PRZEDSIĘBIORSTWO DOŚWIADCZALNO-PRODUKCYJNE SZYBOWNICTWA

"PZL-BIELSKO"

BIELSKO-BIAŁA

F L I G H T M A N U A L

S Z D - 5 5 - 1

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Factory No	.....
Registration No	.....

This is the translation of original Polish text approved by Authority.

Translated by :

.....

W. Stafiej, D.Sc.

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0. L I S T O F R E V I S I O N S

The place where the text has been revised is marked with the vertical line on the right side of the text and with the number of revision.

No of rev.	Page	R e v i s i o n	Date	Signature
1.	Pages :	2, 10, 11, 38, 42, 43 have been replaced as appropriate with pages 2a, 10a, 11a, 38a, 42a, 43a.	7.04.94	Harbaj
2.	Pages :	2a, 10a, 11a, 12, 25 and 39 have been replaced with pages 2b, 10b, 11b, 12a, 25a and 39a.	25.05.95	Harbaj

No of rev.	Page	R e v i s i o n	Date	Signature

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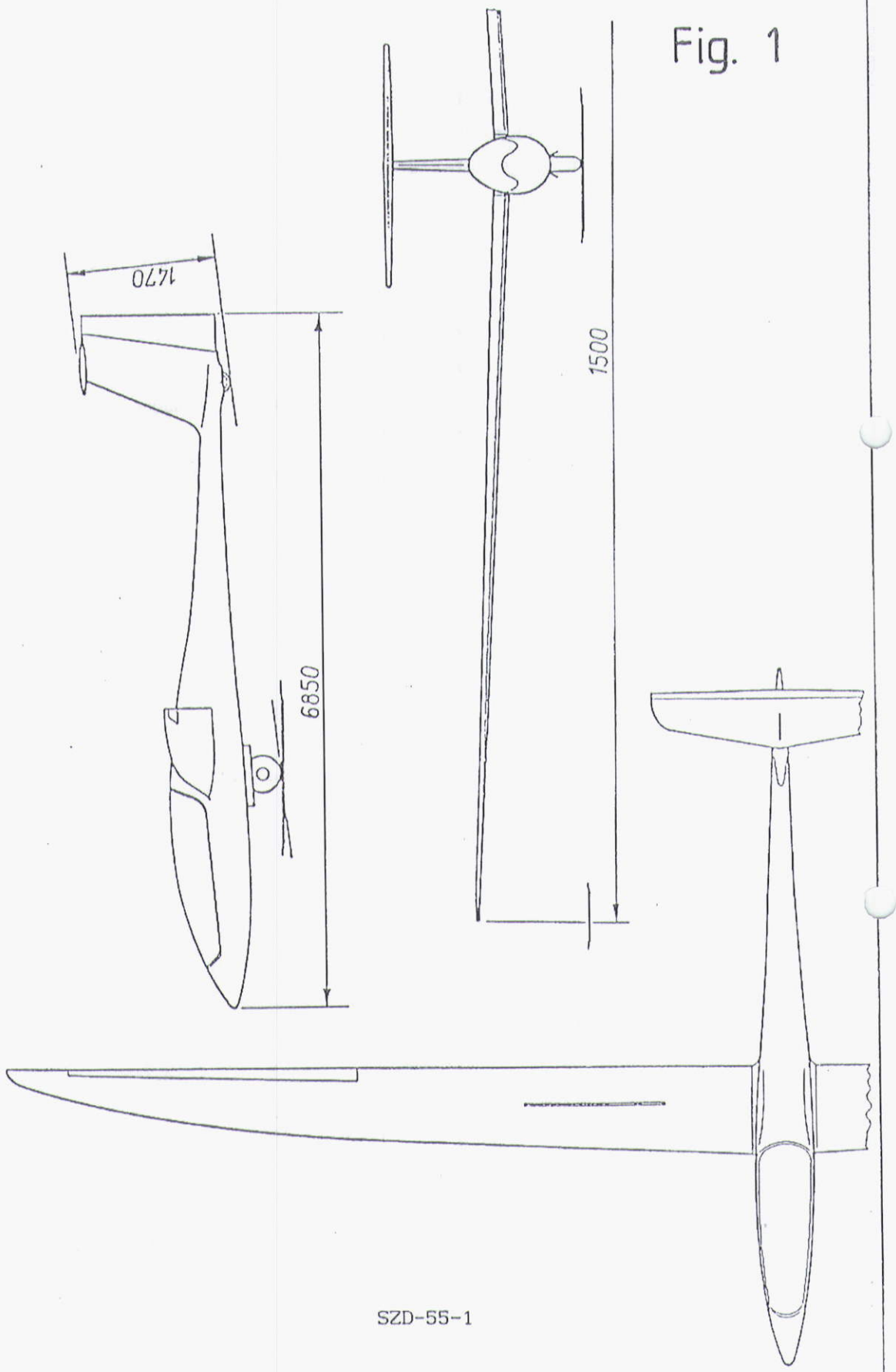
Fig. 1



1. GENERAL INFORMATIONS

1.1. Description of sailplane.

SZD-55-1 is the monoplace competition Standard Class sailplane having mid-wing and "T" tail arrangement.

Two panels wing of trapeze planform and slender outer portions of elliptical chord distribution employs the NN-27 profile. Its monospar design and sandwich covering allow for the integral water ballast tanks of about 195 dm^3 {42,9 British gall.} capacity. The aileron of 20 percent chord ratio is actuated in one point. The double-plate airbrake is extended on the upper wing surface only.

The fuselage integral with the fin is of solid composite shells. The tail water ballast tank of about 9,6 dm^3 {2,11 British gall.} capacity is located under the fin. The pilot's cockpit is formed of the double shell.

The retracted main undercarriage (wheel ϕ 350) employs a disc brake coupled with the airbrake. The fixed tail wheel (ϕ 200) can be optionally replaced with the rubber skid.

The towing hook is installed either on the undercarriage fork or on the fuselage nose portion or on both above locations simultaneously.

In the fuselage nose a coupled air intake for air-conditioning and total pressure head is installed. Slightly lower the pressure head for electroacoustic stall warning device is located.

One piece canopy is "forwards-upwards" opened by means of two handles on the canopy frame.

Column type instrument panel.

The correct pilot's in cockpit position is ensured by the in-flight adjustable pedals and adjustable (on ground) back rest.

The control systems of aileron, airbrake, elevator and water ballast valves in wings are of the push-rod type. The control systems of rudder, towing hook, wheel brake and tail water ballast valve are of the cable type. The elevator control system comprises the spring trimming-device controlled by the lever on the control stick.

The transceiver aerial and battery housing and pressure head nest are installed in the fin.

1.2. Main technical data.

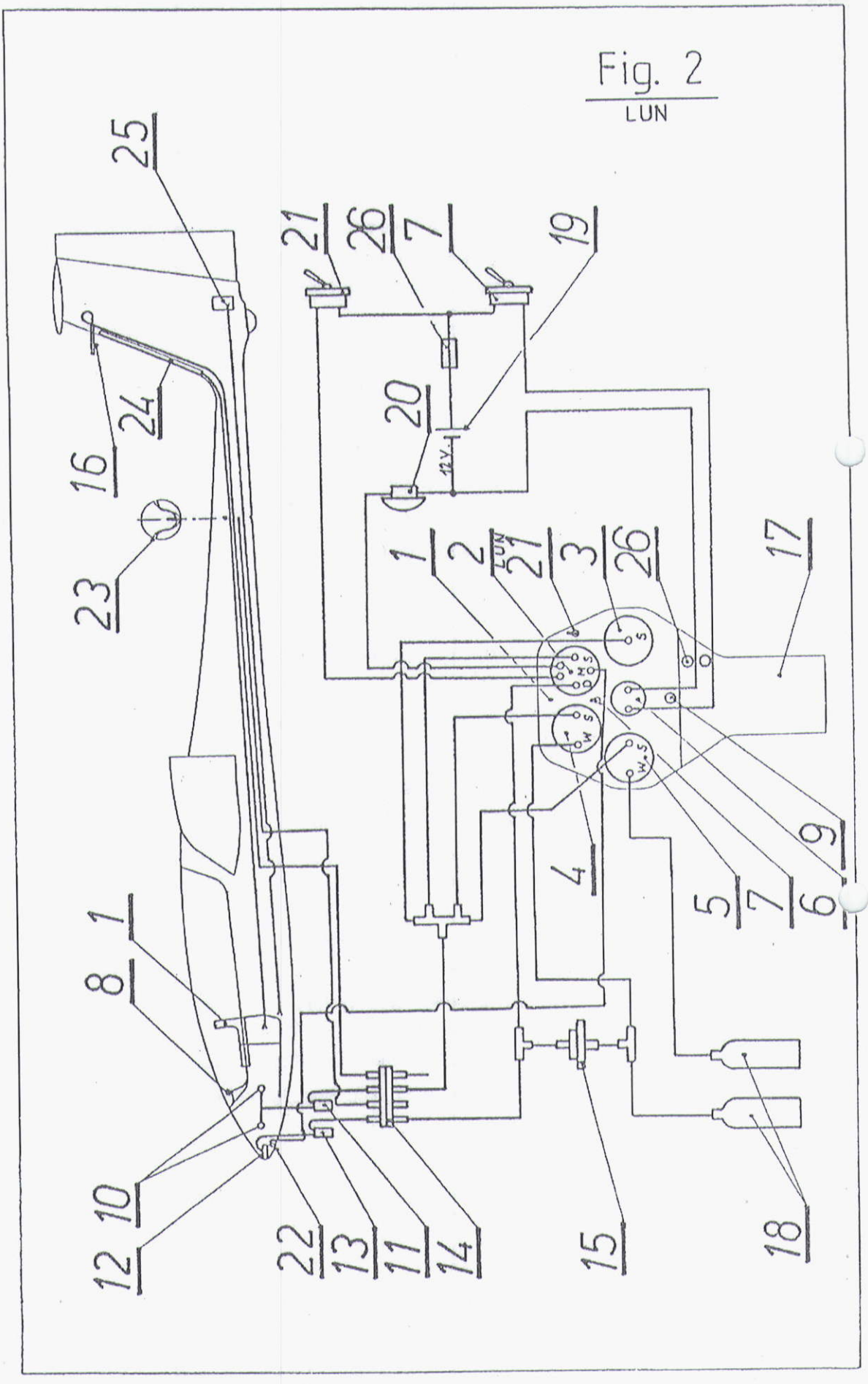
Span	15 m	49,2 ft
Length	6,85 m	22 ft 5,70 in
Height	1,47 m	4 ft 9,88 in
Wing dihedral	3^{o}	
Wing area	9,6 m^2	103 sq ft
Aspect ratio	23,44	
Root chord	0,84 m	2 ft 9,07 in
Mean Standard Chord	0,6874 m	2 ft 3,06 in
Wing profile	NN-27	
Tailplane span	2,5 m	8 ft 2,42 in

Fig. 2 BOARD INSTRUMENT INSTALLATION-SCHEME OF ELECTRIC AND PNEUMATIC CONNECTIONS

1. Instrument panel.
2| 2. Airspeed indicator LUN-1107-8 or PR-400S
3. Altimeter W-10S or W-12S.
4. Variometer WRs-5D (5 m/s).
5. Variometer WRs-30C (30 m/s).
6. Turn indicator EZS-4.
7. Switch of turn indicator supply.
8. Compass KI-13 (under perspex or on the instrument panel cover).
9. Panel fixing screw.
10. Static pressure heads in the fuselage front part.
11. Drainage unit (of static pressure installation).
12. Total pressure head.
13. Drainage unit (of total pressure installation).
14. Joint of pneumatic ducts.
15. Total energy compensator KWEC-2.
16. Nest for pressure head of additional instruments.
17. Instrument panel column.
18. Compensation bottles TM-420C.
19. Board supply source.
2| 20. Electroacoustic stall warning device. In case of PR-400S airspeed indicator the SP 3 one (Instrument Manual enclosed).
21. Switch of stall warning device supply.
22. Pressure head for stall warning device.
23. Additional static pressure ports (for electric variometer).
24. Transceiver aerial with cable.
25. Battery with the supply wire in the fin.
1| 26. Fuse 0,5 to 0,7 A.

NOTE - THE AIRSPEED INDICATOR, ALTIMETER AND VARIOMETER SHALL BE CONNECTED TO (10) AND (12) HEADS ONLY.

