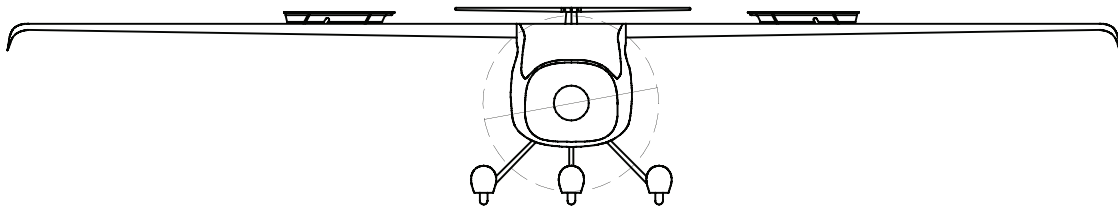




Flight manual and Maintenance manual

**applies to Virus SW MTOM 600 kg equipped with
Rotax 912 UL or Rotax 912 ULS engine to be operated
in compliance with EASA PtF Approval of Flight Conditions
Tail-wheel version owners see
Supplemental sheet at the back of this manual**



REV. I
(4 May, 2012)

This is the original manual of Pipistrel d.o.o. Ajdovscina
Should third-party translations to other languages contain any inconsistencies,
Pipistrel d.o.o. denies all responsibility.

WARNING!

As this manual applies to both models of Virus SW (80 HP and 100 HP) it is mandatory
to designate those specific parts of this manual that regard the aircraft you fly.

This manual **MUST** be present inside the cockpit at all times!
Should you be selling the aircraft make sure this manual is handed over to the new owner.

Virus SW model:

Serial number:

Date of manufacture:

Aircraft empty weight (kg):

Fuel weight:

Available cargo weight:

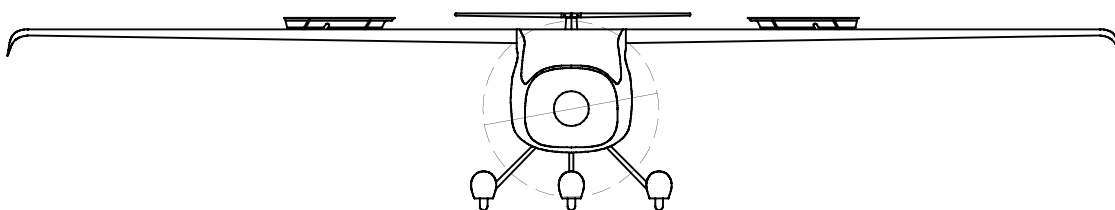
Equipment included in aircraft empty weight:

Date and place of issue: **Ajdovščina,**



Pipistrel d.o.o. Ajdovščina, Goriška cesta 50a, SI-5270 Ajdovščina, Slovenija
tel: +386 (0)5 3663 873, fax: +386 (0)5 3661 263, e-mail: info@pipistrel.si
www.pipistrel.si

Flight manual and Maintenance manual for



Virus SW

Models: Virus 912 SW (tailwheel and nosewheel), with Rotax 912 UL, Rotax 912 ULS

Data Sheet number:

Factory serial number:

Registration number:

Date of Issue: April, 2011

Pages signed under "Approval" in section Index of revisions and List of valid pages
(pages 4 and 5 of this manual) are approved by:

Authority:

Signature:

Stamp:

Original date of Approval:

This aircraft is to be operated in compliance with information and limitations contained herein.
The original English Language edition of this manual has been approved as operating instruction
according the legislations applicable and in-force by the above authority.

Approval of translation has been done by best knowledge and judgement.

List of valid pages

This manual contains 108 original and revised pages listed below.

