0.2 List of Effective Pages

Section	Page		Date
0		0.1	07.03.89
		0.2	07.03.89
		0.3	07.03.89
		0.4	08.02.90
		0.5	07.03.89
		0.6	07.03.89
1		1.1	07.03.89
		1.2	07.03.89
		1.3	07.03.89
		1.4	07.03.89
		1.5	07.03.89
		1.6	07.03.89
2	LBA-App.	2.1	07.03.89
	LBA-App.	2.2	07.03.89
	LBA-App.	2.3	07.03.89
	LBA-App.	2.4	07.03.89
	LBA-App.	2.5	07.03.89
	LBA-App.	2.6	08.02.90
	LBA-App.	2.7	07.03.89
	LBA-App.	2.8	07.03.89
	LBA-App.	2.9	07.03.89
3	LBA-App.	3.1	07.03.89
	LBA-App.	3.2	07.03.89
	LBA-App.	3.3	07.03.89
	LBA-App.	3.4	07.03.89
	LBA-App.	3.5	07.03.89
	LBA-App.	3.6	07.03.89
4	LBA-App.	4.1	07.03.89
	LBA-App.	4.2	07.03.89
	LBA-App.	4.3	07.03.89
	LBA-App.	4.4	07.03.89
	LBA-App.	4.5	07.03.89

Section	Page		Date
	LBA-App.	4.6	07.03.89
	LBA-App.	4.7	07.03.89
	LBA-App.	4.8	07.03.89
	LBA-App.	4.9	07.03.89
	LBA-App.	4.10	07.03.89
	LBA-App.	4.11	07.03.89
	LBA-App.	4.12	07.03.89
	LBA-App.	4.13	07.03.89
	LBA-App.	4.14	07.03.89
	LBA-App.	4.15	07.03.89
	LBA-App.	4.16	07.03.89
	LBA-App.	4.17	07.03.89
	LBA-App.	4.18	07.03.89
	LBA-App.	4.19	07.03.89
	LBA-App.	4.20	07.03.89
	LBA-App.	4.21	07.03.89
5		5.1	07.03.89
	LBA-App.	5.2	07.03.89
	LBA-App.	5.3	07.03.89
	LBA-App.	5.4	07.03.89
	LBA-App.	5.5	07.03.89
	LBA-App.	5.6	07.03.89
		5.7	07.03.89
		5.8	07.03.89
		5.9	07.03.89
6		6.1	07.03.89
		6.2	07.03.89
		6.3	07.03.89
		6.4	08.02.90
		6.5	08.02.90
7		7.1	07.03.89
		7.2	07.03.89

Section	Page	Date	Section	Page	Date
	7.3	07.03.89			
	7.4	07.03.89			
	7.5	07.03.89			
	7.6	07.03.89			
	7.7	07.03.89			
	7.8	07.03.89			
	7.9	07.03.89			
	7.10	07.03.89			
	7.11	07.03.89			
	7.12	07.03.89			
	7.13	07.03.89			
8	8.1	07.03.89			
	8.2	07.03.89			
	8.3	07.03.89			
	8.4	07.03.89			
	8.5	07.03.89			
	8.6	07.03.89			
	8.7	07.03.89			
9	9.1	07.03.89			
	9.2	07.03.89			

2.3 Airspeed Indicator Markings

Airspeed indicator markings and their colour-code significance are shown below:

Marking	(IAS) value or range km/h and (kts)	Significance
Green Arc	102 - 205 (55 - 110,5)	Normal Operating Range. (Lower limit is maximum weight 1.1 V_{S1} at most forward c.g. Upper limit is rough air speed)
Yellow Arc	205 - 280 (110,5 - 151)	Manoeuvres must be conducted with caution and only in smooth air.
Red Line	280 (151)	Maximum speed for all operations.
Yellow triangle	95 (51,5)	Approach speed at maximum weight without water ballast.

the upper part of the fin where trim ballast, for instance in the form of a battery, may be fitted. If any trim ballast is mounted in the fin, the minimum cockpit load will of course be increased ! This increased minimum cockpit load must also be shown in the DATA and LOADING PLACARD in the cockpit. The lower permissible cockpit load without trim ballast in the fin will be shown only on page 6.4 of the Flight Manual.