Fig. 2
LUN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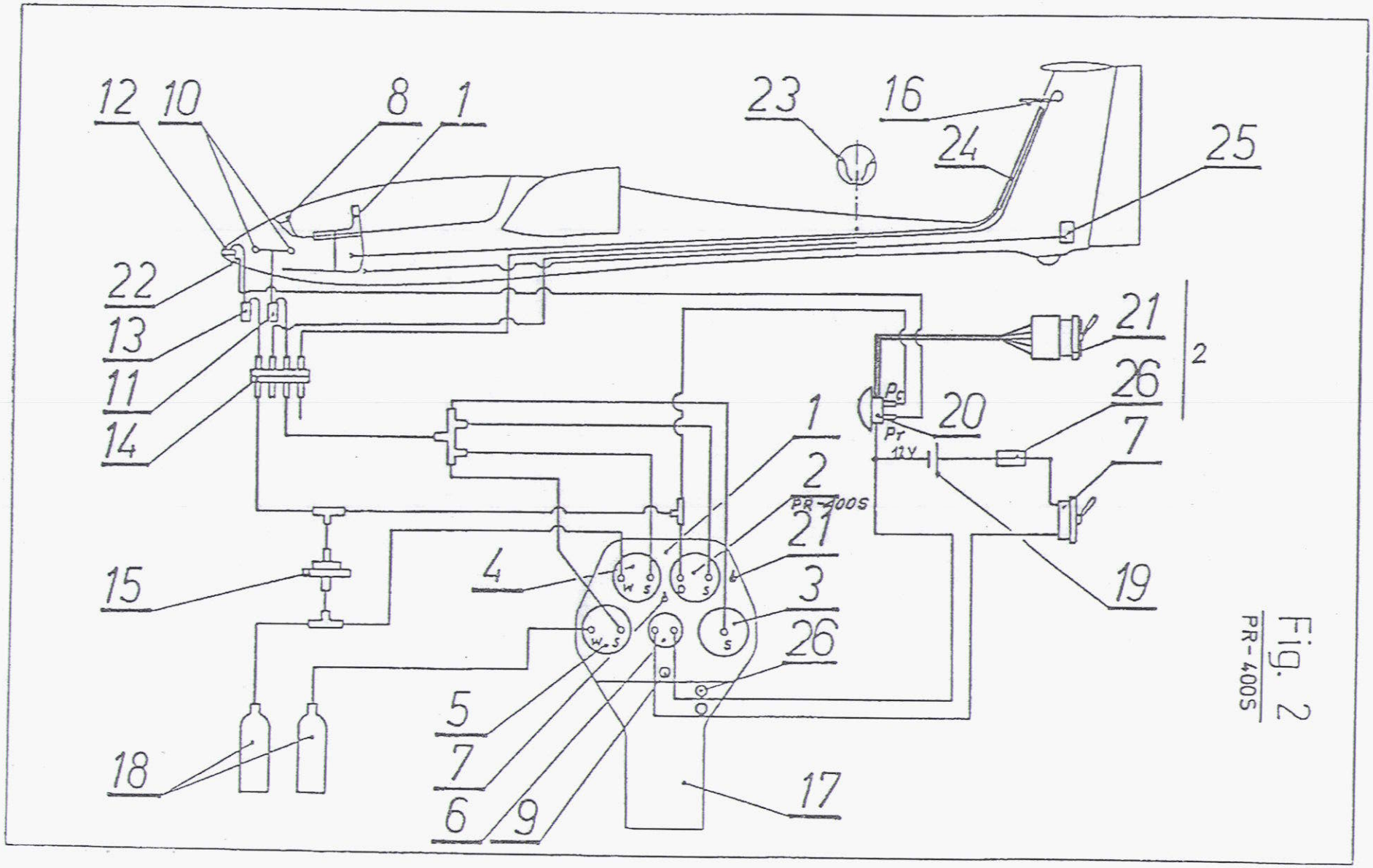
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Fig. 2
PR-400S

1.3. E q u i p m e n t.

1.3.1. Instrument panel.

The sailplane is equipped with the column type instrument panel (Fig. 2) consisting of the basic panel (1) and column (2). The panel allows for installation of five instruments ϕ 80 or four ϕ 80 and two ϕ 60.

The producer recommends to install on the panel the following instruments :

- airspeed indicator LUN-1107-8 (2) with the elektroacoustic stall warning device (20) and supply switch (21) of total mass of 560 g,
  or in case of PR 400S with stall warning device SP 3 of total mass of 580 g, 2
- altimeter W-10S or W-12S (3) of mass of 580 g,
- variometer WRs-5D (4) with compensator KWEC-2 (15) and compensating bottle TM-420C (18) of total mass of 700 g,
- variometer WRs-30C (5) with the compensating bottle TM-420C (18) of mass of 600 g,
- turn indicator EZS-4 (6) with supply switch (7) of total mass of 320 g,
- compass KI-13 (8) located on the instrument panel cover or under perspex of mass of 125 g.

NOTE - FOR AIRWORTHINESS THE JAR-22 REQUIRE THE SAILPLANE TO BE EQUIPPED AT LEAST WITH : AIRSPEED INDICATOR, ALTIMETER AND STALL WARNING DEVICE.

1.3.2. Cockpit equipment.

The pilot's cockpit is equipped with :

- four parts pilot's belts,
- seat upholstery,
- side pocket
- rubber pear of sanitary installation.

1.3.3. Hooks.

The sailplane is factory adapted for installing of TOST type towing hook fixed on the undercarriage fork (G type) or in the fuselage front part (E type).

1.3.4. Source of energy.

The main energy source the PANASONIC Vds 6,5 P battery of 2,2 kg mass is located in the fin.

NOTE - IN CASE THE BATTERY IS NOT INSTALLED THE SUBSTITUTIVE BALLAST OF 2,2 kg {4,85 lb} MASS SHALL BE USED.

1.3.5. Additional equipment.

On the customer's order the sailplane can be additionally equipped with :

- pneumatic adjustable head rest,
- sheepskin cockpit upholstery,
- coloured canopy perspex,
- front or c.g. hook other than TOST type,
- tail skid.

1.3.6. Other equipment.

Apart of the equipment listed in items 1.3.1 ÷ 1.3.5. it is possible to install :

- transceiver,
- electrical variometer,
- additional battery,
- oxygen equipment.

NOTE - THE INSTALLATION OF THE EQUIPMENT LISTED IN ITEM 1.3.6. SHALL BE AGREED WITH THE AUTHORITY.

1.3.7. Service equipment.

1.3.7.1. Basic.

Every sailplane is equipped with the following special service tools :

- extension member for filling with air the tube of main wheel,
- funnels for filling the water to the wing ballast tank,
- calibrated canister for the ballast water,
- spanner for main wheel hub adjustment - 2 pieces,
- turning-member for tailplane assembling.

1.3.7.2. Additional.

On the customer's order the producer supplies the following additional equipment :

- cover for the wings - 2 pieces,
- flannel cover for the canopy,
- cover for the fuselage,
- cover for the tailplane,
- transportation tail wheel,
- transportation wheels under the wing,
- ground towing thill.

2. OPERATION LIMITATIONS

2.1. Base for approval.

The sailplane has been designed and certified on the base of JAR 22 Requirements, Amendment 4 of 07.05.1987.

The Type Certificate No BG 163 has been issued by Central Civil Aviation Inspectorate (Warsaw on 13.Feb.1990).

2.2. Masses.

1. Maximum all-up mass :		
- without ballast in wings	350 kg	771,7 lb
- with ballast	500 kg	1102,5 lb
2. Empty glider mass	205 ÷ 230 kg	452 ÷ 507,2 lb
3. Pilot and parachute mass :		
- minimum	60 kg	132,3 lb
- maximum	110 kg	242,5 lb
4. Maximum loading mass (without ballast in wings) ;	see table 2.4. (page 20)	
5. Maximum mass of the ballast in wings (take into account the limitations resulting from 2.2.1)	195 kg	430,0 lb
6. Maximum tail ballast mass (take into account the limitations resulting from Fig. 11, page 37)	9,6 kg	21,2 lb
7. Minimum wing mass	102 kg	224,9 lb

2.3. C. g. location.

1. Distance between the empty glider c.g. and the base (leading edge of the root rib):

   see table 2.4. and diagrams pages: 18 and 19.

2. Limit front c.g. location in flight :

   19,0 % MSC corresponding to 28,3 cm {11,15 in } of the root chord.

3. Limit rear c.g. location in flight :

   42,0 % MSC corresponding to 44,1 cm {17,37 in } of the root chord.

Fig. 3 MASS DISTRIBUTION

The glider in attitude for weighing acc. to Technical Service Manual, item 2.8. (page 20).

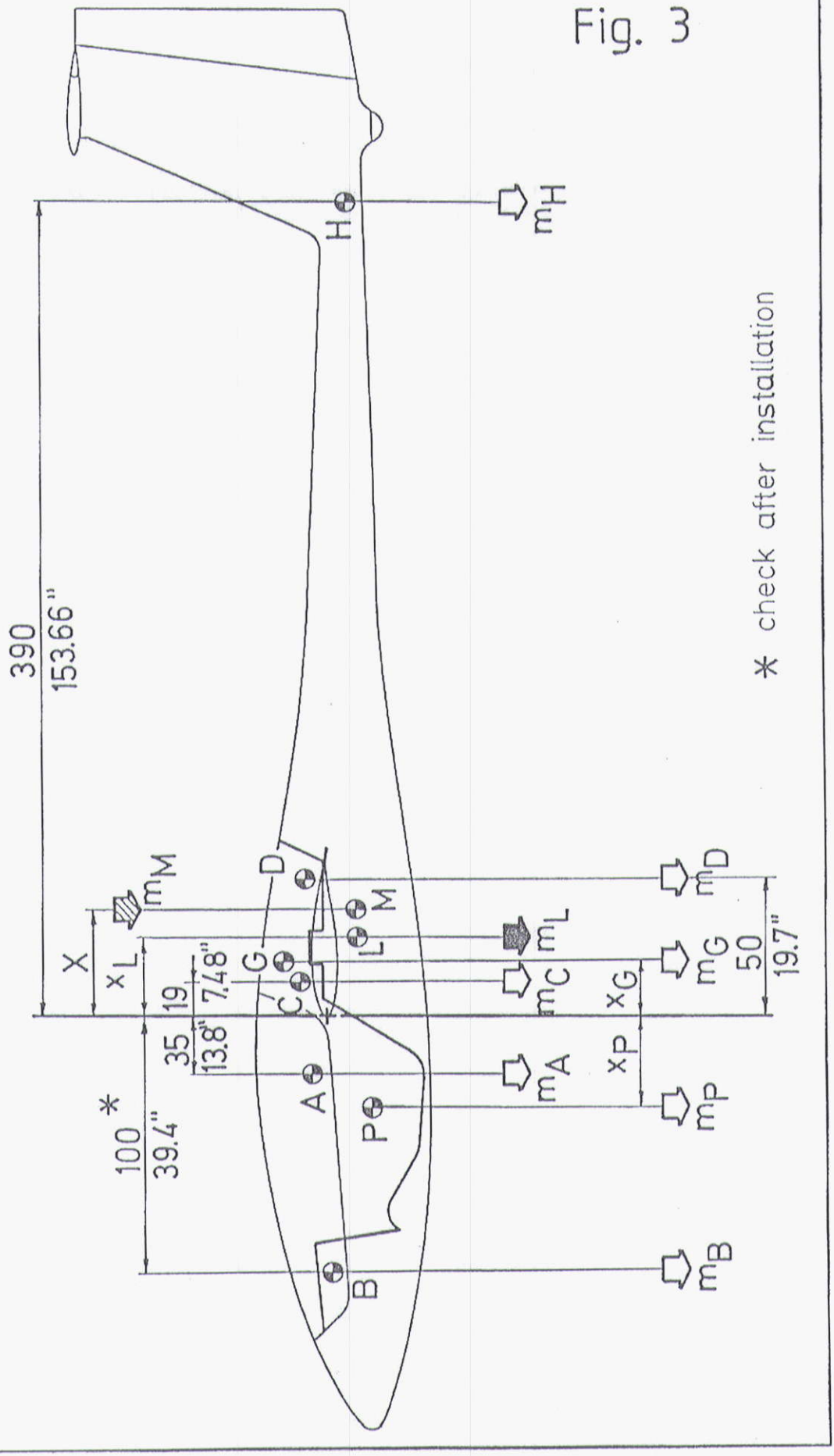
The distance in respect to the base (leading edge of the root rib) in measured in cm {in}.

NOTE - ON THE DRAWING THE MASS OF THE BATTERY IN THE FIN CONTAINER HAS BEEN LEFT. THE BATTERY IS THE OBLIGATORY ELEMENT OF THE EQUIPMENT RECOMMENDED BY THE PRODUCER AND IS CONTAINED IN THE EMPTY SAILPLANE MASS m_M.

THE BATTERY MASS (OR SUBSTITUTIVE ONE) IS 2,2 kg {4,85 lb}.

THE BATTERY MASS ARM IS 438,5 CM {14 ft 4,64 in}.

Fig. 3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m_H
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x_L
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19.7"
x_G
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13.8"
x_P
A
P
m_A
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100 *
39.4"
B
m_B
* check after installation

The sailplane c.g. location in flight is calculated on the base of formula :

- in cm

$$x_L = \frac{m_M \cdot X + m_C \cdot 19 + m_G \cdot x_G + m_D \cdot 50 + m_H \cdot 390 - (m_B \cdot 100 + m_P \cdot x_P + m_A \cdot 35)}{m_L}$$

- in inches

$$x_L = \frac{m_M \cdot X + m_C \cdot 7,48 + m_G \cdot x_G + m_D \cdot 19,7 + m_H \cdot 153,66 - (m_B \cdot 39,4 + m_P \cdot x_P + m_A \cdot 13,8)}{m_L}$$

D e s i g n a t i o n s :

x_L - arm of the sailplane mass in flight (distance of c.g. from the leading edge of wing root chord),

m_L - all-up mass

$m_L = m_M + m_C + m_G + m_D + m_H + m_B + m_p + m_A$

m_M, X - mass, arm of the mass of empty sailplane acc. to item 2.4. (with the equipment recommended by the producer acc. to item 1.3.1.),

m_C - mass of the load in the luggage compartment before the spar (max. 5 kg {11 lb}),

m_G, x_G - mass, arm of the mass of water ballast in wings, where

$x_G = 21 + 0,025\ m_G$ [cm] { $x_G = 8,27 + 0,0045\ m_G$ [in] },

m_D - mass of the load in the luggage compartment behind the spar (max. 15 kg {33,1 lb}),

m_H - mass of the tail water ballast,

m_B - difference of masses of actual equipment and recommended by producer one in the instrument panel acc. to item 1.3.1.