	Pages	State (Revision)	Approval:
Cover		REV 0	
Page numbering		REV 0	
Authority approval sheet	3	REV 0	
Index of revisions	4	REV 0	
List of valid pages	5	REV 0	
Table of contents	7	REV 0	
General	9 - 12	REV 0	
Limitations	13 - 20	REV 0	
Emergency procedures	21 - 24	REV 0	
Normal procedures	25 - 38	REV 0	
Performance	39 - 46	REV 1	
Weight and balance	47 - 52	REV 0	
Aircraft and systems on board	53 - 66	REV 0	
Handling and maintenance	67 - 78	REV 0	
Appendix	79 - 100	REV 0	
Supplemental sheet for Sinus NW	101 - 106	REV 0	

CAUTION!

This manual is valid only if it contains all of the original and revised pages listed above.

Each page to be revised must be removed, shredded and later replaced with the new, revised page in the exact same place in the manual.



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Table of contents

General

Limitations

Emergency procedures

Normal procedures

Performance

Weight and balance

Aircraft and systems on board

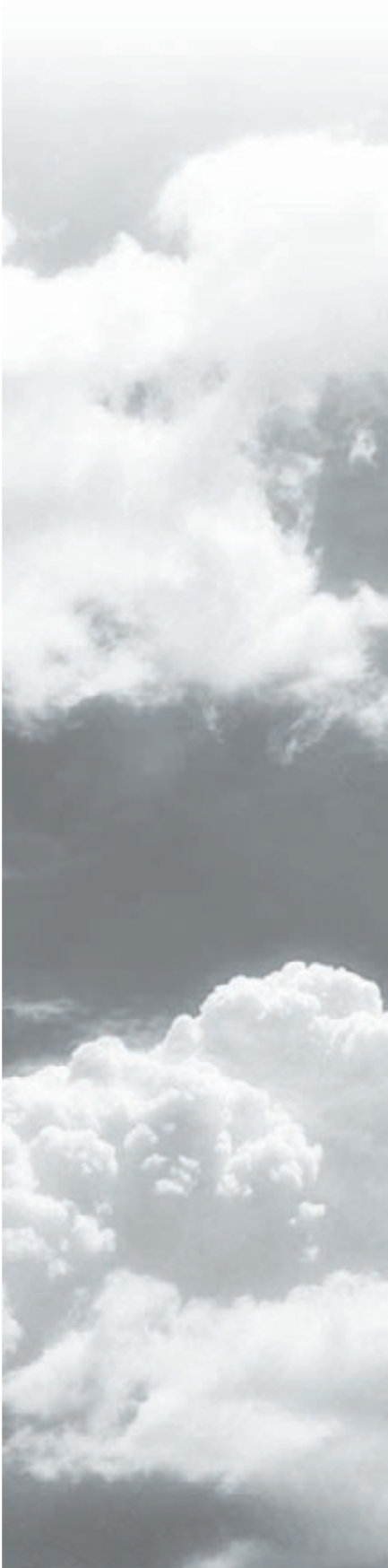
Handling and maintenance

Appendix



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General



Introduction

Certification basis

Notes and remarks

Technical data

3-view drawing

Introduction

This manual contains all information needed for appropriate and safe use of Virus 912 SW.

IT IS MANDATORY TO CAREFULLY STUDY THIS MANUAL PRIOR TO USE OF AIRCRAFT

In case of aircraft damage or people injury resulting from disobeying instructions in the manual PIPISTREL d.o.o. Ajdovscina denies all responsibility.

All text, design, layout and graphics are owned by PIPISTREL d.o.o. Ajdovscina. Therefore this manual and any of its contents may not be copied or distributed in any manner (electronic, web or printed) without the prior consent of PIPISTREL d.o.o. Ajdovscina.

Certification basis

PIPISTREL d.o.o possesses the manufacturing licence issued by SI-CAA (ULN no.: P-03).

Certification basis used in design, manufacture and testing is based largely on LTF-UL 2003 standards with additions of applicable CS-22, CS-23 and CS-VLA sections. ASTM standards are met and surpassed as well.

SACAA standards for LSA aeroplanes are met fully.