In the cockpit, an additional placard is to be affixed:

REDUCED MINIMUM COCKPIT LOAD WITHOUT TRIM BALLAST IN THE FIN: SEE FLIGHT MANUAL - PAGE 6.4 !

Sight apertures in the fin make it easy to check whether any trim ballast has been fitted. Clear view through the fin means: No trim ballast fitted! See also Section 7.11.

MASS AND BALANCE FORM

Date of Weighing	Empty mass C.G. mm aft of RP	Pilot mass incl. chute (kg) min.	Pilot mass incl. chute (kg) max.	Load in baggage compart.* (kg)	Inspector's stamp and signature

* Permissible Load in baggage compartment = 245 kg = 507 LBS less empty mass of non-supporting parts less pilot mass less mass of parachute : BUT not more than 25 kg = 55 lbs (15 kg = 33 lbs in upper compartment, and 10 kg = 22 lbs in lower compartment) !!

2.4 Mass (Weight)

Maximum Take-Off Mass:		
-with water ballast	500 kg	(1102 lbs)
-without water ballast	365 kg	(804,8 lbs)
Maximum Landing Mass:	500 kg	(1102 lbs)
Max. mass of all non-lifting parts	245 kg	(507 lbs)
Max. mass in the upper baggage compartment:	15 kg	(33 lbs)
Max. mass in the lower baggage compartment:	10 kg	(22 lbs)

2.5 Centre of Gravity

Centre of gravity range (for flight):

forward limit	0.24 m (0,79 ft)	aft of RP
aft limit	0.37 m (1,21 ft)	aft of RP

"RP" stands in this context for "Reference Datum Point" which is situated at the wing leading edge at the wing root rib.
An example of the C.G. position calculation and a table of c.g. ranges at different empty weights can be found in Section 6 of the ASW 24 Maintenance Manual.

2.6 Approved Manoeuvres

This glider is approved for use in normal gliding operation (Airworthiness Category "Utility").

Within this Airworthiness Category U the following aerobatic figures are approved for the ASW 24:-
Lazy Eight, Chandelle, Stall Turn, Steep Turn and positive Loop. Further details concerning these manoeuvres will be found in Section 4.5.9.

Maximum Permissible Loading with Water Ballast

Empty Mass kg (lbs)	Pilot mass + parachute + baggage kg and (lbs) : 75 (166)	85 (188)	95 (210)	105 (232)	115 (254)	125 (276)
220 (485)	full	full	full	full	full	155 (342)
230 (507)	full	full	full	full	155 (342)	145 (320)
240 (529)	full	full	full	155 (342)	145 (320)	XXX
250 (551)	full	full	155 (342)	145 (320)	XXX	XXX
260 (573)	full	155 (342)	145 (320)	XXX	XXX	XXX
270 (573)	155 (342)	145 (320)	XXX	XXX	XXX	XXX

XXX: These combinations are precluded as they would cause the maximum permissible mass of non-lifting parts to be exceeded!

The water ballast bags fitted in the wings as standard equipment have a total capacity of 130 liters = 34,3 US.Gal.

An approved special version with a capacity of about 155 Liters = 41 US.Gal. can be supplied on request.