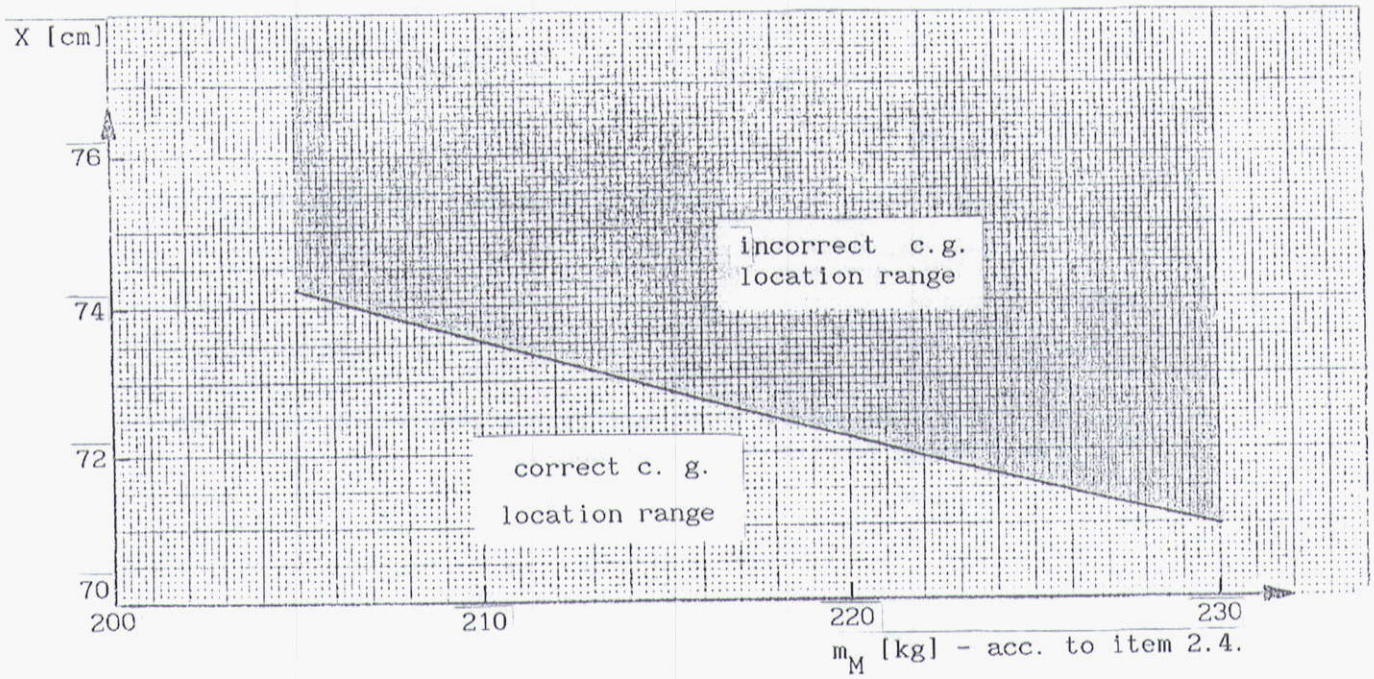
NOTE - THE MAXIMUM MASS OF EQUIPMENT CANNOT EXCEED 5 kg {11 lb}.

m_P, x_P - mass, arm of the mass of the pilot with parachute, where

$x_P = 58 - 0,2(m_P - 55)$ [cm] { $x_P = 22,85 - 0,0357(m_P - 121,3)$ [in] }

m_A - mass of the photo-camera (max. 1,0 kg { 2,2 lb}).

Fig. 4 Allowable rear c.g. location of empty sailplane for the minimum loading of 60 kg {132 lb}.



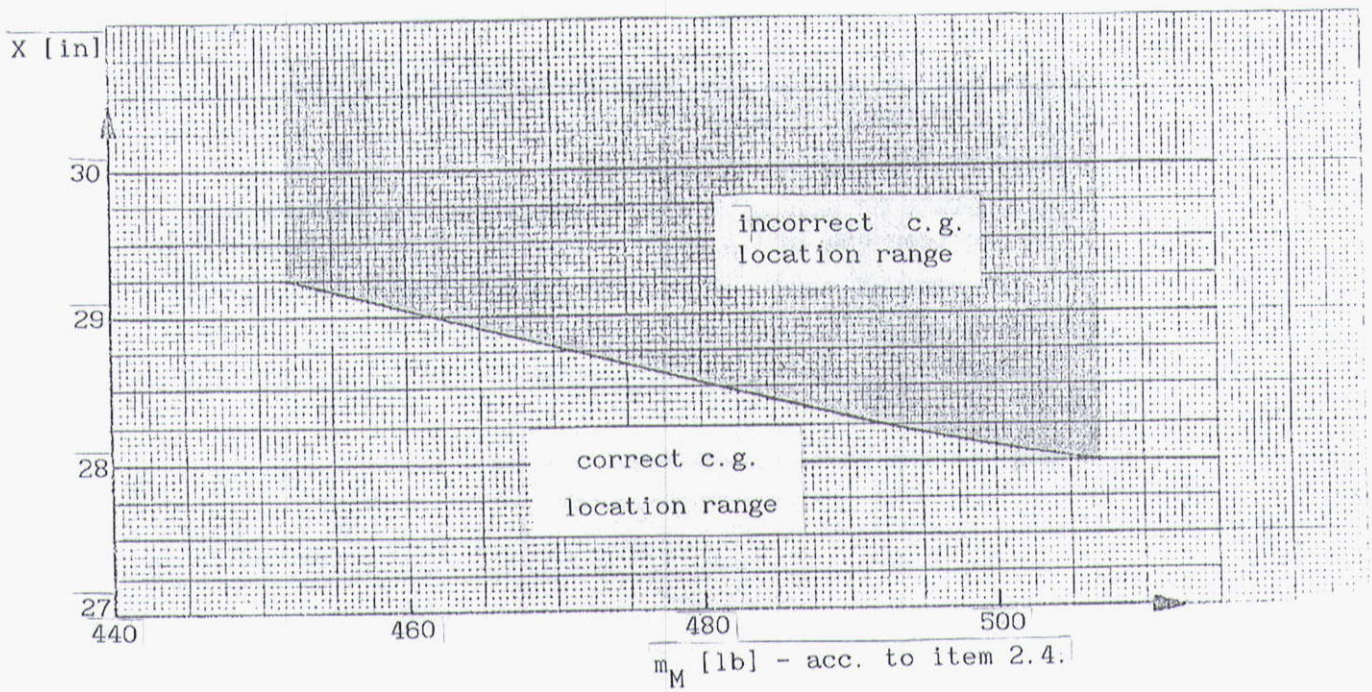
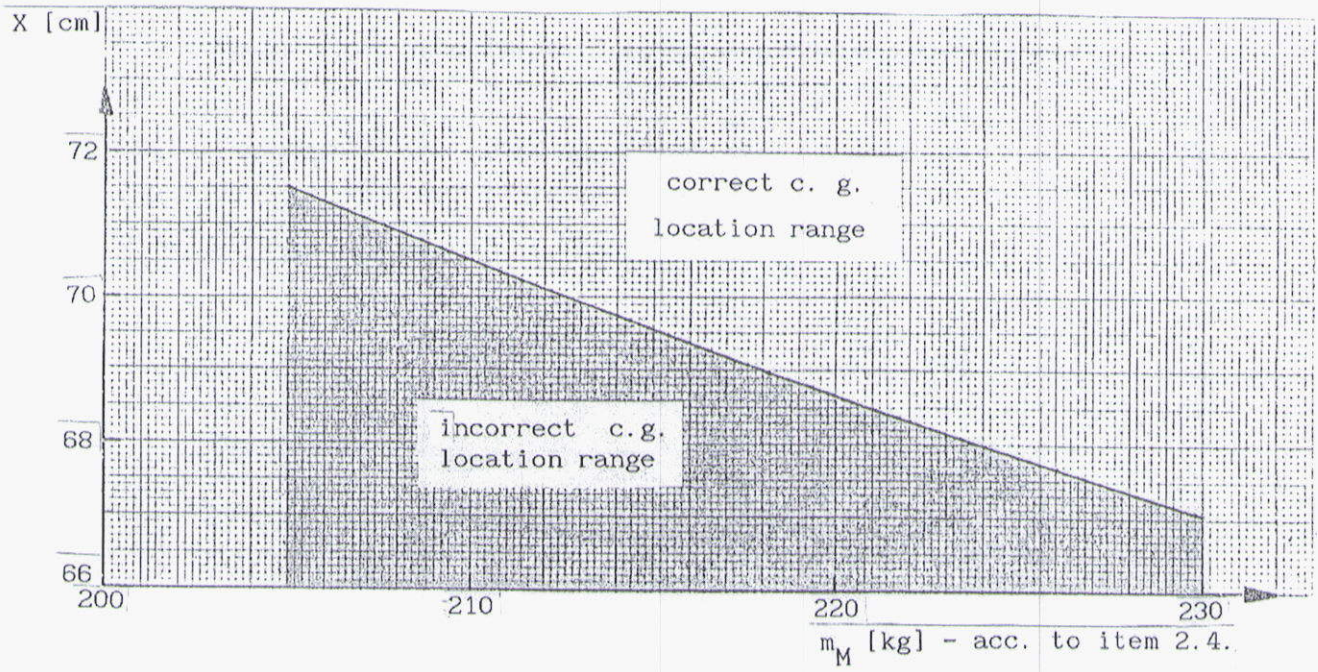
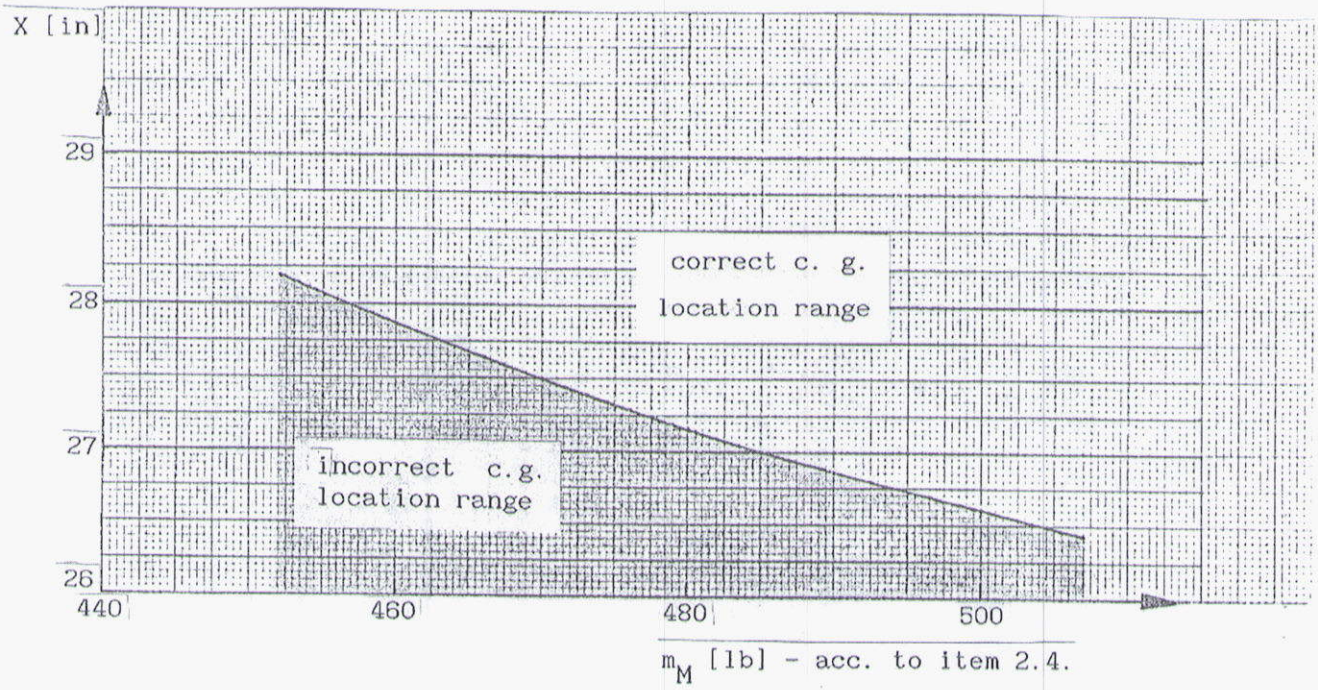


Fig. 5 Allowable front c.g. location of empty sailplane for the loading of 110 kg {242,5 lb} and all up mass of 500 kg {1102,5 lb}.





2.4. Table of weighing for SZD-55-1 sailplane , Fact. No .....

Date of weighing						
Hooks c.g.						
front						
Built-in equipment (recommended by the producer acc. to item 1.3.1.)						
Empty sailplane mass m_M {kg ; lb}						
C.g. location of empty sailplane X {cm ; in}						
Max. loading (without ballast in wings) {kg ; lb}						
Notes						
Signature and seal of Authority Inspector						

2.5. Example of calculation of mass and c.g. location of the sailplane in flight.

Input data :

- empty sailplane

  m_M= 210,0 kg {463 lb}

  X = 75,0 cm {29,55 in} (acc. to table item 2.4.),

- loading in the luggage compartment before the spar

  m_C= 2,0 kg {4,4 lb}

  x_C= 19,0 cm {7,48 lb} (acc. to drawing on page 16),

- water ballast in wings

  m_G= 195,0 kg {430 lb}

  x_G= 21+0,025*195=25,8 cm {x_G=8,27+0,0045*430=10,2 in},

- loading in the luggage compartment behind the spar

  m_D= 3,6 kg {7,9 lb}

  x_D= 50,0 cm {19,7 in} (acc. to drawing on page 16),

- tail water ballast

  m_H= 9,6 kg {21,2 lb}

  x_H= 390,0 cm {153,66 in} (acc. to drawing on page 16),

- difference of masses of actual equipment and recommended by producer one in the instrument panel acc. to item 1.3.1.

  m_B= 2,1 kg {4,6 lb}

  x_B= 100,0 cm {39,4 in} (acc. to drawing on page 16),

NOTE - IN CASE THE ACTUAL EQUIPMENT MASS IS LOWER THAN THE MASS OF EQUIPMENT IN THE INSTRUMENT PANEL ACC. TO ITEM 1.3.1. THE ABOVE DIFFERENCE IS NEGATIVE AND IT SHOULD BE SO TAKEN INTO ACCOUNT IN THE EQUATION.

