FLIGHT MANUAL

for Powered Sailplane

Variant: **A R C U S M**

Serial-No.

Registr.-No.:

Date of issue: **O c t o b e r 2 0 1 2**

Pages as indicated by „appr.“ are EASA approved by

EASA Type Certificate EASA.A.532, issued 20.06.2013

This powered sailplane is to be operated in compliance with information and limitations contained herein.

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

0.1 Record of revisions

Any revisions of the present manual, except actual weighing data, must be recorded in the following table.

The new or amended text in the revised page will be indicated by a black vertical line in the left hand margin, and the revision number and the date will be shown on the bottom left hand side of the page.

0.1 Erfassung der Berichtigungen / *Record of Revisions*

Lfd. Nr. der Berichtigung	Abschnitt	Seiten	Datum der Berichtiungg	Bezug	Datum und Anerkennung durch	Datum der Ein-arbeitung	Zeichen /Unterschrift
Revision No.	*Affected section*	*Affected page*	*Date of issue*	*Reference*	*Date and Approval by*	*Date of Insertion*	*Signature*

MB: *Modification Bulletin* – Änderungsblatt
TN : *Technical Note* – Technische Mitteilung

Hinweis: Nicht eingefügte Berichtigungen sind zu streichen.
Das Verzeichnis der Seiten ist gegebenenfalls handschriftlich zu aktualisieren

Note: Cross out revisions which are not included.
The list of effective pages must be amended by hand if necessary.

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
0	0.1.1 0.1.2		
	0.2.1 0.2.2 0.2.3 0.2.4 0.2.5 0.2.6 0.2.7 0.2.8		
	0.3.1		

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
1	1.1.1	October 2012	
	1.1.2	October 2012	
	1.2	October 2012	
	1.3	October 2012	
	1.4.1	October 2012	
	1.4.2	October 2012	
	1.4.3	October 2012	
	1.5	October 2012	
2	2.1.1	October 2012	
	2.1.2	October 2012	
	appr. 2.2.1	October 2012	
	appr. 2.2.2	October 2012	
	appr. 2.3	October 2012	
	appr. 2.4	October 2012	
	appr. 2.5	October 2012	
	appr. 2.6	October 2012	
	appr. 2.7	October 2012	
	appr. 2.8	October 2012	
	appr. 2.9	October 2012	
	appr. 2.10	October 2012	
	appr. 2.11	October 2012	
	appr. 2.12.1	October 2012	
	appr. 2.12.2	October 2012	
	appr. 2.13	October 2012	
	appr. 2.14	October 2012	
	appr. 2.15	October 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
3	3.1.1	October 2012	
	3.1.2	October 2012	
	appr. 3.2	October 2012	
	appr. 3.3	October 2012	
	appr. 3.4	October 2012	
	appr. 3.5	October 2012	
	appr. 3.6	October 2012	
	appr. 3.7.1	October 2012	
	appr. 3.7.2	October 2012	
	appr. 3.7.3	October 2012	
	appr. 3.7.4	October 2012	
	appr. 3.8	October 2012	
	appr. 3.9.1	October 2012	
	appr. 3.9.2	October 2012	
4	4.1.1	October 2012	
	4.1.2	October 2012	
	appr. 4.2.1.1	October 2012	
	appr. 4.2.1.2	October 2012	
	appr. 4.2.1.3	October 2012	
	appr. 4.2.2.1	October 2012	
	appr. 4.2.2.2	October 2012	
	appr. 4.2.2.3	October 2012	
	appr. 4.2.2.4	October 2012	
	appr. 4.2.2.5	October 2012	
	appr. 4.2.2.6	October 2012	
	appr. 4.2.2.7	October 2012	
	appr. 4.2.2.8	October 2012	
	appr. 4.2.2.9	October 2012	
	appr. 4.2.2.10	October 2012	
	appr. 4.2.2.11	October 2012	
	appr. 4.2.2.12	October 2012	
	appr. 4.2.2.13	October 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
4	appr. 4.3.1	October 2012	
	appr. 4.3.2	October 2012	
	appr. 4.3.3	October 2012	
	appr. 4.3.4	October 2012	
	appr. 4.3.5	October 2012	
	appr. 4.3.6	October 2012	
	appr. 4.4	October 2012	
	appr. 4.5.1.1	October 2012	
	appr. 4.5.1.2	October 2012	
	appr. 4.5.1.3	October 2012	
	appr. 4.5.1.4	October 2012	
	appr. 4.5.1.5	October 2012	
	appr. 4.5.1.6	October 2012	
	appr. 4.5.2.1	October 2012	
	appr. 4.5.2.2	October 2012	
	appr. 4.5.3.1	October 2012	
	appr. 4.5.3.2	October 2012	
	appr. 4.5.3.3	October 2012	
	appr. 4.5.3.4	October 2012	
	appr. 4.5.3.5	October 2012	
	appr. 4.5.3.6	October 2012	
	appr. 4.5.3.7	October 2012	
	appr. 4.5.3.8	October 2012	
	appr. 4.5.3.9	October 2012	
	appr. 4.5.3.10	October 2012	
	appr. 4.5.4.1	October 2012	
	appr. 4.5.4.2	October 2012	
	appr. 4.5.5	October 2012	
	appr. 4.5.6.1	October 2012	
	appr. 4.5.6.2	October 2012	
	appr. 4.5.6.3	October 2012	
	appr. 4.5.6.4	October 2012	
	appr. 4.5.6.5	October 2012	
	appr. 4.5.7.1	October 2012	
	appr. 4.5.7.2	October 2012	
	appr. 4.5.8	October 2012	
	appr. 4.5.9.1	October 2012	
	appr. 4.5.9.2	October 2012	
	appr. 4.5.9.3	October 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
5	5.1.1	October 2012	
	5.1.2	October 2012	
	appr. 5.2.1	October 2012	
	appr. 5.2.2	October 2012	
	appr. 5.2.3	October 2012	
	appr. 5.2.4	October 2012	
	5.3.1	October 2012	
	5.3.2.1	October 2012	
	5.3.2.2	October 2012	
	5.3.2.3	October 2012	
	5.3.2.4	October 2012	
	5.3.3	October 2012	
6	6.1.1	October 2012	
	6.1.2	October 2012	
	6.2.1	October 2012	
	6.2.2	October 2012	
	6.2.3	October 2012	
	6.2.4	October 2012	
	6.2.5	October 2012	
	6.2.6	October 2012	
	6.2.7	October 2012	
	6.2.8	October 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
7	7.1.1	Oktober 2012	
	7.1.2	Oktober 2012	
	7.2.1	Oktober 2012	
	7.2.2	Oktober 2012	
	7.2.3	Oktober 2012	
	7.2.4	Oktober 2012	
	7.2.5	Oktober 2012	
	7.2.6	Oktober 2012	
	7.2.7	Oktober 2012	
	7.2.8	Oktober 2012	
	7.3.1	Oktober 2012	
	7.3.2	Oktober 2012	
	7.3.3	Oktober 2012	
	7.3.4	Oktober 2012	
	7.3.5	Oktober 2012	
	7.3.6	Oktober 2012	
	7.3.7	Oktober 2012	
	7.3.8	Oktober 2012	
	7.3.9	Oktober 2012	
	7.3.10	Oktober 2012	
	7.3.11	Oktober 2012	
	7.3.12	Oktober 2012	
	7.3.13	Oktober 2012	
	7.3.14	Oktober 2012	
	7.3.15	Oktober 2012	
	7.3.16	Oktober 2012	
	7.3.17	Oktober 2012	
	7.3.18	Oktober 2012	
	7.3.19	Oktober 2012	
	7.3.20	Oktober 2012	
	7.3.21	Oktober 2012	
	7.3.22	Oktober 2012	
	7.3.23	Oktober 2012	
	7.3.24	Oktober 2012	
	7.3.25	Oktober 2012	
	7.3.26	Oktober 2012	
	7.3.27	Oktober 2012	
	7.3.28	Oktober 2012	
	7.3.29	Oktober 2012	
	7.3.30	Oktober 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
7	7.3.31	October 2012	
	7.3.32	October 2012	
	7.3.33	October 2012	
	7.3.34	October 2012	
	7.3.35	October 2012	
	7.3.36	October 2012	
	7.3.37	October 2012	
	7.3.38	October 2012	
	7.3.39	October 2012	
	7.3.40	October 2012	
	7.3.41	October 2012	
	7.3.42	October 2012	
	7.4	October 2012	
	7.5	October 2012	
	7.6	October 2012	
	7.7	October 2012	
	7.8	October 2012	
	7.9.1	October 2012	
	7.9.2	October 2012	
	7.9.3	October 2012	
	7.9.4	October 2012	
	7.10	October 2012	
	7.11.1	October 2012	
	7.11.2	October 2012	
	7.11.3	October 2012	
	7.12.1	October 2012	
	7.12.2	October 2012	
	7.12.3	October 2012	
	7.12.4	October 2012	
	7.12.5	October 2012	
	7.12.6	October 2012	
	7.12.7	October 2012	
	7.13.1	October 2012	
	7.13.2	October 2012	

0.2 Verzeichnis der Seiten / List of affected pages

Abschnitt Affected section	Seite Affected pages	Ausgabe-Datum Date of issue	Bezug Reference
8	8.1.1	October 2012	
	8.1.2	October 2012	
	8.2.1	October 2012	
	8.2.2	October 2012	
	8.3	October 2012	
	8.4	October 2012	
	8.5.1	October 2012	
	8.5.2	October 2012	
9	9.1.1	October 2012	
	9.1.2	October 2012	
	9.2		

0.3 Table of contents

Section 1

1.1 Introduction

The Flight Manual for this powered sailplane has been prepared to provide pilots and instructors with information for the safe, appropriate and efficient operation of the powered sailplane

This manual includes the material required to be furnished to the pilot by CS 22. It also contains supplemental data supplied by the manufacturer of the aircraft that out of sight of the manufacturer benefits the pilot

1.2 Certification basis

This self launching powered sailplane, model designation

A r c u s M

has been approved by the EASA in compliance with “CS 22", effective on November 14th, 2003.

The Type Certificate is No. **EASA.A.532** and was issued on

June 20th, 2013

Category of Airworthiness: UTILITY

Noise Certification Basis : Neufassung der Lärmvorschriften für Luftfahrzeuge (LVL)",
effective on August 1st, 2004
(Aircraft Noise Protection Requirements)

1.3 Warnings, cautions and notes

Statements of the manual regarding the flight safety or important matters for operation are highlighted with the following notions:

"Warning"	means that the non-observation of the corresponding procedure leads to an immediate or important degradation of the flight safety
"Caution"	means that the non-observation of the corresponding procedure leads to a minor or to a more or less long term degradation of the flight safety
"Note"	draws the attention on any special item not directly related to safety, but which is important or unusual.

1.4 Descriptive data

The "Arcus M" is a two-seat, high-performance powered sailplane, constructed from fiber reinforced plastic (FRP), featuring camber-changing flaps and a T-tail (with fixed horizontal stabilizer and elevator).

Wing

The four piece wing including winglets has 4 distinct trapezoidal sections.
On the innermost section of each wing, the leading edge sweeps slightly forward, then from the second section on, the wing tapers more and more aft. The flaps span evenly along the entire length of the wing and simultaneously serve as ailerons. The 'Schempp-Hirth' style airbrakes have 3 panels and rise from the upper wing surface.

The water tanks are integrated in the wing and can hold approx. 185 Litres (48.9 US Gal., 40.7 IMP Gal.).
The wing skin is a CFRP foam sandwich, the wing spar caps are made from carbon fibre rovings and the spar shear web is a GFRP foam sandwich.

Fuselage

The cockpit is comfortable and features two tandem seats. The one-piece canopy hinges sideways and opens to the right. For high energy absorption the cockpit region is constructed as an aramid/carbon fibre laminate, which is reinforced by a steel tube transverse frame and a double skin on the sides with integrated canopy coaming frame and seat pan mounting flanges. The aft fuselage section is a pure carbon fibre (non-sandwich) shell of high strength, stiffened by CFRP-sandwich bulkheads and webs. The main wheel is retractable with shock absorber struts and features a hydraulic disc brake. The nose wheel (if installed) and tail wheel (or skid) are fixed.

Horizontal tailplane

The horizontal tailplane consists of a fixed stabilizer with elevator.
The stabilizer is a GFRP/foam-sandwich construction with CFRP-reinforcements, the elevator halves are a pure CFRP/GFRP shell.
The spring trim is gradually adjustable by a lever resting against a threaded rod.

Vertical tail

The fin and rudder are constructed as a GFRP/foam-sandwich.
Optionally a water ballast trim tank with a capacity of 11 Litres (2.9 US Gal., 2.4 IMP Gal.) is provided in the fin.

Controls

All controls are automatically hooked up when the Arcus M is rigged.

Powerplant

The „Arcus M“ was developed from the non-self-launching powered sailplane model “Arcus T” by integrating a more powerful engine and a larger propeller.

The “Arcus M” is powered by an liquid-cooled 50 kW (68 HP) SOLO engine - type 2625-02i - having a programmable fuel injection.
The powerplant is housed in the fuselage aft of the wing, and an electrical spindle drive pivots it such that the propeller pylon extends from the engine bay in the fuselage cone.

To stop the power plant, turn off the ignition and reduce the airspeed.
After turning off the ignition, the retraction process is conducted automatically by the powerplant control unit MCU II.

With the powerplant control unit MCU II apart from the ignition switch, the RPM indicator, the fuel valve and the throttle control no more controls have to be considered. The fuel level in the control unit is displayed in LITERS.

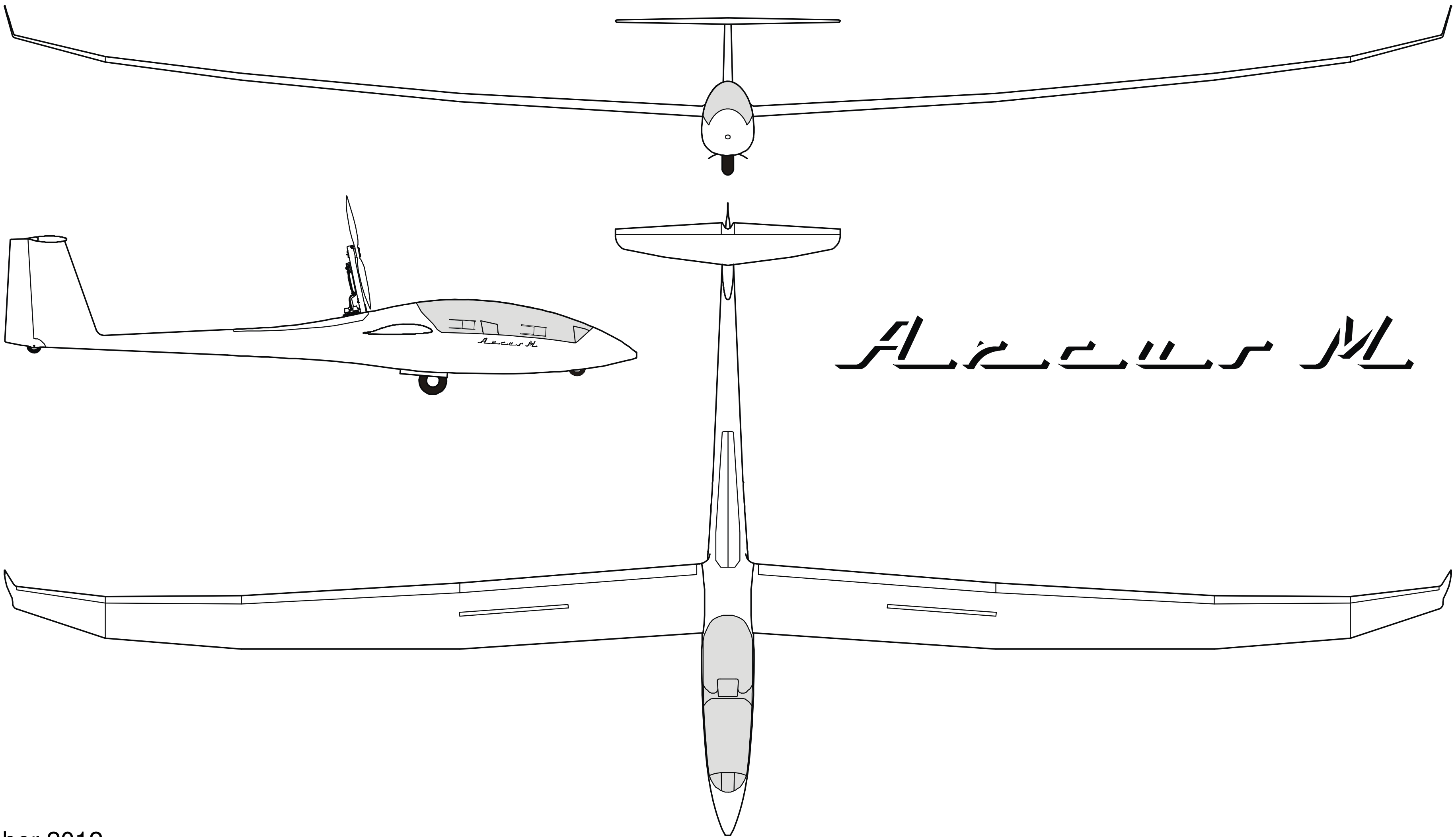
In its appearance the “Arcus M” differs from the model “Arcus T” only by having longer doors covering the engine compartment.

Flight characteristics and performances are identical with those of a correspondingly loaded “Arcus T” (by means of water ballast).

TECHNICAL DATA

Wing	Span	20.00 m	65.62 ft
	Area	15.59 m²	167.81 ft²
	Aspect ratio	25.7	
	MAC	0.824 m	2.70 ft
Fuselage	Length	8.73 m	28.64 ft
	Width	0.71 m	2.33 ft
	Height	1.00 m	3.28 ft
Weight (mass)	Empty mass from approx.	530 kg	1169 lb
	Maximum all-up mass	800 kg	1764 lb
	Wing loading	38.5 - 51.3 kg/m²	
		7.9 - 10.5 lb/ft²	
Engine	Model:	SOLO 2625-02 i	
	Manufacturer:	Fa. Solo Kleinmotoren GmbH. Germany	
	Power at 6600 rpm	50 kW (68 hp)	
Propeller	Model:	KS-1G-160-R-120	
	Manufacturer:	Fa. Technoflug Leichtflugzeugbau GmbH. / Germany	
or (optional)	Model:	BM-G-160-R120-1	
	Manufacturer:	Fa. Binder Motorenbau / Germany	

1.5 Three-side view



Section 2

2.1 Introduction

Section 2 includes operating limitations, instrument markings and basic placards necessary for safely operating the powered sailplane, its standard systems and standard equipment.

The limitations included in this section and in section 9 have been approved by EASA.

2.2 Airspeed

Airspeed limitations and their operational significance are shown below:

SPEED		(IAS)	REMARKS
V_{NE}	Never exceed speed in calm air. Flaps set at "0", "-1", "-2" ,"S"	280 km/h 151 kts 174 mph	Do not exceed this speed in any operation and do not use more than 1/3 of control deflection
V_{RA}	Rough air speed	180 km/h 97 kts 112 mph	Do not exceed this speed except in smooth air, and then only with caution. Rough air is met in lee-wave rotors, thunderclouds etc.
V_A	Maneuvering speed	180 km/h 97 kts 112 mph	Do not make full or abrupt control movements above this speed as the aircraft structure might get overstressed.
V_{FE}	Maximum “flap extended” speed Flaps set at "+2", "+1", "L"	180 km/h 97 kts 112 mph	Do not exceed this speed with the given flap setting.
V_T	Maximum speed on aerotow	180 km/h 97 kts 112 mph	Do not exceed this speed during an aerotow.
V_W	Maximum winch launch speed	150 km/h 81 kts 93 mph	Do not exceed this speed during a winch launch.
V_{LO}	Maximum landing gear operating speed	180 km/h 97 kts 112 mph	Do not extend or retract the landing gear above this speed.

2.2 Airspeed (continued)

Speed		(IAS)	Remarks
V_{max}	Maximum speed with propeller extended	180 km/h 97 kt 112 mph	Do not exceed this speed with propeller extended
V_{POmax}	Maximum speed for extending / retracting the propeller	120 km/h 65 kt 75 mph	Do not extend / retract the propeller outside this speed range
V_{POmin}	Minimum speed for extending / retracting the propeller	90 km/h 49 kt 56 mph	

2.3 Airspeed indicator markings

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

MARKING	VALUE OR RANGE (IAS)	SIGNIFICANCE
White arc	88 - 180 km/h 48 - 97 kts 55 - 112 mph	Positive flap operating range (lower limit is the speed $1.1V_{S0}$ at maximum mass and in landing configuration; upper limit is the max. permissible speed with flaps extended positive).
Green arc	96 - 180 km/h 52 - 97 kts 60 - 112 mph	Normal operating range (lower limit is the speed $1.1V_{S1}$ at maximum mass, c/g at the most for-ward position and flaps at the neutral "0" position; upper limit is the max. permissible speed in rough air).
Yellow arc	180 - 280 km/h 97 - 151 kts 112 - 174 mph	Manoeuvres must be conducted with caution and operating in rough air is not permitted.
Red line at	280 km/h 151 kts 174 mph	Maximum permitted speed
Blue line at	95 km/h 51 kts 59 mph	Speed of the best climbing V_Y
Yellow triangle at	105 km/h 57 kts 65 mph	Approach speed at maximum mass without water ballast.

2.4 Powerplant, fuel and oil

Engine manufacturer:	Solo Kleinmotoren GmbH. D-71050 Sindelfingen, Germany
Engine model:	SOLO 2625-02i
Engine power (MSL, ISA):	
Take-off and max. continuous power	50 kW (68 HP) at 6600 RPM
Max. engine speed:	6700 RPM
Maximum permitted coolant liquid temperature:	115° C (240° F)
Fuel:	premium unleaded not below RON 95, AVGAS 100LL, or mixtures of the two fuels
Oil (lubrication):	Fuel / oil mixture 1 : 50 (2%) Oils according to the specification JASO FC or FD, recommended oil Castrol ACT>EVO
Propeller manufacturer:	Technoflug Leichtflugzeugbau GmbH. D-78713 Schramberg-Sulgen, Germany
Propeller model:	KS-1G-160-R-120
or	
Propeller manufacuter:	Binder Motorenbau GmbH D-97645 Ostheim v.d. Rhön, Germany
Propeller model:	BM-G-160-R-120-1
Reduction ratio:	1 : 2.75
Fuel capacity:	See table below

	Tank in fuselage			Tank(s) in inboard wing panels starbd. side			Tank(s) in inboard wing panels port side - OPTION -			Total capacity incl. optional tank		
	Liter	US Gal	IMP Gal	Liter	US Gal	IMP Gal	Liter	US Gal	IMP Gal	Liter	US Gal	IMP Gal
Fuel capacity	14.5	3.8	3.2	13.0	3.4	2.9	13.0	3.4	2.9	40.5	10.6	9.0
Usable fuel	14.0	3.7	3.1	12.5	3.3	2.7	12.5	3.3	2.7	39.0	10.3	8.5
Non-usable fuel	0.5	0.13	0.11	0.5	0.13	0.11	0.5	0.13	0.11	1.5	0.39	0.33

2.5 Powerplant instrument markings

Power plant instrument markings and their colour code significant are shown below:

Powerplant instrument	Prompt	Normal range	Caution range	Maximum Limit
RPM-Indication	LCD-Display	2500 – 6600 RPM	6600 – 6700[1] RPM	> 6700 [2] RPM (flashing)
	Signal-LED	Green	Yellow[1]	-
	Caution-LED + Audio warning	---	---	Red flashing + continuous tone
Coolant Liquid Temperature Indicator	LCD-Display	25 – 115 °C	---	> 115 °C (flashing)
	Caution-LED + Audio warning	---	---	Red flashing + continuous tone
Fuel quantity Indicator	Operating range	≥ 7 L	6 bis 0 L	---
	LCD-Display	Fuel content – fuselage and wing tank(s) [3]	Fuel content – only fuselage tank (flashing)	---
	Caution-LED + Audio warning	---	Red flashing + continuous tone	---

1) If the RPM is in the area between 6600 and 6700 RPM for more than 5 minutes, the RPM-Indication on the LCD display of the operating unit and the yellow signal-LED will start flashing.

2) The speed limitation of the engine control system (Trijekt) and the redundancy system prevent the exceeding of a speed of 6800 RPM by switching off the ignition.

3) The content of the wing fuel tank(s) will only taken into account, if the fuel content of the wing tank(s) was entered manually into the powerplant operating unit before the flight.

2.6 Weights (masses)

Maximum permitted take-off weight (mass):	800 kg	(1764 lb)
Maximum permitted landing weight (mass):	800 kg	(1764 lb)

Maximum permitted take-off and
landing weight (mass) w i t h o u t water ballast:

Power plant installed:	785 kg	(1731 lb)
Power plant removed:	765 kg	(1687 lb)

Maximum permitted weight (mass) of all non-lifting parts:

Power plant installed:	550 kg	(1213 lb)
Power plant removed:	530 kg	(1169 lb)

Maximum permitted weight (mass) in
baggage compartment: 2 kg (4 lb)
(see page 7.8)

2.7 Centre of gravity

Centre of gravity in flight

Aircraft attitude:	Tail raised up such that a wedge-shaped block, 100 : 4.5, placed on the rear top fuse-lage, is horizontal along its upper edge
Datum:	Wing leading edge at root rib
Maximum forward c/g position:	75 mm (2.95 in.) aft of datum (powerplant removed) 100 mm (3.94 in.) aft of datum plane (powerplant installed)
Maximum rearward c/g position	290 mm (11.42 in.) aft of datum plane

It is extremely important that the maximum rearward c/g position is not exceeded. This requirement is met when the minimum front seat load is observed. The minimum front seat load is given in the loading table and is shown by a placard in the cockpit.
A lower front seat load must be compensated by ballast – see section 6.2 "Weight and Balance Record / Permitted Payload Range".

2.8 Approved manoeuvres

The powered sailplane model Arcus M is certified in category

U T I L I T Y, (self-launching)

Permitted aerobatic manoeuvres:

- without wing water ballast,
- up to a maximum all-up mass of 690 kg (1521 lb)
- with retracted or removed power plant
- with flap position "0"

a) inside loops

b) stalled turns

c) lazy eight

d) spinning

It is recommended to install in addition to the instrumentation recommended in section 2.12 an accelerometer (3 hands, resettable).

2.9 Manoeuvring load factors

The following manoeuvring load factors must not be exceeded:

a) With airbrakes locked

at V_A = 180 km/h, 97 kts, 112 mph

n = + 5.3

n = - 2.65

V_{NE} = 280 km/h, 151 kts, 174 mph

n = + 4.0

n = - 1.5

b) With airbrakes extended

n = + 3.5
n = - 1.5

2.10 Flight crew

The aircraft is two-seated.
When flown solo, the Arcus M is controlled from the front seat.
Observe the minimum load on the front seat – if necessary, ballast must be installed to bring the load up to a permissible figure, see also section 6.2 “Weight and Balance Record / Permitted Payload Range”.

When flown with two pilots, the front as well as the rear seat can be designated as seat for the Pilot in Command. The following requirements have to be met, when the rear seat is designated for the Pilot in Commend:

- All necessary control elements and instruments, including powerplant operating unit, must be installed for the rear seat. The priority selector switch must be switched with the key up (powerplant control unit in the rear panel active).

- The responsible pilot needs sufficient experience and practice in flying from the rear seat.
  The person in the front seat must be sufficiently pre-briefed in order that there is no negative effect on flight safety.

- No water ballast in the wings (because the water dump control is only accessible from the front seat)

2.11 Kinds of operation

With the prescribed minimum equipment installed (see page 2.12), the aircraft is approved for

VFR-flying in daytime

2.12 Minimum equipment

Instruments and other basic equipment must be of an approved type and should be selected from the list in the Maintenance Manual.

a) Normal operations

2 Airspeed indicator
(range up to 300 km/h, 162 kts, 186 mph)
with colour markings according to page 2.3

2 Altimeter

1 Outside air temperature indicator (OAT) with sensor
(when flying with water ballast – red line at + 2° C [35,6° F])

1 Magnetic compass

1 Powerplant operating unit MCU II BG indicating

- RPM
- Coolant liquid temperature (°C)
- Fuel quantity (Liter)
- Engine time
- Warning signals

1 Rear-view mirror

2 Four-piece safety harnesses (symmetrical)

Caution:

The sensor for the OAT must be installed in the ventilation air intake.
For structural reasons the mass of each instrument panel with instruments in place must not exceed 10 kg (22 lb).

Additionally to the minimum equipment each occupant must be equipped either with an automatic or manual rescue parachute, or must use a back cushion (thickness approx. 8 cm / 3.15 in when compressed)

b) Cloud flying:

only permissible: - without wing water ballast
- up to a maximum all-up mass of 690 kg (1521 lb)

In addition to the minimum equipment listed under a) the following instruments are required:

1 Turn & bank indicator with slip ball
1 Variometer
1 VHF-Transceiver

Note: From experience gained to date it appears that the airspeed indicator system installed remains fully operational when flying in clouds.

Recommended additional equipment for cloud flying:

1 Artificial horizon
1 Clock

c) Restricted aerobatics

only permissible: - without wing water ballast
- up to a maximum all-up mass of 690 kg (1521 lb)
- flap setting "0"
- powerplant retracted or removed

Recommended additional equipment for restricted aerobatics

1 Accelerometer (3 hands, resettable)

2.13 Aerotow and winch launch

Aerotow (Powerplant retracted)

Only permissible on the nose tow release and with retracted powerplant!

Maximum towing speed:	180 km/h	(97 kts, 112 mph)
Weak link in tow rope:	max. 850 daN	(1911 lb)
Minimum length of tow rope:	30 m	(98 ft)
Tow rope material	Hemp or Nylon	

Winch launch (powerplant retracted)

Only permissible on the c/g tow release and with retracted powerplant!

Maximum launching speed:	150 km/h	(81 kts, 93 mph)
Weak link in winch cable:	max. 1000 daN	(2248 lb)

2.14 Other limitations

- Below 2°C outside temperature no water ballast may be used.

- Life time of the airframe:

  1. Time limits:

     When the Arcus M has reached a maximum of 6000 hours of service time, then a special inspection of the airframe must be accomplished in accordance with the inspection program for the extension of the allowed service time.

     If the results of this special inspection, possibly after proper repair of detected defects, are satisfactory, the allowed service time is increased by 3000 hours up to a maximum of 9000 hours in total.

     Thereafter the special inspection in accordance with the above mentioned inspection program must be repeated in intervals not exceeding 1000 hours. If the results are satisfactory and the detected defects properly repaired, then the allowed service time may be increased step by step at each inspection by 1000 hours up to a maximum of 12000 hours in total.

  2. The instructions given in the maintenance manual section 3.3 regarding the inspection procedure for the extension of the allowed service time must be observed.

  3. The inspections must be conducted only in an appropriately licensed maintenance organization.

2.15 Limitations placards

PERMITTED ALL-UP MASS:	800 kg / 1764 lb		
MAXIMUM PERMITTED SPEEDS (IAS):	**km/h**	**kt**	**mph**
Flap setting **0, -1, -2, S**	**280**	**151**	**174**
Flap setting **+2, +1, L**	**180**	**97**	**112**
Rough air speed	**180**	**97**	**112**
Maneuvering speed	**180**	**97**	**112**
Aerotowing speed	**180**	**97**	**112**
Winch launching speed	**150**	**81**	**93**
Landing gear operating speed	**180**	**97**	**112**
For power plant extension/retraction	**120**	**65**	**74**
Power plant extended speed	**180**	**97**	**112**
PERMISSIBLE MINIMUM SPEED (IAS):			
For power plant extension/retraction	**90**	**49**	**56**

Max. permitted speed			
Altitude [m]	**V_{NE}(IAS) km/h**	**kt**	**mph**
0	**280**	**151**	**174**
1000	**280**	**151**	**174**
2000	**280**	**151**	**174**
3000	**280**	**151**	**174**
4000	**263**	**142**	**163**
5000	**245**	**132**	**152**
6000	**232**	**125**	**144**
7000	**220**	**119**	**137**
8000	**207**	**112**	**129**
9000	**195**	**105**	**121**
10000	**182**	**98**	**113**

WEAK LINK FOR TOWING	
for Aerotow:	**max. 850 daN (1910 lb)**
for Winch launch:	**max. 1000 daN (2248 lb)**
TIRE PRESSURE	
Nose wheel:	**3.0 bar (43 psi)**
Main wheel:	**4.0 bar (57 psi)**
Tail wheel:	**3.0 bar (43 psi)**

A E R O B A T I C S

ONLY WITHOUT WATER BALLAST IN THE WINGS, UP TO AN ALL-UP MASS OF 690 kg (1521 lb), WITH RETRACTED OR REMOVED POWER PLANT AND WITH FLAP POSITION "0" THE FOLLOWING AEROBATIC MANEUVERS ARE PERMITTED:

(A) Inside loops **(C)** Lazy eight
(B) Stalled turns **(D)** Spins

Operating Conditions: See Flight Manual

LOAD ON THE SEATS (crew incl. parachutes)				
SEAT LOAD	TWO PERSONS min.	TWO PERSONS max.	ONE PERSON min.	ONE PERSON max.
front seat load	**70*** kg **154*** lb	**115** kg **254** lb	**70*** kg **154*** lb	**115** kg **254** lb
rear seat load	at choice	**115** kg **254** lb	———	———
valid for the following battery location(s):				
1 batt.	engine battery (E)			
2 batt.**	in front of rear stick mounting frame (C1, C2)**			
1 batt.**	in fin (F1)**			
Maximum load in the cockpit when the fuel tank is completely filled ***	**232*** kg / **512*** lb			

The maximum load in the cockpit (load on both seats + baggage + trim ballast) must not be exceeded. If the front seat load is below the minimum front seat load: see instructions in the flight manual - section 6.2.