Notes and remarks

Safety definitions used in the manual:

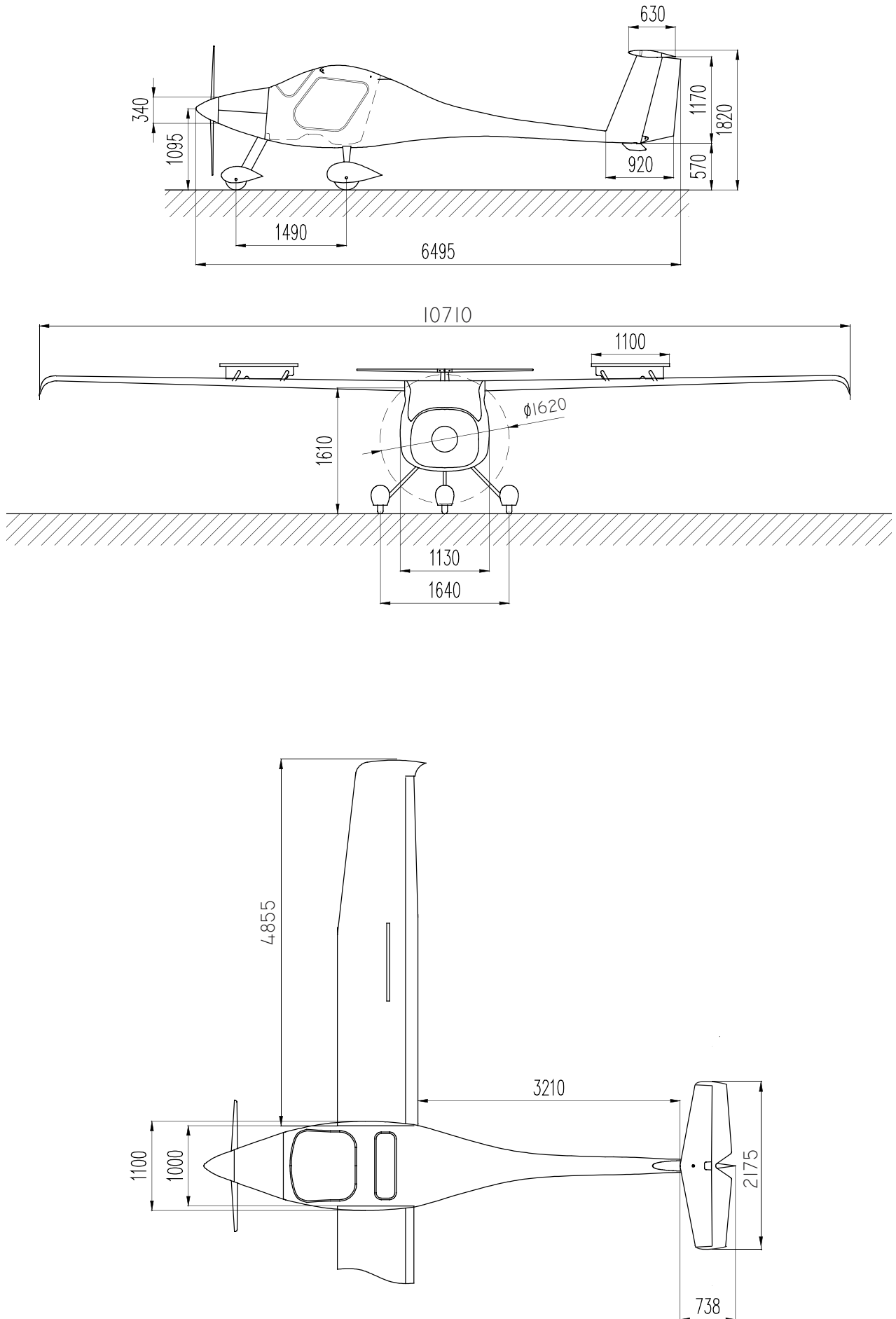
WARNING! Disregarding the following instructions leads to severe deterioration of flight safety and hazardous situations, including such resulting in injury and loss of life.