- pilot with parachute

  m_P= 70 kg {154,3 lb}

  x_P= 58-0,2*(70-55)=55,0 cm

  {x_P=22,85-0,0357*(154,3-121,3)=21,67 in},

- photo-camera

  m_A= 0,8 kg {1,8 lb}

  x_A= 35,0 cm {13,8 in} (acc. to drawing on page 16),

Limitation of the maximum all-up mass 500 kg {1102,5 lb}.

m_M =	210,0 kg	463,0 lb
m_C =	2,0 kg	4,4 lb
m_G =	195,0 kg	430,0 lb
m_D =	3,6 kg	7,9 lb
m_H =	9,6 kg	21,2 lb
m_B =	2,1 kg	4,6 lb
m_P =	70,0 kg	154,3 lb
m_A =	0,8 kg	1,8 lb

m_L = 493,1 kg < 500 kg { m_L = 1087,2 lb < 1102,5 lb }

The all-up mass does not exceed 500 kg {1102,5 lb} - the limitation is satisfied.

Limitation of c.g. location of the sailplane in flight in the range of : 28,3 to 44,1 cm {11,15 to 17,37 in}.

	28,3 cm to 44,1 cm		**{11,15 in to 17,37 in}**	
m_M . X =	210*75 =	15750	463,0*29,55=	13681,65
m_C . 19 =	2,0*19 =	38	4,4*7,48 =	32,91
+ m_G . x_G=	195*25,8 =	5031	430,0*10,2 =	4386,00
m_D . 50 =	3,6*50 =	180	7,9*19,7 =	155,63
m_H .300 =	9,6*300 =	3744	21,2*153,66 =	3257,59
total		24743 kgcm	{total	21513,78 lbin}
m_B . 100 =	2,1*$\overline{100}$=	-210	4,6*$\overline{39,4}$ =	-181,24
+ m_P . x_P =	70,0*$\overline{55}$=	-3850	154,3*$\overline{21,67}$ =	-3343,68
m_A . 35 =	0,8*$\overline{35}$ =	-28	1,8*$\overline{13,8}$ =	-24,84
total		-4088 kgcm	{total	-3549,76 lbin}
The sum is :		24743		21513,78
		-4088		-3549,76
		20655		17964,02

x_L = 20655 : 493,1 = 41,9 cm {x_L = 17964,02 : 1087,2 = 16,52 in}

since : 28,3 < 41,9 <44,1 { since : 11,15 < 16,52 <17,37 }

c.g. is located in the required range, the limitation is satisfied.

2.6. Range of operation.

Maximum permissible airspeeds IAS		Without water ballast in wings			With water ballast in wings		
		km/h	kts	mph	km/h	kts	mph
winch launching, c.g. hook	V_W	145	78,3	89,9	145	78,3	89,9
aerotowed flight	V_T	155	83,7	96,1	155	83,7	96,1
free flight :							
- smooth air	V_{NE}	255	137,7	158,1	255	137,1	158,1
- gust conditions	V_{RA}	195	105,3	120,9	195	105,3	120,9
manoeuvring airspeed	V_A	195	105,3	120,9	195	105,3	120,9
airbrake operation		255	137,7	158,1	255	137,7	158,1
undercarriage operation	V_{LG}	255	137,7	158,1	255	137,7	158,1

Permissible accelerations :		
at the airspeed ≤ V_A/V_G	+5,3/-2,65	+5,3/-2,65
at the airspeed V_{NE}	+4,2/-1,95	+4,7/-2,0

Permissible aerobatic manoeuvres :		
- normal looping	yes	no
- stall turn	yes	no
- quick half-roll-half-loop	yes	no
- chandelle	yes	no
- lazy eight	yes	no
- spinning	yes	no

The sailplane allowed for altitude flights provided the efficient oxygen equipment is installed	yes	no
The sailplane allowed for cloud-flying	yes	yes

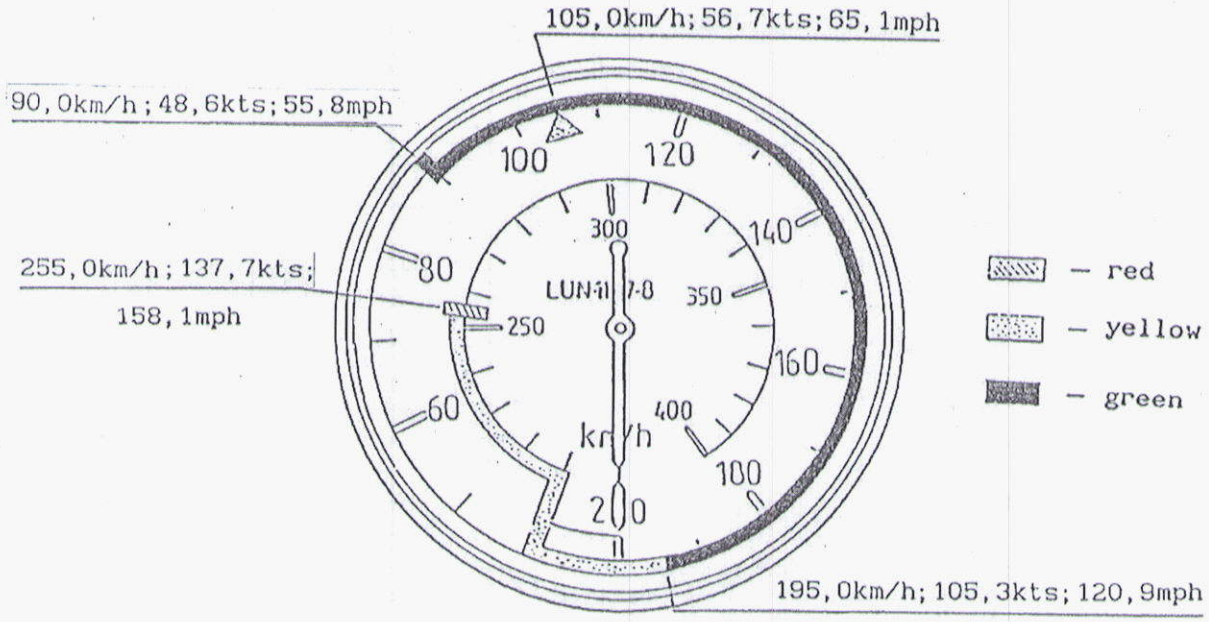
The sailplane in not allowed for :

- winch launching using the front hook,
- night flying,
- flights with water ballast at the ambient temperature below 273 K { 0^{o} C ; 32^{o} F }.

Other statements :

- max intensity of wind side component at the take-off 5 m/s {16,4 ft/s},
- pressure in main wheel 0,2 MPa {0,41 lb/sq ft},
- pressure in tail wheel 0,15 MPa {0,308 lb/sq ft},
- towing cable safety link strength 690 ±50 daN {1323 ±110 lb}.

2.7. Airspeed indicator dial markings.



LUN-1107-8

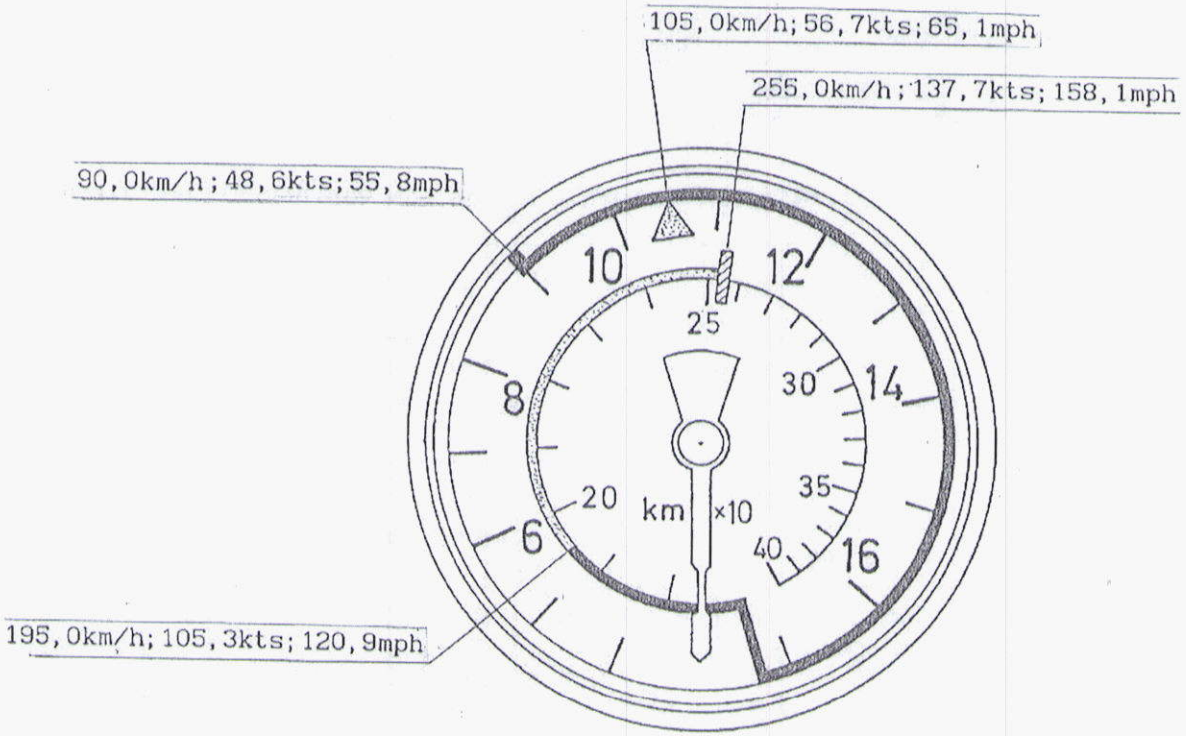


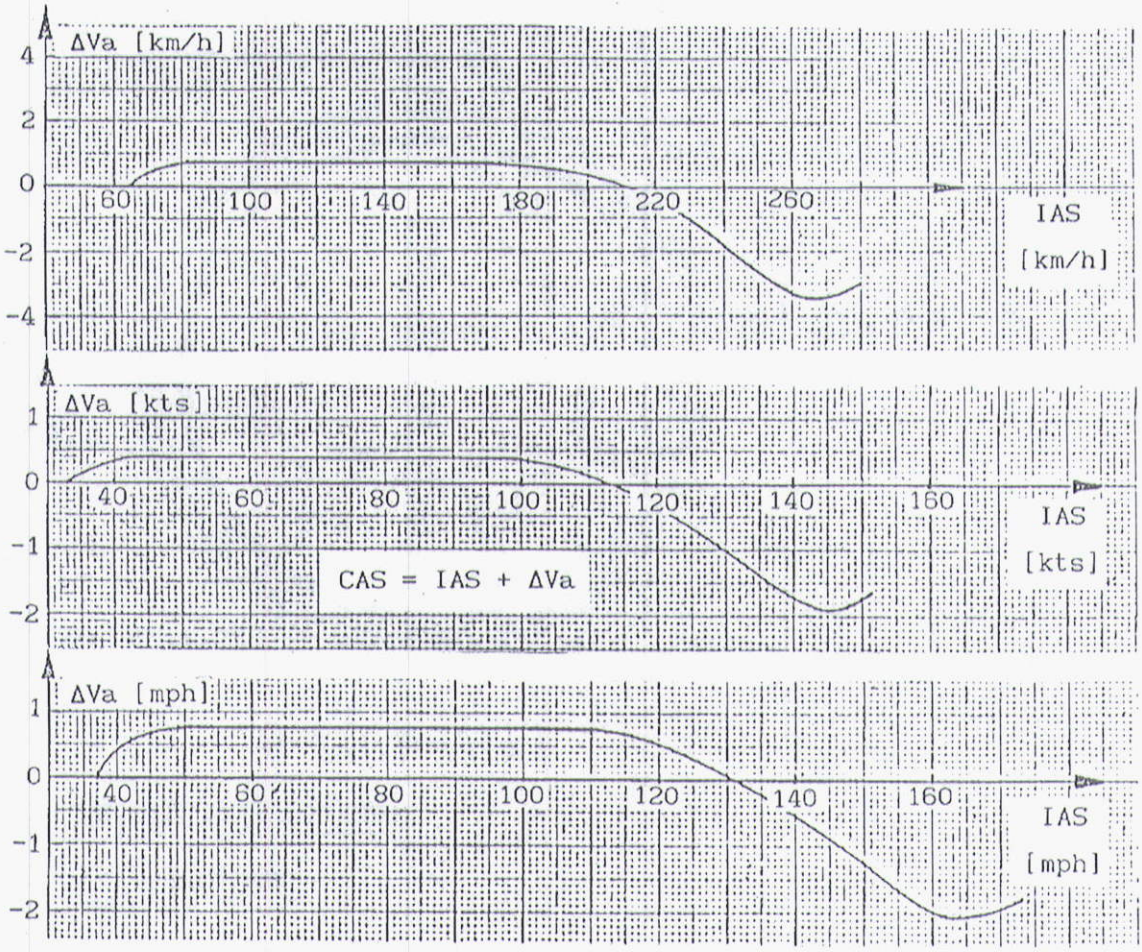
Fig. 6 PR-400S

3. P E R F O R M A N C E

3.1. S p e e d p o l a r.

See Fig. 8, page 27.