Maximum fuel	**kg**	**lb**	**Ltr.**	**US. Gal.**	**IMP. Gal.**
	11	**24.3**	**14.5**	**3.83**	**3.19**

***)** Values as an example, the actually applicable values - see Flight Manual log chart section 6.2 - must be entered.

****)** Enter number of batteries installed at weighing and enlisted in equipment list.

*****)** With removed power plant the amendment "when fuel tank is completely filled" must be crossed out.

WITH NOSE SKID:
Minimum cockpit load raised by 2 kg / 4.41 lb!

BALLAST IN FIN TANK IS DUMPTED SIMULTANEOUSLY WITH WING TANKS

Note:
Further placards are shown in the Maintenance Manual.

Section 3

3. Emergency procedures

3.1 Introduction

Section 3 provides check lists and amplifies procedures for coping with emergencies that may occur.

3.2 Jettisoning the canopy

The canopy is to be jettisoned as follows:

Swing **b a c k** one of the red locking levers provided on the left side of the canopy frame up to the stop (approx. 90°) and swing canopy sideways fully open.

The canopy will then be torn out from its hinges by the airstream and getcarried away.

3.3 Bailing out

If possible, first stop the engine (iginition off) and retract powerplant (manual control switch "Retraction" resp. press emergency system switch DOWN).

After jettisoning of the canopy (see section 3.2) the emergency exit is made.

- release harness

Front crew:

- Bend upper body slightly forward, grab the canopy coaming frame of the fuselage with both hands and lift the body up. The instrument panel is pushed up by the legs.

Rear crew:

- Grab the handles on either side of the instrument panel and use the canopy coaming frame or the arm rest of the seat pan for support.

- Leave the cockpit to the left.

- The rip cord of a manual parachute should be pulled at a safe distance and height.

3.4 Stall recovery

a) Powerplant retracted

When stalling during straight and level fight or in a banked turn, normal flying attitude is regained by firmly easing the control stick forward and, if necessary, applying opposite rudder and aileron.

b) Powerplant extended

With the powerplant extended, there are no significant differences in the stall behaviour, but the turbulent airflow produced by the propeller superimposes any vibration in the controls.

Caution:

If, on stalling, the vibration in the controls and in the cockpit becomes more pronounced, with controls getting spongy and engine noise increasing, immediately release the back pressure on the stick and, if necessary, apply opposite rudder and aileron.

3.5 Spin recovery

A safe recovery from a spin is accomplished by the following method:

a) Hold aileron neutral
b) Apply opposite rudder (i.e. against the direction of rotation of the spin).
c) Ease control stick forward until rotation ceases and the airflow is restored.
d) Level the wings, neutralize rudder, and pull gently out of dive.

With the center of gravity in the mid to rearward position, a steady spinning motion is possible. After having applied the standard recovery method, the Arcus M will stop rotating after about ½ to ¾ turn, depending on the flap position.

The loss of altitude - from the point at which recovery is initiated to the point at which horizontal flight is first regained - can be up to 250 m (590 ft) and the recovery speeds are between 130 and 210 km/h (70 – 113 kts, 81 – 130 mph). Therefore, when recovering using a positive flap position, make sure the maximum speed for that flap setting is not exceeded. It is recommended for positive flap settings to change the flap setting to "0" during spin recoveries.

With the center of gravity in the foremost position, a steady spinning motion is not possible. The Arcus M stops rotating after a half to a full turn and usually ends in a spiral dive. In a spiral dive the sailplane accelerates very rapidly. Therefore a spiral dive must be recovered immediately.
Recovery is by normal use of controls (see page 3.6).

Note:

Should the "Arcus M" enter a spin with its engine running, then - in addition to the actions required by the above recovery method - the throttle must immediately be closed.

Spinning may be safely avoided by following the actions given in section 3.4 "Stall recovery".

Recovery from a spin with a positive flap setting can be hastened by adjusting the flaps to a negative setting.

In extreme configurations outside the allowable limits (e.g. accidental extreme rearward c/g position or extreme asymmetric water ballast) it may be necessary, especially in positive flap settings, to change the flap setting to "S" to stop the rotation.

3.6 Spiral dive recovery

Depending on the use of the controls, a spin may turn into a spiral dive if the centre of gravity is in forward positions. This is indicated by a rapid increase in speed and acceleration.

Recovery from a spiral dive is achieved by easing the control stick forward and applying opposite rudder and aileron.

Warning:

When pulling out of a dive, the permissible maximum speed of the respective flaps position and the permissible control surface deflections at V_A / V_{NE} are to be observed! (if necessary use flap position"0" when pulling out.) See also page 2.2.

3.7 Engine failure

Engine failure on take-off

Ease the control stick forward immediately to obtain sufficient airspeed.
Ignition OFF.

Should the engine fail on take-off from a runway of sufficient length, land straight ahead.

If the runway is too short, the procedure for a proper landing approach will depend on height, position and terrain.

If the safety of the selected landing procedure is improved, the powerplant should at least be partly retracted – regardless of the position of the prop blades – (Ignition OFF and press manual control switch "retraction" resp. press emergency system switch DOWN). Even with partly retracted powerplant the glide ratio will improve considerably.

Thereafter:

Close fuel shut-off valve
Powerplant master switch OFF.

Warning:

With power plant fully extended, the rate of descend increases to a value of about 2.25 m/s (443 fpm) at 105 km/h (57 kt, 65 mph) and the L/D deteriorates to about 13 : 1 – therefore use airbrakes with caution!

Engine failure in flight

Should the engine fail in flight, check

- Fuel quantity
- Fuel shut-off valve (OPEN?)

Should it be impossible to restart the engine, land with retracted powerplant.

Emergency procedure for starting the engine in flight despite a defective starter motor

Follow the normal checklist until the item “depress starter button”.

Set flaps at “0” and accelerate to 150 km/h (81 kt, 93 mph) so that the engine revs will quickly build up (with an audible prop noise).

Maintain speed until the engine has started. Then pull up with about 2g and reduce speed to the desired climb flight speed.

The loss of height from the moment of acceleration to the point where the aircraft is leveled off is in the order of 150 m (492 ft).
For this reason, the emergency procedure should not applied at altitudes below 400 m (1312 ft) over ground.

Icing of induction system

From experience gained to date, no induction system icing has yet occurred on the engine model installed.

Should the engine fail in flight due to the lack of fuel or a defect, retract the powerplant as quickly as possible to avoid any unnecessary deterioration of the flight performance (for more precise data refer to section 5).

Extending / Retracting propeller in spite of a defective powerplant operating unit

The emergency extension/retraction switch is accessible by tilting up its red guard (located at the base of the front instrument panel).

With the key of this switch held up at "EXTD", the propeller pylon swings up – held down at "RETR", it swings down.

On lifting the red switch guard, automatically a bridging of the pylon limit switch "extended" takes place (which normally cut off the spindle drive).
Therefore the final position of the extended propeller pylon has to be checked visual or can be recognized when the 15 A circuit breaker is released.

To start the engine (by following the standard procedure), the emergency system is not required.

NOTE:

In the extreme "down" position the spindle is stopped by the limit switch "retracted" and is shown by the green signal.

Failure of engine control system

The engine SOLO 2625-02i is equipped with a redundancy system for the engine control that allows the continued engine operation if a failure of the regular engine control system occurs.
The failure of the regular engine control system will be indicated by the powerplant operation unit in the instrument panel (ERROR- CAN MISS).
The switch the redundancy system for the engine control has to be carried out by the pilot manually (position of switch see chapter 7.3).

Under operation with the redundancy system the engine power will be decreased because the adaption of the engine operation map to altitude and temperature is missing. The engine operational data and limitations remain the same.
The switch over to the redundancy system is possible while the engine is running.
Also starting the engine in the air with activated redundancy system is possible.

Warning:

Self-launch is not approved under operation with the redundancy system

Failure of the electric power supply for the engine

A defect of the electric power supply is displayed with an error message on the powerplant operation unit MCU II.
The electric power for the engine control and fuel injection will then be only provided by the engine battery. As soon as the engine battery capacity is depleted the engine will stop running and the retraction of the engine is no more possible.
For this reason, as soon as a failure of the electric power supply is indicated, quickly stop and retract the engine.

Failure of the electric power supply for the engine(continued)

Note:

Under optimal conditions (fully charged engine battery, no load from avionic, normal operation of powerplant system) it can be assumed, that the powerplant can be operated for about 15 minutes at maximum power and then still be retracted.

Starting the engine despite a flat batteries

Via the (optional) ground service receptacle

Plug in special starting cable into the receptacle provided below the aft seat on the left hand side.
Clamp negative ground strap to proper terminal of an external 12 V power source, then clamp power strap to positive terminal.
Thereafter follow normal starting procedure with master switch ON.

Caution:

When connecting an external power source, a bridging of the master switch (circuit breaker) takes place so that even with master switch OFF the electrical system is in working order as displayed by the Powerplant operating unit.

WARNING:

BEWARE OF THE PROPELLER !

3.8 Fire

- CLOSE fuel shut-off valve
- Open throttle fully
- If the engine stops: master switch at "OFF"
- Leave powerplant in extended position

This sequence should be followed – if possible –

(a) on the ground
(b) on take-off
(c) in flight

Warning:

Discontinue flight and land immediately !
Avoid any manoeuvres causing a high stressing of the fuselage !

3.9 Other emergencies

Flying with uneven water ballast

If, on dumping water ballast, the wing tanks are emptying unevenly or on one side only - which is recognized at lower speeds by having to apply opposite aileron for normal flying attitude -entering a stall must be avoided.

When landing in this condition, the touch down speed must be increased by about 10 km/h (5 kts, 6 mph) and the pilot must be prepared for the powered sailplane to veer off course as the heavier wing tends to drop somewhat sooner than normal (apply opposite aileron).

Jammed elevator or flap control

While jammed flaps will just result in a "fixed profile flight behaviour",
a jammed elevator control is more serious.
The pilot, however, should take into consideration that the aircraft is still controllable to at least some extent by using its flaps for longitudinal controls

Flap lever pulled back	=	slower
Flap lever pushed forward	=	faster

This may allow the pilot to move over to a more favourable bail-out area
or he may even avoid an emergency exit.

Loss of directional control

Should a rudder control cable break in flight, the aircraft may quickly start yawing and rolling. An ensuing spiral dive, however, may possibly be avoided by resetting the flaps immediately at “0".

If the yawing/rolling motion cannot be stopped by normal opposite aileron, then briefly apply aileron in the direction of the roll so that the wing will level with the aid of the adverse aileron yaw.
Shallow turns can also be effected by using only the aileron in the described manner.

Emergency landing with retracted undercarriage

An emergency landing with the main wheel retracted is on principle not recommended, because the potential energy absorption of the landing gear is many times higher as compared to the fuselage shell.

Should the wheel fail to extend, the powered sailplane should be landed at a flat angle, with flaps set at “L”' and without pan caking.

Ground-loop

If there is the danger of the aircraft overshooting the boundary of the landing field in mind, a decision whether or not to initiate a controlled ground loop should be made at least 40 m (131 ft) away from the boundary:

- If possible, always turn into the wind
- As the wing tip is forced down, push the control stick forward simultaneously.

Emergency water landing

From experience gained from composite sailplane landings on water following recommendations can be given:

Approach:

- landing pattern parallel to the shore
- undercarriage extended
- ventilation closed
- water ballast tanks valves closed
- main switch OFF

Landing:

- Touch down with minimum speed and airbrakes retracted.

Section 4

4. Normal operating procedures

4.1 Introduction

Normal procedures associated with optional equipment are found in section 9.

This section provides checklists and amplified procedures for conducting the daily and pre-flight inspection.

Furthermore this section includes normal operating procedures and recommended speeds.

4.2. Assembly

4.2.1 Rigging and derigging

Rigging

The Arcus M can be rigged by two people if a wing stand or trestle is used under one wing tip.

Prior to rigging, all pins and their corresponding bearings on fuselage, wing panels and tailplane should be cleaned and greased.

Inboard wing panels

Unlock the airbrake lever and set water ballast control lever to “CLOSED” - flap position "L":

Insert the left wing panel first. It is important that the helper on the wing tip should concentrate on lifting the trailing edge of the wing panel more than the leading edge, so that the rear wing attachment pin does not jam into the fuselage bearing.
Check that the spar stub tip is located correctly in the cut-out on the far side of the fuselage and that the fuel- and vent pipes are located correctly in the corresponding cut-out in the fuselage (if necessary, tilt the fuselage or move the wing gently up and down to help it home).
Check that the angular levers on the wing root rib are properly inserted into their corresponding funnels on the fuselage.
Push the main wing pin in approx. 3 cm (1.2 in.) so that the wing panel is prevented from sliding out by the cut-out in the vertical rim of the GFRP-panel covering the front wing locating tube.
The wing tip can now be placed on a wing stand.
Next insert the right wing panel – the procedure is the same as for the left wing. As soon as the pin on the right wing spar stub has engaged in its corresponding bearing on the opposing wing panel (recognized by a sudden extension of the unlocked airbrakes), the right wing panel can be pushed fully home under some pressure.
If it is difficult / impossible to push fully home, remove the main wing pin and draw the panels together with the aid of the rigging lever (use flat side only).

Finally push the main wing pin fully home and secure its handle (depress locking pin and let it engage in the metal fitting on the fuselage inner skin).

Wing tip extensions (outboard. panels)

Insert the spar of the wing tip extension – with locking pin pushed down and aileron deflected upwards – into the spar tunnel of the corresponding inboard wing panel. When fully home, the spring-loaded pin must have engaged (snapped up) in the corresponding opening on the inboard wing panel(s). Make sure that the coupling lap on the lower side of the inner aileron has correctly slid under the adjacent outer aileron.

With the rigging pin, make sure the locking bolt is snapped.

Horizontal tailplane

Take the round-headed rigging tool (to be stored in the side-pocket) and screw into the front tailplane locating pin on the leading edge of the fin.
Thereafter slide the tailplane aft onto the two elevator actuating pins, pull rigging tool and its pin forward, seat stabilizer nose and push locating pin home into the front tailplane attachment fitting.

Remove rigging tool – locating pin must not protrude in front of the leading edge of the fin.

Check whether the elevator actuating pins are really located (by moving the elevator) and check that the nose of the stabilizer is properly mated with the top of the fin.

After rigging

Connect the fuel line(s) of the wing tank(s) (option) to the fuselage tank with the aid of the quick disconnect coupling(s) and connect the small coupling of the vent line(s) from the wing tank(s) to the appropriate line(s) of the fuselage tank.

Check – with the aid of a helper – the controls for full and free movement in the correct sense.
Use tape to seal off the wing / fuselage joint and the joint between main wing panels and their tip extension.

Caution: Do not seal off the aileron gap between inner wing and wing tip extension.

Seal off the opening for the front tailplane attachment pin and also the joint between fin and horizontal stabilizer (only necessary if there is no rubber sealing on the upper end of the fin).
Sealing with tape is beneficial in terms of performance and it also serves to reduce the noise level.

Derigging

Remove sealing tape from wing panels and tailplane, disconnect fuel line and vent line of wing tank(s).

Draining fuel from wing tank(s):

Connect fuel hose to the wing tank(s). Raise respective wing and empty wing tank(s) into a separate canister.

Wing tip extensions (outbd. panels)

Push the locking pin down (using rigging pin) and carefully pull out each tip extension.

Horizontal tailplane

Using the threaded rigging tool, pull out the front tailplane attachment pin, lift the stabilizer leading edge slightly and pull the tailplane forward and off.

Main wing panels

Unlock airbrakes, set the water dump valve control lever to the "CLOSED" position and unlock the handle of the main wing pin.

With a helper on the tip of each wing panel, pull out the main wing pin till the last 20 to 30 mm (0.8 -1.2 in.) and withdraw the right wing panel by gently pulling and rocking it backwards and forwards if necessary.
Thereafter, remove the main wing pin and withdraw the left wing panel.

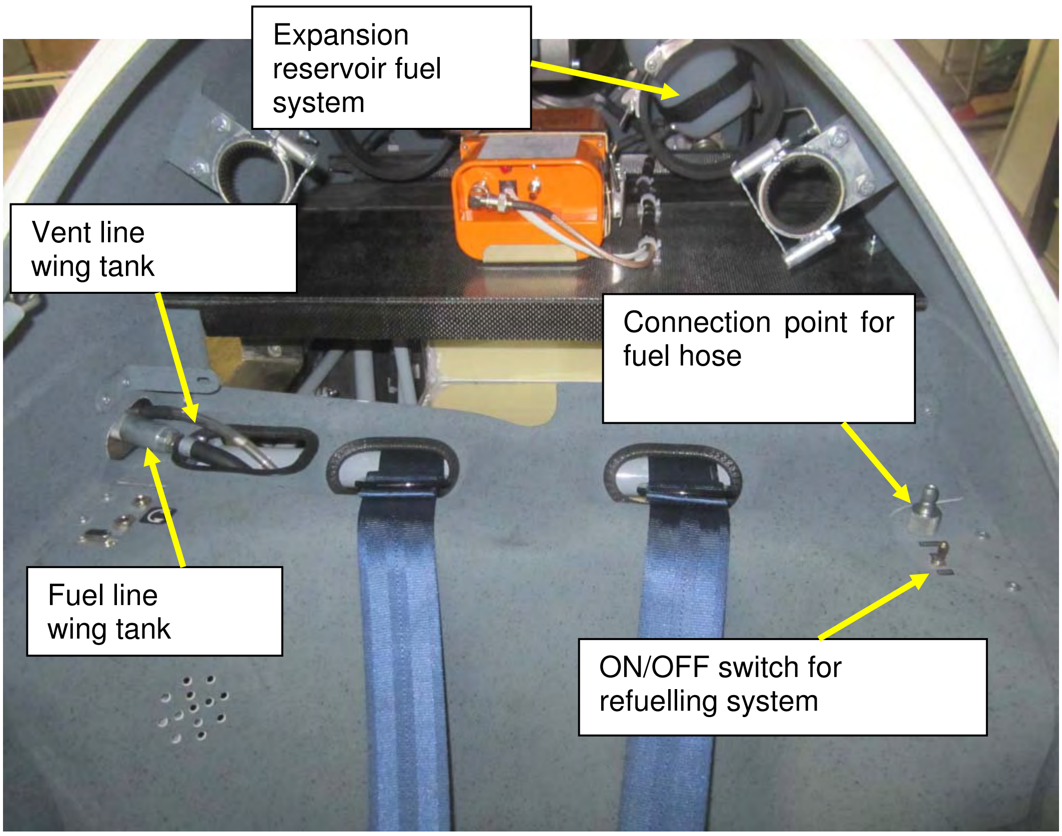
4.2.2 Refuelling

The Arcus M is equipped with a rigid fuselage tank and optional with up to two flexible wing tanks (see section 7.11)

Permitted fuel grades and capacity of fuel tanks see section 2.4.

The electrical fuel pump installed to the fuselage allows the fuelling of the fuel tanks with the aid of a fuel hose equipped with a quick-disconnect coupling.

The connection point for fuel hose and the ON/OFF switch of the refueling system is located in the aft cockpit above the back cover on the left side of the airplane:



Fuel system with refuelling system (Example with one wing fuel tank)

While refuelling the fuselage and/or the wing tank(s) monitor the fuel level in the expansion reservoir in the baggage compartment. Stop the refueling at least when the expansion reservoir starts filling quickly.

Fuselage and wing tank(s) are connected by the vent lines with the expansion reservoir in the baggage compartment. All vent lines are equipped with a pressure relief valve which will prevent the filling of the expansion reservoir over the vent lines under normal conditions.

If the fuselage tank or the wing tank(s) are overfilled while refuelling or if the fuel is heated, fuel can stream via the vent lines into the expansion reservoir. As soon as the expansion reservoir is full, the subsequent fuel will bleed via the overflow line out of the fuselage (overflow outlet on the right, lower fuselage side behind the gear doors).

Caution:

The engine supplied with fuel from the fuselage tank. Therefore always fill sufficiently the fuselage tank first and only afterwards the wing tank(s).

The external fuel hose used for the refuelling of fuselage and wing tank(s) has to be equipped with a suitable fuel filter.

a) Refuelling of fuselage tank with installed refuelling system

The fuselage tank can only be filled via the installed refuelling pump.

In order to refuel the fuselage tank, attach the external fuel hose (see parts list in section 7.11) to the connection point in the baggage compartment, see picture on page 4.2.2.1.

Place the other end of the external fuel hose in a fuel canister that will be used for refuelling.

By actuation of the ON/OFF switch the fuel pump is activated and the refuelling of the fuselage tank is started.

The fuel capacity display on the powerplant operating unit shows the current content of the fuselage tank.
The fuselage tank is filled completely, as soon as the expansion reservoir starts to be filled quickly. At least now the refuelling has to be stopped.

Caution:

The installed refuelling pump will be damaged, if it is operated without pumping fluid over a prolonged period of time.

Only with optional wing tank(s):

For refuelling of the fuselage tank it is recommended to cut the fuel lines of the wing tank(s) at the quick disconnect couplings. Otherwise a unnoticed overflow of fuel into the wing tank(s) might occur during the refuelling process, even before the fuselage tank is completely filled.
After refuelling the fuselage tank, reconnect the fuel line(s) of the wing tank(s).

If one wing will be dropped after refuelling the fuselage tank and reconnection of the wing tank(s), partial overflow of fuel from the fuselage tank into the dropped wing tank can occur.
The resulting asymmetric wing loading must be considered for the take off run.

b) Refuelling of wing tank(s) (Option)

The wing tanks are connected to the fuselage fuel system via one fuel line and one venting line for each wing tank. All lines are equipped with quick release couplings that have to be operated manually.

The wing tank(s) can be refueled with the glider rigged. The refuelling is possible with the installed refuelling pump or with an external fuel pump (optional).

It is recommended to empty the wing tanks before starting the refuelling, see page 4.2.2.12, to avoid overfilling of the wing tanks and to obtain a precise control over the amount of fuel on board.

Before refuelling the wing tanks at the rigged glider connect the vent lines of the wing tanks to the fuselage. Otherwise overflowing fuel can enter the fuselage.

In order to achieve the optimal filling of the wing tanks, the wings have to be kept horizontally while refuelling.

The wing tank(s) aren’t equipped with their own level measurement. Therefore it is recommended to refuel the wing tank(s) from calibrated canisters so that the total amount of fuel on board is known.

Furthermore should the fuselage tank be completely filled before starting to refuel the wing tank(s).

b) Refuelling of wing tank(s) (Option) (continued)

Caution:

If both wing tanks are connected with the fuselage fuel system, fuel can flow from one wing tank into the other if one wing will be dropped.
The resulting asymmetric wing loading must be considered for the take off run.

Due to the risk of leakage a longer, unobserved parking or storage of the glider with filled wing tanks is not permitted.

For the road transport of the glider in the trailer the wing tanks have to be empty!

Emptying the wing tank(s), see page 4.2.2.12

b) Refuelling of wing tank(s) (Option) (continued)

i) Refuelling of wing tanks with installed fuel pump

Connect the fuel line and the vent line of the fuel tank that will be refueled with the connections in the fuselage.

Attach the external fuel to the connection point in the baggage compartment, see picture on page 4.2.2.1. Place the other end of the external fuel hose in a fuel canister that will be used for refuelling.

By actuation of the ON/OFF switch the fuel pump is activated and the refuelling of the wing tank through the fuselage tank is started

Are both wings equipped with a wing tank, it is recommended to refuel the wing tanks one after the other to be able to maintain control of the actual amount of fuel. To do so, disconnect the fuel line of one wing tank from the fuel system at the quick release coupling before refuelling the other one.

Refuelling has to be stopped at least when the maximum amount of fuel (see section 2.4) for the wing tank(s) is reached.

If there is unknown amount of remaining fuel in the wing tank(s) at the beginning of the refuelling, the fuel level in the expansion reservoir has to be observed while refuelling the wing tank(s).
As soon as the fuel level in the expansion reservoir starts to climb quickly, the respective wing tank is completely filled. The amount of fuel inside the wing tank then exceeds the content listed in section 2.4.

Reconnect the fuel line(s) of the wing tank(s) with the fuselage fuel system when the refuelling of the wing tank(s) is finished.

b) Refuelling of wing tank(s) (Option) (continued)

ii) Refuelling of wing tank(s) with external fuel pump

For refuelling the wing tank(s) directly with an external fuel pump a special quick release coupling for the connection of the external fuel hose to the wing tank is necessary (see parts list in section 7.11).

Connect the fuel hose of the external fuel pump with the quick-release coupling of the fuel line of the respective wing tank. Then switch on the external fuel pump.

Refuelling has to be stopped at least when the maximum amount of fuel (see section 2.4) for the wing tank is reached.

If there is unknown amount of remaining fuel in the wing tank at the beginning of the refuelling, the fuel level in the expansion reservoir has to be observed while refuelling the wing tank.
As soon as the fuel level in the expansion reservoir starts to climb quickly, the respective wing tank is completely filled. The amount of fuel inside the wing tank then exceeds the content listed in section 2.4.

Reconnect the fuel line of the wing tank with the fuselage fuel system when the refuelling of the wing tank is finished.

Caution:

Observe the maximum fuel content of the wing tank when refuelling with an external fuel pump!
Powerful fuel pumps can produce enormous pressure and cause damage to the wing shell, if the wing tank will be overfilled, although a pressure relief valve exists.

c) Determination of fuel content in fuselage tank

i) Fuselage tank

The fuel content of the fuselage tank is measured with a capacitive sensor. The panel mounted powerplant operating unit MCU II BG displays the fuel content of the fuselage tank in fuel liters.

When fuel content in the fuselage tank drops below the reserve volume (6 l, allows approx. 15 min engine running time with max. continuous power), the displayed value for the fuel content is blinking and an audio warning sounds. You can switch off the warning temporarily by pressing the Menu-button.

The warning will reappear when the fuel content is decreased by another liter.

c) Determination of fuel content in fuselage tank (continued)

ii) Calibration of fuel quantity indicator for the fuselage tank

If you use a different grade of fuel (i.e. AVGAS instead of MOGAS/Premium), a new capacitive sensor is installed or in case of a suspected indication error, the fuel quantity indicator has to be recalibrated:

Requirements for calibration:

- o Glider sits on even ground with main and tail wheel
- o Wings are leveled
- o Fuselage tank is completely filled (check expansion reservoir in baggage compartment)
- o Powerplant retracted (limit switch for powerplant retracted active)

Scroll through the display of the powerplant operating unit MCU II BG with the Menu-button until “Calibr.?” is displayed. Release the Menu-button shortly and then press again for 5 s to start the calibration of the fuselage tank.

If the new calibration factor for the fuselage tank is displayed (i.e. [94]), the calibration is valid.
The fuel indication of the fuselage tank is then calibrated to 16L as soon as the Menu-button is released.

If the new calibration factor for the fuselage tank is not displayed, the calibration has to be repeated.

The error message „ERRORCAL“ (Error Claibration) appears, if the calibration would show a calibration factor that differs from the primarily calibration factor more than 30%. This would be the case, if, for example, the fuselage tank is not completely filled or the fuel was moving during the calibration.
This error message has to be confirmed pressing the Menu-button.
In this case no calibration will be executed and the primarily calibration factor will still be used. Check if the requirements for the calibration are really met, before the next calibration is attempted.

c) Determination of fuel content in fuselage tank (continued)

Caution:

During level flight the fuel content indication is sufficiently accurate. On the ground with one wing dropped or in flight at extreme pitch attitudes deviations in the fuel indication may occur.

If the calibration was done with only partly filled fuselage tank or if the fuel grade was changed without calibration, the deviation can be up to 30%. The displayed fuel content can then be bigger than the real fuel content!

d) Determination of fuel content in wing tank(s) (Option)

i) wing tank(s) (Option)

The fuel content of the wing tank(s) is not monitored by the powerplant control unit. Therefore the amount of fuel filled into the wing tank(s) has to be determined during refuelling.

ii) Indication of total amount of fuel on board

It is possible to consider the amount of fuel filled into the wing tank(s) at the amount of fuel displayed on the powerplant operation unit MCU II BG.

The requirements to do so are:

- The total amount of fuel on board is known
- The indicated amount of fuel in the fuselage tank is at least 6 Liter
- Powerplant retracted (LED for retracted powerplant is shining)

Then scroll through the display of the powerplant operation unit MCU II BG with the Menu-button until the amount of fuel (i.e."FUEL 12L") is displayed. Release the Menu-button shortly and then press the button again for 5 s until the prompt “FUEL” starts blinking. Now the indicated total amount of fuel on board (fuel content of fuselage tank and wing tank(s)) can be increased by one liter with each successive press on the Menu-button (Attention, slow reaction).
The total amount of fuel can only be increased by pushing the Menu-button.
If the entered total amount of fuel exceeds 60 L, the indicated amount of fuel jumps back to the actual fuel content in the fuselage tank.
If the Menu-button isn’t pressed for at least 5 s, the entered amount of fuel will be adopted and displayed on the powerplant operation unit and the powerplant operation unit returns to normal operation.

The amount of fuel consumed during engine operation is determined from consumptions data of the engine control system. The powerplant control unit calculates with these data the actual total amount of fuel on board und displays this value on the powerplant operation unit in the panel.

d) Determination of fuel content in wing tank(s) (Option) (continued)

If the fuel content of the fuselage tank drops one time below the reserve fuel content of 6 Liter, only the fuel content of the fuselage tank will be displayed regardless the calculated total amount of fuel on board.
In this case the actual value of the total amount of fuel will be erased. As a consequence, the powerplant operation unit displays only the actual measured fuel content of the fuselage tank, even if the reserve fuel content is again exceeded, i.e. if fuel from the wing tank(s) flows again into the fuselage tank.

Caution:

The manually entered value for the total amount of fuel on board will be stored, if the powerplant control unit is disconnected from power supply.

If wrong amounts of fuel were manually entered or the fuel content in the wing tank is decreasing during engine operation i.e. because of leakage, this deviation will not be recognized at first by the indicated total amount on board!
Such a deviation of the total amount of fuel on board is only noticeable because the reserve fuel content in the fuselage tank will be reached early.

e) Emptying of fuel tanks

i) Fuselage tank

The fuselage tank can be emptied through the drain valve. The drain valve is located on the lower left side of the fuselage behind the gear box.
The outlet of the drain line is a short piece of tube within the gear box on the left side at the edge of the landing gear cutout.

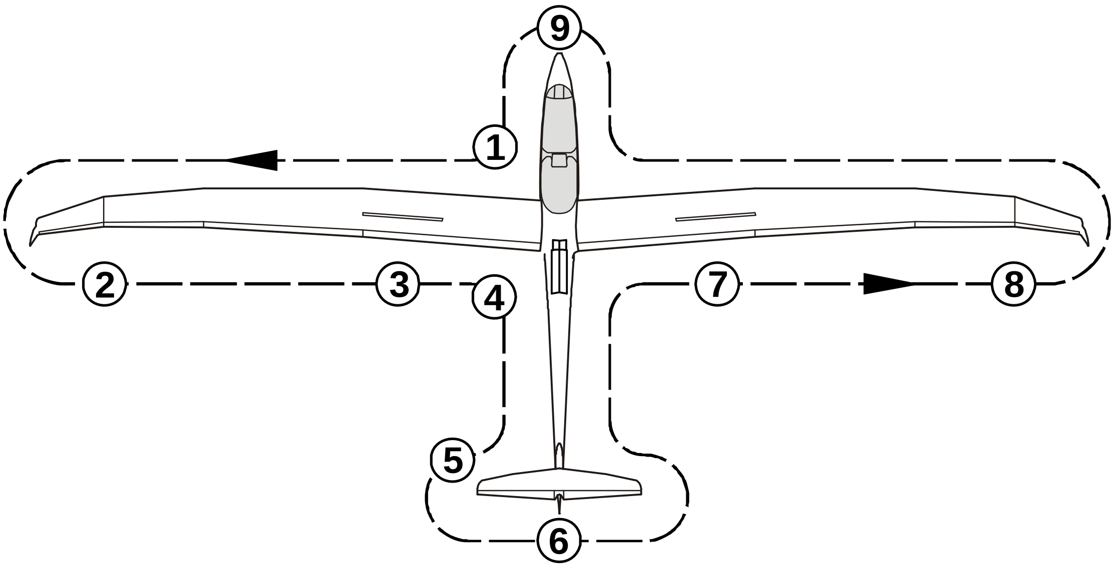
ii) Wing tank(s) (Option)

If the fuselage tank is not completely filled the fuel content of the wing tank can be emptied into the fuselage tank. In order to allow a rapid draining of the fuel, lift the respective wing with the wing tank.

Alternatively it is possible to fill the fuel content of the wing tank into an external canister with a special defueling tube (see parts list in section 7.11). In order to allow a rapid draining of the fuel, lift the respective wing with the wing tank.

4.3 Daily Inspection

The importance of inspecting the powered sailplane after rigging and before the day's flying cannot be over-emphasized, as accidents often occur when these daily inspections are neglected or carried out carelessly.



When walking around the aircraft, check all surfaces for paint cracks, dents and unevenness. In case of doubt, ask an expert for advice.

