Dittel FSG 16

e. Dittel FSG 40 S

f. Becker AR 10

g. Becker AR 7

h. Becker AR 2008 / 25

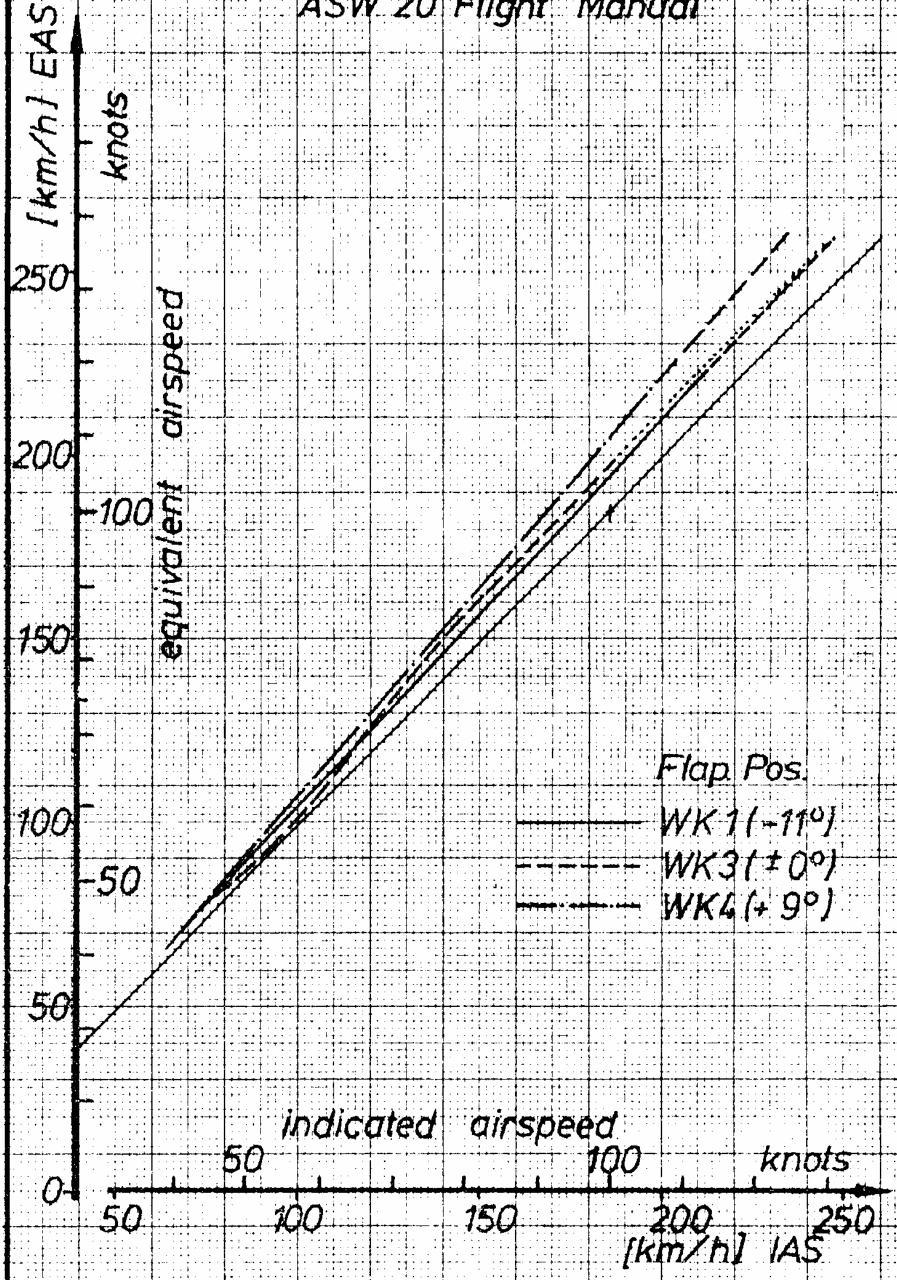
i. Becker AR 2009 / 25

3.8. Check List Pre-flight Check

1. Control connections, main-pins and bolts safetied ?
2. Control check forcewise and for full deflections ?
3. Parachute static line connected ?
4. Gaps for control surfaces in flight direction 1,5 mm or wider ?

Prior to Start

1. Parachute connected to harness ?
2. Safety harness fastened ?
3. Landing gear doors locked ?
4. Airbrakes locked ?
5. Trim lever adjusted to a middle position ?
6. Flap control lever in starting position ?
7. Altimeter adjusted ?
8. What is the wind direction now ?
9. Close your canopy now and move white levers back


[km/h] EAS
knots
equivalent airspeed
250
200
100
150
50
100
50
0
Flap Pos.
WK 1 (-11°)
WK3 (±0°)
WK4 (+9°)
indicated airspeed
50
100
knots
50
100
150
200
250
[km/h] IAS