3.2. Airspeed indicator aerodynamic correction.

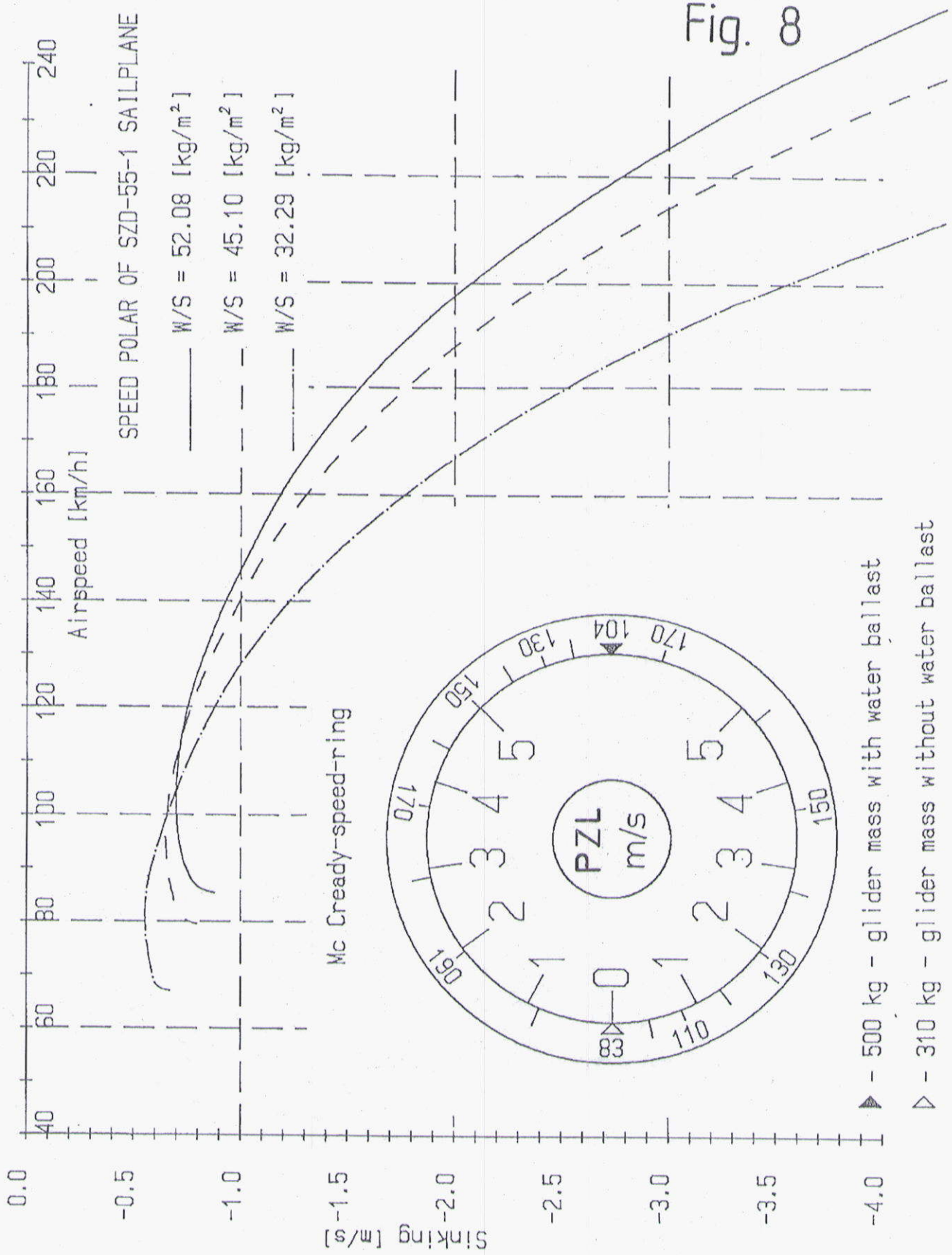


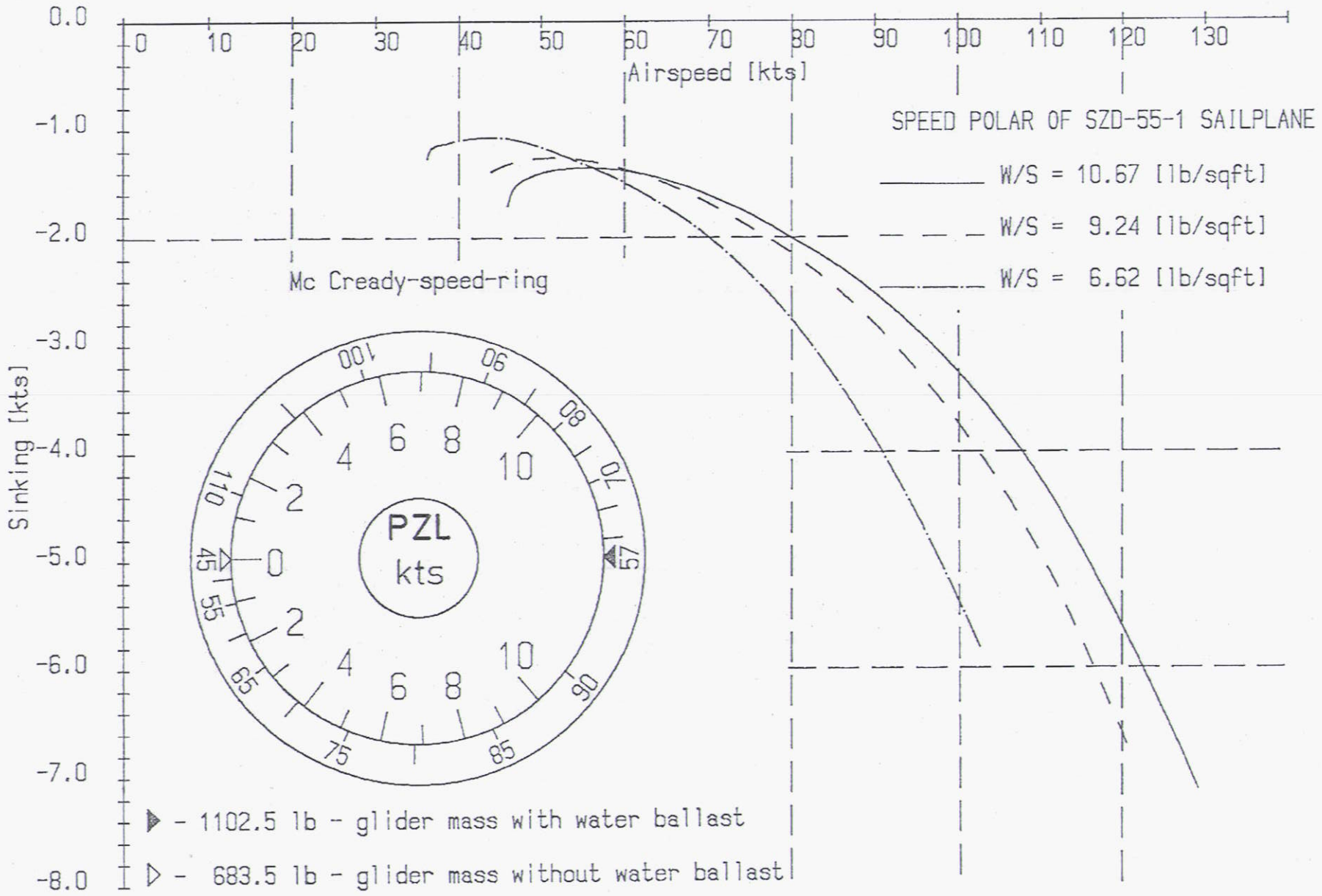
3.3. Permissible airspeed V_{NE} on the various flight altitudes.

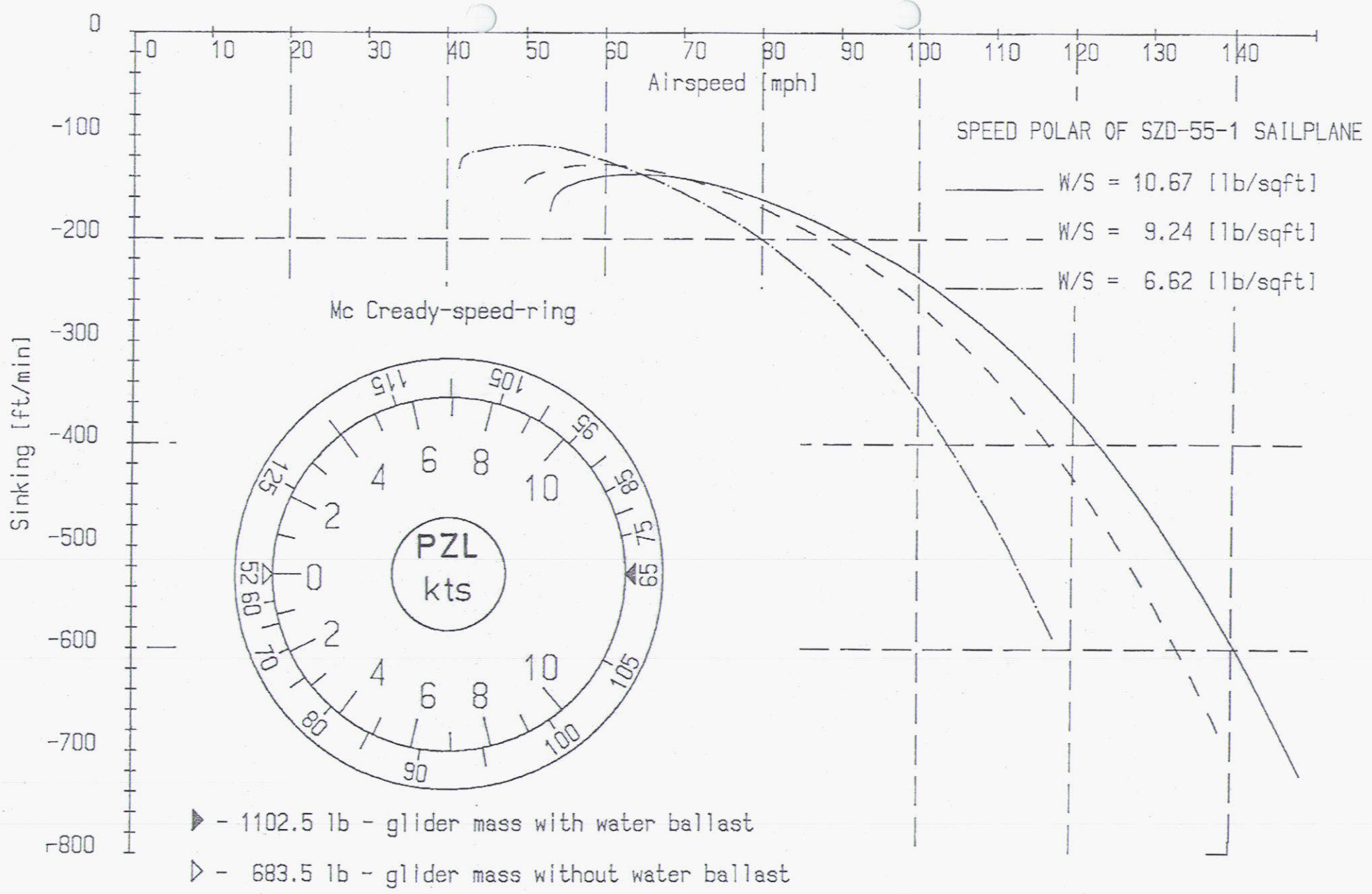
Absolute altitude	km	0÷2	3	4	6	8	10	12
Indicated airspeed IAS	km/h	255	242	230	206	184	163	142
	kts	137,7	130,7	124,2	111,2	99,3	88,0	76,7

Absolute altitude	ft	0÷6560	10000	15000	20000	25000	30000	35000	40000
Indicated airspeed IAS	mph	158,1	150,0	139,0	127,5	116,1	104,9	93,4	85,0
	kts	137,7	130,5	120,2	110,4	100,3	90,3	80,5	70,0

Fig. 8


SPEED POLAR OF SZD-55-1 SAILPLANE
W/S = 52.08 [kg/m²]
W/S = 45.10 [kg/m²]
W/S = 32.29 [kg/m²]
Airspeed [km/h]
Sinking [m/s]
Mc Cready-speed-ring
PZL
m/s
▲ - 500 kg - glider mass with water ballast
△ - 310 kg - glider mass without water ballast


SPEED POLAR OF SZD-55-1 SAILPLANE
W/S = 10.67 [lb/sqft]
W/S = 9.24 [lb/sqft]
W/S = 6.62 [lb/sqft]
Airspeed [kts]
Sinking [kts]
Mc Cready-speed-ring
PZL
kts
▶ - 1102.5 lb - glider mass with water ballast
▷ - 683.5 lb - glider mass without water ballast


SPEED POLAR OF SZD-55-1 SAILPLANE
W/S = 10.67 [lb/sqft]
W/S = 9.24 [lb/sqft]
W/S = 6.62 [lb/sqft]
Airspeed [mph]
Sinking [ft/min]
0
-100
-200
-300
-400
-500
-600
-700
-800
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Mc Cready-speed-ring
PZL
kts
0 2 4 6 8 10
52 60 70 80 90 100 105 115 125
55 58 65 75
▶ - 1102.5 lb - glider mass with water ballast
▷ - 683.5 lb - glider mass without water ballast

4. OPERATION OF SAILPLANE

4.1. Pre-flight and post-flight inspection.

It is necessary to check :

1. Glider documents, complete the inscriptions.
2. External inspection of structure condition and coverings.
3. Undercarriage, condition of tyre, pressure in tube, cleanness of undercarriage housing.
4. Correct securing of bolts of wings and tailplane.
5. Hinges of control surfaces, airbrake, controls operation, wheel brake, friction, plays.
6. Towing hook (hooks) operation.
7. Canopy condition - locking, opening, window.
8. Cockpit inside, back-rest locking, belts, lack of movable things.
9. Instruments, pressure heads, battery(ies), correct operation of turn indicator and stall warning device (ti-ta-ti-ta signal).
10. Correct installation of battery in the fin (or substitutive weight).
11. Water ballast installation : opening and closing of the jettisoning valves, correct water filling, valve tightness.
12. Transceiver - check the operation.

4.2. Pilot in the cockpit, operation of device.

The pilot (with parachute) having the mass lower than minimum mass of pilot acc. to item 2.2. shall complete his mass with the sand pillow (or lead shot) of the proper mass fastened to the abdomen belts.

For the flight without the parachute the hard substitutive pillow of the thickness no lower than 8 cm {3,15 in} should be used.

The canopy opening is added with the gas spring, support the canopy with hand !

The back-rest can be readjusted when the securing slider is pulled up, than push the slider down and check the locking.