Rudder

Surface area	0.27 m²	(2.91 ft²)

Horizontal Tail

Span	2.55 m	(8.37 ft)
Surface area	0.90 m²	(9.67 ft²)
Aspect ratio		7.11
Airfoil Section		DU 86-137/25

Elevator

Surface area	0.21 m²	(2.26 ft²)

Airbrake Paddles (Schempp-Hirth - top sfce.only)

Length	1.10 m	(3.61 ft)
Surface area (both together)	0.37 m²	(3.98 ft²)
Max. Height above wing top surface	0.18 m	(0.59 ft)

Aileron

Span	3.00 m	(9.84 ft)
Surface area (each)	0.25 m²	(2.69 ft²)

Masses (Weights)

Empty mass approx.	230 kg	(507 lb)
Max. cockpit load	130 kg	(286.7 lb)
Max. load pilot seat	115 kg	(253.6 lb)
Max. mass of non-lifting parts	245 kg	(540.2 lb)
Max. all-up mass with water ballast	500 kg	(1102 lb)
Max. all-up mass without water ballast	365 kg	(804.8 lb)
Wing loading	30.0 - 50.0 kg/m²	(6.14 - 10.24 lb/ft²)
Max. loading of upper baggage compartment	15 kg	(33 lb)
Max. loading of lower baggage compartment, left	10 kg	(22 lb)
Max. trim ballast (battery) in the fin	6 kg	(13.2 lb)

See also **Flight Manual** Section 2 !

In their neutral position the ailerons should have a slightly positive (downwards) deflection because it has been found that in flight the ailerons are sucked upwards out of their neutral position by the stated amount.

Maximum Permissible Control Surface Play

The maximum permissible tolerance of control surface play may be measured from the same measuring points used for measuring control surface deflections. The cockpit controls should be immobilised for this purpose.

	MPE*		Max. permissible Play	
	mm	in.	mm	in.
Rudder	280	11.02	3.5**	0.14**
Elevator	75	2.95	2.0	0.08
Aileron	90	3.54	2.0	0.08

*MPE = MessPunktEntfernung zur Drehachse = Distance from Measuring Point to Pivot Axis

** If the actuating crank at the rudder is screwed on tightly, play in the cable-actuated rudder circuit with pedal springs is normally not measurable !

Fig.3.0.-1 Control Surface Deflections and Jacking Points for Wing Bending Frequency Tests