(1) a) Open canopy

b) Check that the main wing pin is properly secured

c) Make a visual Check of all accessible control circuits in the cockpit

d) Check for full and free movements of the control elements

e) Check batteries for firm attachment and accordance with the loading chart

f) Check for the presence of foreign objects

g) Check fuel quantity (at powerplant operating unit)

h) Check fuel line(s) and vent line(s) – especially those for the wing tank(s) - for proper connection

i) Check tire pressure:

Nose wheel:	3.0 bar	(43 psi)
Main wheel:	4.0 bar	(57 psi)

j) Check tow release mechanism(s) for proper condition and function

(2) a) Check upper and lower wing surface for damage

b) Clean and grease water ballast dump valves (if necessary)

c) Check wing tip extensions for proper connection

d) Check that the flaperons are in good condition and operate freely. Check for any unusual play by gently shaking the flaperons. Check flaperon hinges for damage

(3) a) Check airbrakes for proper condition, fit and locking

(4) a) Check fuselage for damage, especially on its lower side

b) Check that the Static pressure ports for the airspeed indicator on the tail boom are clear (1.02 m / 3.35 ft forward of the base of the fin)

Visual inspection of the powerplant (see also engine manual)

CAUTION: IGNITION **"OFF"**!
Extend powerplant with manual extension/retraction switch

c) Check propeller pylon during extension for sufficient clearance to the rim of the engine compartment

d) Check propeller for damage

e) Check propeller pylon and fittings for damages and cracks

f) Check conditions and secure attachment of both proximity switches at the propeller pylon and of both signal generators at the upper belt pulley which are needed for the automatic retraction process.

g) Propeller brake: Check easy movement of brake lever and clearance to brake bell in inactive position, condition of brake lever with attachments of Bowden cables, wear of brake pad. Check brake servo and Bowden cable from brake servo to brake lever. Check condition and function of manual actuation of propeller brake.

h) Check belt drive for changed tension and wear. Check pinch roller for easy movement.

i) Check air intake filter of air induction system for tight attachment

j) Check condition and function of throttle attachment at carburettor (Bowden cable, limit stop for throttle cable)

k) Check ignition system incl. cables and Spark plug caps at the engine for damages and firm attachment.

l) Visual inspection: Check bolt connections at the powerplant and their respective locking. Check external condition of engine.

m) Check cooling water hose for damages and firm attachment at the plug-in connections

n) Check level of coolant liquid. Ensure tight closure of pressure cap.

o) Check functionality of water pump with ignition “ON”

p) Visual inspection of rubber elements for damages (radiator mounts, propeller pylon mounts and front and rear spindle drive mounting)

q) Check exhaust manifold, exhaust joint, exhaust coupling and silencer for damages and cracks.

r) Look after scuffing marks on components and cables

s) Check arresting wire and the respective attachments

t) Check functionality of engine-door kinematic

u) Turn propeller manually several times. Check if abnormal sounds or stiffness in the engine are noticeable

v) Drain condensation of fuselage tank with drain valve in rear cockpit, on the left side of the gear box behind the back seat cover. Check outlet of drain valve on the left side within the gear box for cleanness.

w) Check venting line of the fuse system on the right side behind the landing gear cut out. Outlet has to be clean and not covered by tape.

(5) a) Check condition of tail wheel (air pressure 3.0 bar)

b) If TEK-probe is present, install probe and check TEK-line (connected Variometer have to read climbing when blowing from front of probe)

Should a water ballast fin tank be installed (option):

c) Check that fin tank spill holes are clear

d) Check water ballast level in fin tank (in case of doubt, discharge ballast)

e) Check that the dump hole for the fin tank in the tail wheel fairing is clear

(6) a) Check correct battery installation in vertical tail according to loading chart

b) Check horizontal tailplane for proper attachment and locking

c) Check elevator and rudder for free movement

d) Check trailing edge of elevator and rudder for damage

e) Check elevator and rudder for any unusual play by gently shaking the trailing edge

(7) See (3)

(8) See (2)

(9) Check that the Pitot pressure head in the nose cone is clear.
When blowing gently into the tube, the airspeed indicators must register

b) After heavy landings

After heavy landings or after the powered sailplane has been subjected to excessive loads, the resonant wing vibration frequency should be checked (its value is to be extracted from the last inspection report for this serial number).

Check the entire aircraft thoroughly for surface cracks and other damage.
For this purpose it should be de-rigged.

After a ground loop, especially the rear part of the fuselage tube and the transition to the vertical tail has to be checked for damage and detached bulkheads.
To do so, support the wings of the rigged glider (without horizontal tail) and apply hand force to the side at the bracket for the horizontal tail. Check the fuselage structure for excessive deformation, buckling and crackling noise.

If damage is discovered (i.e. surface cracks in the fuselage tail boom or tailplane, or if delamination is found at the wing roots or at the bearings in the root ribs etc.), then the aircraft must be grounded until the damage has been judged respectively repaired by a qualified person.

This inspection must also include a complete check of the power plant system.

4.4 Preflight inspection

CHECK LIST BEFORE TAKE-OFF

- O Water ballast in fin tank correctly filled (if installed) ?
  Dump all water ballast in case of doubt !
- O Loading chart checked ?
- O Parachute securely fastened ?
- O Safety harness secured and tight ?
- O Seat back, head rest and pedals in comfortable position ?
- O All controls and instruments easily accessible ?
- O Airbrakes checked and locked ?
- O All control surfaces checked with assistant for full and free movement in correct sense ?
- O Trim correctly set ?
- O Flaps set for take-off ?
- O Canopy closed and locked ?

CHECK LIST FOR SELF-LAUNCHING

- O Fuel quantity checked ?
- O Warning messages on operating unit ?
- O Coolant liquid temperature checked ?
- O Ignition circuits checked ?
- O Redundancy system test (engine control) ?
- O Take-off RPM checked ?
- O Rear-view mirror properly adjusted ?

4.5 Normal operating procedures and recommended speeds

4.5.1 Methods of launching

a) Aerotow

(Only permissible on nose tow release and retracted powerplant)

Maximum permitted towing speed:

V_T = 180 km/h (97 kt, 112 mph)

For aerotow only the nose tow release may be used - hemp and nylon ropes of between 30 and 40 m length (98-131 ft) were tested.

Prior to take-off set elevator trim as follows:

Rearward c/g positions:	Lever full forward
Other c/g positions:	Lever 1/3 of its travel from forward

As the tow rope tightens, apply the wheel brake gently (by actuating the stick-mounted lever) to prevent the glider from over running the rope.

In crosswind conditions, keep in mind that at the beginning of the take off roll, there is an increase of the lift generated on the downwind wing from the tug’s prop wake, which drifts with the wind. Therefore it may be necessary to hold downwind aileron to start.

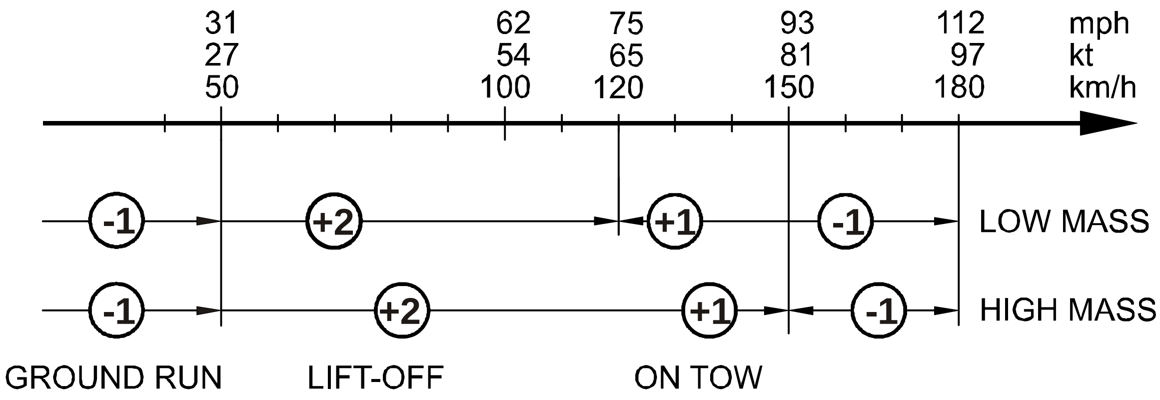
For intermediate to forward c/g positions the elevator control should be slightly back for the ground run; in the case of rearward c/g positions it is recommended that neutral elevator is maintained until the tail lifts.

After lift-off the elevator trim can be set for minimum control stick loads.

An aerotow can be made with a flap setting of "+2". Although it is recommended to start the takeoff roll with a flap setting of "-1 or -2" in a crosswind take off or on rugged surface. When sufficient aileron control is attained (at about 50 km/h / 26 kts / 30 mph) the flap position should be moved to "+2" for lift off.
With a negative flap setting during takeoff roll the effectiveness of the ailerons will be increased and it will be easier to keep track behind the towplane.

After lift off at 80 to 90 km/h (43-49 kts, 50-56 mph) – depending on loading and flap setting – the trim can be set so that minimal force is felt in the elevator control.
Normal towing speed is 110 to 130 km/h (59-70 kts, 68-80mph) with a flap setting "+2". At higher flying masses the towing speed is about 120 to 140 km/h (65-76 kts,75-87 mph).

At higher towing speeds, negative flap settings as far as flap setting "S" can be used. The flap setting can be chosen so that pleasant high control forces can be adjusted with the trim.



Only small control surface deflections are normally necessary to keep position behind the tug. In gusty conditions or when flying into the propeller slip stream of a powerful tug correspondingly greater control stick movements are required.

The undercarriage may be retracted during the tow; this is not, however, recommended at low altitude, as changing hands on the stick could easily cause the aircraft to lose station behind the tug.

When releasing the tow rope, pull the yellow T-shaped handle fully multiple times and turn only after the rope has definitely disconnected.

b) Winch launch

(Only permissible on C/G tow release and retracted powerplant)

Maximum permitted launching speed:

$$V_W = 150 \text{ km/h (81 kts, 93 mph)}$$

For winch launching only the c/g tow release and the flap settings "+1" or "+2" must be used.

With only one seat occupied and no water ballast or with an aft C/G position, a flap setting of “+1” should be used.
With both seats occupied or when water ballast is used, a flap setting of “+2” should be used.

Prior to take-off set elevator trim as follows:

Rearward c/g Positions	Lever full forward
Intermediate c/g Positions	Lever full forward
Forward c/g positions	Lever neutral

As the cable tightens, apply the wheel brake gently (by actuating the stick-mounted lever) to prevent the glider from overrunning the winch cable.

Ground run and lift-off are normal - there is no tendency to veer-off or to climb excessively steeply on leaving the ground. Depending on the load on the seats, the Arcus M is lifted off with the control stick pushed slightly forward in the case of aft c/g positions and pulled slightly back with the c/g in a forward position. After climbing to a safe height, the transition into a typical steep winch launch attitude is effected by pulling the control stick slightly further back.

At normal all-up masses, i.e. both seats occupied, the launch speed should not be less than 100 km/h (54 kts, 62 mph). At maximum takeoff mass, the launch speed should not be less than 110 km/h (59 kts, 68 mph).

Normal launch speed is about 110 to 120 km/h (59-65 kts, 68-75 mph) with two occupants. At maximum take off mass this speed is about 125 km/h (67 kts, 78 mph).

At the top of the launch the cable will normally back-release automatically. The cable release handle should, nevertheless, be pulled firmly multiple times to ensure that the cable is actually gone.

Warning:

It is explicitly advised against winch launching with a tail wind!

Caution:

Winch launching at the maximum permitted all-up mass should only be done if there is an appropriately powerful winch and a cable in perfect condition available.
Furthermore, there is not much point in launching by winch for a soaring flight if the release height gained is less than 300 m (984 ft).

In case of doubt, reduce the all-up mass.

Prior to launching by winch, it must be ensured that the crew is properly seated and able to reach all control elements.
Particularly when using seat cushions it must be made sure that during the initial acceleration and while in the steep climbing attitude the occupants are not able to slide backwards and up.

c) Self launch

i) Starting the engine on the ground:

- Apply wheel brake
- Start the engine according to following check list:

Powerplant extension and starting procedure	
- Powerplant master switch **ON**	**On the ground:**
- **OPEN** fuel shut-off valve	- Apply wheel brake, pull stick back
- Set throttle to idle	- Check that propeller is clear
- Set speed to **95-100 km/h** (**51-54 kt, 59-62 mph**)	
- Ignition **ON**	
*- Only in manual operation: **EXTEND** powerplant with manual operating switch*	
- When powerplant is fully extended (green signal):	
- Depress starter button until engine is running	

- As soon as the engine is running, release starter button
- Set throttle as needed

ii) Ignition circuit check:

- Warm up engine (CHT ca. 40°C / 104°F)
- Set rev to 2500 through 3000 RPM
- When toggle switch is set to one ignition circuit, the drop in rev has to be smaller than 300 RPM
- After ignition circuits check engine has to reach primarily RPM
- Check both ignition circuits

ii) Redundancy system test (engine control):

- Warm up engine (CHT ca. 40°C / 104°F)
- Set rev to 4500 through 5000 RPM
- Activate redundancy system with switch next powerplant operation unit MCU II BG
- Test: engine must maintain operation and react to changes in throttle position despite a temporary drop in speed. Otherwise the redundancy system is defective.
- Switch back to regular system for engine control
- Set rev to normal idle speed

ii) Redundancy system test (engine control): (continued)

> **Warning:**
>
> A ground start with the activated redundancy system is prohibited!

iv) Engine run up

Advance to full throttle prior to or during take-off run. At a minimum speed of about 6000 RPM the engine runs smoothly.

v) Taxiing

If the wings are equipped with the respective wheels, the powered sailplane can be operated independently with the steerable tail wheel on the ground. Nevertheless you have to take care, that the lowered wing won't be damaged by i.e. bigger stones.
While Taxiing pull the elevator all the way back. Operate the wheel brake with the right hand on the stick.

vi) Stopping the engine on the ground

If the engine is stopped on the ground with the ignition switch, the powerplant control system will switch into the process for the automatic positioning of the propeller. But on the ground the automatic retraction of the powerplant is not possible without manual help.

To avoid unnecessary power consumption of the powerplant control system in this situation, it is recommended to push shortly the manual operation switch up or down after the engine has stopped. This way the powerplant control system will witch into the manual mode (idle mode).

vii) Starting the engine in flight

- Set speed to 95 through 100 km/h for extending the powerplant and starting the engine

The starting process of the engine in flight is the same as on the ground.

4.5.2 Take off (on own power) and climb

Conduct take-off check (see page 4.4) and observe page 5.2.3 (take-off distances). For take-off the wing should be held level by an assistant. Compensate an asymmetric fuel load in the wing tanks by applying opposite aileron when commencing the take-off run.

Note:

During the initial acceleration of the take-off run only apply so much throttle that the tail wheel still remains on the ground. Rolling on the nose-wheel respectively on the nose skid increases especially on soft grounds the rolling drag and therefore also the take-off distance considerably.
That's why the above described method is recommended especially on uneven grounds and at high cockpit payload (forward C/G position).

The following launching method is recommended:

- Set elevator trim at its aft range
- Set flaps at "0" (or "-1" in crosswind conditions)
- Pull control stick fully back and
- Advance gradually to full throttle
- On reaching a speed of about 40 km/h (22 kt, 25 mph), reset flaps at "+ 2" (or "L" on soft ground)
- With the c/g in forward position, lift off aircraft at a speed of about 85 km/h (46 kt, 53 mph) with the stick fully pulled back.
  In the case of aft c/g positions slightly less back pressure is applied.
  If flap setting "L" was used for lift off, reset flaps at "+2"
- Ease control stick forward until reaching the speed for best climb
  V_Y = 95 km/h (51 kt, 59 mph)

Observe coolant liquid temperature while climbing.
When reaching the maximum permitted temperature, reduce power to avoid exceeding the limit.

Warning:

Taking-off in rain, with wet or iced-up wings is not permitted, as the take-off distance increases considerably. Furthermore the climb performance is adversely affected!

Caution:

If, at high ambient temperatures, the coolant liquid temperature rises too high, the cause may also be the anti-freeze proportion being too much for such temperatures. The effectiveness of coolant liquid with less anti-freeze is significantly better!

4.5.3 Flight / Cross country flight

a) Powerplant retracted

The aircraft has pleasant flight characteristics and can be flown effortlessly at all speeds, loading conditions (with or without water ballast), configurations, and c/g positions.

With a mid-point c/g position the maximum speed range covered by the elevator trim ranges from about 70 km/h (38 kts, 43 mph) (flap **L**) to about 200 km/h (108 kts, 124 mph) (flap **S**).

Flying characteristics are pleasant and the controls are well harmonized. Turn reversal from + 45° to - 45° can be accomplished without any noticeable skidding. Ailerons and rudder may be used to the limits of their travel.

All-up mass	600	kg
	1323	lb
Flaps at	**L**	
Speed	98	km/h
	53	kts
	61	mph
Reversal time	4.8	sec

Note:

Flights in conditions conducive to lightning strikes must be avoided.

High speed flying (powerplant retracted)

At high speeds up to V_{NE} = 280 km/h (151 kts, 174 mph) the aicraft is easily controllable.

Full deflections of control surfaces may only be applied up to V_A = 180 km/h (97 kts, 112 mph).

At V_{NE} = 280 km/h (151 kts, 174 mph) only one third (1/3) of the full deflection range is permissible. Avoid especially sudden elevator control movements.

In strong turbulence, i.e. in wave rotor, thunderclouds, visible whirlwinds or when crossing mountain ridges, the speed in rough air V_{RA} = 180 km/h (97 kts, 112 mph) must not be exceeded.

With the c/g at an aft position, the control stick movement from the point of stall to maximum permissible speed is relatively small, though the change in speed will be noticed through a perceptible change in control stick loads.

The airbrakes may be extended up to V_{NE} = 280 km/h (151 kts, 174 mph). However, they should only be used at such high speeds in an emergency or if the maximum permitted speed is being exceeded inadvertently.

When extending the airbrakes suddenly, the deceleration forces are noticeable.

Warning:
Consequently it is wise to check in advance that the seat harnesses are tight and that the control stick is not inadvertently moved when the airbrakes are extended. There should be no loose objects in the cockpit. At speeds above 180 km/h (97 kts, 112 mph) extend the airbrakes gradually (allow 2 seconds).

It is strictly noted that in a dive with airbrakes extended the aircraft has to be pulled out less abruptly (maximum 3.5 g) that with retracted airbrakes (maximum 5.3 g), see section 2.9 “Manoeuvring Load Factors”. Therefore pay attention when pulling out with airbrakes extended at higher speeds.

A dive at V_{NE} with the airbrakes fully extended is limited to an angle to the horizon of 38° at maximum permitted all-up mass of 800 kg (1764 lb).

At an all-up mass of up to 690 kg (1521 lb) an angle to the horizon is more than 45°.

Optimum flap positions

The camber-changing flaps alter the wing section such that the laminar bucket is always well suited to the actual flying speed.

Use of flaps for	flaps at	units	AUW = 625 kg 1378 lbs	AUW = 800 kg 1764 lbs
Low speed flying (straight and level)	L	km/h kts mph	83 45 52	94 51 58
	+2	km/h kts mph	84 – 90 45 – 49 52 - 56	94 – 100 51 – 54 58 - 62
	+1	km/h kts mph	90– 105 49 – 57 56 – 65	100 – 120 54 – 65 62 – 75
Max. L/D	0	km/h kts mph	105 – 130 57 – 70 65 – 81	120 – 150 65 – 81 75 - 93
Flying between thermals and high speed flying	-1	km/h kts mph	130 – 155 70 – 84 81 – 96	150 – 180 81 – 97 93 – 112
	-2	km/h kts mph	155 – 175 84 – 94 96 - 109	180 – 195 97 – 105 112 – 121
	S	km/h kts mph	175 – 280 94 – 151 109 - 174	195 – 280 105 – 151 121 - 174

For a speed polar diagram refer to section 5.3.2.

For smooth thermals and while climbing in slow straight flight flap setting **"+2"** is recommended. In turbulent thermals, which require a quick aileron response, and climbing in straight, slow flight flap setting **"+1"** is advantageous.

Near the lower end of the optimum circle speeds in thermals the pilot may even use flap setting **"L"**, especially at high all-up masses or in updrafts with hardly any variation in flying speed.

Best glide and moderate inter-thermal speeds are covered by flap setting "0" and "-1" – for high cruise the optimum performance is achieved with the more negative settings.

Low speed flight and stall behaviour
(powerplant retracted)

In order to become familiar with the powered sailplane it is recommended to explore its low speed and stall characteristics at a safe height. This should be done using the various flap settings while flying straight ahead and also in a 45° banked turn.

Wings level stall

The first signs of a stall usually occur 5 to 10 km/h (3-5 kts, 3-6 mph) above stalling speed. It begins with a slight rolling motion and vibration in the controls. If the stick is pulled further back, these effects become more pronounced, the ailerons get spongy and the powered sailplane sometimes tends to slight pitching motions (speed increases again and will then drop to stalling speed).

> Note:
>
> Before reaching a stalled condition, depending on C.G. position, the ASI reading drops quickly by 5 to 10 km/h (3-5 kts, 3-6 mph).

When reaching a stalled condition with the c/g in middle and rearward positions, the stick reaches the stop and the powered sailplane remains in deep stall or drops the wing respectively the nose.

A normal flight attitude is regained by easing the stick firmly forward and, if necessary, applying opposite rudder and aileron.

The loss of height from the beginning of the stall until regaining a normal level flight attitude is up to 60 m (200 ft)

In the case of forward c/g positions and stick fully pulled back, the powered sailplane just continues to fly in a mushed condition without the nose or wing dropping.

Normal flying attitude is regained by easing the stick forward.

Turning flight stalls
(powerplant retracted)

When stalled during a coordinated 45° banked turn and a forward c/g, the Arcus M - with the control stick pulled fully back -will continue to fly in a stalled condition.
With aft c/g during the turning stall, the inside wing will drop and the nose will drop below the horizon. The stall can be stopped immediately by relieving the back pressure on the control stick.
There is no uncontrollable tendency to enter a spin. The transition into a normal flight attitude is conducted by an appropriate use of the controls.

The loss of height from the beginning of the stall until regaining a normal level flight attitude is approx. 150 m (492 ft).

Influence of water ballast

Apart from higher stall speeds - caused by the higher mass in flight - water ballast in the wing tanks has no negative influence on the stall characteristics.

With water ballast in the fin tank (option), stall characteristics are like those found in an aft c/g position.

Flight (continued)

b) Powerplant extended

As the propeller used is mainly pitched for good climb (rather than for high cruise), the speed attained in level flight at 6600 RPM is approx. 150 km/h (81 kt, 93 mph) with flaps set at “-1”.

At this speed the “Arcus M” shows a stable behaviour and is easy to control.

Flown in a shallow dive, the maximum permitted engine speed of 6600 RPM must not be exceeded!

Idling only in emergency

With engine idling (throttle closed), descending flights are only allowed for short periods.
Long idling periods must be strictly avoided to prevent the danger of an engine failure due to carbon accumulation on the spark plugs!

Caution:

On longer flights with the throttle closed it is therefore necessary to open it momentarily at least once every minute to keep the engine clean!

Note:

Flight conditions under lightning strikes must be avoided!

Cruising on own power

As clearly shown by the figures of section “Flight Performance”, the longest range results from the

“sawtooth method”,

which consists of the following flight sections being repeated as required:

- a climb at a speed of about 95 km/h (51 kt, 59mph)
- a glide in “clean” sailplane configuration

Thereby the height to be consumed in glide should not be less than 500 m (1640 ft).
The maximum range in glide is achieved at a speed of approx. 110 to 120 km/h (59-65 kt. 68-75 mph), resulting in an average speed of about 100 km/h (54 kt, 62 mph).

Should the “sawtooth method” be impracticable due to low clouds ceiling or because of airspace restrictions, the cruising in level flight at a speed of approx. 150 km/h (81 kt, 93 mph) is also possible. The range, however, is then considerable less – see section 5.3.2.

For cruising flight, the “sawtooth method” should always be preferred as – besides the longer range – the crew is also less exposed to engine noise.

Stopping the engine, retracting the powerplant

See also the following checklist:

STOPPING ENGINE / RETRACTING POWER PLANT	
O	Reduce speed to about **95-100 km/h (51-54 kt, 59-62 mph)**
O	Cooling down power setting 20% for 1 minute
O	Ignition **OFF**
O	*Only in manual operation:* - *Stop propeller with the manually operated propeller brake and fix it in the vertical position* - ***RETRACT** power plant*
O	When power plant is fully retracted (green signal): Power plant master switch **OFF**

Remarks regarding the vertical positioning of the propeller

- If the propeller hasn’t reach its vertical position after the engine has stopped, the movement of the propeller can be accelerated by:
  - increasing the flight speed or
  - pressing the starter button
- If the propeller has to turn only about 15° until reaching its vertical position, don’t use the starter anymore
- If the propeller was not caught in its vertical position by the automatic propeller brake for the last three attempts, support the vertical positioning of the propeller with the manual propeller brake during the next attempt.

Caution:

Through the mirror observe the propeller retracting to check if the propeller rotates further.

The powerplant retracts within about 14 seconds, but the entire process from stopping the engine to the moment the propeller has fully retracted takes about 90 seconds and consumes a height of about 100 m (328 ft).

Extending the powerplant, starting the engine in flight

1. With the powerplant extended and engine off, the rate of descent is approx. 2.25 m/s (443 fpm) at a speed of 105 km/h (57 kt, 65 mph), resulting in a glide ratio of only about 13 : 1 – contrary to the best L/D of around 49 : 1 in clean configuration (powerplant retracted).
   Therefore the engine should only be restarted over terrain suitable for an off-field landing and, if possible, n o t below 300 m (984 ft) AGL.

   But extending the powerplant to restart the engine at a height of 200 m (656 ft) AGL on the down-wind leg to a suitable landing field is safer then e.g. restarting it at 500 m (1640 ft) AGL above a forest or the like.

   Should a flight be planned over long distance without any acceptable landing fields, the powerplant should be extended at a height giving sufficient time for all emergency procedures and, if necessary, for re-retracting the power plant.

2. Starting procedures - see also check list on page 4.5.1.5

   - Powerplant master switch **ON**
   - **OPEN** fuel shut-off valve
   - Set throttle to idle
   - Set speed to **95 to 100 km/h** (51-54 kt, 59-62 mph)
   - Ignition **ON**
   - *Only in manual operation: **EXTEND** powerplant*
   - When powerplant is fully extended (green signal): Depress starter button
   - Set throttle as required

   The loss of height from extending the propeller to the moment the engine is running is about 40 to 50 m (131-164 ft) and needs 35 to 45 seconds.

Low speed flight and stall behaviour

(powerplant extended)

Compared with the stall behaviour in “clean” configuration (powerplant retracted), there are no significant differences when aircraft stalls from straight and level or from turning flight.

On stalling the turbulent airflow produced by the propeller superimposes the vibration in the controls.

Furthermore the noise of the propeller increases considerably.

Warning:

When stalling with extended power plant and engine idling or with ignition off the turbulent airflow produced by the propeller superimposes the vibration in the controls, so that in this case a stall warning is not noticeable.

4.5.4 Approach

a) Power plant retracted / powerplant removed

Normal approach speed with airbrakes fully extended, flap position L and wheel down is 95 km/h (51 kts, 59 mph) without water ballast and flown solo, or 105 km/h (57 kts, 65 mph) at maximum permitted all-up mass.
The yellow triangle on the ASI at 105 km/h (57 kts, 65 mph) is the recommended approach speed for the maximum all-up mass without water ballast
(785 kg (1731 lb) with power plant installed / 765 kg (1687 lb) with removed power plant.

The airbrakes open smoothly and are very effective. The landing flare with the airbrakes fully opened, must be flown with care and very precisely. It is not recommended to leave the airbrakes fully opened while flaring.
There is no noticeable change in trim.
During approach and landing flap setting +2 can also be used.
Other than a 5 km/h (3 kts, 3 mph) speed increase, there are no other differences in the landing characteristics.
Side slipping is also a useful aid for landing. It is possible to maintain a straight line with the rudder deflected up to about 30 - 50 % of its travel resulting in a yaw angle of about 25° and a bank angle of about 10 - 20°.
The rudder must be held with perceptible counter-pedal pressure because of the control force reversal.
To return to level flight, normal opposite controls are required.

Caution:

With rudder fully deflected, side slips in a straight flight path are not possible.
The sailplane will slowly turn in the direction of the displaced rudder.
Side slipping causes the ASI to read lower than the actual speed.
During side slip with water ballast some water escapes through the vent hole of the water tank filler cap of the lower wing. Prolonged slips with water ballast are therefore not recommended.

Warning:

Both the performance and the aerodynamic characteristics of the ARCUS M are affected adversely by rain or ice on the wing.
Be cautious when landing!
Increase the approach speed at least 5 to 10 km/h (3-5 kts, 3-6 mph).

Approach

b) Powerplant extended
(only permissible with ignition switched OFF and in emergency case)

With powerplant extended (and ignition OFF), the "Arcus M" can be landed in a similar manner as in "clean configuration" (powerplant retracted).

However the disturbances of the extended powerplant influence the airflow around the fin, whereby a manipulation of the effectiveness of rudder and elevator control is possible.

On approach it must be taken into account that the flight performance has considerably deteriorated due to the extended power plant:

All-up weight (mass)	600 kg 1543 lb	800 kg 1764 lb
Approach speed	95 km/h 51 kts 59 mph	105 km/h 57 kts 65 mph
Rate of descent Approx.	2.0 m/s 394 fpm	2.25 m/s 443 fpm
L/D approx.	13	13

However, the performance, though reduced, is sufficient to conduct approaches with the same techniques as in "clean" configuration.

Warning:

1. Be cautious when extending the airbrakes.
   Due to the additional drag of the extended powerplant, more forward stick must be applied for maintaining the above approach speeds.

2. On stalling with extended powerplant and ignition off, the turbulent airflow produced by the propeller superimposes the vibration in the controls, so that in this case no noticeable stall warning exists.

Note:

Approaches and landings are normally conducted in "clean configuration" (powerplant retracted).

4.5.5 Landing

a) **Powerplant retracted**

For off-field landings the undercarriage should always be extended, as the protection of the crew is much better, especially from vertical impacts on landing.

Main wheel and tail wheel should touchdown simultaneously.

After touch-down the flaps can be set at “0” or “-1” for improved aileron response during the landing run.

To avoid a long ground run, make sure that the aircraft touches down at minimum speed.
A touch-down at 90 km/h (49 kt, 56 mph) instead of 75 km/h (40 kt, 47 mph) means that the kinetic energy to be dissipated by braking is increased by a factor of 1.44 and therefore the ground run is lengthened considerably.

As the effectiveness of the hydraulic wheel brake is good, the landing run is considerably shortened (the elevator control should be kept fully back).

b) **Powerplant extended** (Ignition switched OFF)

Landings with powerplant extended should only conducted in case of emergency.

4.5.6 Flight with water ballast

Water ballast is required for reaching the maximum permitted all-up mass.

Wing ballast tanks

The water tanks are integral compartments in the nose section of the main wing panels.

The tanks are to be filled with plain water only, through round openings in the upper wing surface featuring a strainer.

Tank openings are closed with plugged-in filler caps having a 6 mm (0.24 in.) female thread for lifting and venting. Lifting these caps is done with the aid of the tailplane rigging tool.

> **Warning:**
>
> As the threaded hole in the filler cap also serves for venting the tank, it must always be kept open!
>
> Never place tape over the hole.

Each wing tank has a capacity of approx. 92 Litres (24.30 US Gal., 20.24 IMP Gal.).

Dumping the water from full tanks takes approx. 3.5 minutes.

When filling the tanks it must be ensured that the maximum permitted all-up mass is not exceeded - see page 6.2.5.

The tank in either wing must always be filled with the same amount of water to prevent any lateral imbalance.

Before taking off with partially full tanks, ensure that the wings are held level to allow the water to be equally distributed so that the wings are balanced.

Because of the additional mass in the wing panels, the wing tip runner should continue running for as long as possible during the launch.

Water ballast is dumped through an opening on the lower side of the main wing panels, 3.75 m (12.30 ft) away from the inbd. root rib.
When dumping water, make sure that water is flowing at the same rate from both wings (see below). If that is not the case, stop dumping in order to avoid unbalanced wings.

The dump valves are hooked up automatically on rigging the powered sailplane (ballast control knob to be set at "CLOSED).

Thanks to baffles inside the ballast tanks there is no perceptible movement of the water ballast when flying with partially filled tanks.

When flying at maximum permitted all-up mass, the low speed and stall behaviour of the Arcus M is slightly different from its flight characteristics without water ballast:
The stall speeds are higher (see section 5.2.2) and for correcting the flight attitude larger control surface deflections are required. Furthermore, more height is lost before a normal flight attitude can be regained.

Warning:

In the unlikely event that the tanks empty unevenly or that only one of them empties (recognized by having to apply significant opposite aileron during straight flight, particularly at low speed), it is necessary to fly faster because of the higher mass and also to avoid stalling the airplane.

During the landing run the heavier wing should be kept somewhat higher (if permitted by the terrain) so that it touches down only at the lowest possible speed.
This reduces the danger of the airplane veering off course.

Water ballast fin tank

To ensure optimum performance in circling flight, a forward centre of gravity, caused by water ballast in the wing nose and/or by a crew member in the rear seat, may be compensated by carrying water ballast in the fin tank.