The inclination of the back-rest with head-rest is adjusted when the click supports are lifted (behind the back-rest).

The pilot is able to adjust the pedals in flight (7 positions adjusted with legs when the hand-grip is pulled).

The adjusted pilot's position must allow for correct operation of all controls and cockpit device. The pilot of mass above 70 kg {154,3 lb} should adjust the most possible rear position.

The trimming spring is adjusted by means of lever on the stick. The lever when pushed disconnects the spring out of the control system. When the lever is released the spring helps to retain the stick in a position.

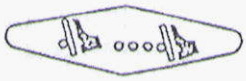
The other controls and cockpit devices are marked with placards.

Fig. 9 INFORMATION PLACARDS

1. Emergency jettisoning of canopy - on the hand-grip at the top of instrument panel.
2. Adjustment of pedals - on the hand-grip at the upper right corner of instrument panel base.
3. Releasing of towing cable - on the hand-grip at the upper left corner of instrument panel base.
4. Extending of airbrake - on the hand-grip of airbrake control at the left side of seat pan.
5. Extending of undercarriage - on the hand-grip of undercarriage control at the right side of seat pan.
6. Opening of canopy lock; left side - on the hand-grip of canopy frame at left side.
7. Opening of canopy lock; right side - on the hand-grip of canopy frame at right side.
8. Opening of water ballast tank valves - on the hand-grip at the right board.
9. Air-conditioning - on the hand-grip at the left side of instrument panel column.
10. Switching on and off of supplying for :
    - turn indicator - on the instrument panel above the turn indicator
    - stall warning device - on the instrument panel at the side of airspeed indicator.

Fig. 9

1 

2 

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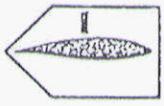
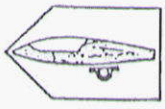
4 

5 

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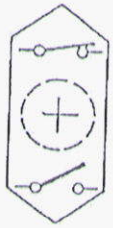
10 

4.3. W a t e r b a l l a s t.

4.3.1. General direction for applying the water ballast.

1. Decision for filling the water ballast is taken by the pilot providing the max. permissible water amount given in items 4.3.2. and 4.3.4. are respected.

2. It is recommended, as a rule, the tail ballast equal to the maximum permissible amount (4.3.4.) or slightly less.

3. It is strongly prohibited to fly with water ballast at the ambient temperature below 0^{o} C {32^{o} F}.

NOTE - THE FROZEN WATER MAY RESULT THE SEVERE SAILPLANE DAMAGE, WETTING OF THE STRUCTURE INSIDE, INCORRECT TRIM, LOCKING OF THE WATER VALVES ETC.

When the board termometer is not installed the following allowable flying altitude with water ballast are stated:

Minimum temperature on ground during the take-off [^{o}C]	13,5	17,5	24,0	31,0	38,0
Permissible flight altitude limit [m]	1500	2000	3000	4000	5000

Minimum temperature on ground during the take-off [^{o}F]	56,8	68,2	83,7	95,0	100,6
Permissible flight altitude limit [ft]	5000	8000	12000	15000	16500

4. It is allowed to use the liquids lowering the freezing temperature, chemically non-irritant (e.q. liquid for spraying the motor car windows).
It this case the temperature scale should be corrected.

5. Use only the clear water or liquid.
It is recommended to filter using the nylon stocking in the funnel.

4.3.2. Wing ballast.

The wing ballast provides the possibility of flying with the increased wing loading. The tanks in left and right wing are independent. The control of jettisoning valves is coupled.

The total capacity of wing tanks is about

195 dm^3 { 42,9 British gall. }.

The maximum never exceed mass of water ballast results from the formula :

$$m_G = m_{max} - (m_M + m_C + m_D + m_H + m_B + m_P + m_A)$$

where :

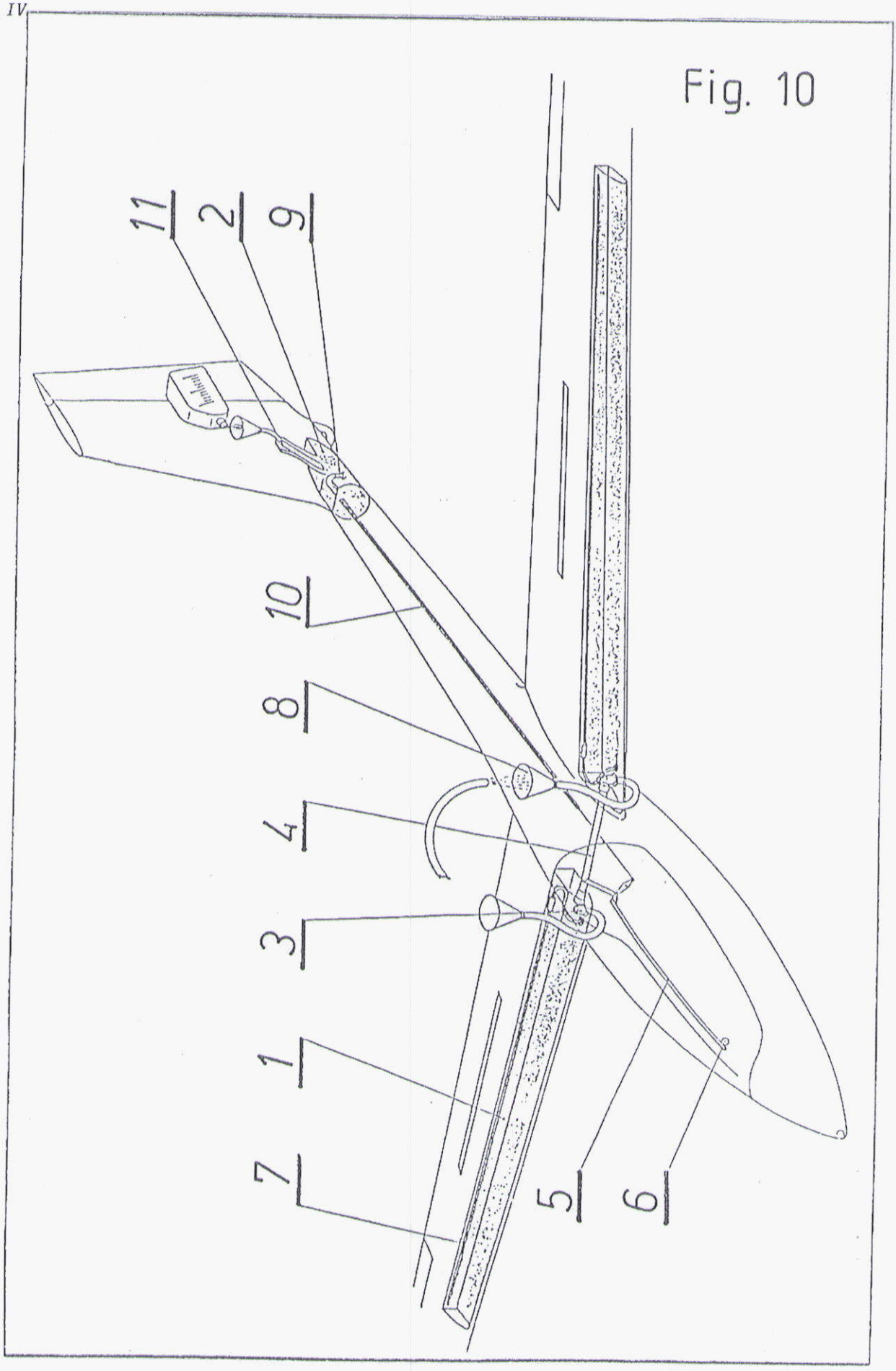
m_{max} = 500 kg { 1102,5 lb }

Designations acc. to item 2.3. (page 17).

Fig. 10 WATER BALLAST INSTALLATION

1. Wing tank.
2. Tail tank.
3. Jettisoning valve of wing tank.
4. Torque tube of valve control.
5. Push-rod of valve control.
6. hand-grip of water ballast valve control.
7. Venting duct (outlet on the lower covering surface near the valves).
8. Funnels for filling the wing tanks.
9. Jettisoning valve of tail tank.
10. Tension member.
11. Tail tank filling hole.

Fig. 10



4.3.3. Filling of the wing tanks (Fig. 10).

1. Put the wings level without a bank (support the wing).
2. Open the valves.
3. Insert the ends of special funnels (8) into the jettisoning openings.
4. Fill the tanks through the funnels till the continuous water flow from the venting holes appears (use only clear water).

NOTE - NEVER FILL THE TANKS WITH THE WATER HOSE INSERTED IMMEDIATELY INTO THE JETTISONING OPENING WITHOUT THE INTERMEDIATION OF FUNNEL !

5. Close the valves when the tanks are full, what results the funnel ends to be pressed out from the jettisoning openings.
6. Remove the funnels out of the wings.
7. Check and eventually correct the lateral balance pouring the water excess out of one tank when closing with the palm the jettisoning opening of the second tank.

4.3.4. Tail ballast.

The tail ballast ensures the possibility of compensation the influence of the wing ballast on the sailplane c.g. location in flight.

The tail tank is placed in the fuselage "tube" under the fin (2), the intake on the lefthand surface of the fin.

The jettisoning valve (9) is located on the lower part of fuselage covering before the tail wheel.

The tail ballast jettisoning valve opens always together with the wing valves (coupled controlling) and closes loaded by the spring when the wing valves are being closed.

On ground the tail valve can be opened independently of the wing valves :

- from the cockpit pulling by hand the tension-member (10),
- immediately by pushing upwards the valve piston (9) e.g. with the wooden stick.

The valve piston can be taken off together with the spring (e.g. for greasing purpose) screwing into it on the bottom surface the arbitrary M8 screw.

The maximum allowable amount of the tail water ballast is given on Fig. 11.

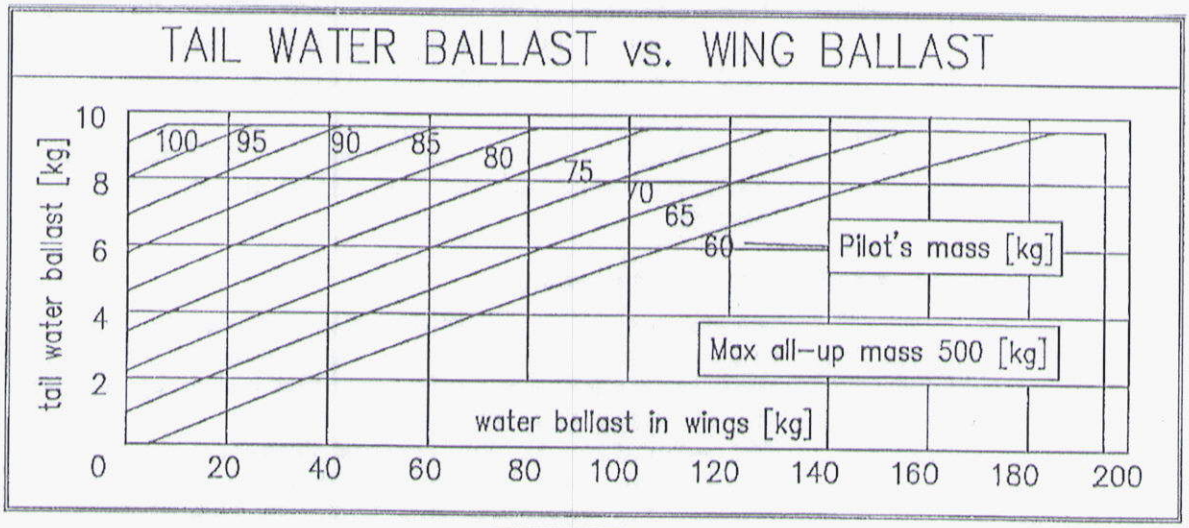


Fig. 11

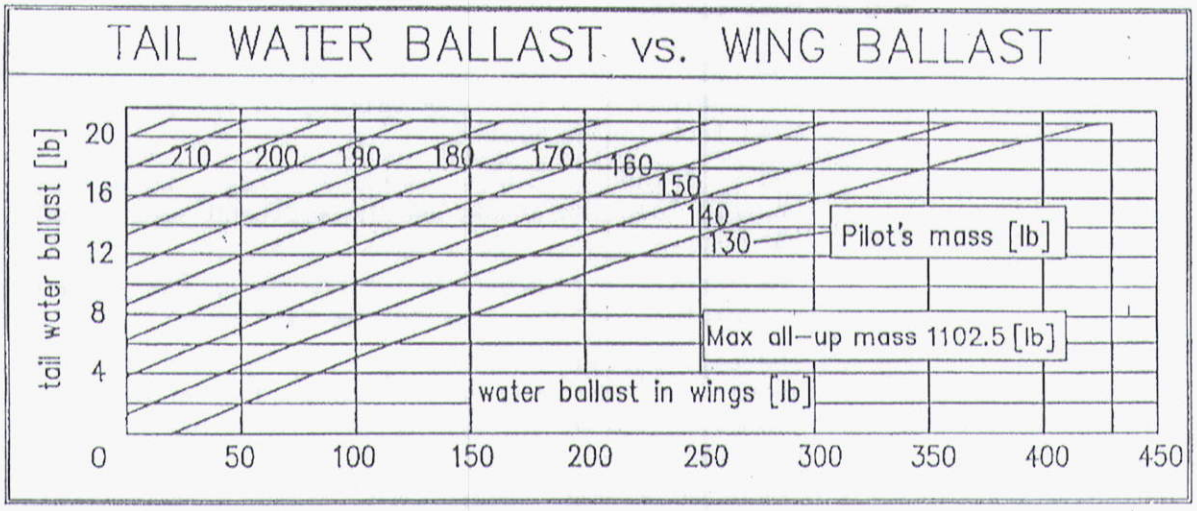


Fig. 11

4.3.5. Filling of the tail tank (Fig. 10).

Pour the water through the funnel freely inserted into the intake hole.
Depending on the amount required pour in the water measured in calibrated container or without measuring up to the full tank (9,6 dm^3 {2,11 British gall.}).