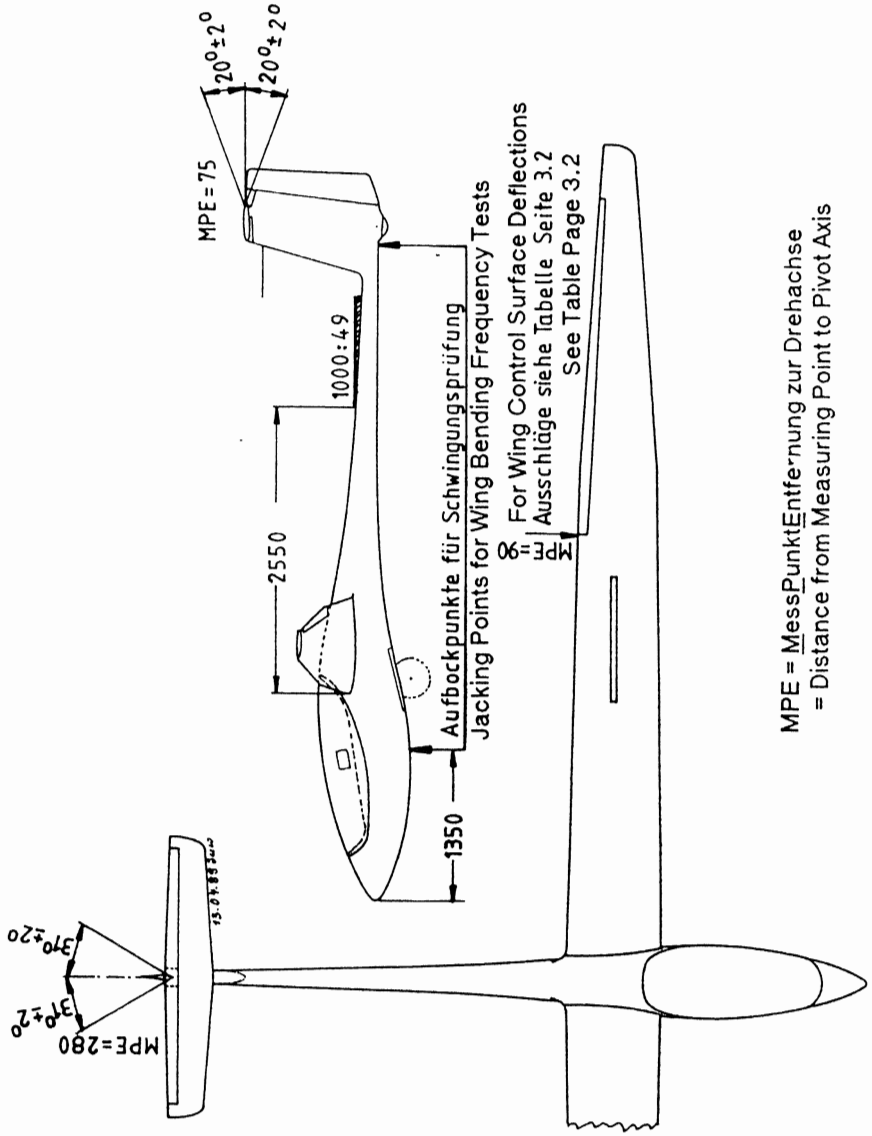
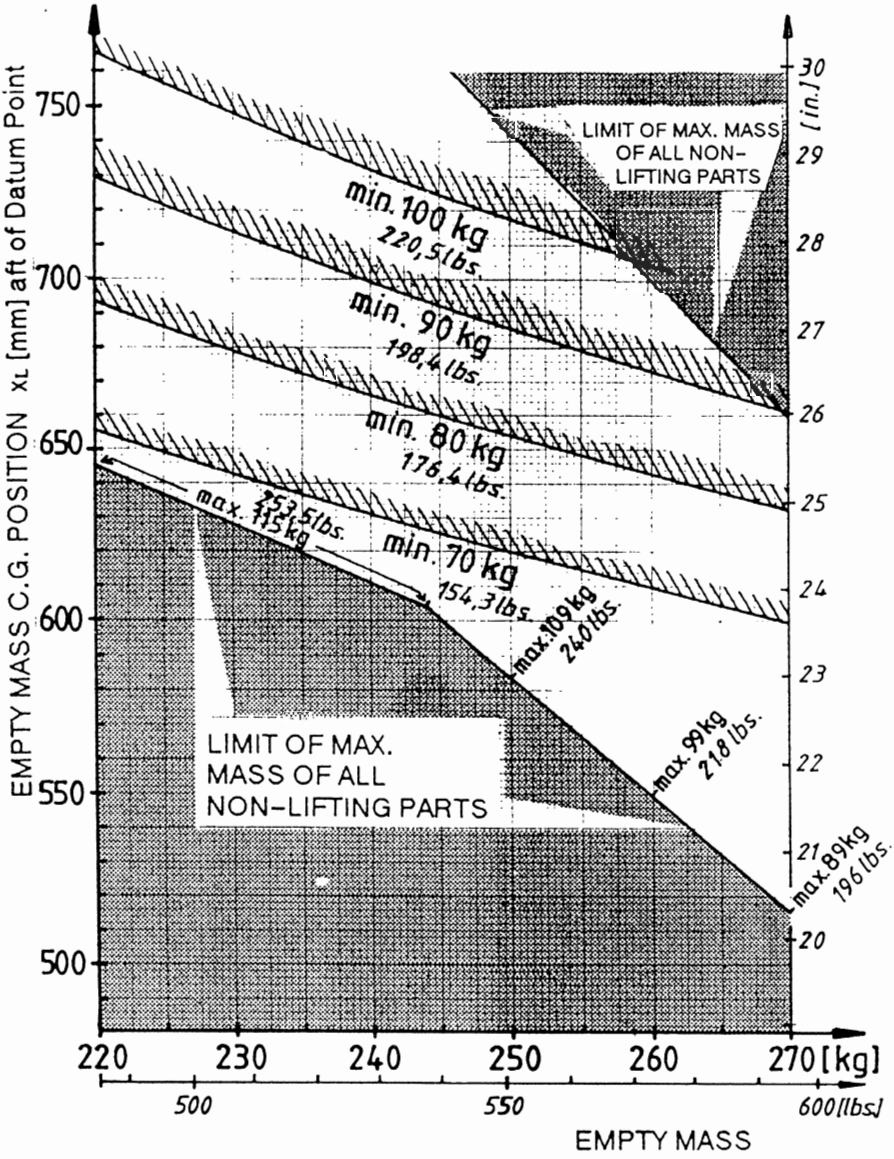