For details concerning the quantities to be filled refer to page 6.2.8.

The water ballast tank is an integral compartment in the fin with a capacity of 11.0 kg/Litres (2.91 US Gal., 2.42 IMP Gal.). This tank is filled as follows (with the horizontal tailplane in place or removed):

Set elevator trim to the rear.
Insert one end of a flexible plastic hose (outer diameter 8.0 mm/0.31 in.) into the tube (internal diameter 10.0 mm/0.39 in.) protruding from the rudder gap at the top of the fin on the left hand side. The other end of this hose is then connected to a suitable container which is to be filled with the required amount of clean water.

The fin tank has eleven (11) spill holes, all properly marked, on the right hand side of the fin, which indicate the water level – see accompanying sketch.

The venting of the tank is through the uppermost 11.0 kg/Litres hole (which always remains open – even with a full tank).

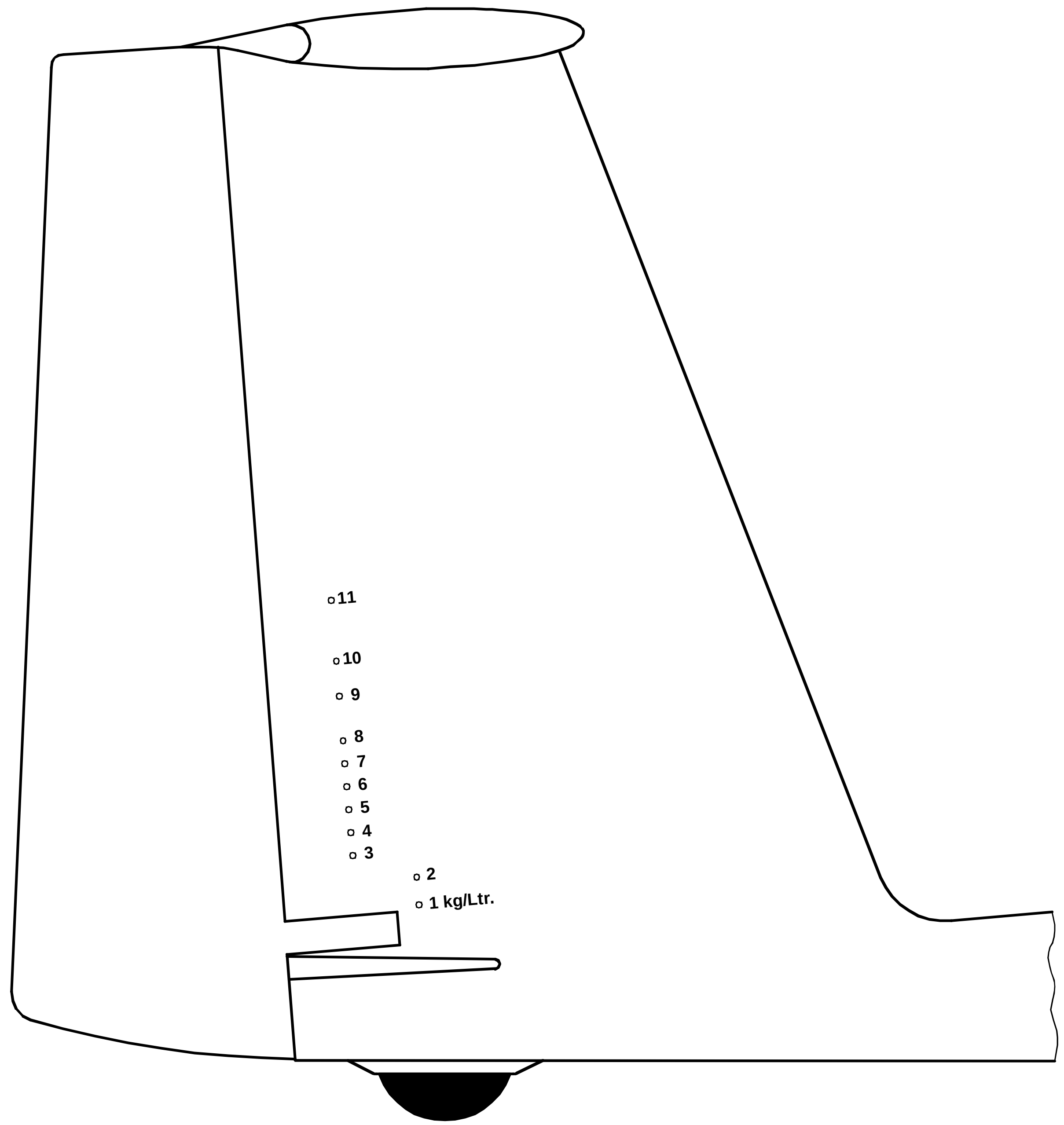
The ballast quantity to be filled depends on the water load in the wing tanks and/or on the load on the aft seat – see loading table on page 6.2.8.

Before filling the tank always tape closed one hole less than the load required, measured in kg/Litres.

If, for instance, a fin ballast load of 3.0 kg /Liters is required, only the lower two holes (1 and 2) are taped closed.

Any excessive water then escapes through the third spill hole, thus preventing overloading.

The tank label is on the right hand side of the fin.



Water is dumped from the fin tank through an opening on the underside of the fuselage tail boom - adjacent to the rudder.
The fin tank dump valve is linked to the torsional drive for the valves in the main wing panels so that these three tanks are always emptying simultaneously.

The time required to dump the ballast from a full fin tank is about two (2) minutes, therefore draining the full tanks of the main wing panels always takes longer.

Continued. on page 4.5.6.5

General

Warning:

1. On longer flights at air temperatures near 0° C (32° F), water ballast must always be dumped when reaching a temperature of 2° C (36° F). Thus freezing of the valves with subsequent damages can be prevented.

Caution:

2. Before filling the wing water ballast tanks check with open valves if both sealing caps of the valves open equally wide.
   In addition, the valves seats have to be cleaned and greased slightly. It must be checked that both valves close tight when operated in the cockpit.
   Smaller dripping leaks can easily remedies by pulling down the sealing caps into the valve seat with the mounting screw for the horizontal stabilizer.

3. There is little point in loading much water ballast if the average rate of climb expected does not exceed 1.0 m/s (197 fpm).
   The same applies to flights in narrow thermals requiring steep bank angles.

4. If possible, all water ballast should be dumped before conducting an off-field landing.

Warning:

5. Never pressurize the tanks - for instance by filling them directly from a water hose – and always pour in clean water only.

6. The aircraft should never be parked with full ballast tanks if there is any danger whatsoever of them freezing.
   Even in normal temperatures the parking period with full tanks should not exceed a few days. Optimally, for parking, all water ballast should be completely drained and the filler caps should be removed to allow the tanks to dry out.

7. Before the fin tank is filled, check that those spill holes not being taped closed are indeed clear.

4.5.7 High altitude flight

When flying at high altitude it should be noted that true airspeed (TAS) increases in relation to indicated airspeed (IAS). This difference does not affect the structural integrity or load factors, but to avoid any risk of flutter, the following indicated values (IAS) must not be exceeded

Altitude		V_{NE} (IAS)		
m	ft	km/h	kts	mph
0	0	280	151	174
1000	3281	280	151	174
2000	6562	280	151	174
3000	9843	270	146	168
4000	13123	263	142	163
5000	16404	245	132	152
6000	19685	232	125	144
7000	22966	220	119	137
8000	26247	207	112	129
9000	29528	195	105	121
10000	32808	182	98	113

Flying at temperatures below freezing point

When flying at temperatures below 0° C (32° F), as in wave or during the winter months, it is possible that the usual ease and smoothness of the control circuits is reduced.
It must therefore be ensured that all control elements are free from moisture so that there is no danger of them freezing solid. This applies especially to the airbrakes!

From previous experience, it has been found to be beneficial to cover the mating surfaces of the airbrakes with “Vaseline” along their full length so that they cannot freeze together. Furthermore the control surfaces should be moved frequently.

When flying with water ballast observe the instructions given in section 4.5.6.

Note:

From many years of experience, the polyester finish on this aircraft is known to become very brittle at low temperature.

Particularly when flying in wave at altitudes in excess of about 6000 m (approx. 20000 ft), where temperatures below - 30°C (- 22°F) may occur, the gel-coat, depending on its thickness and the stressing of the aircraft's components, is prone to cracking!

Initially, cracks will only appear in the polyester coating, however, with time and changing environment, cracks can eventually reach the Epoxy/glass cloth matrix.

Cracking is obviously enhanced by quick descents from high altitudes with associated very low temperatures.

Warning:

For the preservation of a proper surface finish free from cracking, the manufacturer strongly advises against high altitude flights with temperatures below - 20°C (- 4°F)!

Also, a steep descent with the airbrakes extended should only be conducted in case of emergency (instead of the airbrakes the undercarriage may also be extended to increase the rate of sink).

4.5.8 Flight in rain

a) Powerplant retracted:

When flying the aircraft with a wet surface or in rain, the water drops adhering to the wings cause a deterioration of its flight performance which cannot be expressed in numerical values due to the difficulties involved with such measurements. Often the air mass containing the moisture is also descending so that - compared with a wet powered sailplane in calm air - the sink rates encountered are higher.

Flight tests in rain, conducted by the manufacturer, did not reveal any significant differences in the stalling behaviour or stalling speeds.

It cannot be excluded, however, that excessive alterations of the airfoil (as caused by snow, ice or heavy rain) may result in higher minimum speeds.

Approach in rain: see page 4.5.4.1

b) Powerplant extended, engine running:

The approved propellers didn’t show any defects after operation in light rain so far.
Nevertheless, the use of the engine in rain is not recommended.

4.5.9 Aerobatics

Only allowed **without** water ballast in the wings,

up to an all-up mass of **690 kg (1521 lb)**

with **retracted or removed powerplant** and

with **flap position "0"**:

The following aerobatic manoeuvres are allowed:

(a) inside loop

(b) stall turn

(c) lazy eight

(d) spinning

> **WARNING:**
> The Arcus M is a high performance powered sailplane.
> Therefore the Arcus M will gain speed very rapidly in dive.
> Aerobatic manoeuvres with the Arcus M should only be performed if you can handle these aerobatic manoeuvres safely with similar sailplane types or if you've been briefed in detail by a pilot experienced in aerobatic manoeuvres with the Arcus M.
> The permitted operating limits, see section 2, must be observed.

Compensation for the influence of the pilot in the rear seat on the centre of gravity of the powered sailplane for aerobatic manoeuvres is allowed.

Inside loop

Enter manoeuvres at a speed between 180 km/h and 210 km/h (recommended). The speed during the recovery of this manoeuvre should remain in the same speed range.
The load factor during the manoeuvre depends on the selected entering speed. The higher the entering speed is, the lower the needed maximum load factors are.

Lazy eight

Enter manoeuvre at a speed of about 180 km/h. After pulling up in a 45°-climb enter the turn at about 120 km/h. The speed during recovery: about 180 km/h.

Stalled turn

Enter manoeuvre at a speed between 180 km/h and 210 km/h.
Pull up continuously into the vertical climb.

It is recommended to enter the manoeuvre at a speed of 200 km/h because then you will have more time to establish the vertical climb and you will not have to apply the maximum permitted load factor.
During the vertical climb you can let the outside wing drag, so to speak.
At an indicated airspeed of about 140 km/h to 150 km/h, apply continuous but smooth full rudder deflection in the desired direction, respectively against the dragged wing.
During the turn apply aileron deflection in the opposite direction,
to turn as cleanly as possible in one plane.
If you have induced the turn too late or too weakly, the turn may no longer be able to be executed as planned and the powered sailplane will fall backwards or sideward.
If this occurs, the control surfaces could slam to one side and be damaged as the sailplane accelerates backwards. This must be avoided. Hold all the control surfaces firmly to their stops to avoid this knock over. Once the sailplane is moving in a forward direction again, roll level and pull out to recover to normal flight.

Spinning

Stationary spinning is possible with middle to rear centre of gravity positions and is only allowed with flap position **"0"**.

Spinning is induced with the standard method:

Stall the powered sailplane slowly until the first signs of separated airflow can be recognized, i.e. vibration in the controls. Then jerkily pull back the control stick and apply full rudder deflection into the desired direction of rotation. Depending on the position of the centre of gravity, the pitch attitude will differ widely.

Spinning is terminated with the standard method:

Neutralize aileron, apply full rudder deflection in the opposite direction of the rotation and neutralize elevator deflection. After the rotation has stopped return all control surfaces to neutral and pull out into normal flight.
The loss of height during the recovery to normal flight is about 100m (300ft.), the maximum speed is about 180 km/h.

With forward centre of gravity positions no stationary spinning is possible.
The sailplane will switch over into a spiral dive very rapidly. This has to be stopped immediately.
With middle centre of gravity positions stationary spinning is possible if induced with the standard method. But if the spinning is induced with rudder deflection into the direction of rotation and aileron deflection against the direction of rotation, then the sailplane will switch over into the spiral dive after a half to one turn. The spiral dive has to be ended immediately.

You can detect the spiral dive because of the increasing indicated airspeed and the increasing load factor on the pilots.

It is not recommended to attempt a spin with a forward centre of gravity because the spin will change to a spiral dive almost immediately upon being initiated.

Section 5

5.1 Introduction

This section provides approved data for airspeed calibration, stall speeds and non-approved additional information.

The data in the charts has been computed from actual flight tests with a Arcus M in good condition and using average piloting techniques.

5.2 Approved data

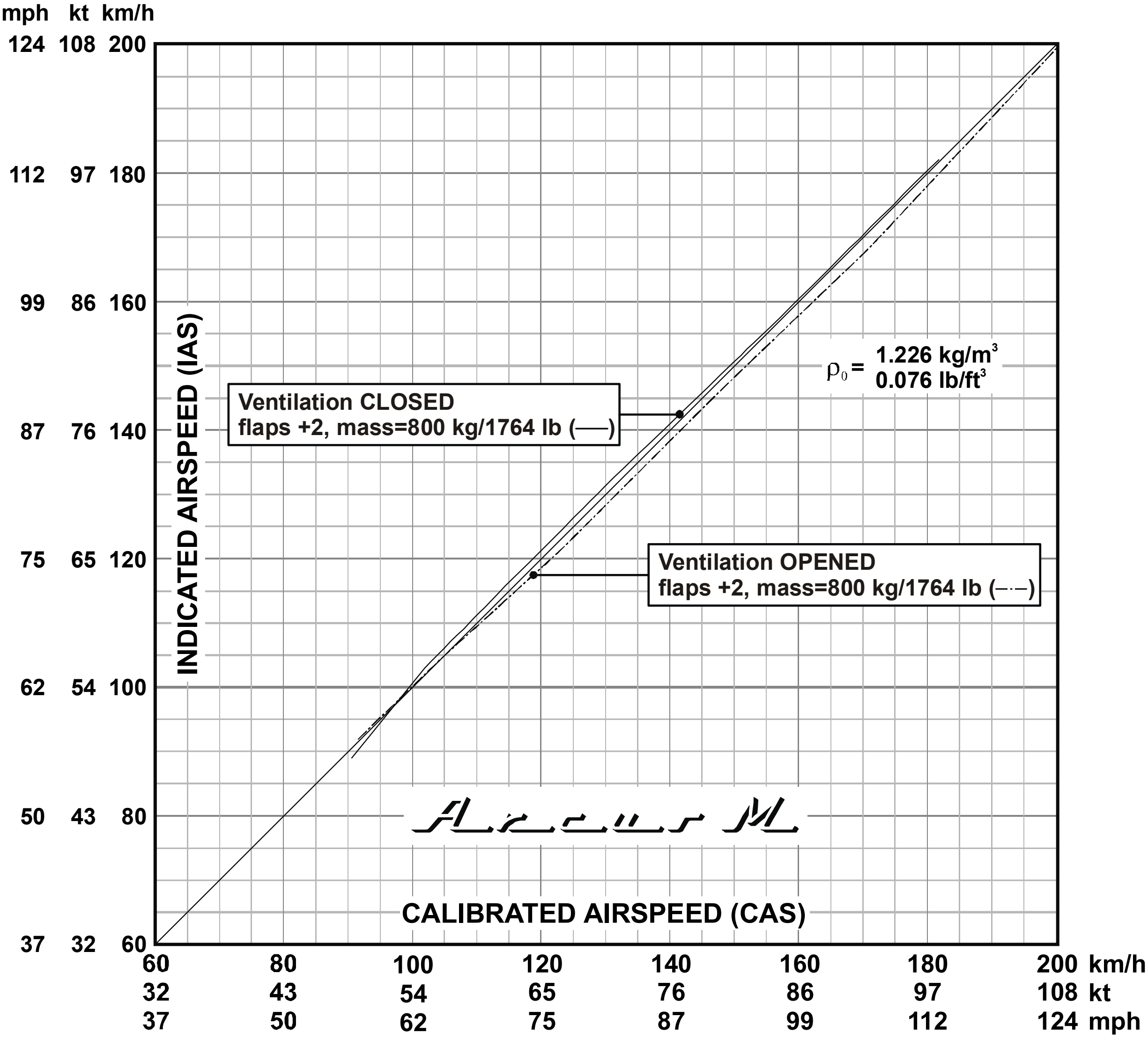
5.2.1 Airspeed indicator system calibration

From the diagram below, the errors of the Airspeed Indication (IAS) caused by Pitot/Static pressure errors may be read off. These charts are applicable to free flight.

PITOT pressure source: Fuselage nose cone

STATIC pressure ports: Fuselage tail boom, approx.
1.02 m (40.16 in.) forward of the base of the fin

All airspeeds shown in this manual are indicated airspeeds (IAS) as registered by the airspeed indicator.



5.2.2 Stall speeds

The following stall speeds (IAS) at various flap settings were determined in straight and level flight:

Configuration		POWERPLANT RETRACTED	
All-up mass (approx.)		800 kg 1764 lb	800 kg 1764 lb
C/G position (aft of datum)		75 mm 3 in.	290 mm 11 in.
Stall speed, airbrakes closed			
flaps at "+2"	km/h kts mph	82 44 51	69* 37* 43*
flaps at "0"	km/h kts mph	87 47 54	69* 37* 43*
flaps at "S"	km/h kts mph	95 51 59	80* 43* 50*
airbrakes extended			
flaps at “L”	km/h kts mph	86 46 53	73* 39* 45*

Configuration		POWERPLANT EXTENDED	
All-up mass (approx.)		800 kg 1764 lb	800 kg 1764 lb
C/G position (aft of datum)		75 mm 3 in.	290 mm 11 in.
Stall speed, airbrakes closed, full speed			
flaps at "+2"	km/h kts mph	82 44 51	78 42 48
airbrakes extended standing prop			
flaps at “L”	km/h kts mph	82 44 51	82 44 51

The loss of height from the beginning of the stall until regaining a normal level flight attitude is up to
60 m (197 ft).

* Airspeed indication near the stall speed is heavily oscillating especially with rearward c/g positions.

5.2.3 Take-off distances (at calm air)

All figures shown below refer to ICAO standard atmosphere and are based on the maximum permitted all-up mass of 800 kg (1764 lb).

Ground run distance:	233 m (764 ft)
Total distance over 15 ft obstacle:	450 m (1476 ft)
Lift-off speed approx:	82 km/h (44 kt, 51 mph)
Speed over 50 ft obstacle:	95 km/h (51 kt, 59 mph)

	Field elevation above MSL		OUTSIDE AIR TEMPERATURE							
			- 15° C 5 ° F		0° C 32 ° F		+ 15° C 59 ° F		+ 30° C 86 ° F	
	m	ft	m	ft	m	ft	m	ft	m	ft
Ground run distance till lift-off	0	0	183	600	207	679	233	764	260	853
	500	1640	199	653	225	738	253	830	283	929
	1000	3281	216	709	245	804	275	902	308	1011
	1500	4921	235	771	266	873	300	984	335	1099
	2000	6562	257	843	291	955	327	1073	365	1198
Total distance over 50 ft obstacle	0	1640	354	1161	400	1312	450	1476	504	1654
	500	3281	384	1260	435	1427	490	1608	548	1798
	1000	4921	418	1371	474	1555	533	1749	596	1955
	1500	6562	456	1496	516	1693	580	1903	649	2129
	2000	1640	497	1631	562	1844	633	2077	707	2320

The above distances are for take-off from a paved runway.

Taking-off from a level hard grass runway lengthens the above ground run distances by about 20%.

Warning:

Wet and/or soft ground lengthens the take-off distance **considerably.**

5.2.4 Additional information

N o n e

5.3 Non-approved additional- information

5.3.1 Demonstrated crosswind performance

The maximum crosswind velocity, at which take-offs and landings have been demonstrated, is

20 km/h (11 kts).

5.3.2 Flight polar

All values shown below refer to **MSL (0 m) and 15° C (59° F)**.

a) Power plant retracted (or removed)

All-up weight (mass)	**620*) kg** **1367 lb**	**800*) kg** **1764 lb**
Wing loading	**kg/m²** **lb/ft²**	
Minimum rate of sink	**m/s** **fpm**	
Best L/D		
at a speed of	**km/h** **kts** **mph**	

*) aircraft performance not yet measured

b) Powerplant extended – iginition switched OFF

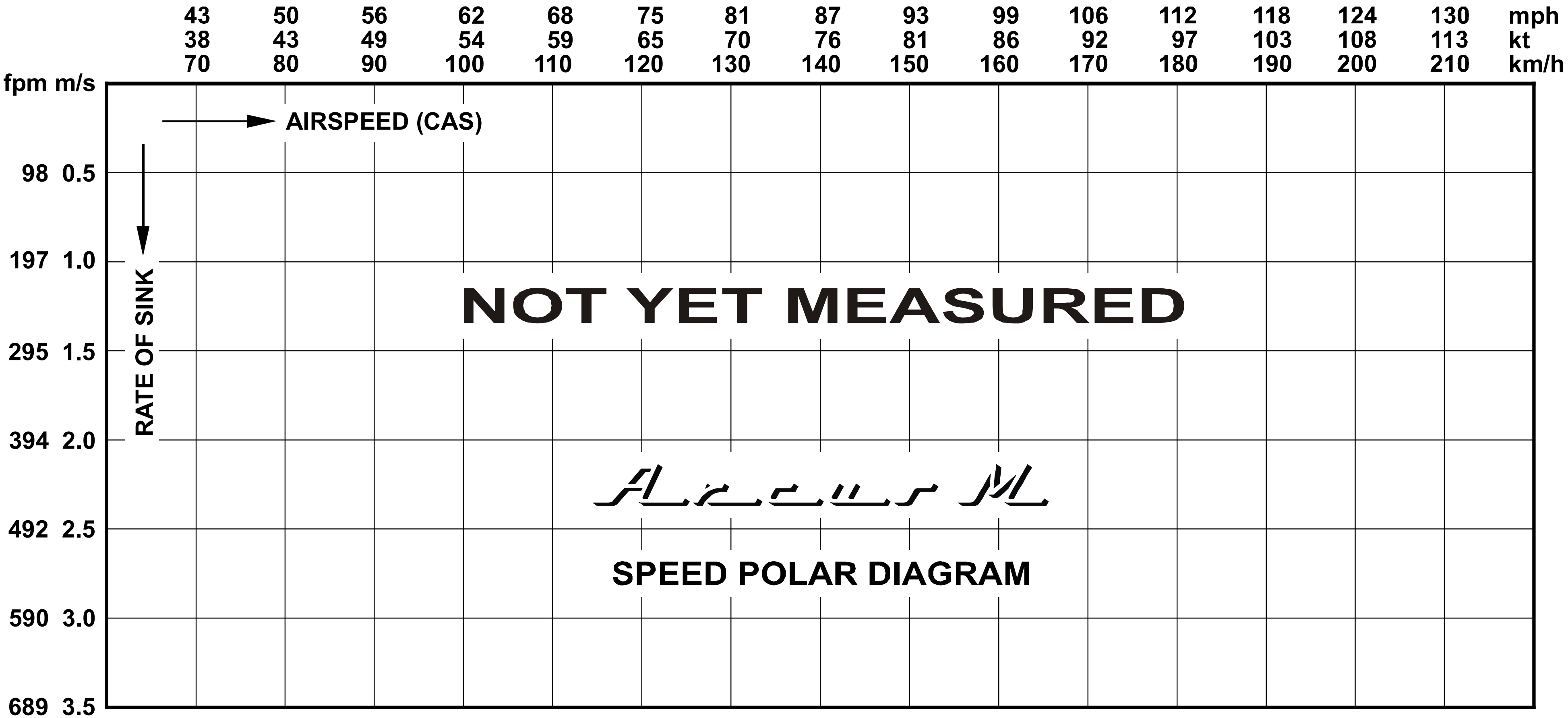
(engine not running)

All-up weight (mass)	800 kg 1764 lb
Rate of sink approx.	2.25 m/s 443 fpm
at a speed of approx.	105 km/h 57 kts 65 mph
Best L/D (-)	13

Powerplant extended – maximum power applied, flap setting +2

All-up weight (mass)	680 kg 1499 lb	800 kg 1764 lb
Best rate of climb	3.42 m/s	2.836 m/s
at a speed of	90 km/h 49 kts 56 mph	95 km/h 51 kts 59 mph

A level flight attitude is attained at a speed V_H = 150 km/h (81 kts, 93 mph).


43 50 56 62 68 75 81 87 93 99 106 112 118 124 130 mph
38 43 49 54 59 65 70 76 81 86 92 97 103 108 113 kt
70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 km/h
fpm m/s
98 0.5
197 1.0
295 1.5
394 2.0
492 2.5
590 3.0
689 3.5
AIRSPEED (CAS)
RATE OF SINK
NOT YET MEASURED
SPEED POLAR DIAGRAM

Range (without influence of wind)

a) Values below refer to level flight at cruising power (continuous RPM):

Cruising speed approx.: 150 km/h (81 kt, 93 mph)
Fuel consumption approx.: 24.50 Liter/h (6.47 US Gal./h, 5.39 IMP Gal./h)

Usable fuel:			Fuel supplied from			level flight endurance	Range
			fuselage tank	optional			
Liter	US Gal.	IMP Gal		right wing tank	left wing tank		
14.0	3.7	3.1	X			38 min	95 km 51 nm
26.5	7.0	5.8	X	X		69 min	173 km 93 nm
39.0	10.3	8.6	X	X	X	100 min	250 km 135 nm

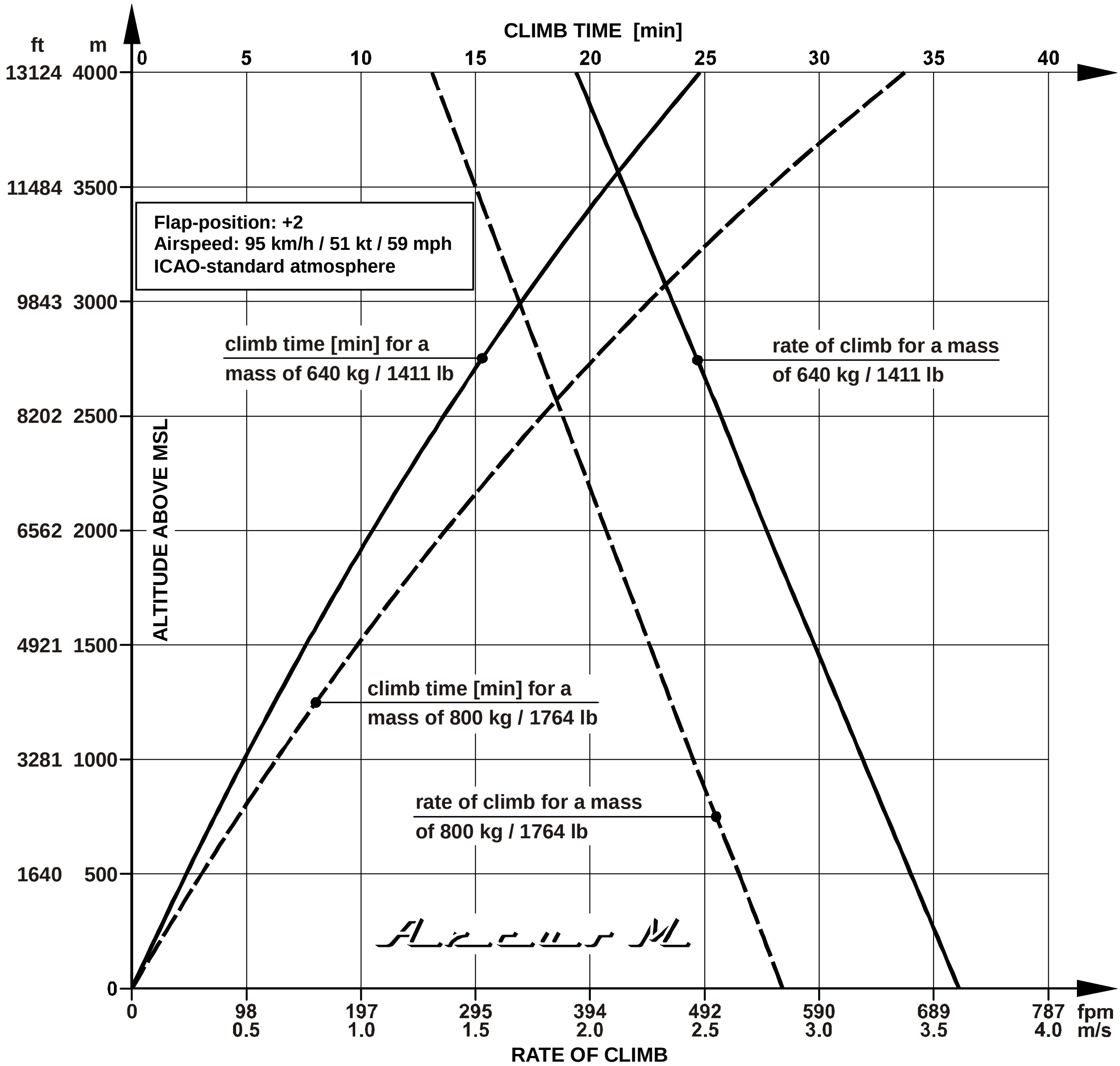
b) The following values are based on the “sawtooth"-method (see page 4.5.3.7) at an all-up mass of 800 kg(1764 lb) and the climb effected at

max. continuous power:
Average cruising speed approx.: 100 km/h (54 kt, 62 mph)
Fuel consumption approx.: 24.50 Liter/h (6.47 US Gal./h, 5.39 IMP Gal./h)

Usable fuel:			Fuel supplied from			level flight endurance	Range
			fuselage tank	optional			
Liter	US Gal.	IMP Gal		right wing tank	left wing tank		
14.0	3.7	3.1	X			171 min	335 km 181 nm
26.5	7.0	5.8	X	X		300 min	605 km 326 nm
39.0	10.3	8.6	X	X	X	440 min	875 km 472 nm

The range determined is based on climbs from 1000 m (3281 ft), starting at a height of 500 m (1640 ft) above MSL.

Climb performance: See diagram on page 5.3.2.4 established for a mass of 800 kg (1764 lb).


CLIMB TIME [min]
0 5 10 15 20 25 30 35 40
ft m
13124 4000
11484 3500
9843 3000
8202 2500
6562 2000
4921 1500
3281 1000
1640 500
0
ALTITUDE ABOVE MSL
Flap-position: +2
Airspeed: 95 km/h / 51 kt / 59 mph
ICAO-standard atmosphere
climb time [min] for a
mass of 640 kg / 1411 lb
rate of climb for a mass
of 640 kg / 1411 lb
climb time [min] for a
mass of 800 kg / 1764 lb
rate of climb for a mass
of 800 kg / 1764 lb
Arcus M
0 98 197 295 394 492 590 689 787 fpm
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 m/s
RATE OF CLIMB

5.3.3 Noise data

The noise level limit according to chapter 10 of ICAO Appendix 16, Volume 1, for the powered sailplane Arcus M (equipped with the SOLO engine 2625-02 i) is

73,1 dB(A).

This noise level limit is met by the Arcus M, equipped with the propellers

- KS-1G-160-R-120 of Technoflug Leichtflugzeugbau GmbH
- BM-G-160-R-120 of Binder Motorenbau GmbH.

The measured noise level of the Arcus M, equipped with the Propeller KS-1G-160-R-120 of Technoflug Leichtflugzeugbau GmbH is

65,8 dB(A) < noise level limit 73,1 dB(A)

and is thus far below (- 7,3 dB(A)) the noise level limit according to chapter 10 of ICAO Appendix 16, Volume 1.

It is recommended to wear a head set while the engine is running.

Section 6

6.1 Introduction

This section contains the seat load range within which the Arcus M may be safely operated.

Procedures for weighing the powered sailplane and the calculation method for establishing the permitted payload range and a comprehensive list of all equipment available are contained in the Arcus M Maintenance Manual.

The equipment actually installed during the last weighing of the powered sailplane is shown in the "'Equipment List" to which page 6.2.3 and 6.2.4 refer to.

6.2 Weight and balance record and permitted payload range

The following loading chart, page 6.2.3 (powerplant installed) or 6.2.4 (powerplant removed), show amongst others the empty mass, the maximum and minimum load on the seats and the maximum payload in the fuselage.

These charts are established with the aid of the last valid weighing report - the required data and diagrams are found in the Maintenance Manual.

Both loading charts (weight & balance log sheets) are only applicable for this particular Arcus M, the serial number of which is shown on the title page.
The indicated required minimum load is only applicable for operating with nose wheel. If the aircraft is operated with the optional nose skid the indicated required minimum increases about 2 kg (4.4 lb), see also page 6.9 of the Maintenance Manual.