Eventual water excess flows out of the fuselage by the drainage hole.

NOTE - FILL THE TAIL TANK WHEN THE WING TANKS ARE FILLED.

- THE WATER IN TANK AMOUNT IS TO BE CHECKED BY THE CHECKING WINDOW (WHEN THE GLIDER IS ON THE LEVEL GROUND).
- TO CHANGE THE TAIL BALLAST AMOUNT IT SHOULD BE JETTISONED COMPLETELY AND FILLED WITH THE CORRECT WATER AMOUNT.

4.3.6. Water jettisoning.

The cockpit control slider moved forwards opens the wing valves and tail valve. The water flows out from the wing tanks partially over the lower wings surfaces and fuselage till to the tail.
The water flow is not visible from the cockpit.
The time of full jettisoning depends on the water amount. For the full wing tanks it ranges about 3 1/2 minutes (the tail water jettisoning time is shorter).

1 **NOTE** - IN FLIGHT THE WATER BALLAST SHOULD BE JETTISONED WITH THE VALVE OPENED FULL (COCKPIT CONTROL HAND-GRIP IN ITS LIMIT REAR POSITION).

4.4. Stall warning installation (Fig. 2).

The installation consists of :

2| - LUN 1107-8 airspeed indicator or PR-400S one (2),

- the controlling pressure head on the fuselage nose (22),
- switch on the instrument panel (21),
- electroacoustic monitor (20) in the instrument panel,

2| in case of PR-400S airspeed indicator, the SP 3 one.

The installation is charged with the current of 12 V of board installation.

NOTE - THE INSTALLATION SHOULD BE ALWAYS SWITCHED ON DURING THE WHOLE FLIGHT.

The modulated warning signal (ti-ta-ti-ta ...) appears automatically near the stalling condition in straight flight and circling, in spinning and also during the stand-by before the take-off, ground run of take-off ground run of landing.

The signal switches off immediately when the safe flying condition is gained.

The installation is poor sensitive for the voltage variations and works correctly up to about 9 V, and in case of SP 3 up to 10.5 V.

2| At the further voltage decrement in case of LUN airspeed indicator the broken signal appears (ti-ti-ti-ti ...).

The point of signal initiation should be adjusted on the airspeed of 1,1 stalling speed in straight flight.

The adjusting procedure is described in the Technical Service Manual, item 2.5. (page 16).

4.5. Service on the take-off point.

The sailplane does not require the aid wheel facility.

The ground airfield service as : protecting against the wind, connecting the towing cable, anchoring, washing and maintenance of external surfaces, procedures when the sailplane gets wet, drainage of pneumatic installation of the instruments, should be performed acc. to the generally know procedures for performance sailplanes service.

The glider can be taxied on the airfield (connected on the towing hook) with the speed up to 10 km/h {5 kts ; 6 mph} or using the additional equipment (see item 1.3.7.2) for towing on the tail (tail transportation wheel, transportation wheels under the wing, towing thill).

NOTE - AVOID TO EXPOSE THE OPENED CANOPY INSIDE CURVATURE AGAINST THE SUN (DANGER OF FIRE DUE TO THE FOCUSING OF SUN BEAMS INSIDE THE COCKPIT).

4.6. Procedures before the flight.

BALLAST	-venting ? -lateral balance ?
BACK-REST	-adjust
PARACHUTE	-put on
TAKE PLACE	-pedals, belts, instrument panel ?
MOVEABLE THINGS ?	
CANOPY	-close
FULL DEFLECTIONS of controls	
AIR BRAKE	-retract
ALTIMETER	-adjust „0"
STALL WARNING	-check
TOWING CABLE	-connect, check
TRANSCEIVER	-report „ready"

4.7. W i n c h l a u n c h i n g.

On c.g. hook only.

Adjust, before the take-off, the pilot's in cockpit position very carefully to avoid the backward movement under the influence of acceleration. All control elements should be easily accessible and in the full range of movements.

Adjust preliminary the trimming device (push and release the lever on stick) :

- pilot of below 90 kg {198,5 lb} - with the stick on 1/3 of forward deflection,
- pilot of above 90 kg {198,5 lb} - with the stick neutral,

(concerns the sailplane with and without water ballast).

NOTE - IN CASE OF TAKE-OFF WITH WATER BALLAST THE WINCH OPERATOR SHOULD BE INFORMED ON.

The take-off is typical one, as for the take-offs on the c.g. hook. It is recommended to delay the steep climbing till the airspeed of 120÷125 km/h {64,8÷70,2 kts ; 74,4÷77,5 mph} is gained and then pass into the climbing.

The recommended airspeed range for the steep climbing phase is : 100÷120 km/h {54,0÷64,8 kts ; 62,0÷74,4 mph} without, and 120÷130 km/h {64,8÷70,2 kts ; 74,4÷80,6 mph} with water ballast.

After the cable releasing adjust the glide flight.

The undercarriage may be retracted.

4.8. A e r o t o w i n g.

On front hook (use c.g. hook only on the sailplanes having no front one).

Directions for towing aeroplane pilot :

1. Gently tension the cable, avoid the surges !
2. After airborning it is allowed to begin climb when the minimum aerotowing airspeed is gained, namely :
   - for the sailplane without water ballast
     100 km/h { 54,0 kts ; 62,0 mph },
   - for the sailplane with water ballast
     110 km/h { 59,4 kts ; 68,2 mph }.

Direction for the helping person :

1. Before the take-off with water ballast level the sailplane by holding the wing.

Directions for the sailplane pilot :

1. When the towing cable is tensioned the wheel should be braked. To avoid rolling over the cable.
   In case of surge and loosing of the cable immediately release the towing cable.
2. On the very beginning of ground run a heavy pilot should pull the stick (this makes more easy to keep the direction at the side wind). A light pilot should push the stick.
3. When taking-off at the side wind on the very beginning of ground run the air brake should be slightly extended. When the full aileron control appears, slowly retract the airbrake.
4. If the glider banks and the wingtip hits the ground immediately release the towing cable !
5. When the towing airspeed becomes steady trim the stick force (push the trimming lever and release).
6. It is not recommended to fly below the towing aeroplane due to the towing cable friction on the fuselage surface.

NOTE - IN CASE THE HOOK INSTALLED ON THE UNDERCARRIAGE FORK IS USED IT IS PROHIBITED TO RETRACT THE UNDERCARRIAGE WHEN THE SAILPLANE IS AEROTOWED.
PAY A SPECIAL ATTENTION THAT THE TOWING CABLE HAS NO EXCESSIVE SAG SINCE IT MAY RESULT A SELF-RELEASING.

1 - DURING TAKE-OFF WITH WATER BALLAST THE GROUND RUN SHOULD BE PERFORMED WITH AIR BRAKE PARTLY EXTENDED (ABOUT 10 cm {4 in} OF COCKPIT CONTROL MOVEMENT) TILL THE LATERAL CONTROLABILITY IS GAINED. THEN RETRACT THE AIR BRAKE GENTLY.

4.9. F r e e f l i h g t.

4.9.1. Stalling and characteristic airspeed IAS.

1

	All-up mass					
	265 kg; 584,3 lb light pilot without ballast			500 kg; 1102,5 lb heavy pilot with ballast		
	km/h	kts	mph	km/h	kts	mph
stalling in straight flight	63	34,0	39,1	84	45,4	52,1
stalling in circling with 45^{o} bank	75	40,5	46,5	101	54,5	62,6
stalling in straight flight with airbrake extended	67	36,2	41,5	99	53,3	61,4
circling airspeed with 45^{o} bank	79	42,7	49,0	105	56,7	65,1

The stalling is preceded by the modulated acoustic signal (see item 4.4.), which switches on when the airspeed decreases below 1,1 ÷ 1,05 V_{s1}.

Just before the stalling the weak fuselage vibrations appear.

When the signal is heard the pilot should immediately push the stick. In circling the bank should be reduced.

The stalled sailplane drops down symmetrically or with the tendency to drop the wing.

The recovery after pushing the stick follows without the troubles and failless.

The height loss is lower then 40 m {130 ft} in straight flight and 80 m {260 ft} in circling.

4.9.2. Spinning.

Allowed without water ballast !

The spinning is performable in the whole range of pilot's mass (60÷100 kg {132÷220 lb}).
Introduction requires the static stalling.

Recommended aileron deflections:

- for pilots of 60÷80 kg {132÷176 lb} mass - aileron neutral or deflected accord to rotation,
- for pilots above 80 kg {176 lb} mass - aileron deflected accord to rotation.

For pilots of above 90 kg {198,5 lb} mass only 1÷2 turns of spinning are possible (aileron accord to rotation) since the airspeed increment forces to recover.

Typical recovery action - concerns also the unintended spinning with water ballast :

- rudder opposite to rotation,
- short wait,
- stick forwards (not too much),
- recover from diving.

The recovery is immediate or with a little delay.

4.9.3. Airbrake.

The efficient airbrake allows for precise adjusting the required approach angle.

The forces of control are rather high.

NOTE - THE AIRBRAKE CAN BE EXTENDED AT THE AIRSPEEDS UP TO 255 km/h {137,7 kts; 158,1 mph} (ABOVE 200 km/h {108,0 kts; 158,1 mph} EXTEND THE AIRBRAKE GENTLY - STRONG SURGE APPEARS).

The retraction is possible at the airspeeds of up to 220 km/h {118,8 kts; 136,4 mph}.

4.10. L a n d i n g.

Before the landing the water ballast should be jettisoned with such a calculation that all the water is drained off at the altitude of no lower than 200 m {650 ft}.

In the emergency conditions the landing with full or partially jettisoned ballast is possible but **on the airfield only.**

Extend the undercarriage on the altitude of 200 m {650 ft}. Approach at 90 km/h {48,6 kts; 55,8 mph} airspeed (light pilot without ballast) to 105 km/h {56,7 kts; 65,1 mph} (heavy pilot with ballast). In gust conditions the airspeed should be increased by 10 km/h {5 kts; 6 mph} or more. Touch ground with main and tail wheels. The wheel brake is coupled with the airbrake. Avoid the sharp braking of the wheel.

4.11. A e r o b a t i c s.

Allowed without water ballast only.

Before performing the aerobatics check the water ballast to be jettisoned (control slider back) and locking of airbrake and undercarriage fasten the belts and trim the sailplane on 120÷150 km/h {64,8÷81,0 kts; 74,4÷93,0 mph} airspeed.

The sailplane performs correctly the following manoeuvres :

AEROBATIC MANOEUVRES	ENTRY AIRSPEEDS		
	km/h	kts	mph
- looping and stall-turn	160÷180	86,4÷97,2	99,2÷111,6
- lazy eight	170÷185	91,8÷99,9	105,4÷114,7
- chandelle	180÷195	97,2÷105,3	111,6÷120,9
- quick half-roll-half-loop	90÷100	48,6÷54,0	55,8÷62,0

Performing of the above manoeuvres is the standard one.

4.12. F l i g h t i n r a i n.

Flying in rain the decrement of performances should be taken into account. In circling and in approach increase the airspeed by about 10 km/h {5 kts; 6 mph}.
In case of the weak visibility or the moistured perspex open the window and use the air conditioning facility.

4.13. A s s e m b l i n g p r o c e d u r e s.

For rigging at least 3 persons are necessary or when special supports are available 2 persons only. Before rigging all the working surfaces of fittings, bolts and joints should be cleaned with a clean rag and greased. First the wings then the tailplane should be assembled. Disassembling requires the inverted procedures i.e. first the tailplane and then the wings.

4.13.1. Assembling and disassembling of the wings (Fig. 12).

1. Open the canopy. Put the stick into the aileron neutral position, the hand-grips of airbrake and water ballast tank valves into "closed" position. The airbrake plates on wings should be retracted.
2. Insert the fork of left wing spar (1) into the fuselage so that its lower surface slides paralelly on the guide of luggage compartment floor.
3. Moving the wing tip pilot the nests (2) onto the pivots (3) and join-in the control system of aileron, airbrake and water ballast tank valve.
4. The right wing should be assembled in the same way.
5. With small motions of wing tips match the horizontal openings (5) of spars connection and insert the bolts (left shorter (6) and right longer with slot (7)).
6. Secure the bolts with safety pins (8) on the pins (9).
7. Check the correct assembling and operation of controls.

NOTE - THE WING-TO-FUSELAGE SLOTS SHOULD BE SEALED WITH THE ELASTIC TIXOTAPE.

For disassembling use the inverted procedure :

- dissecure and remove the bolts (ease the wing's weight),
- hold the fuselage and shift off the wings one after other.

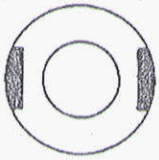
4.3.12. Assembling and disassembling of the tailplane (Fig. 13).

1. Put the stick in the neutral position using the trimming device.
2. Fit the tailplane (1) on the fin. Move the stick, if necessary, to insert the lever (7) into the guide (8).
3. Connect the tailplane (3) and fin (4) fittings by means of bolt (5) with the assembling turn-member (9) screwed-in.
4. Screw-off the assembling turn-member and check at the final phase of screwing-off (2 threads) the efficient securing the bolt against shifting out.

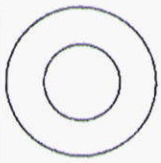
NOTE - THE BOLT IS TO BE PUT ON AND OFF BY MEANS OF ASSEMBLING TURN-MEMBER ONLY BEING SCREWED IN TILL TO STOP INTO THE BOLT HOLE.
THE BOLT-IN-FITTING SECURING IS OBTAINED AUTOMATICALLY WHEN THE TURN-MEMBER IS SCREWED IN.

5. Additionally check by eye through the opening in the fin leading edge that the securing dogs (6) lock the bolt as below :

Bolt secured in fitting correctly



Bolt secured incorrectly



6. Hold the elevator and ailerons and check the operation of the control systems under the loading.
7. Glue up the hole in the fin by means of tixotape.
The disassembling requires the inverted procedure : screw-in the turn-member, take-off the bolt and remove the tailplane. Put the bolt into the fitting of fin again and screw-off the turn-member.