Fig. 6.4-1 Diagram of Empty Mass C.G. Position



6.5 Mass of all Non-Lifting Parts

The maximum permissible mass of non-lifting parts is 245 kg (540,13 lbs).

These non-lifting parts comprise:

- fuselage with tail units
- equipment fitted in fuselage as listed under 6.2
- pilot and parachute (max. 115 kg = 253,57 lbs max.).
- baggage
- equipment carried on board in flight but NOT weighed as under 6.2 (e.g. O_2)

Removeable trim ballast is NOT considered one of the non-lifting parts if the glider is weighed as under 6.2. and remains within the permissible range of diagram Fig. 6.4-1. !

6.6 Mass (Weight) and Balance Form

The Mass and Balance form is included in Section 6 of the Flight Manual. After weighing the aircraft, the maximum and minimum permissible loads in the seat and baggage compartments are entered in this Mass and Balance Form, using the diagram Fig.6.4-1.

This will ensure that during flight, so long as the load limitations are observed, the in-flight C.ofG. will always be within safe and approved limits.

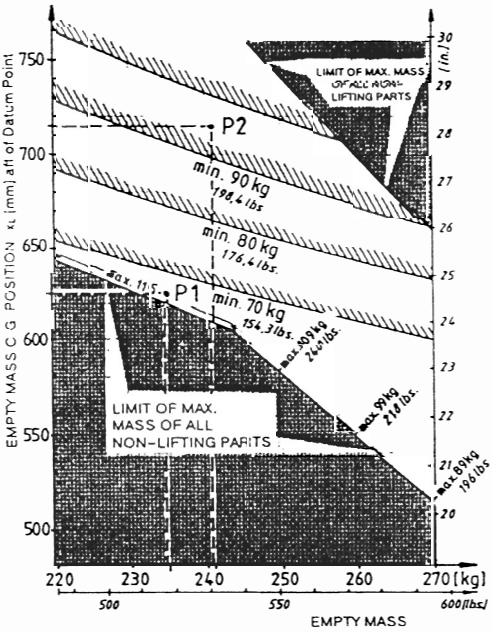
If removeable trim ballast is provided in the fin, the increased minimum cockpit load which results from the trim ballast, must be entered into the Mass and Balance Form for safety reasons.
By a placard next the Mass and Balance Form it has to be notified that Flight Manual page 6.4 has to be regarded where the lower minimum cockpit load without trim ballast in the fin is shown.

In the following pages two examples of how to evaluate the weighing results are given.

EXAMPLES :

(1) A weighing in accordance with Section 6.2 gave the following results:
Empty Mass m_L = 235 kg (518.09 lbs)
Empty Mass C.G. x_L = 0.626 m (24,65 inches)

By use of the diagram Fig.6.4-1 it is found that:



Point P1 is below the line giving 70 kg (154 lbs) minimum cockpit load in the seat, and above the line limiting maximum cockpit load to 115 kg (253,53 lbs).
It follows that:
The sailplane is within the required limits and may therefore be flown by a pilot weighing 70 kg (incl. parachute), and with water ballast up to a total take-off mass of 500 kg (1102,50 lbs).