A front seat load of less than the required minimum load

is to be compensated by ballast - there are three (3) methods:

1. By attaching ballast (lead or sand cushion) firmly to the lap belt mounting brackets.

Optional trim ballast mounting provision(s)

2. a) By installing ballast (by means of lead plates) at the base of the front instrument panel
   (for further information refer to page 6.2.2)

   b) By attaching, ballast (in addition to method 2 a) by means of lead plates to the front control stick mounting frame on the starboard side near the base of the instrument panel
   (for further details refer to page 6.2.2).

3. When flown with two occupants, the minimum load on the front seat can be reduced by 25% of the load on the rear seat. This reduction of the minimum load on the front seat is allowed only if the nose heavy moment of the load in the rear seat is not compensated by water ballast in the fin.

Altering the front seat load by using trim ballast

Optional trim ballast mounting provision

On request the aircraft is equipped with one or two mounting provisions for trim ballast, thus allowing a reduction of the placarded minimum front seat load (when flown solo) as shown in the table below.

a) Trim ballast mounting provision below the front instrument panel:

This tray holds up to three (3) lead plates with a weight of 3.7 kg / 8.2 lb each. Plates are made to fit only into this tray.

Lever arm of trim ballast plates: 2153 mm (7.06 ft) ahead of datum

b) Trim ballast mounting provision on front stick mounting frame on the right side:

This tray holds up to three (3) lead plates with a weight of 3.9 kg / 8.6 lb each. Plates are made to fit only into this tray.

Lever arm of trim ballast plates: 1953 mm (6.41 ft) ahead of datum

WHEN FLOWN SOLO: Difference in seat load as compared with placarded front seat minimum		**Number of lead plate required:**
up to 5,0 kg (11 lb) less	see a)	1
up to 10,0 kg (22 lb) less		2
up to 15,0 kg (33 lb) less		3
up to 20,0 kg (44 lb) less	see b)	4
up to 25,0 kg (55 lb) less		5
up to 30,0 kg (66 lb) less		6

WEIGHT AND BALANCE LOG SHEET (loading chart) FOR S/N ....

(POWERPLANT INSTALLED)

<table>
<tr><td colspan="2">Date of weighing:</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Empty mass [kg]</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Equipment list dated</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="4">Installed batteries [2)]</td><td colspan="2">count</td><td colspan="2">count</td><td colspan="2">count</td><td colspan="2">count</td></tr>
<tr><td>1</td><td>E</td><td>1</td><td>E</td><td>1</td><td>E</td><td>1</td><td>E</td></tr>
<tr><td></td><td>C1/C2</td><td></td><td>C1/C2</td><td></td><td>C1/C2</td><td></td><td>C1/C2</td></tr>
<tr><td></td><td>F1/F2</td><td></td><td>F1/F2</td><td></td><td>F1/F2</td><td></td><td>F1/F2</td></tr>
<tr><td colspan="2">Empty mass c/g position aft of datum</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Max. useable load [kg] in fuselage</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="10">Load [kg] on the seats (crew including parachute):</td></tr>
<tr><td>Front seat load
when flown solo:</td><td>max.</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td></tr>
<tr><td>with two occupants:</td><td>max.</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td></tr>
<tr><td>Rear seat load
with two occupants:</td><td>max.</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td><td colspan="2">115</td></tr>
<tr><td>Water ballast fin tank installed (YES / NO)</td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Front seat load regard-
less of load on rear seat</td><td>min. [1)]</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Inspector
Signature / Stamp</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

[1)]

Warning:
If fin tank installed, the pilot must either dump all water ballast prior of take-off, or perform an accurate check of the fin tank loading. He must also take the responding compensation loadings (wing water ballast and/or load on rear seat) into account.

[2)] Installed batteries (see page 7.12.2):

(E) engine battery
(C1/C2) batteries in front of rear stick mounting frame
(F1/F2) batteries in fin

For the determination of the water ballast quantity permitted in the wing tanks refer to page 6.2.5.
For the determination of the water ballast quantity permitted in the fin tank refer to page 6.2.6 through 6.2.8.

WEIGHT AND BALANCE LOG SHEET (loading chart) FOR S/N ....
(POWERPLANT REMOVED)

Date of weighing:					
Empty mass [kg]					
Equipment list dated					
Installed batteries [2)]		count	count	count	count
		E	E	E	E
		C1/C2	C1/C2	C1/C2	C1/C2
		F1/F2	F1/F2	F1/F2	F1/F2
Empty mass c/g position aft of datum					
Max. useable load [kg] in fuselage					
Load [kg] on the seats (crew including parachute):					
Front seat load when flown solo:	max.	115	115	115	115
with two occupants:	max.	115	115	115	115
Rear seat load with two occupants:	max.	115	115	115	115
Water ballast fin tank installed (YES / NO)					
Front seat load regardless of load on rear seat	min.[1)]				
Inspector Signature / Stamp					

1) **Warning:**
If fin tank installed, the pilot must either dump all water ballast prior of take-off, or perform an accurate check of the fin tank loading. He must also take the responding compensation loadings (wing water ballast and/or load on rear seat) into account.

2) Installed batteries (see page 7.12.2):
(E) engine battery
(C1/C2) batteries in front of rear stick mounting frame
(F1/F2) batteries in fin

For the determination of the water ballast quantity permitted in the wing tanks refer to page 6.2.5.
For the determination of the water ballast quantity permitted in the fin tank refer to page 6.2.6 through 6.2.8.

Maximum water ballast load

Maximum all-up mass including water ballast: 800 kg / 1764 lb

C/G position of water ballast in wing tanks (forward of datum): 17 mm / 0.70 in.

Total capacity of wing tanks: 185 Litre (48.9 US. Gal /40.7 IMP Gal)

Table of water ballast loads at various empty masses and seat loads:

Empty mass + fin ballast + fuel		LOAD ON THE SEAT (kg / lb)																													
		kg 70		lb 154	kg 80		lb 176	kg 100		lb 220	kg 120		lb 264	kg 140		lb 308	kg 160		lb 353	kg 180		lb 396	kg 200		lb 441	kg 220		lb 485	kg 230		lb 507
kg	lb																														
450	991	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	120	31.7	26.4
460	1013	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	180	47.6	39.6	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	110	29.1	24.2
470	1035	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	100	26.4	22.0
480	1057	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	180	47.6	39.6	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	100	26.4	22.0	90	23.8	19.8
490	1079	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	90	23.8	19.8	80	21.1	17.6
500	1101	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	180	47.6	39.6	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	100	26.4	22.0	80	21.1	17.6	70	18.5	15.4
510	1101	185	48.9	40.7	185	48.9	40.7	185	48.9	40.7	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	90	23.8	19.8	70	18.5	15.4	60	15.9	13.2
520	1147	185	48.9	40.7	185	48.9	40.7	180	47.6	39.6	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	100	26.4	22.0	80	21.1	17.6	60	15.9	13.2	50	13.2	11.0
530	1169	185	48.9	40.7	185	48.9	40.7	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	90	23.8	19.8	70	18.5	15.4	50	13.2	11.0	40	10.6	8.8
540	1191	185	48.9	40.7	180	47.6	39.6	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	100	26.4	22.0	80	21.1	17.6	60	15.9	13.2	40	10.6	8.8	30	7.9	6.6
550	1213	180	47.6	39.6	170	44.9	37.4	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	90	23.8	19.8	70	18.5	15.4	50	13.2	11.0	30	7.9	6.6	20	5.3	4.4
560	1235	170	44.9	37.4	160	42.3	35.2	140	36.9	30.8	120	31.7	26.4	100	26.4	22.0	80	21.1	17.6	60	15.9	13.2	40	10.6	8.8	20	5.3	4.4	10	2.6	2.2
570	1257	160	42.3	35.2	150	39.6	33.0	130	34.3	28.6	110	29.1	24.2	90	23.8	19.8	70	18.5	15.4	50	13.2	11.0	30	7.9	6.6	10	2.6	2.2	0	0	0
		Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.	Litre	US Gal.	IMP Gal.
		WATER BALLAST IN WING TANKS																													

Note:
When determining the max. permitted wing water ballast load, allowance must be made for water ballast in the fin tank (see page 6.2.7 and 6.2.8) and fuel , i.e. this load must be added to the empty mass shown on the above table.
Empty mass as per page 6.2.3 resp. 6.2.4, fin ballast as per page 6.2.8.

Water ballast in (optional) fin tank

In order to shift the centre of gravity close to its aft limit (favourable in terms of performance), water ballast may be carried in the fin tank (m_{FT}) to compensate for the nose-heavy moment of:

- water ballast in main wing panels (m_{WT})
  and/or
- loads on the aft seat (m_{P2})

Compensating water ballast in main wing panels

The determination of the ballast quantity in the fin tank (m_{FT}) is done with the aid of the diagram shown on page 6.2.8.

Compensating loads on the aft seat

Pilots wishing to fly with the centre of gravity close to the aft limit may compensate the nose-heavy moment of loads on the aft seat with the aid of the diagram shown on page 6.2.8.

Warning:

Compensation for masses exceeding the placarded minimum front seat load by the use of water ballast in fin tank is n o t allowed!

If the influence of the load on the rear seat is taken into account for the minimum load on the front seat, the nose-heavy moment of the load on the rear seat may not be compensated with water ballast in the fin tank.

Caution:

When using fin ballast to compensate for the nose - heavy moment of wing ballast and loads on the aft seat, then both values resulting from the diagrams on page 6.2.8 must be taken into account.

Note:

The maximum amount of water ballast, available for compensating the above mentioned nose-heavy moments, is 11 Litres (2.91 US Gal., 2.42 IMP Gal.), which is the maximum capacity of the fin tank.

Water ballast in fin tank (optional)

Note:

When determining the maximum usable load in the fuselage, the quantity of water ballast in the fin does **not** need to be taken in account because of flight mechanic reasons.

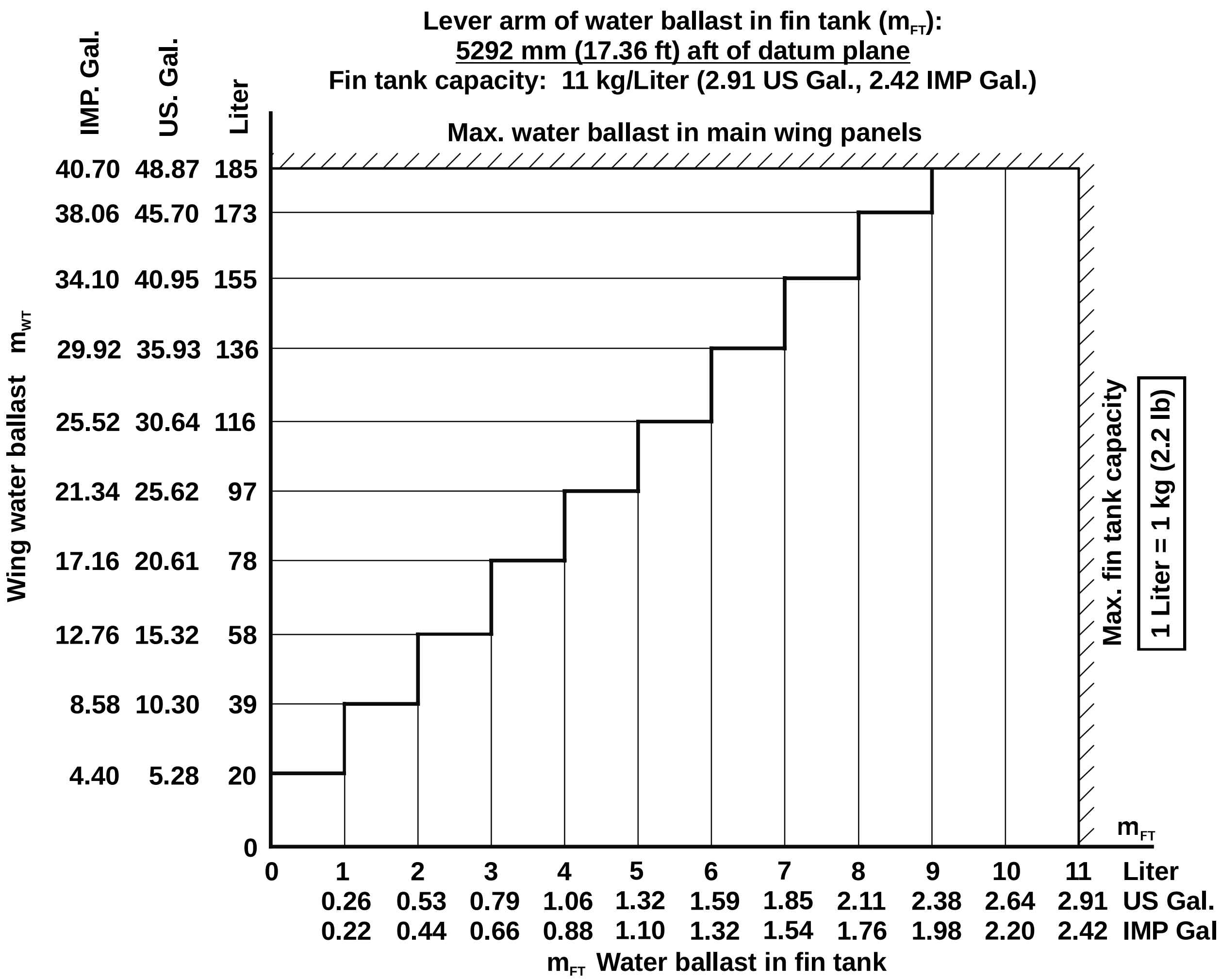
In order to avoid exceeding the maximum permitted all-up weight (mass), the ballast in the fin tank must be taken into account when determining the maximum allowable ballast quantity for the wing tanks.

Example:

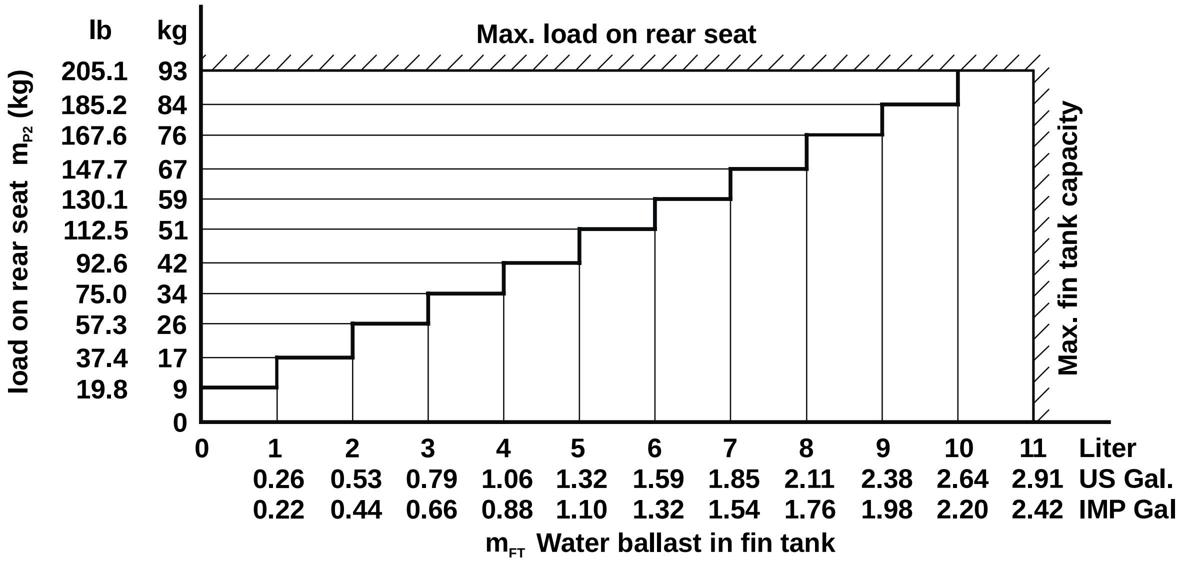
Assumed ballast load in wing tanks:	40 kg/Litres (88 lb/10.6 US Gal)
Assumed load on aft seat:	75 kg (165 lb)

According to the diagrams on page 6.2.8 the following loads in the fin tank are permissible (fill only full Litres):

For ballast in wing tank	:	m_{FT}	=	2 kg/Litre (4.4 lb/0.53 US Gal)
For load on aft seat	:	Δm_{FT}	=	8 kg/Litres (17.6 lb/2.11 US Gal)
Total ballast in fin tank	:	$m_{FT} + \Delta m_{FT}$	=	10 kg/Litres (22.1 lb/2.64 US Gal)



NOTE: Always full Liters are to be filled. Where value jumps, either the higher or the lower amount of ballast may be used.



Section 7

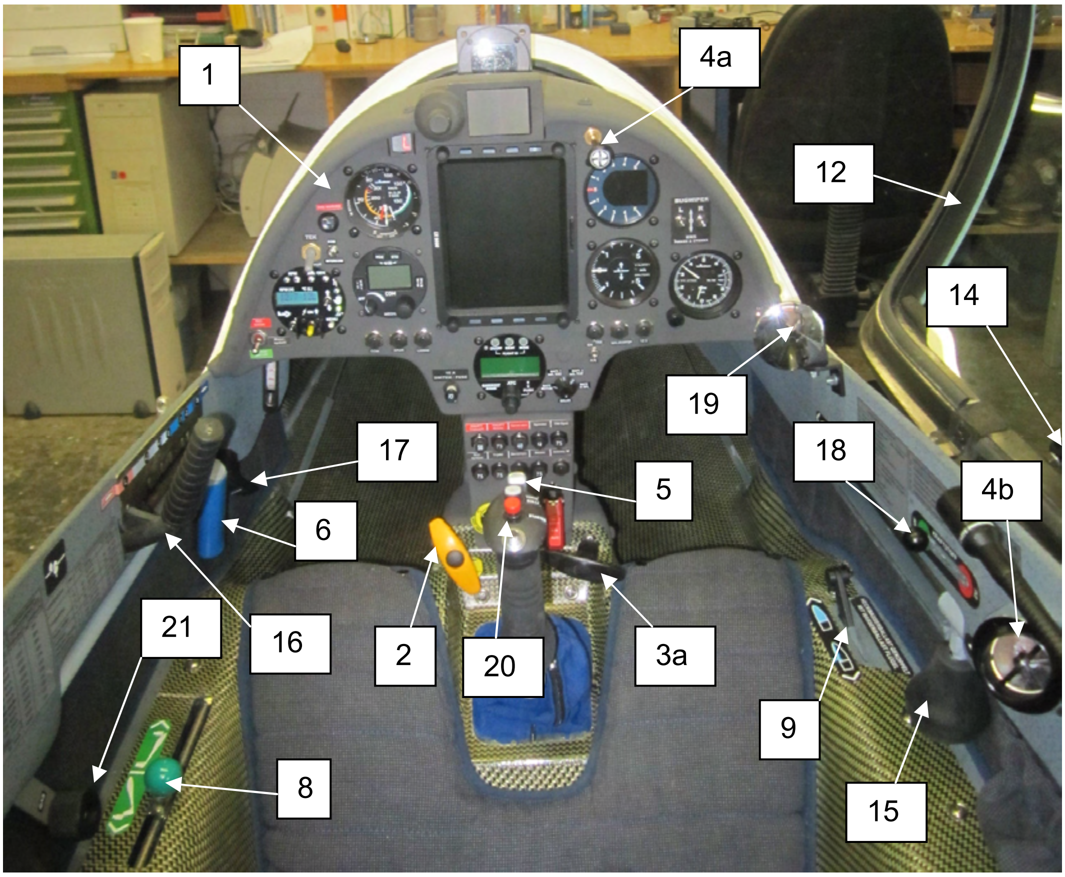
7.1 Introduction

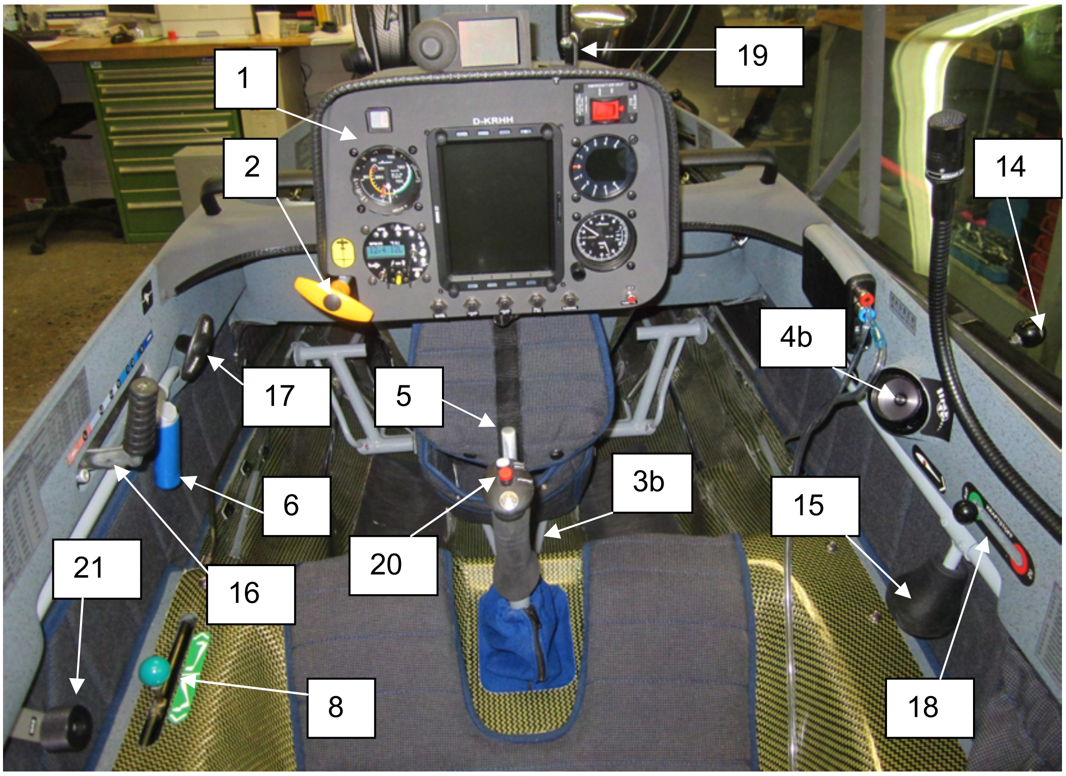
This section provides a description of the powered sailplane including the operation of its systems.

In Section 9 supplements to the flight manual due to the incorporation of non-standard systems and equipment can be found – if necessary.

For further descriptions of components and systems refer to section 1 of the Maintenance Manual for the Arcus M.

7.2 Cockpit-Description





All instruments and control elements are within easy reach of the crew.

(1) Instrument panels

With canopy opened, the instruments for either seat are easily accessible.

The front instrument panel can be pivoted upwards if the canopy is open. The front instrument panel covering is attached to the front instrument panel with two bolts. With removed covering the instrument panel can be detached from the mounting.

The rear panel is mounted to the steel tube transverse frame between the seats. After unscrewing the mounting bolts, the instrument panel and the covering can be removed.

(2) Tow release handles

T-shaped handles, actuating the tow release(s) installed
(c/g and/or nose hook)

Front seat: Yellow handle at the base of the control stick on the left

Rear seat: Yellow handle on the lower left hand side of the instrument panel

The winch cable/aerotow rope is released by pulling one of the handles.

(3a) Rudder pedal adjustment (front seat)

Black T-shaped handle on the right hand side near the base of the control stick.

Forward adjustment:	Release locking device by pulling the handle, push pedals to desired position with the heels and let them engage.
Backward adjustment:	Pull handle back until pedals have reached desired position. Forward pressure with heels (not the toes) engages pedals in nearest notch with an audible click.

An adjustment of the rudder pedals is possible on the ground and in the air.

(3b) Rudder pedal adjustment (rear seat)

Locking device on pedal mounting structure on the cockpit floor.

Forward or backward adjustment:

Pull up locking pin by its ring, slide pedal assembly to desired forward or backward position and push locking pin down into nearest recess.

An adjustment of the rudder pedals is possible on the ground and in the air.

(4) Ventilation

a) Small black knob on the front instrument panel on the right:
(Ventilation air quantity)

Pull to open ventilator nozzle
Push to close ventilator nozzle

b) Adjustable bull-eye-type ventilator starboard of the right:

Turned clockwise:	Ventilator closed
Turned anti-clockwise:	Ventilator open

Additionally the clear vision panels or the air scoop in the panels may be opened for ventilation.

(5) Wheel brake

A wheel brake handle is mounted on either control stick.

(6) Airbrake levers

Levers (with blue marking), projecting downwards, below cockpit inner skin on the left.

Forward position:	Airbrakes closed and locked
Pulled back about 40 mm (1.6 in.):	Airbrakes unlocked
Pulled fully back:	Airbrakes fully extended

(7) Head rests

a) Front seat (not illustrated):

Head rest is an integrated component of the seat back and is adjusted with the seat back.

b) Rear seat (not illustrated):

Mounting rail on upper fuselage skin. Head rest is gradually and horizontally adjustable:
Depress locking tap, slide head rest in desired position and let locking tap engage into nearest recess.

(8) Elevator trim

Green knob (for either seat) at the seat pan mounting flange on the left.

The spring-operated elevator trim is gradually adjustable by swinging the knob slightly inwards, sliding it to the desired position and swinging it outwards to lock.

Forward position	-	nose-heavy
Backward position	-	tail-heavy

(9) Control- lever for dumping water ballast from wing tanks and (optional) fin tank

Black lever on the front seat rest on the right.

Forward position	-	dump valves closed
Backward position	-	dump valves opened

The lever is held in the respective final positions

Fin tank (option)

The fin tank dump valve control is connected to the torque tube actuating the valves in the wing so that all three valves open and close simultaneously.

(10) Seat back (front seat) (not illustrated)

Sliding black knob on the cockpit inner skin on the right.

Adjustment: Tilt front end of grip slightly inwards, slide grip to desired position and let engage by tilting it outwards.

In addition, the lower attachment position can be varied in the seat rest.

(11) Rip cord anchorage (not illustrated)

Front seat:	Red steel ring on steel tube transverse frame between the seats on the left
Rear seat:	Red steel ring at the front of the steel tube center frame on the left

(12) Canopy

The one-piece Plexiglas canopy hinges sideways to the right on flush fittings. Take care that the cable restraining the open canopy is properly hooked up.

(13) Canopy locking and jettisoning levers (not illustrated)

Lever with red grip for either seat on the canopy frame on the left.

Forward position: canopy locked

To open or jettison the canopy, swing one of the levers back up to the stop (approx. 90°) and raise canopy to the right side..

(14) Canopy release

Remove restraining rope from the canopy at the clipper.
To open or jettison the canopy, push one of the levers back up to the stop and raise canopy.

Undercarriage

(15) Front / Rear seat

RETRACTING : Disengage black handle below the cockpit inner skin on the right, pull it back and lock in rear recess

EXTENDING: Disengage handle, push it forward and lock in front recess

(16) Flap lever

Black lever, projecting upwards, on cockpit inner skin on the left.
Swing lever slightly inwards, move to desired setting and let engage in appropriate notch.

Forward position: High speed range

Backward position: Low speed range

(17) Manual propeller brake

Black T-shaped handle on the front of the left cockpit inner skin (for either seat)

T-shaped pulled back:	brake operation (for manual stopping and holding propeller)

(18) Fuel shut-off valve

Black knob on cockpit inner skin on the right (for either seat)

Forward position:	Valve opened
Rearward position:	Valve closed

(19) Rear-view mirror

This is provided in the front cockpit on the right side and in the rear cockpit on the instrument glare shield.

(20) Starter button

Red press button on control stick (either cockpit)

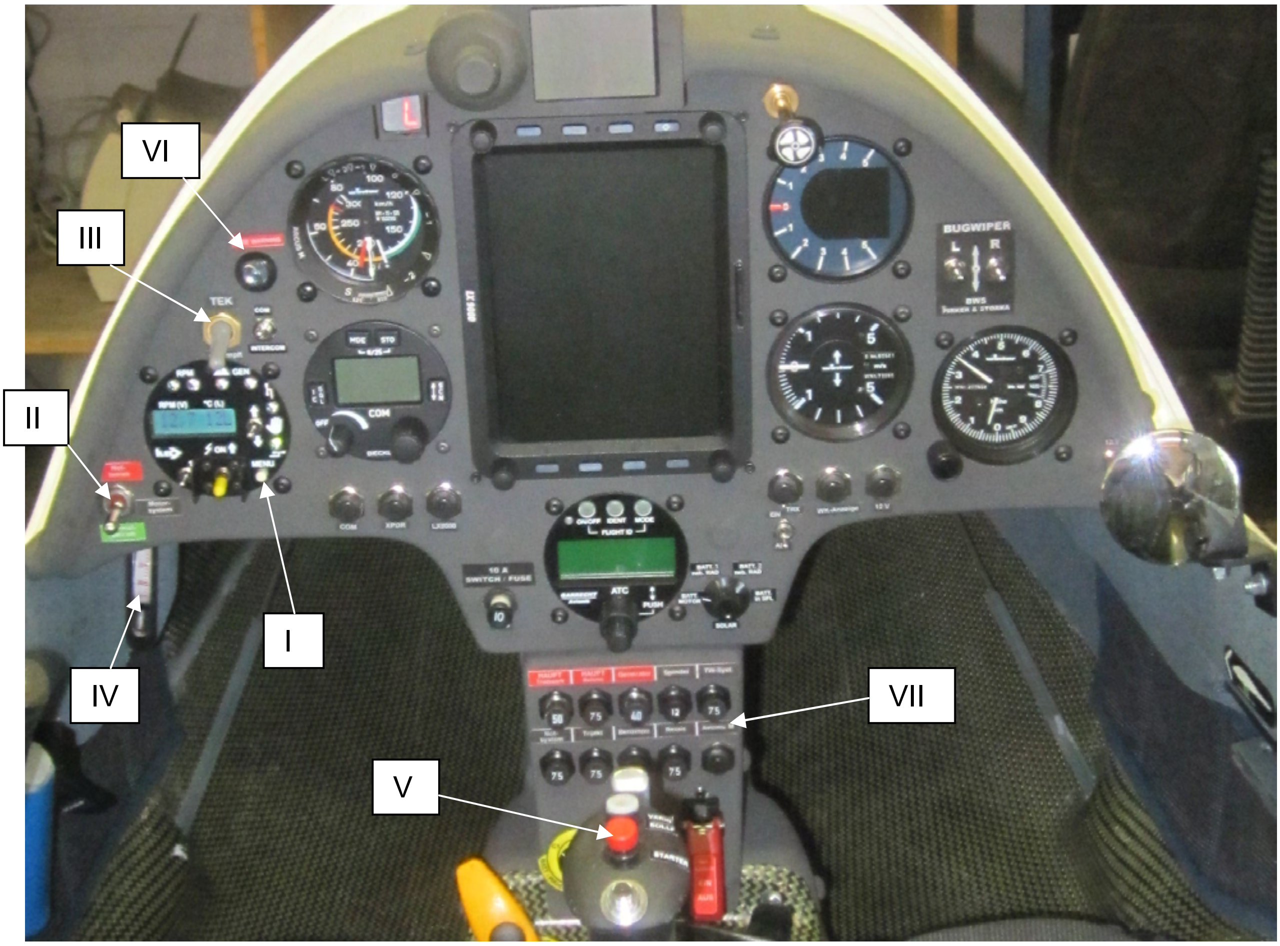
(21) Throttle control

Pivoting lever on the left side of the cockpit (for either seat)

Fully forward position:	Full throttle
Fully aft position:	Idle

7.3 Instrument panels

Instrument panel front:



A description of the designated components I - VII is found on the following pages section 7.3.2 to 3.7.42.
A description of the instruments as well as presentation of the rear Instrument panel is not included.

I Powerplant operating unit MCU II

Description see page 7.3.11 and on

II Switch for the engine control redundancy system

Toggle switch in the instrument panel

bottom position	-	engine control on regular system
top position	-	Emergency operation because of breakdown of regular engine control system (redundancy system activated)
	-	Fuel pump of redundancy system and coolant liquid pump are running permanently

Note:

The powerplant operating unit will display the error-massage ERROR- CAN MISS (s. page 7.3.38) when switching the engine control system to redundancy system. Pushing the MENU-button will shut of the warning.

III Switch TE (optional)

The toggle switch is in the instrument panel for use with a TE-probe. Switching to static pressure or heavily muted TE-pressure while in powered flight dampens the variometer reading.