Fig. 12 ASSEMBLING OF THE WINGS

1. Fork of left wing spar.
2. Nests (in wing rib).
3. Pivots (in fuselage).
4. Right wing.
5. Horizontal openings.
6. Left bolt (shorter).
7. Right bolt (longer with slot).
8. Safety pins.
9. Pins for securing the bolts (in fuselage).
10. Joint for aileron control.
11. Joint for airbrake control.
12. Joint for water ballast valve control.

Fig. 12

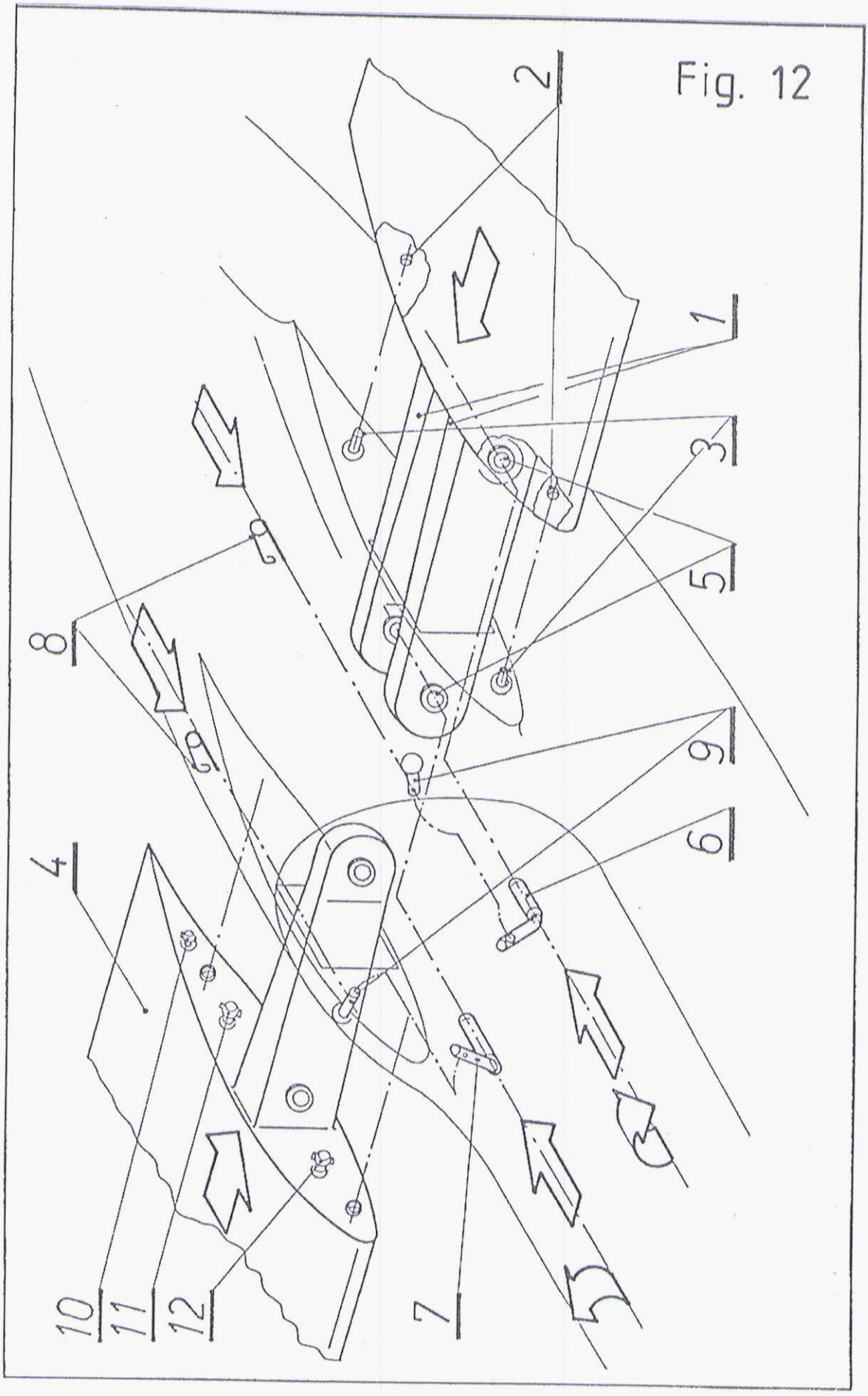
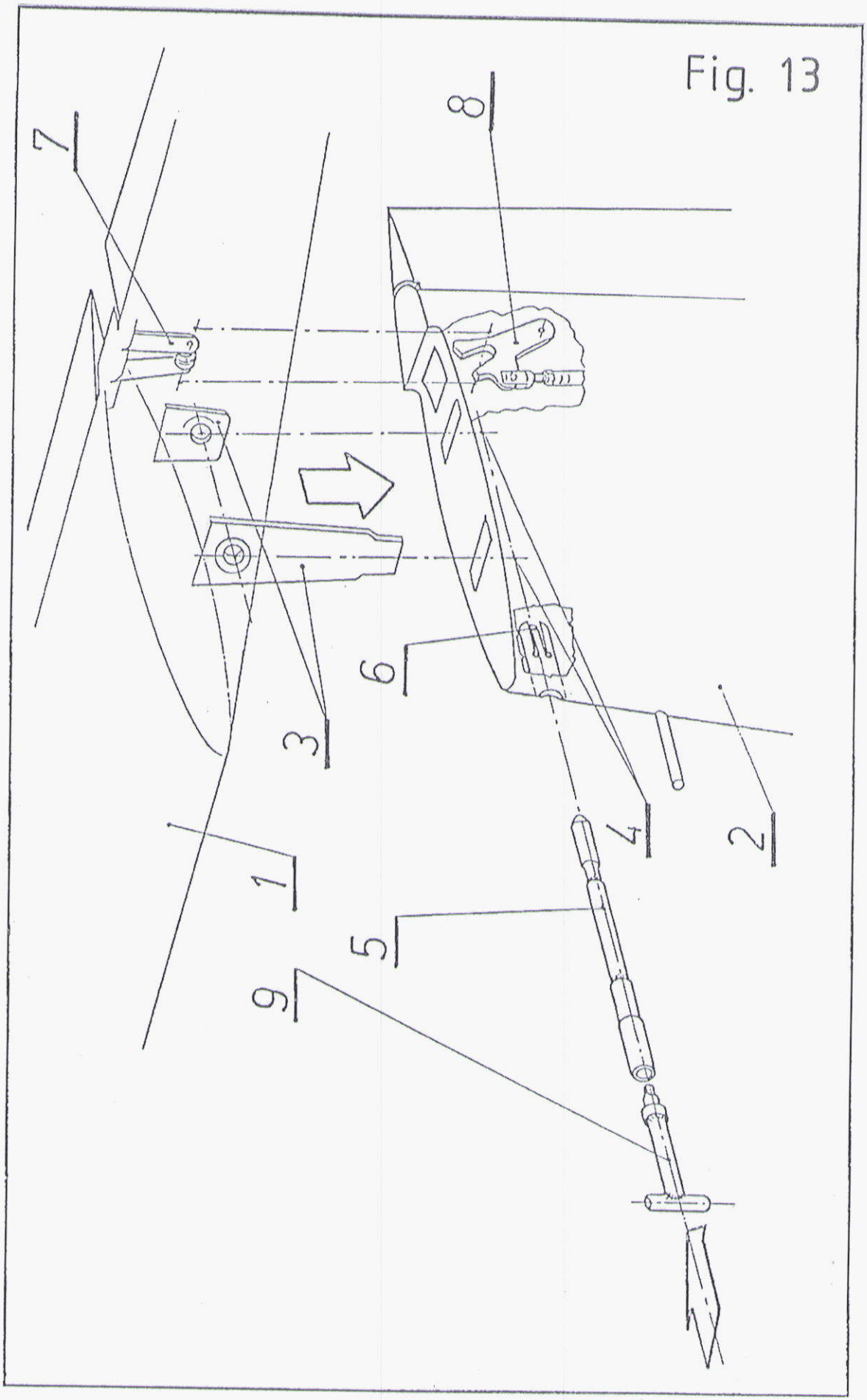


Fig. 13 ASSEMBLING OF THE TAILPLANE

1. Tailplane.
2. Fin.
3. Fittings of stabilizer.
4. Fittings of fin.
5. Bolt.
6. Securing click.
7. Elevator lever.
8. Lever with guide.
9. Stabilizer assembling turn-member.

Fig. 13



4.14. Ground transportation.

To prepare disassembled sailplane for ground transportation :

1. Fix the movable elements of cockpit and luggage compartment.
2. Fix the control stick (by means of pilot's belts).
3. Shut the canopy and window.
4. Put the cover on the canopy.

Moreover if the opened trailer is used for transportation the assembling elements and control joints should be protected against the dust (wrapped with paraffin paper or greased rags).
Put the covers on the main sailplane components and eventually secure them additionally with a foil.

5. EMERGENCY CONDITIONS

5.1. Landing with the water ballast.

Due to the undercarriage loading the landings with water ballast should be limited to an unavoidable cases only (c.g. failed take-off, damage water tank valve control system).

Approach with the airspeed increased by 10÷20 km/h {5÷10 kts ; 6÷12 mph}.

Land with the extreme attention, on the runway if possible.

Avoid the yaw, heavy landing or ground-touching.

5.2. Flight and landing with the asymmetrical ballast.

The small ballast asymmetry in wings normally is not felt by the pilot and has no significant influence for the safety of flight and landing.
The greater degree of asymmetry results the significant tendency for bank and requires to be compensated with aileron.
With the one wing tank full and second wing tank empty the levelling of wings requires the stick deflection of 3/4 of whole range towards the "light" wing.
The turn towards "light" wing is restricted, but possible.

The asymmetry may be caused by :

1. Leakage of water from one wing due to the not tight valve. The asymmetry increases gradually till to the situation of one wing "full" and second "empty".

   In case the tendency for banking increases (in flight with water ballast) it's necessary to :

- open the jettisoning valves,
- retain the necessary bank towards the "light" wing,
- avoid the stalling, especially in turns towards the "heavy" wing,
- pay attention to the variations of lateral balance,
- when the correct lateral balance is gained the water jettisoning can be stopped and the flight continued acc. to the program.

2. Restricted or plugged water flow-out from one of the wing valves during the jettisoning.

   In case the increased tendency for banking after opening the valves appears it's necessary to :

   - delay the landing, if possible, (by means of approaching with airbrake retracted) or even use the thermal for climbing,
   - retain the necessary bank towards the "light" wing,
   - avoid the stalling, especially in turns towards the "heavy" wing,
   - if after about 10 minutes the asymmetry gradually disappears the flight can be continued acc. to the program,
   - if after about 10 minutes the asymmetry remains unchanged or increases, look for the nearest airfield and report the necessity of "emergency" landing.

Land with the bank towards the "light" wing and with the safe distance of obstacles at the "heavy" wing side.
If the glider on ground run banks towards the "heavy" wing immediately deflect the rudder in opposite direction and push the stick.
Braking the main wheel helps to retain the direction at the ground run.

5.3. Flight and landing with the tail ballast.

The tail tank may be not emptyfied e.g. due to icing, valve damage or tension member broken.
If, after water jettisoning, the sailplane is clearly "tail heavy" the control slider of water valves should be moved several times and then put into the opened position.
Continue the flight avoiding the stalling and spinning.
The pilot of mass of below 70 kg {155 lb} should land on the nearest airfield.

5.4. Water jettisoning at ambient temperature below 0°C (32°F).

Up to the moment of descending below the altitude with the temperature of 0°C {32°F} the aileron and rudder should be intensively deflected and attention paid to the eventual incorrect longitudinal and lateral trim.

5.5. Landing with the retracted undercarriage.

Landing with the retracted undercarriage is to be performed only when the correct extending and locking of the undercarriage is impossible !!!

Land on the smooth surface, if possible, grass or soft agricultural ground, against the wind.

Do not make touched or heavy landing.

5.6. Landing with the ground-looping.

If during the landing it is firmly necessary to shorten the ground run (e.g. to avoid the crash onto the obstacle) the controlled ground-looping should be performed :

- bank the sailplane on the wing (outer in respect to the obstacle and at the side wind component bank the sailplane against the wind, if possible),
- together with turning push the stick and deflect the rudder opposite to turn.

5.7. Emergency pilot's bail-out.

The bail-out is the last and obligatory safety action, if no possibility of controlled return to the ground is possible.

PROCEDURES :

1. Pull the emergency canopy jettisoning lever till to stop.
2. Take with both hands the canopy locking levers and resolutely push the canopy **forwards**.
3. Release the safety belts.
4. Move the legs back and bail-out of the cockpit. If the sailplane rotates quickly (e.g. spinning) go out towards the axis of rotation.
5. Open the parachute with a delay depending on a situation.

PROCEDURES IN SPECIAL CONDITIONS :

1. If the canopy cannot be jettisoning, damage the perspex beginning from the window and eventually use the legs for.
2. If the bail-out exit takes place on the altitude of below 200 m {650 ft} the parachute should be opened immediately after the exit.
   the collision with the sailplane if possible should be avoided.

5.8. Broken winch-launching.

In case the winch-launching has been broken as a result of self-releasing, launching cable broken or winch engine power collapse take-on the following action :

1. Push the stick and pass into the glide flight (secure the airspeed).
2. Pull several times the hook releasing hand-grip, till to stop.
3. Depending on the altitude and conditions :

   Without water ballast :

   - below 50 m {165 ft} - land ahead,
   - above 50 m {165 ft} - at the weak wind it is possible to land with back wind after a turn of 180°,
   - above 100 m {330ft} - perform the shortened round and land against the wind.

   With water ballast :

   - below 50 m {165 ft} - land ahead,
   - above 50 m {165 ft} - perform the shortened round and land against the wind.