(2) A second weighing with a removeable trim ballast of 6 kg (13,23 lbs) in the fin showed:

m_L = 241 kg (531,31 lbs) and
x_L = 0.715 m (28,15 inches)

In the diagram, point P2 is <u>above</u> the line of minimum cockpit load of "90 kg (198,42 lbs)" near 95 kg but below the line of 100 kg (220,46 lbs). Therefore, the "Mass and Ballance Form" placard in the cockpit must show a min. cockpit load of 95 kg (pilot incl. parachute) and the following placard must be fixed in addition :

REDUCED MINIMUM COCKPIT LOAD <u>WITHOUT</u> TRIM BALLAST IN THE FIN: SEE FLIGHT MANUAL - PAGE 6.4 !

The Mass and Balance Form in the Flight Manual page 6.4 must be filled in according to the following example :

Date of Weighing	Empty mass C.G. mm aft of RP	Pilot mass incl. chute (kg) min.	Pilot mass incl. chute (kg) max.	Load in baggage compart.* (kg)	Inspector's stamp and signature
xx.xx.90	626 mm <u>without</u> Trim ballast in the fin	70		25	X X X
			115	13.4	
	715 mm <u>with</u> 6 kg trim ballast in the fin	95		25	
			115	13.4	

6.7 Useful Loads

The useful cockpit load is influenced and limited by various factors:

(1) Total mass of non-lifting parts (must not exceed 245 kg (540,13 lbs).
(2) In-flight C.G. position (must remain within 0.24 m and 0.37 m (9,45 inch and 14,57 inches) aft of Datum whatever the cockpit load)
(3) Maximum Take-Off Mass (must not exceed 500 kg (1102,50 lbs) and mainly affects the water ballast load).

Load in the baggage compartment

The mass of the baggage is calculated as follows:

max. mass of non-lifting parts	= 245 kg(540,13lb)
- weighed mass of non-lift. parts	= xxx kg (xxx lbs)
- actual load in the seat	= xxx kg (xxx lbs)
= permissible load in the baggage compartment	= xx kg (xx lbs)

But never to exceed 15 kg (33 lbs) in the upper and 10 kg (22 lbs) in the lower left baggage compartment.

6.8 In-Flight Mass/C.G. Envelopes and Pilot Mass Arms

(1) How to determine pilot mass arms:
In the normal seating position the pilot mass arm is for:
a 55 kg (121,25 lbs) pilot incl.parachute 0.54 m (21,26 inch) fwd of datum and for:
a 115 kg (253.53 lbs) pilot incl. parachute 0.535 m (21,06 inch) fwd of datum.
If an exact pilot mass arm is needed, a weighing must be done with the pilot incl. chute in place.

(2) Calculation of In-Flight C.G. Position

$$X_{CG} = \frac{X_L * m_L + X_P * m_P + X_W * m_W + X_{o2} * m_{o2} + X_B * m_B + X_{uc} * m_{uc} + X_{lc} * m_{lc}}{m_L + m_P + m_W + m_{o2} + m_B + m_{uc} + m_{lc}}$$

Where the symbols stand for:

X_L	Empty mass C.G. position
m_L	Empty mass
X_P	Pilot mass arm
m_P	Mass of pilot incl. parachute
X_{o2}	Distance of oxygen bottle from datum point in standard fitting location
m_{o2}	Mass of oxygen bottle
X_W	Distance of water ballast from datum point
m_W	Mass of water ballast (1 Liter = 1 kg or 2,2 lbs)
X_B	Distance of fin mounted battery from datum point (if fitted)
m_B	Mass of battery
X_{uc}	Distance of upper baggage compartment from datum point
m_{uc}	Mass of load in upper baggage compartment
m_{lc}	Mass of load in lower baggage compartment (left of landing gear)
X_{lc}	Distance of lower baggage compartment from datum point