TE - Tube to TE-tube
STATIC - Static pressure

or

TE - Tube to TE-tube
TE dampened - Tube with constrictor to TE-tube

IV Outside air temperature

For flights with water ballast, the ambient temperature shall not go below +2°C (35°F)

V Electric start button on the control stick

The starter motor can be used in two different types of operation

1) Starting the engine

Requirements for starting the engine:
- Powerplant fully extended (check Position-LED)
- RPM of engine 0
- Ignition ON

2) Pulse-Mode for Propeller Positioning

Requirements for Pulse-Mode:
- Powerplant fully extended (check Position-LED)
- RPM of engine 0
- Ignition OFF
- Emergency system for spindle drive inactive (red cap of emergency switch closed)

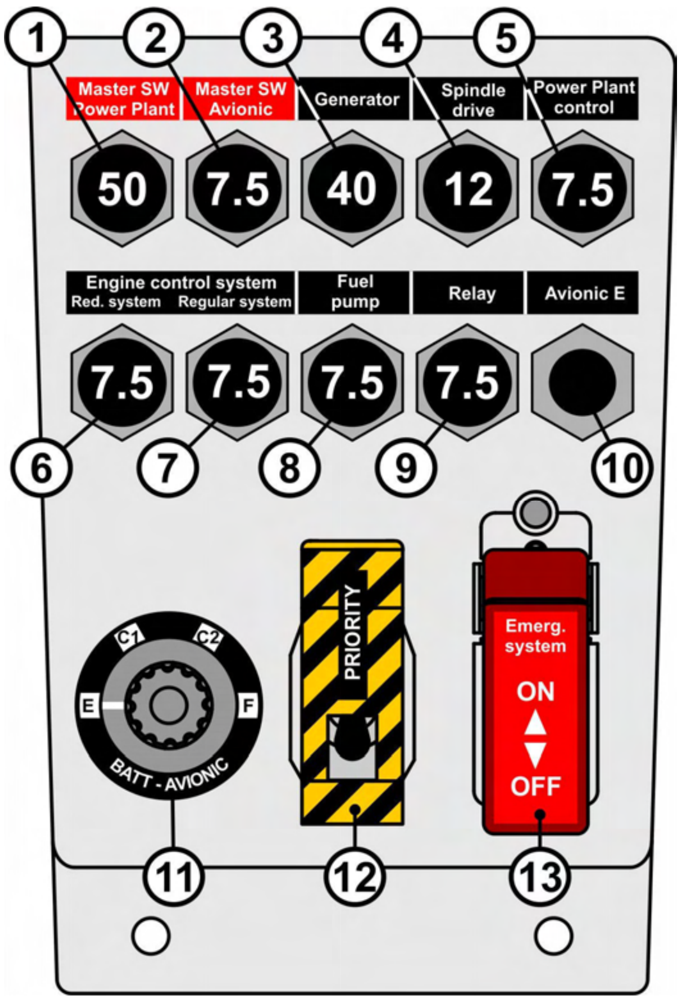
VI Blinking fire warning light

The temperature gauge for the fire warning LED is placed in the upper area of the front engine compartment wall. The fire warning LED will start blinking, if the temperature in the engine compartment exceeds 140°C, for example because of a fire.

Note:

When starting the engine control, the fire warning light will flash for a short period of time (self test).

VII <u>Fuse panel</u> (under the instrument panel):



1	Master-switch powerplant
2	Master-switch avionic
3	Generator-circuit breaker
4	Spindle drive-circuit breaker
5	Circuit breaker powerplant control system
6	Circuit breaker engine control - redundancy system
7	Circuit breaker engine control - regular system
8	Circuit breaker fuel pump – regular system
9	Relay circuit breaker
10	Avionic E- circuit breaker
11	Battery selector dial
12	Priority switch for the powerplant control, if two powerplant operating units are installed (optional)
13	Emergency switch for spindle drive

All master switches and circuit breakers of the most important electrical circuits of the powerplant system are automatic circuit breaker which can be open and closed manually.

Electrical circuits, that have to be secured only in case of electrical defect for the operation of the powerplant, are manually resettable fuses.

VII Fuse panel (under the instrument panel): (continued)

1. Master-switch powerplant – circuit breaker 50 A

The master switch interrupts the power supply from battery E to the propulsion system and to all other electrical consumers supplied by this battery.

Warning:
The engine control system (Regular and redundancy system) is supplied by the electrical circuit of the engine battery (battery E).
If the master switch powerplant is opened, the engine will stop!

2. Master-switch Avionic – circuit breaker 7.5 A

The main-switch interrupts the power supply from the avionic batteries (C1, C2, F etc.) to all of the avionics.

3. Generator- circuit breaker 40A

The generator circuit breaker must always be pushed in when the engine is running. Otherwise the generator will supply no energy to the powerplant and also for charging the engine battery.

Warning:

- With opened generator circuit breaker the powerplant and the engine control system are only supplied with energy by the engine battery (battery E). If the battery is empty, the engine will stop.
- Open the generator circuit breaker during engine operation only in case of an emergency (for example at continuous over-voltage). Otherwise the internal device for measuring the generator current (prompt “GC”) might be damaged.

4. Spindle- circuit breaker 12 A

Protection for the spindle drive motor to extend and retract the powerplant.

5. Powerplant control system- circuit breaker 7.5 A

Fuse protection for the powerplant control system MCU II including:
- powerplant operating unit(s) and powerplant control unit
- cooling water pump (internal fuse in control unit)
- proximity switches for propeller positioning (internal fuse in control unit)

VII Fuse panel (under the instrument panel): (continued)

6. Engine control redundancy system- circuit breaker 7.5 A

Protection for the following electric circuits:
- Redundancy system for engine control
- Fuel pump and RPM-sensor of redundancy system

7. Engine control regular system - circuit breaker 7.5 A

Protection of the regular system for the engine control ("Trijekt") including RPM-Sensor, throttle position sensor, coolant-temperature sensor, air-pressure and air-temperature sensor.

8. Fuel pump- circuit breaker 7.5 A

Protection for the following electric circuits:
- Fuel pump of regular system for the engine control
- Installed refueling pump for the fuselage tank

9. Relay- circuit breaker 7.5 A

Protection of relay for ignition.

10. Circuit breaker for Avionic-operation with engine battery 7.5 A

Separate fuse protection for the avionics using the engine battery (see also 11.).

11. Battery selector dial

Battery selector for power supply to the avionic system and to additional equipment (optional), see page 7.12.3:

C1/C2:	Batteries in the feet area in the rear cockpit.
E:	Engine battery
F (1/2):	Battery in the tail fin (Option)

VII Fuse panel (under the instrument panel): (continued)

12. Priority switch (optional, only with two powerplant operating units)

The priority switch (toggle switch) is covered with a yellow-black protecting cap.

If the protecting cap is opened, the active powerplant control can be transferred between the both powerplant operating units in front and rear cockpit.

Position DOWN: Powerplant operating unit in FRONT instrument panel operational

Position UP: Powerplant operating unit in REAR instrument panel operational

Note:

With the inactive powerplant operating unit the powerplant can not be operated, but all information is still displayed.

In order to avoid an interruption of the automatic powerplant control, be sure to satisfy the following conditions before using the priority switch:

- Both ignition switches must be in the same position
- Powerplant must be fully extended or fully retracted
- Both manual operation switches (see page 7.3.11 and 7.3.16) are in the middle position

Warning:

- If the engine is running, switch priority only when the ignition switches on both engine operating units are in the ON position in order to prevent the engine from stopping.
- If the engine is stopped, switch priority only if the ignition switches^ both are in the OFF position.

VII Fuse panel (under the instrument panel): (continued)

13. Emergency switch for spindle drive

If the powerplant controls fail or the operating unit in the instrument panel does not react to pilot input, the powerplant can be extended or retracted using a separate emergency system.

For the extension and the retraction of the powerplant with the emergency system the following master switches and circuit breaker have to be switched on:

- Master switch powerplant **MASTER SW POWERPL**
- Circuit breaker spindle drive **Spindle Drive**
- Fuse emergency system **Emergency system**

The emergency system is activated when the red protecting cap lifted (prompt on operating unit: EMERG.- OPERAT.)
Below the red protecting cap is the emergency switch (toggle switch) for the control of the spindle drive of the powerplant:

Toggle switch UP ⇨ powerplant extends
Toggle switch NEUTRAL ⇨ no movement of powerplant
Toggle switch DOWN ⇨ powerplant retracts

If the powerplant is operated with the emergency switch the travel of the spindle drive isn't limited by the limit switches anymore. Therefore you have to judge the end-position of the powerplant during the extension process visually (rear view mirror).
The end position of the extension und retraction process will be indicated at last by triggering the circuit breaker for the spindle drive **Spindle** in the cockpit.

a) Powerplant extension with the emergency system

- lift red protecting cap
- confirm prompt EMERG.- OPERAT. on the display of the operating unit with the MENU-button to close the warning
- extend powerplant completely with the emergency system
- to start the engine: Ignition ON, Push start button on control stick

VII Fuse panel (under the instrument panel): (continued)

13. Emergency switch – continued

b) Stopping the engine and retraction of powerplant with emergency switch

- Ignition OFF
- Lift red protecting cap
- Confirm prompt EMERG.- OPERAT. on the display of the operating unit with the MENU-button to close the warning
- Stop the propeller with the manual propeller brake (handle on left side in the forward area of the cockpit)
- Center the propeller with the aid of the airstream as close as possible at its retracting position by varying the force on the handle of the manual propeller break (Display of operating unit will show Prop. Ok when the propeller is in retracting position).
- Retract powerplant with emergency switch

If it's not possible to center the propeller in its proper retracting position, the powerplant can be nevertheless retracted to a large extend. In order to prevent damage to the airplane, stop the retraction process, if possible, as soon as the propeller touches audibly the engine cover doors.

Warning:

The operation with the emergency system should be limited to emergency situations.

As soon as the emergency system is activated (red protecting cap lifted up) all security checks of the powerplant control system are off, in contrast to the operation with the manual operation switch. That means:

- The electric starter can be used in all positions of the powerplant, even if the engine is running!

- The powerplant can be retracted and extended with the emergency switch regardless the RPM of the engine or the position of the propeller!

- Due to vibrations during flights with idle power setting a regular readjustment of the spindle drive is necessary in order to prevent a creepy retraction of the powerplant. This function is performed by the powerplant control system in during normal operation automatically. With activated emergency system the readjustment of the spindle drive has to be done by the pilot.

VII Fuse panel (under the instrument panel): (continued)

13. Emergency switch – continued

Note:

If the circuit breaker for the engine control – regular system is still closed during the operation with the emergency system for the spindle drive and the LCD-Display of the powerplant operating unit is still working, the following notification will be shown:

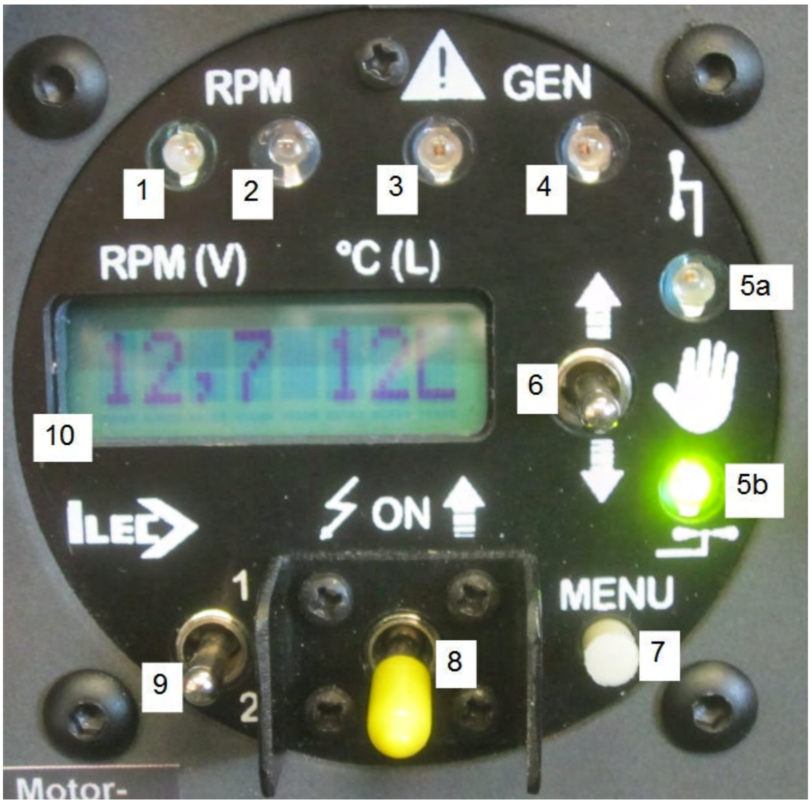
- Lifting the red protecting cap the LCD-Display will show EMERG.- and OPERAT. alternately. This notification can be closed pushing the MENU-Button. Then the operating indicators of all working system for the control of the powerplant will be available.

- If the limit stops for the powerplant are still operational, they will be recognized and the end positions of the powerplant will be indicated in powerplant operation unit.

14. Emergency system – automatic reset fuse (no picture)

The emergency system for the extension and the retraction of the powerplant is protected by an automatic reset fuse.
This fuse is integrated into the electrical circuit as a “flying” fuse and is located in the fuse panel, right behind the emergency system switch.

I Powerplant operating unit MCU II BG



No.	Meaning	Color
1	Signal LED Engine RPM *Normal Operation*	Green
2	Signal LED Engine RPM *Caution zone*	Yellow
3	Warn-LED *General warning*	Red
4	Signal LED *Generator- charging control*	Red
5a	Signal-LED *Powerplant extended*	Green
5b	Signal-LED *Powerplant retracted:*	Green
6	manual operation switch	---
7	MENU-button	---
8	Ignition switch	Yellow
9	Test switch ignition circuits 1 + 2	---
10	LCD-display (8 digits)	---

I Powerplant operating unit MCU II BG - continued

The powerplant control system MCU II simplifies the operation of the powerplant:

- The extension and the retraction of the powerplant is for the pilot reduced to the operation of the ignition switch (automatic mode).

- The powerplant control system informs the pilot of all key parameter of the powerplant system. The powerplant operating unit will show warnings if operating limits of the powerplant system are exceeded or if failure of important components occurs.

- If required that pilot can extend and retract the powerplant manually.

The powerplant control system MCU II of the Arcus M consists of two main components:

1) The powerplant operating unit MCU II BG is found in the front instrument panel (see page 7.3.1). It contains important controls for the powerplant and shows all important data for the operation of the powerplant. Optionally a second operating unit MCU II BG, identical in construction, can be installed in the rear instrument panel. The control over the powerplant can be executed always only by a single powerplant control unit. But it is possible to switch the guidance function between the both operating units during operation (s. page 7.3.7 “Priority switch”)

2) The powerplant control unit MCU II SG is found on the right side under the rear seat in the Cockpit. It monitors processor-controlled data of all sensors relevant for the powerplant operation, and switches signals and currents to all elements of the powerplant control system.

I Powerplant operating unit MCU II BG - continued

A) Device description

The switch to start the powerplant control system is found on the fuse panel on the lower fixed portion of the instrument panel (see section VII of this chapter, page 7.3.4 and on).

For operation of the powerplant control system MCU II, at a minimum the following circuit breakers must be closed:

- Master switch powerplant **MASTER SW Powerplant**
- Spindle drive circuit breaker **Spindle drive**
- Powerplant control system circuit breaker **Powerplant control**

Note:

After turning on the master powerplant switch and the circuit breaker for the powerplant control system, all lights on the Powerplant operating unit light up for approx. 2 seconds, the control unit display shows 88888888 and a warning tone can be heard.

If the circuit breakers for the spindle drive (**Spindle drive**) and for the engine control regular system (**Engine control system - Regular system**) are open while the Powerplant control system is started, warning massages on the display of the powerplant operating unit will occur, which can be confirmed and close by pushing the MENU-button.

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(1) RPM light

Green LED-light for normal RPM operation range.
For values see page 2.5.
No display as long as the RPM is below the normal operation range.

(2) RPM light

Yellow LED-light for the cautionary RPM range.
For values see page 2.5.

(3) General Warnings

a) Red LED-light blinks when exceeding any recommended limit, when there are any warning or failure reports as well as operating instructions that are indicated on the LCD display. The display is coupled with a warning tone.

b) Warning tone (Summer) (no picture)

Tone sequence	Meaning	LCD-Display
Pulse Tone	Operating instruction fuel valve	FUELCOCK
	Operating instruction retraction process	BRAKE ?
Two-tone	Operating instruction Manual operation	MAN.MODE
Constant tone	Warning tone when exceeding operating limits, failure reports, various operating instructions	Various

In many instances the general warning indicator can be temporarily turned off by pressing the MENU button (see section (10) LCD-Display).

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(4) Generator – charging control

a) The red LED-Indicator lights, if the Master switch Powerplant is on and:

- Ignition is ON and
- there is no charging voltage at the charge regulator

In this case no energy will be supplied by the generator. All electrical consumers in the circuit of the powerplant master switch are then fed only by the engine battery.

b) No light, if the Master switch powerplant is on and:

- if the ignition is OFF, or
- if the engine is running and there is charge voltage at the charge regulator.

In this case charging of the battery will be carried out, if the wiring of the generator is intact and the generator circuit breaker isn't tripped.

c) Red LED blinks if the ignition is turned ON with low voltage.

Warning:

A flash-up of the charging control during powerplant operation at RPM in normal range is an indication of insufficient power supply of the electrical system by the generator.
Due to the high power consumption of the powerplant system only a short running time of the engine, depending on the current charge level of the battery, is then still possible.

As soon as the battery is empty, the powerplant will stop running.

(5) Powerplant position indicator

(5a) Upper LED

green light blinking ⇨ Powerplant being extended
green light on ⇨ Powerplant fully extended

(5b) Lower LED

green light blinking ⇨ Powerplant being retracted
green light on ⇨ Powerplant fully retracted

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(6) Manual operation switch (spindle drive switch)

a) If the pilot starts the extension or retraction process during flight with the ignition switch, there is no need to use the manual operation switch as long as there is no failure in the powerplant control system.

b) The manual operating switch (toggle switch) has 3 positions

Position up
- Automatic operation turned off
- Extends the powerplant as long as the switch is held
- Spindle stops by itself when the powerplant is fully extended and the limit switch is reached

Position middle - Automatic operation (default postion)

Position down
- Automatic operation turned off
- Retracts the powerplant as long as the switch is held
- Spindle stops by itself when the powerplant is fully retracted and the limit switch is reached

c) The manual operation switch can be used to extend and retract the powerplant in the following cases:

i) on the ground (recommended for preflight inspection and maintenance).

ii) if the automatic powerplant control for extension and retraction of the powerplant becomes disabled. This occurs when there is missing or unclear information about the position or operating condition of the engine. The powerplant control changes to manual operation (display reads MAN.MODE) and the pilot must take over control of extending or retracting the powerplant.

iii) if the pilot would like to take over control of the extension or retraction of the powerplant.

Caution:

The powerplant can only be retracted with the manual operation switch if the ignition is OFF.

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(6) Manual operation switch (spindle drive switch) (continued)

d) Interrupting the automatic extension and retraction process:

Is the manual operation switch pushed up or down while the powerplant is extending or retracting automatically with the ignition switch:

- the movement of the powerplant is stopped
- the automatic mode is shut down (operation changes to manual mode; display reads MAN.MODE + warning tone)
- the brake servo for the automatic propeller brake opens and the propeller is free to rotate.
- if the sequence to center the propeller vertically has already begun, the sequence is interrupted

e) In order to return from manual to automatic mode for extension or retraction of the powerplant, the following steps must be taken:

i) To continue the extension in automatic mode:

- Ignition OFF then ON again.

⇨ *Continuing of the automatic extension*

ii) To continue retraction or centering the propeller for retraction in automatic mode:

- Switch the ignition ON

- Wait until the powerplant is completely extend
(LED light must show that that powerplant has extended completely!)

- Turn the ignition back OFF

⇨ *Automatic retraction begins again after the warning* BRAKE ? *on the display has been confirmed pushing the MENU-Button (see page 7.3.25)*

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(6) Manual operation switch (spindle switch) (continued)

Caution:

In Manual Mode:

- all automatic operations are stopped. The pilot has to conduct and control the extension and the retraction of the powerplant by himself with the manual operation switch.

- the pilot has to stop, position and hold the propeller during the retraction with the manual propeller brake handle (see section 7.2).

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(7) MENU-Button

The menu button is used to:

- select in the display menu of the LCD display
- confirm operating instructions, warnings and failure notices
- enter the total available fuel when using wing-fuel-tanks (Option)
- reset the short term service time counter
- calibrate the read-out of the fuselage tank fuel volume

(8) Ignition switch

Position UP:
- Ignition ON
- Powerplant extends fully (automatic operation)
- Electric fuel pump is turned on
- Water pump is turned on

Position DOWN:
- Ignition OFF
- Powerplant retracts automatically as soon as the propeller stops and is positioned properly (automatic operation)
- Electric fuel pump is turned off
- the water pump is shut down when the water temperature sinks below 60°C

Note:
When the powerplant reaches the fully extended position with ignition ON but is not started, after a short period of time the fuel pump and water pump will be shut off (energy saving mode).
As soon as the starter button is pushed, both pumps will be turned on.

(9) Test switch ignition circuit

Toggle switch with 3 positions to test the separate ignition circuits 1 and 2.
In middle position (default position) both ignition circuits are active

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(10) LCD-Display

Various information is shown on the 8 digit LCD-diplay. The outputs of the LCD-display can be distinguished into one of the following categories:

- Operational data (abbr. „D“), that gives the pilot details about essential parameters

- Operational instruction (abbr. „I“), that tells the pilot that he must take action in order to continue safe operation of the powerplant.
  When the instruction is coupled with a prompt to the pilot, the notification ends with „?“.

- Error indication (abbr. „E“), that notifies the pilot that there is a failure in one of the system components.

Note:
The display messages are only available in English language.

Because the display has only 8 characters, many terms are abbreviated. In order to be able to categorize text messages, a number of messages is spread onto 2 text pages that alternate on the display.
In order to indicate that the message continues, the text on the first page ends with a hyphen, e.g. PAUSE- STARTER .

Notifications that are essential for the pilot controlling and monitoring the powerplant system are displayed exclusively with capital letters.

All other notifications that include lower case letters are used as information about the status of the program sequence in automatic operation. They require no action from the pilot.

The most important abbreviations and terms shown on the display are described in the following glossary.

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(10) LCD-Display (continued)

Glossary:

Display	Meaning	see page
AIR-SENS	Air temperature sensor of engine control system	7.3.38
BAT	Voltage of engine battery	7.3.24 7.3.28
BRAKE?	Query of powerplant control system, if the automatic retraction process should be started	7.3.25 7.3.31
CALIBR.?	Query of powerplant control system, if the calibration of the display of the fuel amount in the fuselage tank should be started	7.3.24 7.3.31
CAN MISS	„**CAN** bus **miss**ing“ – data transfer between engine control system and powerplant control system disturbed	7.3.38
COM MISS	„**Com**munication **miss**ing“ – data communication between powerplant operating unit and powerplant control unit disturbed	7.3.39
GC	**G**enerator **C**urrent	7.3.24 7.3.28
EMERG.- OPERAT.	„**Emerg**ency **Operat**ion“ – Emergency system for Extension and Retraction of powerplant activated	7.3.8 7.3.31
ERROR	Error	7.3.38 and on
EXTEND	Powerplant not fully extended	7.3.32
FUEL	Fuel amount	7.3.24 7.3.28
FUELCOCK	Fuelcock	7.3.32
FUSE	electrical fuse	7.3.35
FUSE IN	internal fuse of powerplant control unit	7.3.34
H2.03	Hardware version 2.03 (Example)	7.3.42
H20-PUMP	electric cooling water pump	7.3.35 7.3.39
IGNI.	**Igni**tion	7.3.32

I Powerplant operating unit MCU II BG - continued

A) Device description (continued)

(10) LCD-Display (continued)

Glossary: (continued)

Display	Meaning	see page
MAN.MODE	Manual operation for extension and retraction of the powerplant	7.3.32
PAUSE	Blocking of the automatic extension and retraction process of the powerplant when turning on the powerplant control	7.3.33
POWERSUP	Power supply of control unit	7.3.40
PROP. BRK	Electric servo for automatic propeller brake	7.3.40
Prop. Ok	Propeller is in proper position for retraction	7.3.25 7.3.29
Prop.Pos	Program for the automatic retraction of the powerplant is active	7.3.25 7.3.29
PulseBrk.	Pulse-break of automatic propeller break is active	7.3.25 7.3.29
PROPSENS	Proximity switch for the propeller position	7.3.35
S5.67	**S**oftware version 5.67 (example)	7.3.42
SPINDLE	Spindle drive fort he extension and retraction oft he powerplant	7.3.35
STARTER	electric starter	7.3.33
SW	**S**oft**w**are	7.3.40
SWITCH	Limit switches	7.3.36 an on
TEKVALVE	(Optional) switch of TEK-Probe with ignition switch	---
THROTTLE	Throttle position sensor of engine control	7.3.41
WPC	**W**ater**p**ump **c**urrent	7.3.24 7.3.28

I Powerplant operating unit MCU II BG - continued

B) Functional description

The following description of the displays on the Powerplant operating unit is divided into the following:

Important notifications for normal flight operations (page 7.3.24 and on):

a) Overview **POWERED FLIGHT DISPLAY**
This section includes the most important information about the notifications on the powerplant operating unit display while flying with extended powerplant.

b) Overview of powered flight display– Automatic powerplant retraction
This section includes the most important information about the notifications on the powerplant operating unit display when the powerplant is retracted using the ignition switch.

c) Overview **GLIDING DISPLAY**
This section includes the most important information about the notifications on the Powerplant operating unit display while flying with retracted powerplant.

Advanced information regarding notifications of the powerplant operating unit display:

d) Additional Information to the notifications (p. 7.3.27 and on)
This section includes additional information about notifications and warnings on the powerplant operating unit under normal operations.

e) Operating notifications (p. 7.3.30 and on)
This section includes a description of operating notifications that are shown on the powerplant operating unit if required.

f) Error reports (p. 7.3.34 and on)
This section includes a description of Error reports that are shown on the powerplant operating unit display if required.

g) Information regarding Hard- and Firmware (p. 7.3.42)
This section describes the process to determine the hardware- and firmware version of the powerplant operating and control unit.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

a) Overview **POWERED FLIGHT DISPLAY**

When the ignition is turned on or the powerplant is extended completely, the LCD display shows the screen for powered flight. By default, the following variables are displayed alternately:

Display (example)	Variable	Value (example)	Unit	No.
6100 85°	Engine RPM	6100	RPM	D1 3)
	Water temperature	85	°C	D2 3)
6100 10L	Engine RPM	6100	RPM	D1 3)
	Fuel quantity	10	Liter	D3 3)

The following variables or operational notifications will be shown sequentially when depressing the MENU button.

Display (example)	Variable (Notification)	Value (example)	Unit	No.
FUEL 10L	Fuel quantity	10	Liter	D3 3)
BAT12,3V	Voltage engine battery	12.3	V	D4 3)
GC 5,67A	Generator current	5.67	A	D5 3)
WPC1,23A	Water pump current	1.23	A	D6 3)
7654,98h	operating hour counter	7654.98	h	D7 3)
12:34M:S	short term operating hour counter 1)	12:34	min:s	D8 3)
[100]	Tank percent full	100	%	D9 3)
CALIBR.?	Calibrate tank sensor 2)	---	---	I2 4)

1) short term service operating hour counter can be reset, s. p. 7.3.29
2) Display and function are only available when the engine is retracted.
3) For further information concerning the indicated variables s. p. 7.3.27 and on.
4) For further information concerning the indicated notifications s. p. 7.3.30 and on.

If the MENU button is not pushed for more than 3 seconds, the display will automatically return to the powered flight display.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

b) Overview of powered flight display– Automatic powerplant retraction

When the engine is fully extended, switching off the ignition will begin the automatic powerplant retraction sequence.
During the automatic retraction sequence the LCD display will show the following notifications or information:

Display	Operation notifications / information	No.
BRAKE?	Operation notification will only occur, if the conditions for automatic retraction aren't met. The automatic retraction be started nevertheless by pushing the MENU-button. The retraction process can be stopped at any time with a short operation of the manual operation switch (switch to manual mode)	I1 [4]
Prop.Pos	Powerplant control system is executing the automatic retraction process of the powerplant.	D10 [3]
PulseBrk	Powerplant control system is executing the automatic propeller positioning process.	D13 [3]
Prop. Ok	Propeller is in proper position for retraction. Both proximity switches have contact.	D14 [3]

[3] For further information concerning the indicated variables s. page 7.3.29 and on.
[4] For further information concerning the indicated notifications s. page 7.3.30 and on.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

c) Overview **GLIDING DISPLAY**

The LCD screen shows the gliding display when the powerplant is fully retracted. By default, the following variables are displayed:

Display (example)	Variable	Value (example)	Unit	No.
12,3 10L	Voltage engine battery	12.3	V	D4 [3)]
	Fuel quantity	10	Liter	D3 [3)]

As long as the water temperature remains above 60°C with retracted powerplant, the following variables will be shown:

Display (example)	Variable	Value (example)	Unit	No.
12,3 62°	Voltage engine battery	12.3	V	D4 [3)]
	Water temperature	62	°C	D2 [3)]

[3)] For further information concerning the indicated variables s. page 7.3.27 and on.

All the other notifications shown under subsection a) can also be displayed by depressing the MENU button.

If the MENU button is not pushed for more than 3 seconds, the display will automatically revert to the gliding screen.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

d) Additional information to the notifications

To No.	Remarks, Range limits	Display (example)	associated warning signals	Warning resettable?
D1	Engine RPM display from RPM > 10	250 - - -	None	---
	Operating limitations see page 2.5	6750 85° (RPM blinking)	Signal-LED; Warn-LED + Constant tone	Nein
D2a	Powerplant extended: Display minimum water temperature 25°C	---- 35°	None	---
	Powerplant extended: Operating limitations see page 2.5	6100 118 (Water temperature blinking)	Warn-LED + Constant tone	Yes
D2b	Powerplant retracted: Display minimum water temperature 60°C	12,5 62°	None	---
	Powerplant retracted: water temperature ≥ 105°C	12,5 108 (Water temperature blinking)	Warn-LED + Constant tone	Yes
D2c	Powerplant extended or retracted: Water temperature sensor defect. Confirm error report ERROR - H2O-SENS with MENU-button. Then a constant value for the water temperature will be displayed: - "999" if the signal line is broken - "000" if a short-circuit fault occurred	12,5 999 (Water temperature blinking)	Warn-LED + Constant tone	Yes

Marked warning signals can be confirmed and reset using the MENU button. If the cause of the warning continues, the notification will be repeated at regular intervals.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

d) Additional information to the notifications (continued)

To No.	Remarks, Range limits	Display (example)	associated warning signals	Warning resettable?
D3	The display shows the available fuel quantity instead of the water temperature at constant intervals.	6100 85° 6100 10L	None	---
	Fuselage fuel tank quantity ≤ 8L	6100 7L (fuel quantity blinking)	Warn-LED + Constant tone	Yes
	Fuel gauge sensor failure	6100 0L (fuel quantity blinking)	Warn-LED + Constant tone	Yes
D4	Voltage engine battery < 11,5V or >16,0V	BAT11,3V (blinking)	Warn-LED + Constant tone	Yes
D5	Generator current	GC_5,67A	none	---
D6	Water pump current < 0,8A or >2,0A [1)]	WPC0,50A (blinking)	Warn-LED + Constant tone	Yes

[1)] A one time appearance of the warning at the start of the engine run can be caused by temporary air bubbles in the water circulation and is not critical.

> **Warning:**
> If the warning repeats while the engine is running, there could be a water pump failure or a heavy loss of coolant water! Observe coolant water temperature!

Marked warning signals can be confirmed and reset using the MENU button. If the cause of the warning continues, the notification will be repeatedly displayed at regular intervals.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

d) Additional information to the notifications (continued)

To No.	Remarks, Range limits	Display (example)	associated warning signals	Warning resettable?
D7	Operating time in hours (0-9999h) and decimal minutes (0-99min) (values are stored in powerplant control unit)	7654,98h	none	---
D8	Resettable short term operating hour counter[1)] Counting in minutes (0-99min) and seconds (0-59s)	12:34M:S	none	---
D9	Tank percent full (Description see page 4.2.2.6)	[100]	none	---
D10	Automatic powerplant retraction sequence is underway.	Prop.Pos	none	---
D11	- INTENTIONALLY LEFT BLANK -	---	---	---
D12	- INTENTIONALLY LEFT BLANK -	---	---	---
D13	Break-sequence for the propeller positioning is underway	PulseBrk	none	---
D14	Propeller is in the proper position for retraction. Both proximity switches have contact with the sensors on the belt pulley.	Prop.Ok	none	---

1) Resetting the short term operating hour counter: With retracted powerplant, use the MENU button to scroll through the pages. When the display shows the short term operating hour counter, depress and hold the MENU-button until the counter is reset.

Marked warning signals can be confirmed and reset using the MENU button. If the cause of the warning continues, the notification will be repeatedly displayed at regular intervals

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

e) Operating notifications

Operating notifications shall inform the pilot:

- if single steps in the progress of an operation have not or have not entirely been executed and
- if the pilot must take remedial action in order to end a running operation safely.