CAUTION! Disregarding the following instructions leads to serious deterioration of flight safety.

Technical data

PROPORTIONS	912 SW <small>(all models)</small>
wing span	10.71 m
length	6.50 m
height	1.85 m
wing surface	9.51 m ²
vertical fin surface	1.1 m ²
horizontal stabilizer and elevator surface	1.08 m ²
aspect ratio	11.3
positive flap deflection (down)	9°, 19°
negative flap deflection (up)	5°
centre of gravity (MAC)	25% - 37%

3-view drawing





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Limitations



Introduction

Operational velocities

Engine, fuel, oil

Weight limits

Centre of gravity limits

Manoeuvre limits

G-load factors

Cockpit crew

Types of operations

Minimum equipment list

Other restrictions

Placards

Introduction

This chapter provides information about operational restrictions, instrument markings and basic knowledge on safe operation of aircraft, engine and on-board appliances.

Operational velocities

Speed limits

	Velocity	IAS [km/h (kts)]	Remarks
VNE IAS up to 4000 m/13100 ft, TAS above	Velocity never to be exceeded	302 (163)	Never exceed this speed. Should the VNE be exceeded, land as soon as possible and have the aircraft verified for airworthiness by authorised service personnel.
VH	Maximum permitted horizontal speed	272 (163)	Do not exceed this speed in horizontal flight.
VRA	Maximum safe velocity in rough air	250 (135)	Maximum speed in turbulent air.
VA	Manoeuvring velocity	174 (94)	Do not use rough or full stick and rudder deflections above this speed.
VFE	Max. velocity flaps extended	130 (70)	Do not exceed this speed with flaps extended (+5, 19 degrees).
VAE	Max. velocity of airbrake extension	205 (110)	Do not extend spoilers above this speed.

Airspeed indicator markings

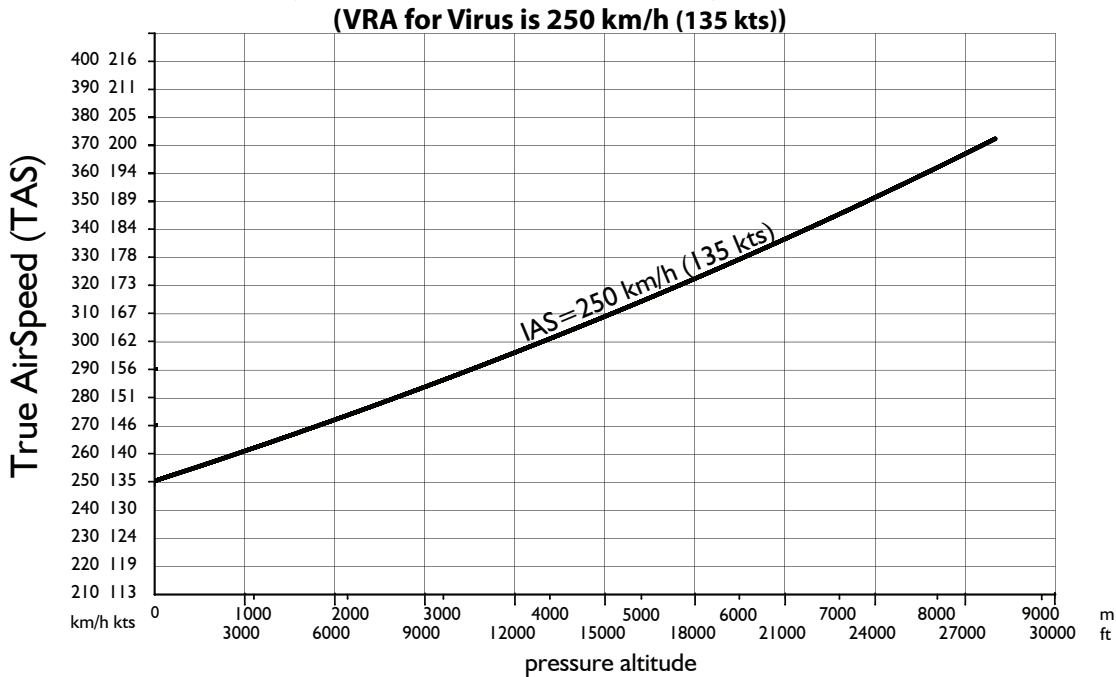
MARKING	IAS [km/h (kts)]	Definition
white arc	88 - 130 (47 - 70)	Speed range where flaps may be extended. Lower end is defined as 110% of VS0 (stall speed in landing configuration at MTOM - 64 km/h), upper end of speed range is limited by VFE (see above).
green arc	96 - 250 (52 - 135)	Speed range of normal operation. Lower end is 110% of VS1 (stall speed at MTOM with flaps in neutral position - 79 km/h), upper end is limited by VRA (see above).
yellow arc	250 - 302 (135-163)	Manoeuvre the aircraft with great caution in calm air only.
red line	302 (163)	Maximum speed allowed.
blue line	148 (79)	Best climb rate speed (V_{γ})