Table of established Arms and Masses

Designation	Unit of Measmt.	Amount	Remarks
X_{O2}	Meter inch	+0,17 +6,69	in factory-standard fitting location
m_{O2}	kg lbs.	4,4 9,70	O_2-bottle, 3 Liters
X_T	Meter inch	-1,11 -43,7	Trim discs in front cockpit
X_W	Meter inch	+0,258 +10,16	waterballast dist. from Datum
X_B	Meter inch	+4,19 +164,96	Trim Ballast (Battery) in fin
m_B	kg lbs.	≈1,8* ≈4,0*	Optional Battery for Fin Position
X_I	Meter inch	-0,93 -36,61	instrument mass arm in instr. panel
X_{uc}	Meter inch	+0,175 +6,89	baggage in upper baggage compartment
X_{lc}	Meter inch	+0,20 +7,87	baggage in lower baggage compartment

* The exact mass of the battery (see chapter 2.6) or the mass of the trim ballast has to be weighed!
The max. permissible mass of 6kg (13,23 lbs.) in the fin must not be exceeded (see flutter calculation).

Examples of C.G. Position Calculation

1. Example of a weight and balance for empty mass

$$X_L = \frac{m_2 * b}{m_L} + a$$

m_L = 235 kg, from weighing of all components
m_2 = 27,7 kg
b = 4038 mm
a = 150 mm
For weighing the sailplane was levelled correctly.

$$X_L = \frac{27,7 * 4038}{235} + 150$$

x_L = 625,9 ≈ 626 mm aft of datum.

Note: Distance "a" is not constant due to the landing gear suspension and must therefore be determined again for every change of the mass.

2. Example of a change of empty mass (weight) and empty weight C.ofG.:

Into an ASW 24 according to example 1. showing the weight and balance data m_L = 235 kg and x_L = 626 mm a pneumatic variometer (m_{I1} = 0,3 kg) is exchanged against an electric one (m_{I2} = 1,3 kg); the capacities will not be changed.

How do the data of the ASW 24 change?

Before the varios were exchanged the mass of the non-lifting parts was m_{NLP} = 116,6 kg. As the max. mass of the non-lifting parts is 245 kg, the sail-plane could be loaded in the fuselage with 128,4 kg.
Because of the change of instruments the mass of the non-lifting parts increases by:

$m_{I1} - m_{I2} = 1,3 - 0,3 = 1,0$ kg up to
$m_{NLP} = 117,6$ kg.

The new max. payload in the fuselage is now
245 - 117,6 = 127,4 kg.

The G.of C. changes accordingly:

$$m_{Lnew} = m_{Lold} + m_{I2} - m_{I1}$$
$$m_{Lnew} = 235 + 1,3 - 0,3 = 236 \text{ kg.}$$

$$X_{Lnew} = \frac{(m_L * X_L)_{old} + (m_{I2} - m_{I1}) * X_I}{m_{Lnew}}$$

$$X_{Lnew} = \frac{235 * 626 + 1,0 * (-930)}{236}$$

$$X_{Lnew} = 619,4 \approx \underline{619 \text{ mm}}$$

3. Example of a weight and balance for empty mass inclusive a 6 kg (13,23 lbs.) trim ballast mass in the fin:

m_L = 241 kg, from weighing of all components
m_2 = 33,7 kg
b = 4038 mm
a = 150 mm
For weighing the sailplane was levelled correctly.

According to the formula given in Fig. 6.2-1 follows:

$$X_L = \frac{33,7 * 4038}{241} + 150$$

X_L = 715 mm aft of datum.

The new data are shown in the mass and balance form of the Flight Manual, section 6 according to the example given on page 6.8.
This entry has to be done by a licensed inspector.

4. Examples for in-flight mass C.of G. calculatios:

For the follwing rough calculations the pilot mass arms can be estimated between the limits given on page 6.9.

4a: With an ASW 24 of an empty mass of m_L = 235 kg and an empty mass C.of G. of x_L = 626 mm a pilot of 85 kg (incl. parachute) plans his flight. He takes 2 kg of food with him in the cockpit and 2 kg baggage in the upper compartment and 3 kg (barograph, tie dowm equipment, canopy cover and raincoat etc.) in the lower baggage compartment.
What is the in-flight C.of G. position?