For these reasons, the operating notifications are partially coupled with warning signals, in order to steer the pilots attention to the display.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

e) Operating notifications (continued)

To No.	Display	associated warning signals	System status, Reason for the notification ➩ ***Action***
I1	BRAKE? (blinking)	Warn-LED + Pulse Tone	When turning off the ignition, the requirements for starting the automatic retraction process have not been met. [1)] *To start the automatic retraction process.* ➩ ***Depressing the MENU button starts the automatic retraction process.*** *Otherwise* ➩ ***Retract the powerplant manually***
I2	CALIBR.?	None	Powerplant operating unit is ready to calibrate the fuselage fuel gauge. ➩ *Calibration procedure (see FM section 4.2.2.9)*
I3	EMERG.- OPERAT.	Warn-LED + Constant tone	Red protecting cap of emergency system lifted up and emergency system activated *If cap has been opened unintentionally:* ➩ ***Close protecting cap*** *Otherwise* ➩ ***Use the MENU-button to confirm*** ➩ ***Extend or retract the powerplant using the emergency switch*** ➩ ***Engine operation possible*** *(see page 7.3.8 and on)* • *Caution: electric starter is enabled!* • *Water pump and electrical fuel pump run constantly.*

[1)] *Requirements for starting the automatic retraction process by switching off the ignition:*
- *Engine RPM > 2000 RPM when switching off the ignition and*
- *for at least 10s the engine RPM > 2000 RPM and*
- *limit switch for extended position is closed*

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

e) Operating notifications (continued)

To No.	Display	associated warning signals	System status, Reason for the notification ➩ ***Actions and important notifications***
I4	EXTEND (blinking)	Warn-LED + Pulse Tone	Powerplant not fully extended and Ignition is ON and Starter button is pushed ➩ ***Release starter button*** *If the engine shall be started:* ➩ ***Extend the engine fully, paying attention to the LED light!*** ➩ ***Depress starter button again***
I5	FUELCOCK (blinking)	Warn-LED + Pulse Tone	Powerplant is being extended and the fuel cock is closed. ➩ ***Open fuel cock***
I6	IGNI.OFF (blinking)	Warn-LED + Pulse Tone	Manual switch at retract and the ignition is ON ➩ ***Switch the ignition OFF*** ➩ ***Continue retracting***
I7	IGNI.ON (blinking)	Warn-LED + Pulse Tone	Powerplant extended completely and Ignition is OFF and Starter button is pushed ➩ ***Release starter button*** *If the engine shall be started:* ➩ ***Switch the ignition ON*** ➩ ***Depress starter button again***
I8	MAN.MODE	Two-tone	Powerplant control has been switched to manual mode, automatic mode has been turned off ➩ ***Extend or retract powerplant manually*** *or* ➩ ***Return to automatic mode*** *(see Page 7.3.17)*

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

e) Operating notifications (continued)

To No.	Display	associated warning signals	System status, Reason for the notification ⇨ ***Actions and important notifications***
I9	PAUSE	None	Blocking of automatic process when turning on the powerplant control system (safety switching): Current position of the Ignition switch would cause an immediate movement of the powerplant.
			If the powerplant should be extended or retracted automatically: ⇨ ***Make sure that the automatic extension or retraction of the powerplant is safely possible.*** ⇨ ***Switch the ignition switch*** *(from ignition ON to OFF or from ignition OFF to ON)* ⇨ ***Switch the ignition switch again to start the desired movement of the powerplant***
I10	PAUSE- STARTER	None	Blocking the starter (safety switching): When engaging the master switch powerplant while ignition is ON and the starter button is already depressed
			⇨ ***Release the starter button*** *If the engine shall be started:* ⇨ ***Depress the starter button again***

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports

Failure reports shall inform the pilot:

- if electrically operated components and sensors that are necessary for safe operation of the powerplant have failed.

- if the pilot must take remedial action in order to end an unsafe situation. The reason for the failure shall be investigated and resolved before next operation of the powerplant!

- if the pilot must be more attentive while operating the powerplant because of a failure.

For these reasons, failure reports are always coupled with warning signals in order to steer the pilots attention to the display.

The failure reports are subdivided into:

- A blown fuse or tripped electrical circuit breaker (FUSE)
- Travel limit switch function failure (SWITCH)
- Device error (ERROR)

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – Fuse (FUSE):

Display	associated warning signals	System status, Reason for the notification ⇨ ***Actions and important notifications***
FUSE- SPINDLE	Warn-LED + Constant tone	Electrical circuit breaker for the spindle drive to extend/retract the powerplant has been tripped. ⇨ ***Depress*** **Spindle** ***circuit breaker***
FUSE IN- H2O-PUMP	Warn-LED + Constant tone	Internal fuse of coolant water pump has been tripped ⇨ ***Confirm with MENU-Button*** ⇨ ***In case of emergency engine operation possible for a short period of time*** ⇨ ***Risk of engine overheating, observe coolant water temperature!*** ⇨ ***Stop engine in time!***
FUSE IN- PROPSENS	Warn-LED + Constant tone	Internal fuse for both proximity switches of propeller positioning system has been blown. ⇨ ***Confirm with MENU-Button*** ⇨ ***Operation of Powerplant unharmed*** ⇨ ***Automatic retraction of the powerplant not possible*** ⇨ ***Stop and position the propeller with manual propeller brake handle after turning off ignition*** ⇨ ***Retract powerplant with manual operation switch***

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – travel switch (SWITCH):

<table>
<tr><th></th><th rowspan="2">Display</th><th rowspan="2">associated warning signals</th><th>System status,
Reason for the notification</th></tr>
<tr><th></th><th>➩ Actions and important notifications</th></tr>
<tr><td rowspan="5">Powerplant extension</td><td rowspan="2">SWITCH E
At the end of the powerplant extension process</td><td rowspan="2">Warn-LED
+
Constant tone</td><td>Extension limit switch for powerplant travel hasn't closed, spindle circuit breaker tripped.</td></tr>
<tr><td>➩ Confirm with MENU-button
➩ Depress Spindle Circuit breaker
➩ Engine operation possible</td></tr>
<tr><td rowspan="3">SWITCH E
At the beginning of the powerplant extension process</td><td rowspan="3">Warn-LED
+
Constant tone</td><td>Extension limit switch for the powerplant does not open, powerplant does not extend</td></tr>
<tr><td>In case of emergency:
➩ Extend powerplant with emergency system
➩ Engine operation possible
➩ No automatic readjustment of spindle drive!</td></tr>
<tr><td>To extending the powerplant on ground:
➩ push and hold the manual operation switch in the direction to extend !
➩ After 3 seconds following the failure report confirm using the MENU button
➩ Extend powerplant fully</td></tr>
<tr><td rowspan="5">Powerplant retraction</td><td rowspan="2">SWITCH R
At the end of the powerplant retraction process</td><td rowspan="2">Warn-LED
+
Constant tone</td><td>Retraction limit switch for the powerplant hasn't closed, spindle circuit breaker tripped.</td></tr>
<tr><td>➩ Confirm with MENU-button
➩ depress Spindle Circuit breaker</td></tr>
<tr><td rowspan="3">SWITCH R
At the beginning of the powerplant retraction process</td><td rowspan="3">Warn-LED
+
Constant tone</td><td>Retraction limit switch won't open, powerplant won't retract.</td></tr>
<tr><td>In case of emergency:
➩ Retract powerplant with emergency system</td></tr>
<tr><td>To continue retracting the powerplant on ground:
➩ Push and hold the manual operation switch in the direction to extend !
➩ After 3 seconds following the failure report confirm using the MENU button
➩ Retract powerplant</td></tr>
</table>

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – travel switch (SWITCH) (continued):

	Display	associated warning signals	System status, Reason for the notification / ➩ ***Actions and important notifications***
Man. Extension	SWITCH E At the end of the powerplant extension process	Warn-LED + Constant tone	Extending the powerplant with the manual operation switch although the limit switch is already closed. ➩ ***Release Manual operation switch*** ➩ *Confirm with MENU-button* ➩ ***Engine operation possible***
Man. Retraction	SWITCH R At the end of the powerplant retraction process	Warn-LED + Constant tone	Retracting the powerplant with the manual operation switch although the limit switch is already closed. ➩ ***Release Manual operation switch*** ➩ *Confirm with MENU-button*
	SWITCH 2	Warn-LED + Constant tone	Extension and retraction limit switches for powerplant travel are both simultaneously closed. ***In case of emergency:*** ➩ ***Extend/Retract powerplant with emergency system*** ➩ ***Engine operation possible*** *Extend/Retract powerplant on ground:* ➩ *Confirm with MENU-button* ➩ *Only manual operation possible*

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – equipment failure or malfunction (ERROR)

Display	associated warning signals	System status, Reason for the notification ➩ ***Actions and important notifications***
ERROR- AIR-SENS	Warn-LED + Constant tone	Sensor for air temperature not connected to engine control, defect or measured value out of range ➩ *Confirm with MENU-button* ➩ ***In case of emergency engine operation possible*** ❗ *Caution: Engine has less power because of limited engine control*
ERRORCAL	Warn-LED + Constant tone	Fuel tank calibration value outside of the range (e.g. because the tank was only filled partially when calibrating) ➩ *Confirm with MENU-button* ➩ *Establish conditions for safe calibration (see page 4.2.2.9)* ➩ *Repeat calibration*
ERROR- CAN MISS	Warn-LED + Constant tone	Data link between powerplant control unit MCU II and engine control regular system (Trijekt) defect or disconnected by actuation of switch for engine control redundancy system ➩ *Confirm with MENU-Button* *If switch for engine control with redundancy system was not activated (s. page 7.3.2)* ➩ ***Switch to engine control with redundancy system*** ➩ ***In case of emergency engine operation possible*** ❗ *Caution: Engine has less power when operated with redundancy system*

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – equipment failure or malfunction (ERROR) (continued)

Display	associated warning signals	System status, Reason for the notification ⇨ ***Actions and important notifications***
ERROR- COM MISS	Warn-LED + Constant tone	Data link failure between powerplant operating unit and powerplant control unit. ⇨ ***Confirm with MENU-button*** ! ***Electrical water pump inoperative!*** ⇨ ***In case of emergency engine operation possible for a short period of time*** ⇨ ***Upcoming engine overheating, observe coolant water temperature (if possible)!*** ⇨ ***Stop engine in time!*** ⇨ *Extension/Retraction of powerplant only with manual operation switch or with emergency system possible* ! *Caution, no RPM display!* ! *Caution, no coolant water temperature display*
ERROR- H2O-SENS	Warn-LED + Constant tone	Coolant temperature sensor signal failure ⇨ *Confirm with MENU-button* ⇨ ***In case of emergency engine operation without coolant water temperature display possible*** ! *Caution: Display of a constant value instead of real water temperature:* *- „999“ if signal line is broken* *- „000“ if short circuit fault occurred*
ERROR- H2O-PUMP	Warn-LED + Constant tone	Electrical water pump not connected or malfunctioning ⇨ *Confirm with MENU-button* ⇨ ***In case of emergency engine operation without electrical water pump for a short period of time possible*** ⇨ ***Upcoming engine overheating, observe coolant water temperature!*** ⇨ ***Stop engine in time!***

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – equipment failure or malfunction (ERROR) (continued)

Display	associated warning signals	System status, Reason for the notification / ⇨ ***Actions and important notifications***
ERROR- **POWERSUP**	Warn-LED + Constant tone	Power supply of power lines of control unit interrupted
		⇨ *Confirm with MENU-button* ❗ ***Electric water pump inoperative!*** ⇨ ***In case of emergency engine operation without electrical water pump for a short period of time possible!*** ⇨ ***Upcoming engine overheating, observe coolant water temperature!*** ⇨ ***Stop engine in time!*** ⇨ *Extension/Retraction of powerplant with manual operation switch or emergency system possible*
ERROR- **PROP.BRK**	Warn-LED + Constant tone	Failure of the automatic propeller brake (e.g. because of low voltage, excessive load, malfunctioning servo, etc.)
		⇨ *Confirm with MENU-button* ⇨ ***Propeller brake must be operated manually be the pilot***
ERROR SW	Warn-LED + Constant tone	Performance test found an invalid change in the program.
		⇨ ***Engine inoperative!*** ⇨ *No display* ⇨ *No automatic features available* ⇨ ***Powerplant movement possible only using the emergency switch (see page 7.3.8)***

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

f) Failure reports – equipment failure or malfunction (ERROR) (continued)

Display	associated warning signals	System status, Reason for the notification ⇨ ***Actions and important notifications***
ERROR- THROTTLE	Warn-LED + Constant tone	Throttle position sensor of engine control system not connected or defect ⇨ ***If this failure occurs in a critical flying condition: To continue engine operation set throttle immediately to full power!*** ⇨ *Confirm with MENU-button* ⇨ ***In case of emergency engine operation possible*** *In case of failure of throttle position sensor the engine control system switches automatically to full power operation. Engine operation in part load range or starting the engine is possible only to a limited extend.* ⇨ ***Switch to redundancy system of engine control at safe altitude, if required*** ! *Caution: Engine operation with engine control system only limited operative or with redundancy system activated reduces engine power!*

Warning:

If ERROR- THROTTLE is displayed in critical flying condition set throttle to full power to continue engine operation.

I Powerplant operating unit MCU II BG - continued

B) Functional description (continued)

g) Information regarding Hard- and Firmware

i) Requirements to readout the units:

- Master switch powerplant ON
- Powerplant completely retracted

ii) Readout the system version of the operating unit:

- Push MENU-button of operating unit and keep it pushed
- Close powerplant circuit breaker
- After successful booting the information are display on the operating unit as scrolling text (Exp.):
-

ILEC MCU II-BG	BG12094	H2.01	S0.06
Unit designation	*SN*	*Hardware*	*Firmware*

Note:

If operating units are installed in both cockpits (option), both operating units have to be readout.

iii) Readout the system version of control unit:

- Close powerplant circuit breaker
- After successful booting push the MENU-button on the operating unit and keep it pushed.
- After approx. 5 s the information will be displayed as scrolling text:
-

ILEC MCU II-SG	ARCUS M	SG12079	H1.06	S1.02
Unit designation	*Typ*	*SN*	*Hardware*	*Firmware*

As soon as the display of the system version is finished the LCD-display switches automatically into the gliding display.

7.4 Undercarriage

The landing gear of the Arcus M consist of a retractable main wheel, equipped with shock absorber struts and a hydraulic disc brake, a fixed nose wheel (if installed) and a tail wheel (optionally steerable) respect. A tails skid.

The extension/retraction process of the main wheel is described in sectionr 7.2 “Cockpit description) on page 7.2.4 (Wheel break) and on page 7.2.7 (Undercarriage).

For a technical description of the retractable undercarriage including its wheel brake system see also page 1.2.3 of the Arcus M Maintenance Manual.

7.5 Seats and restraint systems

The seat pans are bolted to mounting flanges provided on both sides of the cockpit.

The front seat features a back rest, which is adjustable in flight - see also page 7.2.5 concerning the procedure for its adjustment.

For each seat the lap straps are anchored to the seat pan.

While the shoulder straps for the front seat are attached to the steel tube transverse frame, those for the rear seat are anchored to the steel tube center frame.

A list of approved restraint systems is provided in section 7.1 of the Arcus M Maintenance Manual.

7.6 Static pressure and Pitot pressure system

Static pressure sources

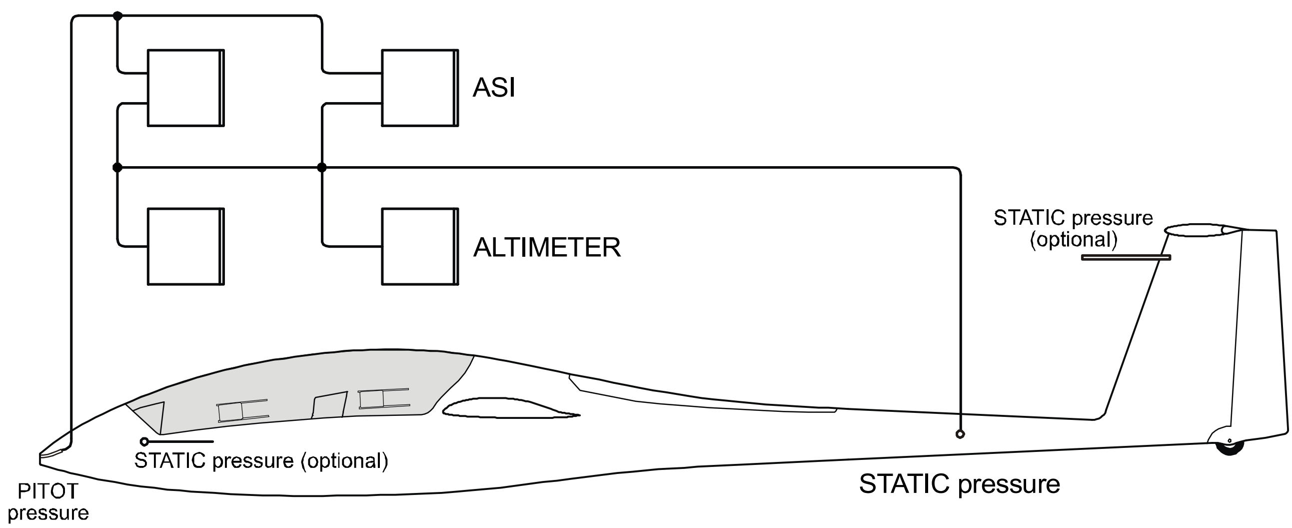
a) Static pressure ports are on either side of the fuselage tail boom, 1.02 m / 40.16 in. forward of the base of the fin.

b) On request a special static pressure probe can be installed near the top of the fin (for other instruments besides the ASI).

c) On request additional static pressure ports can be provided on either side of the fuselage skin next to the front instrument panel.

Pitot pressure sources

a) Pitot pressure head situated in the fuselage.



7.7 Airbrake system

Schempp-Hirth type airbrakes are employed on the upper surface of the main wing panels.

A schematic view of the airbrake system is given in the Maintenance Manual.

7.8 Baggage compartment

An enclosed baggage compartment is not provided.

For soft objects (like jackets etc.), however, there is space above the spar stubs. Any such items must be taken into account when determining the permissible load on the seats.

7.9 Water ballast system(s)

A steel cable connects the operating lever in the cockpit to the dump valve of the (optional) fin tank and a further steel cable to the torque tube actuating the wing tanks - see page 7.9.3.

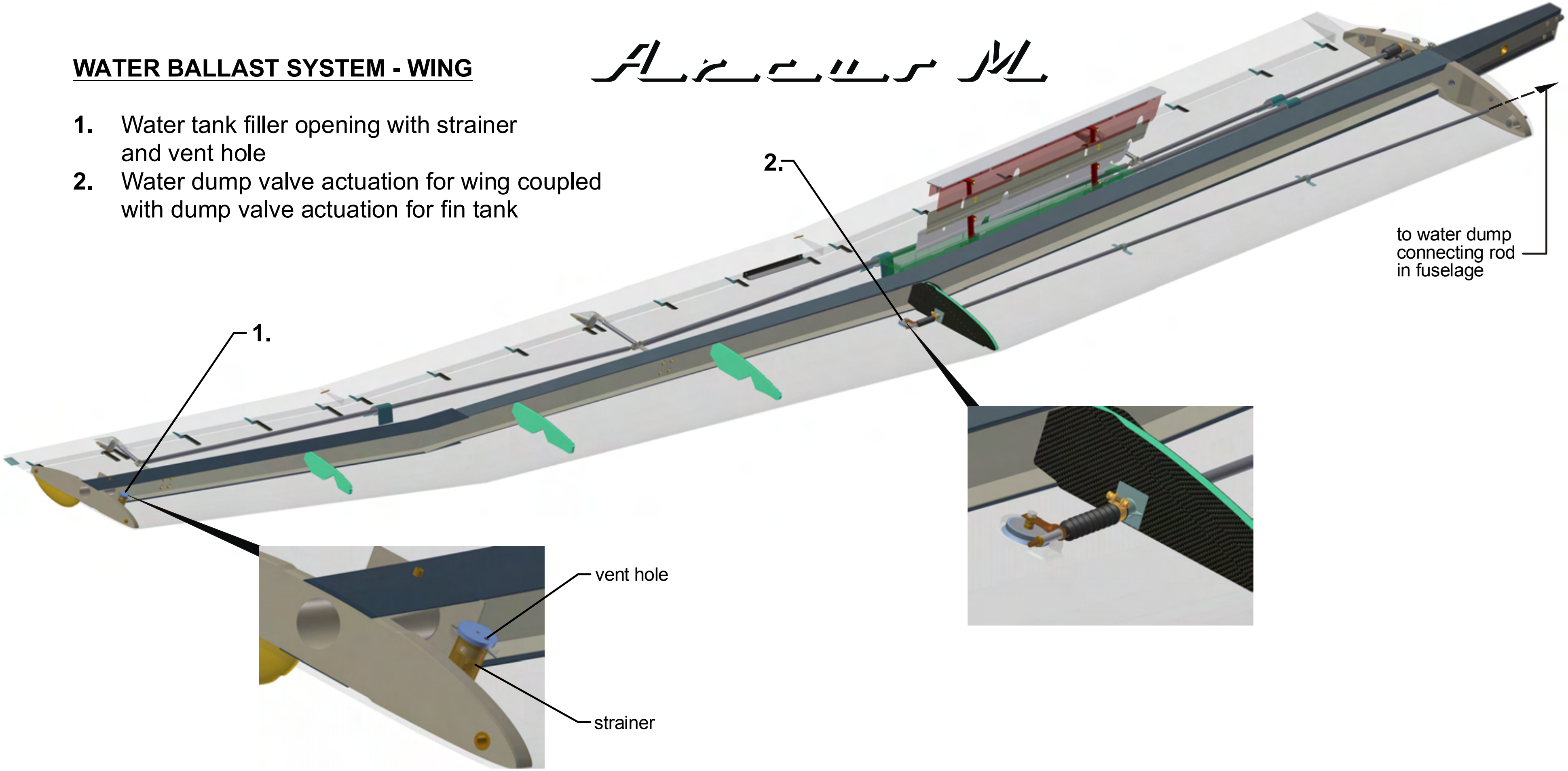
On rigging the main wing panels, the torque tube in the fuselage is automatically hooked up to the torsional drive of the dump valve plugs.

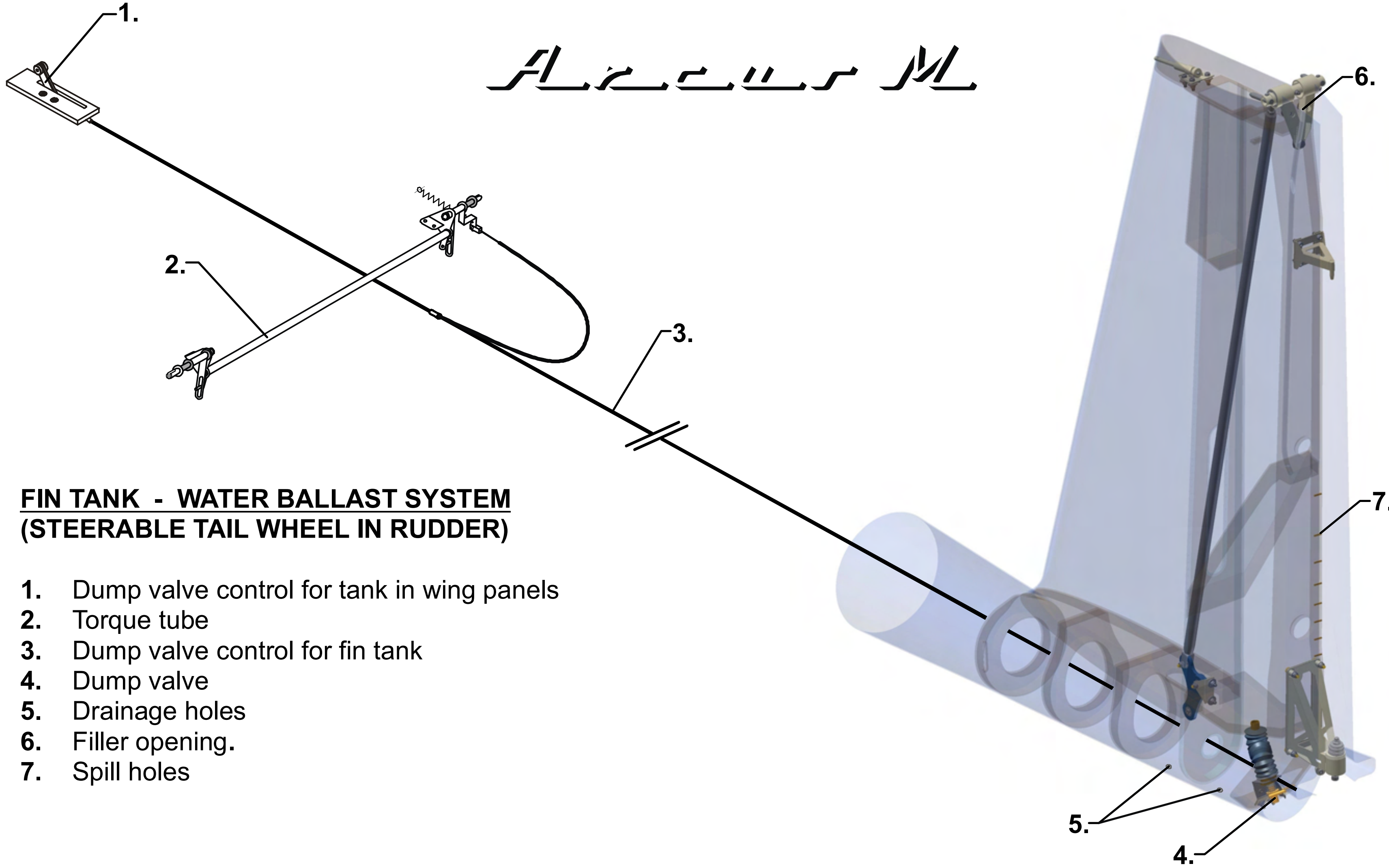
The torque tube is rotated to the "CLOSED" position by spring force - see page 7.9.2.

The operating lever locks in its respective final positions.

WATER BALLAST SYSTEM - WING

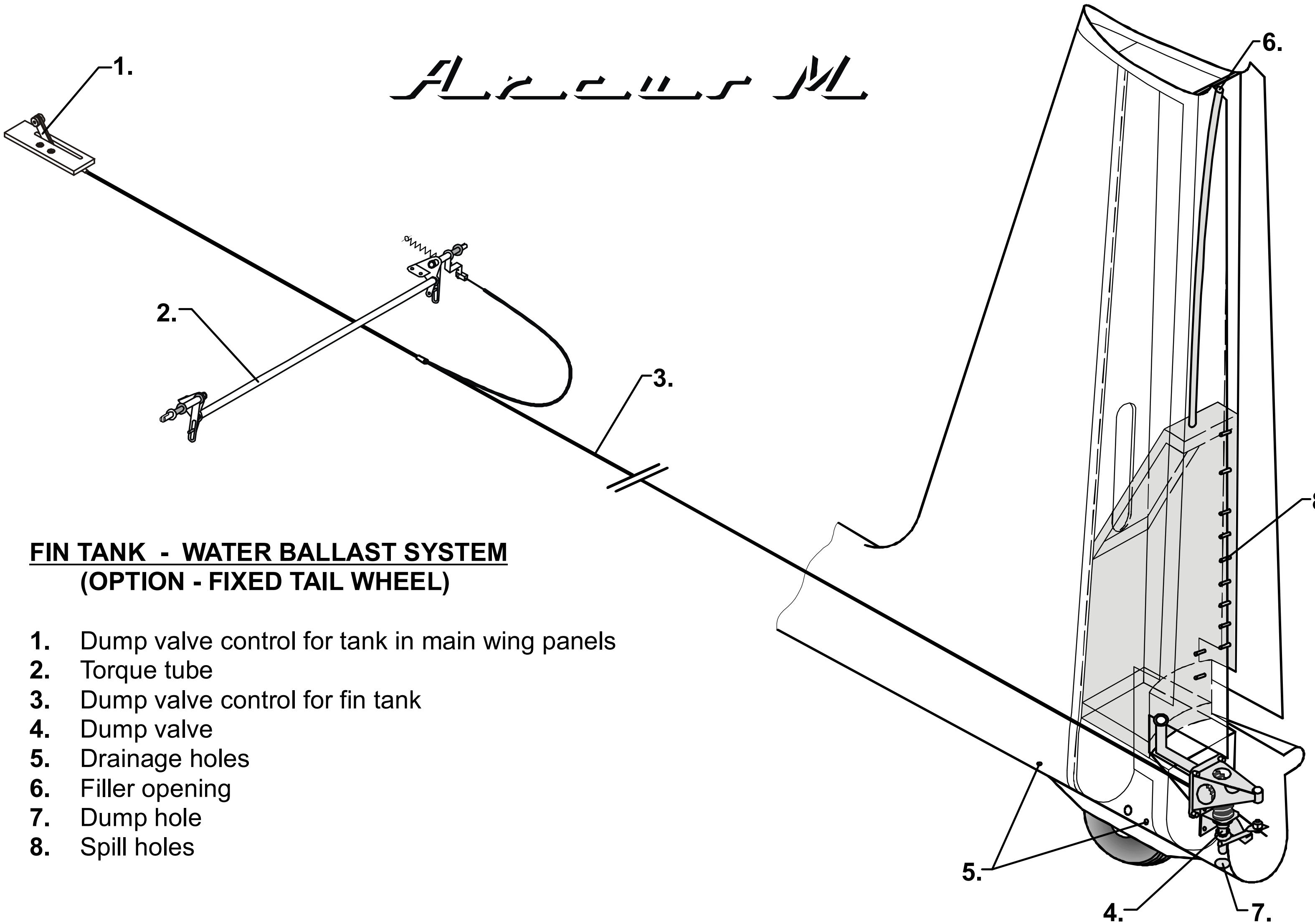
1. Water tank filler opening with strainer and vent hole
2. Water dump valve actuation for wing coupled with dump valve actuation for fin tank





FIN TANK - WATER BALLAST SYSTEM
(STEERABLE TAIL WHEEL IN RUDDER)

1. Dump valve control for tank in wing panels
2. Torque tube
3. Dump valve control for fin tank
4. Dump valve
5. Drainage holes
6. Filler opening.
7. Spill holes



FIN TANK - WATER BALLAST SYSTEM
(OPTION - FIXED TAIL WHEEL)

1. Dump valve control for tank in main wing panels
2. Torque tube
3. Dump valve control for fin tank
4. Dump valve
5. Drainage holes
6. Filler opening
7. Dump hole
8. Spill holes

7.10 Powerplant system

Engine and propeller (for a description and relevant data refer to the engine and propeller manual) are accommodated in a special CFRP mounting structure (pylon), which is pivoted to the fuselage steel tube center frame by means of two rubber shock mounts (vibration isolators). The arresting wire is attached to the pylon.

An electrical spindle drive, anchored to the fuselage deck and linked to the pylon, extends and retracts the latter.

The doors of the engine compartment are automatically opened and closed by a linkage while the pylon extends / retracts.

The panel-mounted engine control unit MCU II combines a number of functions required for operation of the power plant, a description of this unit is given on page 7.3.2 and the following.

Other additional controls for the power plant are just the fuel shut-off valve, the throttle lever and if necessary the manually operated propeller brake.

7.11 Fuel system

A view of the fuel system is given on page 7.11.2 – for a specification of the fuel to be used refer to page 2.4

Up to two flexible tanks may be used inside left and right wing optionally. Instructions on how to refuel the aircraft are found on page 4.2.2.1 through 4.2.2.3.

Fuel from the fuselage tank is drained via a valve situated on the right side of the u/c housing.

Fuel to the engine is always supplied from the fuselage tank, which is filled by the optional wing tanks by means of an interconnecting line featuring a quick-disconnect coupling.
Fuel from the fuselage tank is fed via a strainer, the electrical pump, a filter element and the shut-off valve to the injection system, which is connected to the engine.

Total fuel contents (in fuselage and wing panel(s)) are displayed by the powerplant operation unit MCU II BG – its fuel quantity indicator is adjustable.

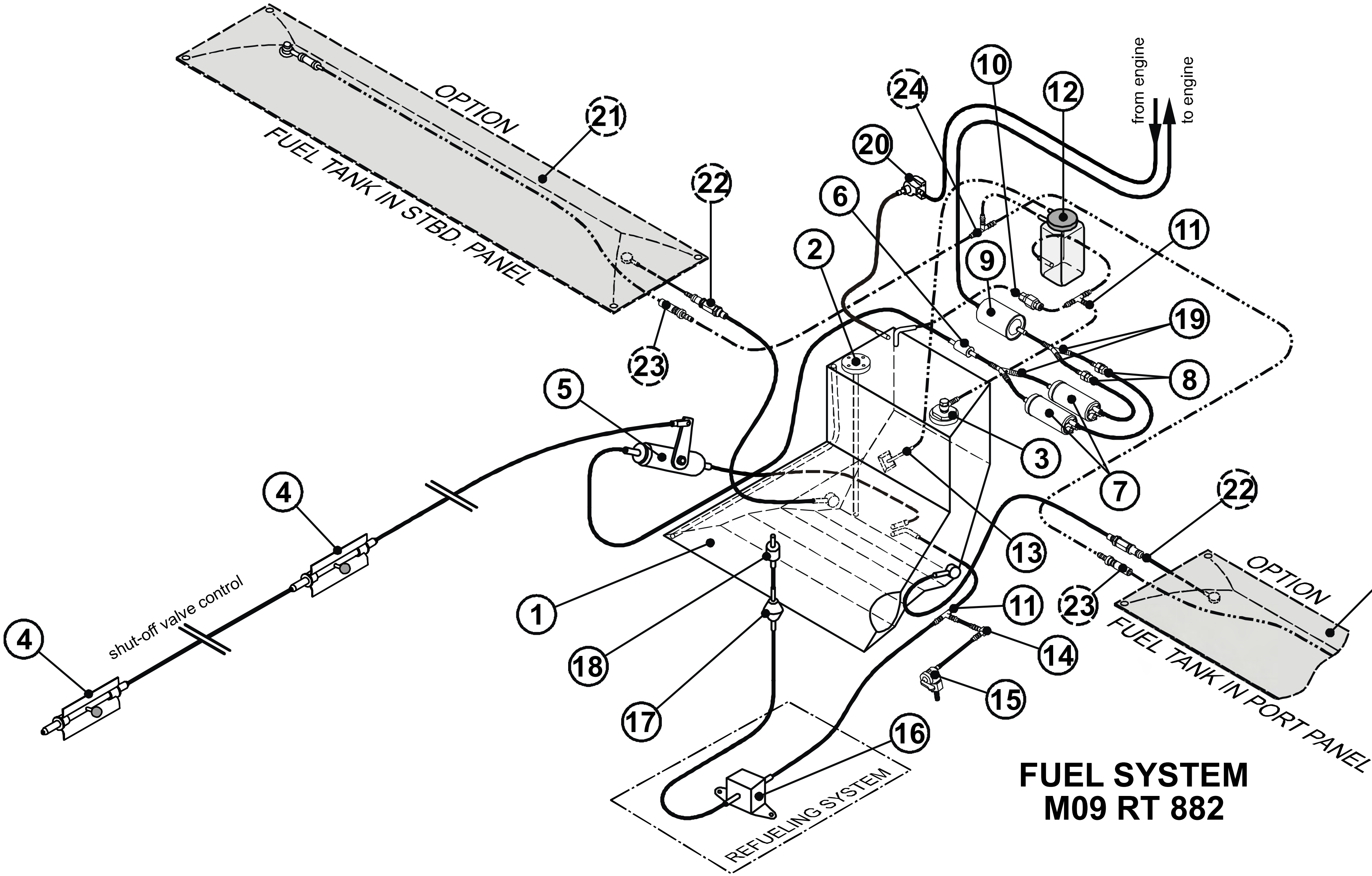
The vent line of the fuselage tank extends via an expansion reservoir to an opening on the lower side of the fuselage tube, on the right side behind the u/c housing.

Warning:
In order to prevent that the engine stops due to the lack of the fuel, the opening of the vent line must never be taped closed!

Each wing tank has a vent line – routed to the expansion reservoir – featuring a pressure relief valve and a connecting plug for the quick connection coupling on the fuselage tank system.

Refuelling system

The connecting point (with ON/OFF switch) for the refueling system is on the left side of the GFRP panel above the front transverse tube of the fuselage steel frame. The additional electrical fuel pump (with strainer) is found below the seat pan – see page 7.11.2.



FUEL SYSTEM
M09 RT 882

Parts list – see page 7.11.2

OPTIONS

Teil	Stück	Benennung	Bezeichnung	Hersteller/Lieferant
24	1	T-Connector	T5	NORMA
23	1(2)	Hose coupling	2-LP002-1-SL006-23-2	WALTHER
22	1(2)	Hose coupling	SP-006-0(2)-SL006-11-2	WALTHER
21	1(2)	Locking coupling	G1/4" IG	WALTHER
20	1(2)	Wing tank (1500 x 250)	HFK-W-TLF	HEIMANN

Teil	Stück	Benennung	Bezeichnung	Hersteller/Lieferant
20	1	Fuel controller	23 00 884	SOLO
19	2	Y-Connector	YS5	NORMAPLAST
18	1	Hose coupling	SP-006-0(2)-SL-11 mod.	WALTHER/SHK
17	1	Fuel filter element	99.106/8-100	KARCOMA
16	1	Refueling pump 12V	40 107	FACET
15	1	Drain valve	115.510	KARCOMA
14	1	Hose fitting	WS5	NORMAPLAST
13	1	Hose connector 90°	HS08-10.098 T5	SHK
12	1	Expansion reservoir	0.75 Liter	SHK
11	2	T-Connector	TS5	NORMAPLAST
10	1	Pressure relief valve	UA-11-0.2 (0.2 bar)	DRUKON
9	1	Fuel filter element	KL 14	MAHLE
8	2	Non-return valve	C1-Y8D3MV 1.5	DRUKON
7	2	Fuel pump	7.21287.53.0	PIERBURG
6	1	Fuel filter element	4.00030.80.0	PIERBURG
5	1	Fuel shut-off valve	4932 08 13AC	LEGRIS
4	2	Fuel valve control	M08 RT 855	SHK
3	1	Non-return valve	M03 RJ 806	SHK
2	1	Tank sensor	TF 0/0300	ILEC
1	1	Aluminium fuselage tank	M09 RT 880	SHK

FUEL SYSTEM
with opt. wing tanks
M09 RT 882

7.12 Electrical system

Gliding avionics

When operated in the plain sailplane configuration, the minimum instrumentation prescribed does not require an electrical power source.

Additional equipment is connected to the power supply “ELECTRICAL SYSTEM – AVIONIC”, see pages 7.12.3 and 7.12.5 and must comply with the manufacturer’s instructions for the relevant equipment.

Power for the gliding avionics is supplied by the battery for the power plant or by one of the up to 4 optional additional batteries which can be selected by the selector switch. See page 7.12.3 and 7.12.5.

For the gliding avionics and for the power plant separate main switches are installed.

Powerplant

The engine features a breakerless, map-controlled double-magneto ignition.

An electric power supply is necessary for the operation of the spindle drive, the starter motor, the electronic fuel injection system and the power plant operating unit. For this purpose there is a 12V battery provided. It is located at the cockpit steel tube transverse frame see "ELECTRICAL SYSTEM -POWER PLANT", page 7.12.4.

This battery is controlled by the power plant master switch. The state of charge may be checked by the powerplant operating unit.

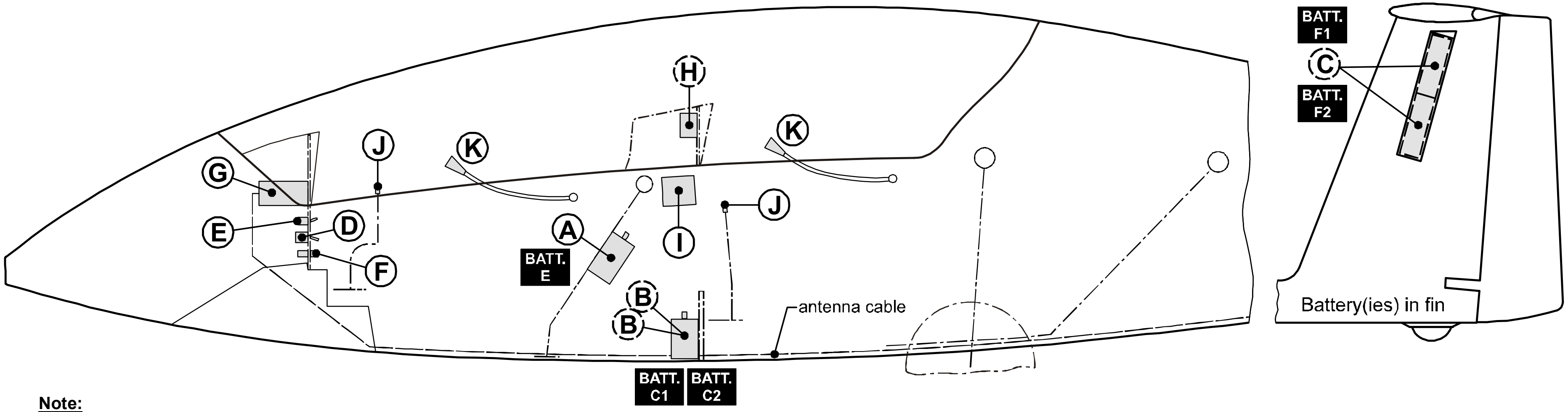
By means of the selector switch the gliding avionics may also be supplied by this battery.

The engine features an AC-generator which recharges this battery via a rectifier regulator. However the battery may also be charged from an external power source via a charger socket provided on the left side in front of the rear seat.

With powerplant master switch and powerplant control system switched on, the signals and values from the powerplant operating unit MCU II BG are provided.

A description of this unit's various functions and of all other power plant control elements including their interconnections is given in section 7.3.

.



Note:
VHF-Transceiver and other additional equipment to be wired in compliance with the manufacturer's instructions and be fused individually.

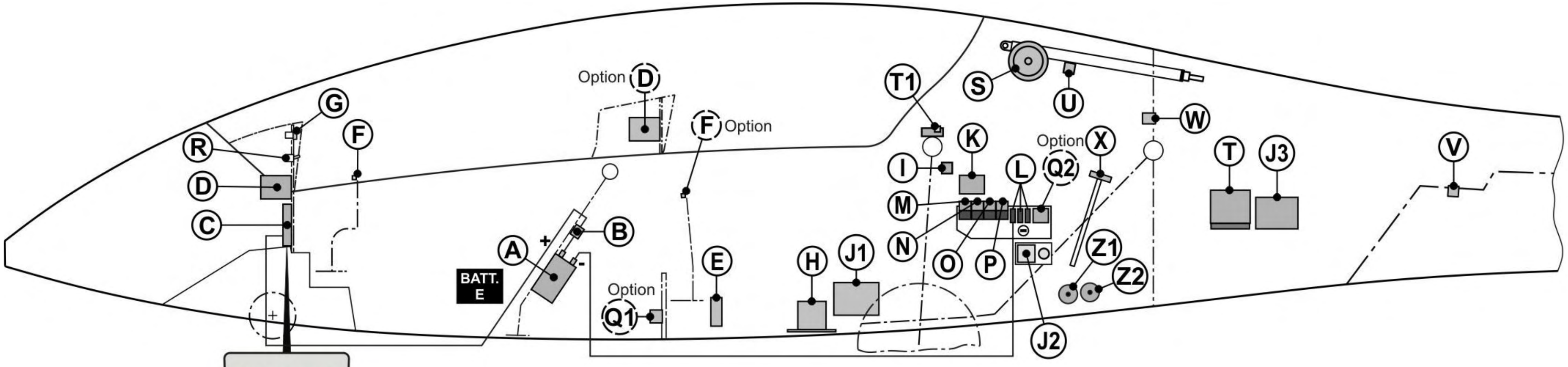
***)** Alternative types of storage batteries may be used if they meet the respective demands.

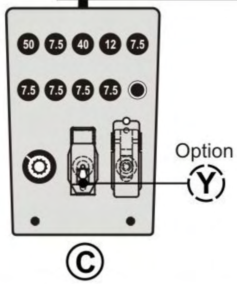
- (A) 1 battery 12V / 16 - 18Ah***)** BATT. E
- (B)(B) (OPTION) 1 - 2 batteries 12V / each 5.7 - 9Ah***)** BATT. C1 BATT. C2
- (C) (OPTION) 1 - 2 batteries 12V / each 5.7 - 9Ah***)** BATT. F1 BATT. F2, optional parallel connected

- (D) Master switch
- (E) Battery-selector switch (OPTION: additional Battery-selector switch - see 7.12.3)
- (F) Fuse board
- (G) VHF-Transceiver
- (H) (OPTION) VHF-Transceiver - slave control
- (I) Speaker
- (J) PTT button
- (K) Boom-microphone

Arcus M

ELECTRICAL SYSTEM - AVIONIC
M09 RE 880

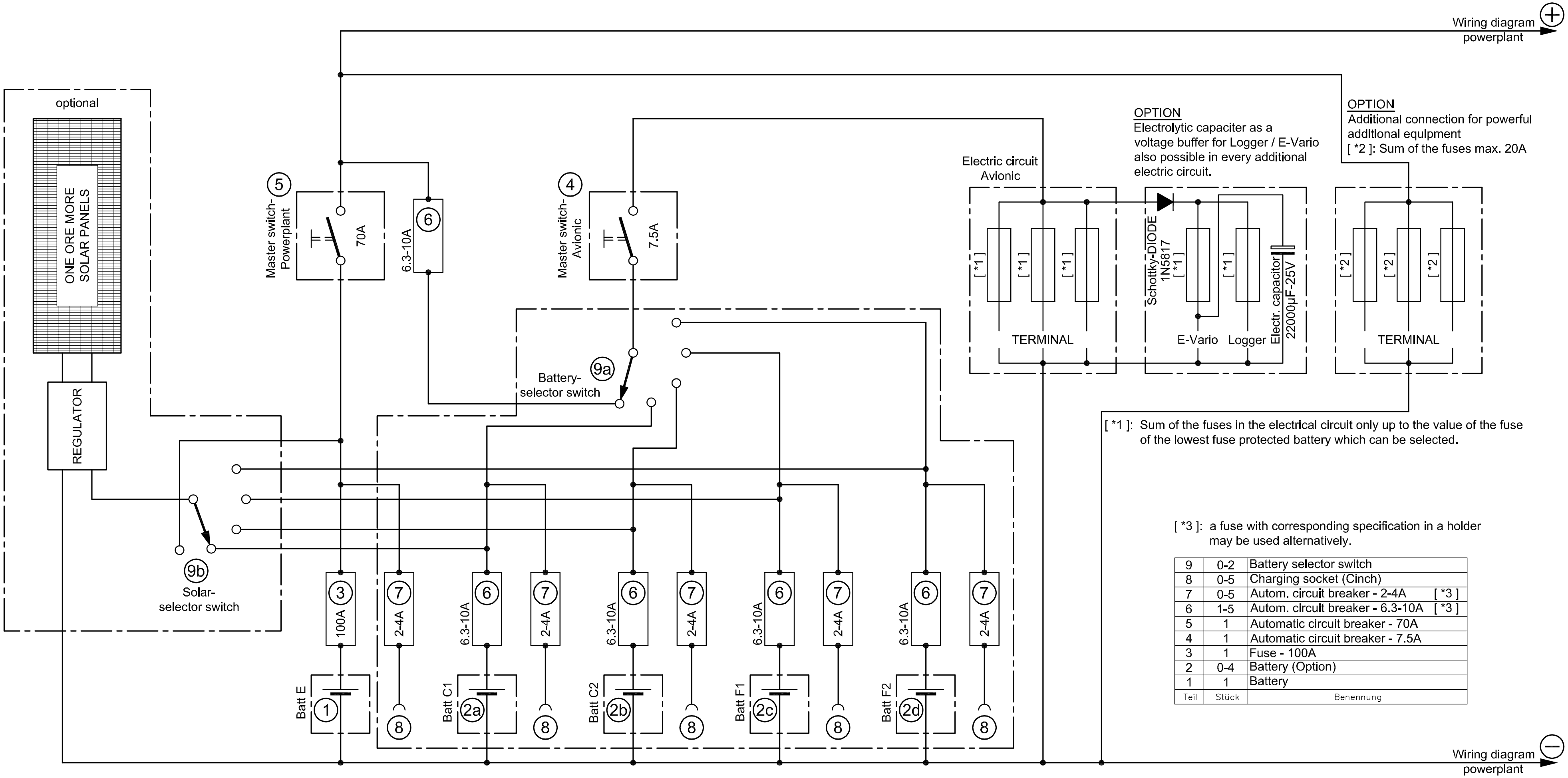




*) Alternative types of storage batteries may be used if they meet the respective demands.

ELECTRICAL SYSTEM - POWER PLANT M09 RE 882

(A)	1 Battery BATT. E 12V / min. 16Ah*)
(B)	Crash fuse 100A
(C)	Fuse panel (Description s. page 7.3)
(D)	Power plant operating unit - MCU II BG
(E)	Rectifier regulator
(F)	Starter button
(G)	Flashing light (Fire warning)
(H)	Electrical refueling pump
(I)	Refueling pump on/off switch
(J1)	Power plant control unit - MCU II SG
(J2)	Starter motor control
(J3)	Propeller brake servo
(K)	Redundancy system for engine control unit
(L)	Ground connection
(M)	Relay for fuel pump emergency system
(N)	Relay for fuel pump standard system
(O)	Relay for ignition 2
(P)	Relay for ignition 1
(Q1)	Ext. power receptacle (Option)
(Q2)	Relay - ext. power receptacle (Option)
(R)	Change-over switch - Redundancy system
(S)	Spindle drive
(T)	Engine control unit (Trijekt) - Standard system
(T1)	PC-Interface engine control (Trijekt)
(U)	Limit switch - Power plant extended
(V)	Limit switch - Power plant retracted
(W)	Thermal switch (Fire warning)
(X)	Fuel tank capacitor (inside fuel tank)
(Y)	Priority switch (Option)
(Z1)	Fuel pump - Normal system
(Z2)	Fuel pump - Redundancy system



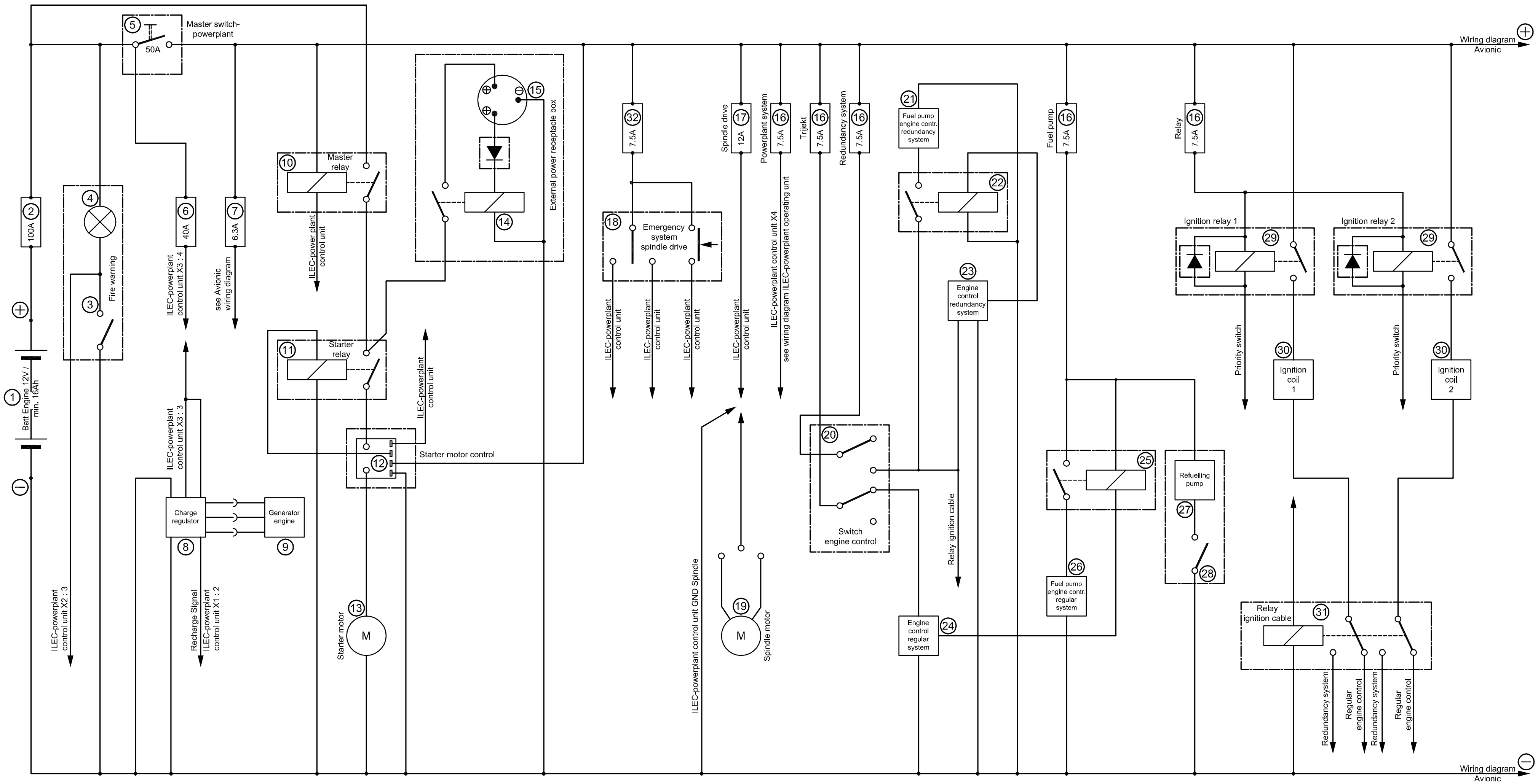
[*3]: a fuse with corresponding specification in a holder may be used alternatively.

Teil	Stück	Benennung
9	0-2	Battery selector switch
8	0-5	Charging socket (Cinch)
7	0-5	Autom. circuit breaker - 2-4A [*3]
6	1-5	Autom. circuit breaker - 6.3-10A [*3]
5	1	Automatic circuit breaker - 70A
4	1	Automatic circuit breaker - 7.5A
3	1	Fuse - 100A
2	0-4	Battery (Option)
1	1	Battery

Solar panels must be wired at the main power supply only by a regulator with maximum voltage of = 14.1V.
An appropriate battery type must be used.

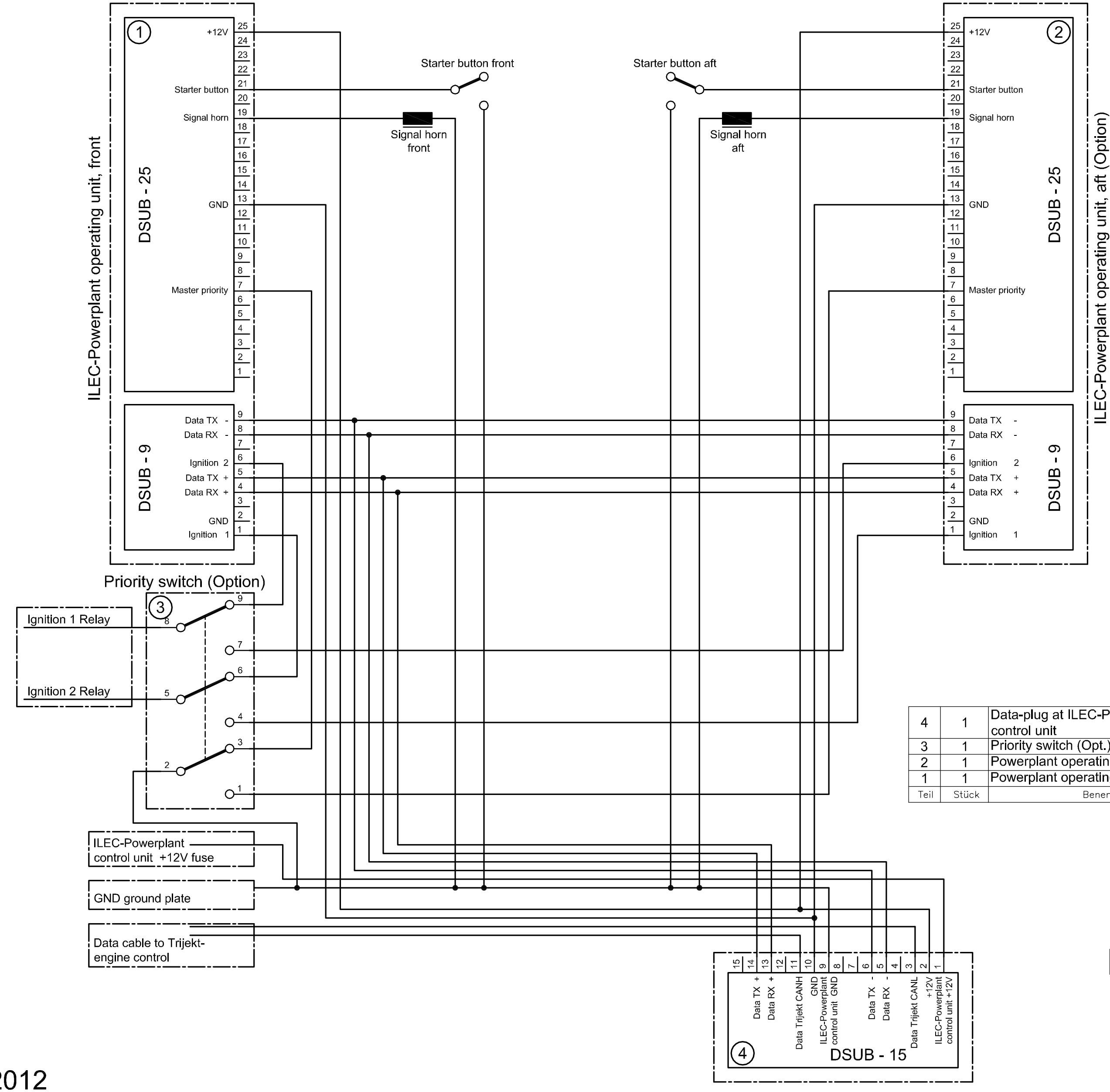
2a to 2d: optional up to 4 Batteries (without battery ①)
9a: Battery selector switch - Avionic.
9b: Solar selector switch (optional).

WIRING DIAGRAM - AVIONIC



Teil	Stück	Benennung	Teil	Stück	Benennung	Teil	Stück	Benennung
			22	1	Relay	11	1	Starter relay
32	1	Self-resetting fuse - 7.5A	21	1	Fuel pump	10	1	Relay
31	1	Relay	20	1	Switch engine control	9	1	Generator
30	2	Ignition coil	19	1	DC spindle drive	8	1	Charge regulator
29	1	Relay	18	1	Emergency switch spindle drive	7	1	Automatic circuit breaker - 6.3A/NA
28	1	Toggle switch refuelling	17	1	Automatic circuit breaker - 12A	6	1	Automatic circuit breaker - 40A
27	1	Refuelling pump	16	3	Automatic circuit breaker - 7.5A	5	1	Automatic circuit breaker - 50A
26	1	Fuel pump	15	1	External power receptacle box (Option)	4	1	Blinking LED, red
25	1	Relay	14	1	Relay	3	1	Temperature switch
24	1	Engine control regular system	13	1	Starter motor	2	1	Fuse - 100A
23	1	Engine control redundancy system	12	1	Starter motor control	1	1	Starter battery

WIRING DIAGRAM - POWERPLANT



4	1	Data-plug at ILEC-Powerplant control unit
3	1	Priority switch (Opt.)
2	1	Powerplant operating unit, aft (Opt.)
1	1	Powerplant operating unit, front
Teil	Stück	Benennung

WIRING DIAGRAM ILEC - POWERPLANT OPERATING UNIT

7.13 Miscellaneous equipment

Removable ballast (optional)

A mounting provision for removable ballast (trim ballast weights) is provided at the base of the front instrument panel.

A second ballast mounting provision is found on the right side of the front stick mounting frame.

The trim ballast weights (lead plates) are to be secured in place by bolts.

For information on how to alter the minimum front seat load refer to section 6.2.

Oxygen systems

Attachment points for the mounting brackets for oxygen bottles are provided on the fuselage skin above spar joint on the left and right sides. To prevent injuries, a hood must be installed covering each valve.

For the installation of oxygen systems, drawings may be obtained from the manufacturer.

> Caution:
>
> After oxygen systems are installed, it is necessary to re-establish the empty mass c/g position of the concerned Arcus M to ensure that the centre of gravity is still within the permitted range.

A List of oxygen regulators, currently approved, is found in the Arcus M Maintenance Manual.

ELT-installation

The installation of an Emergency Locator Transmitter is possible in the following places and must comply with the instructions obtained from Schempp-Hirth:

- In the region of the rear seat on either seat pan mounting flange
- beside the top of the main wheel housing
- on the reinforced baggage compartment floor above the wing spar stubs

Section 8

8.1 Introduction

This section contains manufacturer's recommended procedures for proper ground handling and servicing of the powered sailplane.
It also identifies certain inspection and maintenance requirements which must be followed if the powered sailplane is to retain optimal performance and dependability.

CAUTION:

It is wise to follow a planned schedule of lubrication and preventative maintenance based on climate and flying conditions encountered -see section 3.2 of the Arcus M Maintenance Manual.

8.2 Powered sailplane inspection periods

For details concerning the maintenance of this powered sailplane refer to its Maintenance Manual.

Airframe maintenance

Under normal operating conditions no airframe maintenance work is required between the annual inspection, except for the routine greasing of the spigots and ball bearings of the wing and tailplane attachment fittings.

Should the control system become heavy to operate, lubricate those places in the fuselage and in the wing panels where plain bearings are used (sliding control rods like u/c- and airbrake linkage).

Cleaning and greasing the wheels and the tow release mechanism(s) depends on the accumulation of dirt.

Rudder cables

After every 200 flying hours and at every annual inspection, the rudder cables are to be inspected at the point where they feed through the S-shaped guides in the pedals, especially at the points of maximum pedal adjustment.

If the rudder cables are damaged, worn or corroded, they must be replaced.
It is permissible for individual strands of the cables to be worn up to 25 %.

Powerplant maintenance

Propeller:

Maintenance work on the propeller is required after every 25 hours of engine time or at least once every year and must comply with the instructions given in propeller manual.

Engine:

Maintenance work on the engine is required after every 25 hours of engine time or at least once every year and must comply with the instructions given in the engine manual.

For all other powerplant accessories (pylon, pivoting mechanism, fuel system etc.), maintenance work is also required after every 25 hours of engine time or at least once every year.

8.3 Alterations or repairs

Alterations

Alterations on the approved model, which might affect its airworthiness, must be reported to the responsible airworthiness authorities p r i o r to their accomplishment. The authorities will then determine whether and to what extent a “supplemental type approval” is to be conducted.

In any case, the manufacturer’s opinion about the alteration(s) must be obtained. This ensures that the airworthiness does not become adversely affected and enables the aircraft owner/ operator to demonstrate at any time that the powered sailplane concerned complies with an approved version.

Amendments of the approved sections of the Flight- and/or Maintenance Manual must in any case be approved by the responsible airworthiness authority.

Repairs

Abbreviations:

CFRP: carbon-fibre reinforced plastic
GFRP: glass-fibre reinforced plastic

Before every take-off and especially after the powered sailplane has not been used for a while, it should be checked on the ground as shown in section 4.3.

Check for any sign of a change in the condition of the aircraft, such as cracks in the surface, holes, or delamination in the CFRP/GFRP structure etc.

If there is any uncertainty whatsoever regarding the significance of damage discovered, the Arcus M should always be inspected by a CFRP/GFRP expert.

There is no objection to minor damage - which does not affect the airworthiness in any way - being repaired on site.
A definition of such damage is included in the “REPAIR INSTRUCTIONS" which are found in the appendix to the Arcus M Maintenance Manual.

Major repairs may only be conducted by a certified repair station having appropriate authorization.

8.4 Ground handling / road transportation

a) Towing / pushing

When towing the powered sailplane behind a car, a tail dolly should always be used to avoid unnecessary tailplane vibration on the fittings - especially in tight turns.
When pushing the aircraft by hand, it should not be pushed at its wing tips, but as near to the fuselage as possible.

b) Hangaring

The powered sailplane should always be hangared or kept in well ventilated conditions. If it is kept in a closed trailer, there must be adequate ventilation.
The water ballast tanks and the wing fuel tanks must always be left completely empty.
The powered sailplane must never be subjected to loads when not in use, especially in the case of high ambient temperatures.

c) Tie-down

In the case of a powered sailplane remaining rigged permanently, it is important that the maintenance program includes rust prevention for the fittings on fuselage, wing panels and tailplane.
Tie-down kits common in trade may be used to anchor the aircraft.
Dust covers should be regarded as essential for the powered sailplane.

d) Preparing for road transport

As the wing panels have a thin airfoil section, it is important that they are properly supported, i.e. leading edge down, with support at the spar stubs and at the outer portion in cradles of correct airfoil section.
The fuselage can rest on a broad cradle just forward of the u/c doors and on its tail wheel (or skid).
The horizontal tailplane should be kept leading edge down in two cradles of correct airfoil section or placed horizontally on a padded support.
Under no circumstances should the tailplane be supported by its fittings in the trailer.
For the road transport the wing fuel tanks must always be drained completely.

8.5 Cleaning and care

Although the surface coating of a composite aircraft is robust and resistant, always take care to maintain a perfect surface.

For cleaning and caring the following is recommended:

0 Clean the surface (especially the leading edge of wing panels, horizontal stabilizer and fin) with clear water, a sponge and a chamois leather.

0 Do not use rinsing additives common in trade too often.

0 Polish and polishing materials may be used.

0 Petrol and alcohol may be used momentarily only, thinners of any kind are not recommended.

0 Never use chlorine hydrogen (i.e. Tri, Tetra, Per etc.).

0 The best polishing method is the buffing of the surface by means of an edge buffing wheel, fitted to a drilling or polishing machine. Thereby hard wax is applied to the rotating disc and distributed crosswise over the surface.

Warning:

To avoid localized overheating, the buffing wheel should be moved constantly!

0 For cleaning those fuselage and tailplane areas that are facing the wake of the propeller, the use of a water soluble degreaser (e.g. FLEET - MAGIC EXTRA by Messrs. Chemsearch) is recommended.

Note:

Polishes, wax and additives containing silicone should not be used because this might cause additional work in the case of repairs of the coating.

- The canopy should be cleaned with a Plexiglas cleaner (e.g. "Mirror Glaze", "Plexiklar" or similar) or with warm water if necessary.
  The canopy should be wiped down with a soft clean chamois leather or a very soft material such as cotton.
  N e v e r rub the canopy when it is dry!

- The powered sailplane should always be protected from the wet.
  If water is found inside, the components should be stored in a dry environment and turned frequently to eliminate the water.

- The powered sailplane should not be exposed unnecessarily to intense sunlight or heat and should not be subjected to continual mechanical loads.

Warning:

All external portions of the powered sailplane exposed to sunlight must be painted white with the exception of the areas for the registration and anti-collision markings.

Colours other than white can lead to the CFRP/ GFRP overheating in direct sunlight, resulting in insufficient strength.

Section 9

9. Supplements

9.1 Introduction

9.2 List of inserted supplements

9.1 Introduction

This section contains the appropriate supplements necessary to safely and efficiently operate the Arcus M when equipped with various optional systems and equipment not provided with the standard aircraft.

9.2 List of inserted supplements

Date	Section	Title of inserted supplements
	--	--