In the above mentioned case the cockpit load adds up to:
m_P = 85 kg (pilot + parachute) + 2 kg food supply
m_P = 87 kg

According to the formula given under 6.8 (2) results:

$$X_{CG} = \frac{X_L * m_L + X_P * m_P + X_{uc} * m_{uc} + X_{lc} * m_{lc}}{m_L + m_P + m_{uc} + m_{lc}}$$

(here m_W, = m_{O2} = m_B = 0)

$$X_{CG} = \frac{626 * 235 + (-538) * 87 + 175 * 2 + 200 * 3}{235 + 87 + 2 + 3}$$

X_{CG} = 310 mm

The in-flight C.of G. is about in the middle of the approved range.

4b: If the sailplane according to example 4a is loaded with 100 Liters of water ballast the in-flight mass C.of G. changes as follows:

$$X_{CG} = \frac{X_L * m_L + X_P * m_P + X_W * m_W + X_{uc} * m_{uc} + X_{lc} * m_{lc}}{m_L + m_P + m_W + m_{uc} + m_{lc}}$$

$$X_{CG} = \frac{626*235+(-538)*87+258*100+175*2+200*3}{235 + 87 + 100 + 2 + 3}$$

X_{CG} = 298 mm for an in-flight mass of 427 kg.

The water ballast load of 100 kg shifts the C.of G. only marginally forward by 12 mm.

4c: Into an ASW 24 according to example 4a a battery weighing 1,8 kg is mouted into the fin. How does the in-flight mass C.of G. shift?

$$X_{CG} = \frac{X_L * m_L + X_P * m_P + X_{uc} * m_{uc} + X_{lc} * m_{lc} + X_B * m_B}{m_L + m_P + m_{uc} + m_{lc} + m_B}$$

$$X_{CG} = \frac{626*235+(-538)*87+175*2+200*3+4190*1,8}{235 + 87 + 2 + 3 * 1,8}$$

X_{CG} = 331 mm

The in-flight mass C.of G. is in the rear part of the approved range.

4e: With an ASW 24 of an empty mass of m_L = 235 kg and an empty mass C.of G. of x_L = 626 mm a trim ballast mass of 6 kg is mounted into the fin.
As one can learn from example 3 the empty mass C.of G. is:

m_L = 241 kg
x_L = 715 mm

What is the in-flight mass C.of G. position if a pilot incl. parachute of m_P = 95 kg and arm x_P = 537 mm sits in the sailplane?

$$x_{CG} = \frac{x_L * m_L + x_P * m_P}{m_L + m_P}$$

$$x_{CG} = \frac{715 * 241 + (-537 * 95)}{241 + 95}$$

x_{CG} = 361 mm

The in-flight mass C.of G. is therefore only 9 mm in front of the approved rear limit!

For all these examples, the C.G. position was found to be within permissible limits which are:

between 0.24 m and 0.37 m aft of Datum.

The C.of G. range of good performance has been found to be from 0,32 to 0,35 m aft of datum by experience and tests.

12.6 Maintenance Instructions

The following Maintenance Instructions are established from time to time as required, in accordance with experience accumulated in operating the ASW 24. The Maintenance Manual is to be supplemented in case of new issues of Maintenance Instructions.

The general "Maintenance Instruction ALL FRP GLIDER MODELS dated June 19, 1986" describes the removing of play between the sockets (= bushings) and bolts (= pins) of the wing-to-fuselage transition.

The general Maintenance Instruction "PAINT CRACKS" dated June 26, 1989, describes how to inspect, preserve, and repair the paint surface.

The Maintenance Instruction A for the ASW 24 (dated Feb.5, 1990) describes how to apply or replace the elastic plastic fairing strips for the control surface gaps.

The Maintenance Instruction B for the ASW 24 (dated Feb.7, 1990) describes how to apply or replace the turbulators on the wing, and on the horizontal and vertical tail unit.