Indicated airspeed (IAS) to true airspeed (TAS) relation

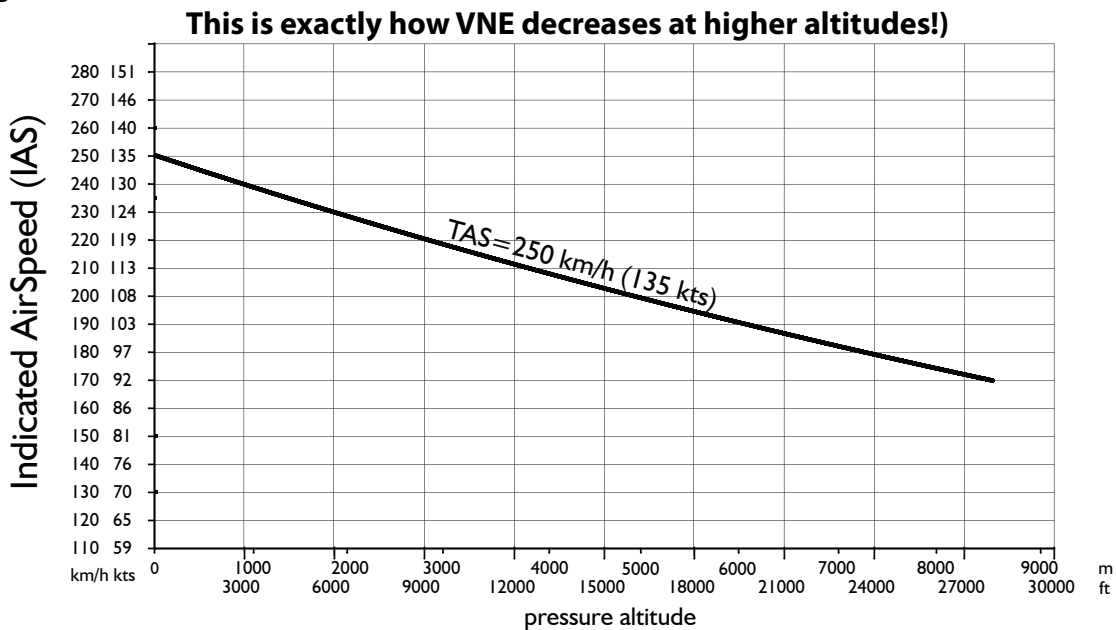
Airspeed indicator measures the difference between total and static pressure (also called dynamic pressure), which does not only change as speed increases, but is also linked with altitude. Flying at high altitudes, where the air is getting thinner, results in misinterpreting airspeed which is being indicated. The indicated airspeed value is actually lower than the true airspeed to which the aircraft is exposed. The higher you fly, the bigger the difference between IAS and TAS. Be aware of this effect especially when flying at high altitude at high speeds, not to exceed VNE unawarely. Bear in mind this can happen even with the indicator still pointing within the yellow arc! However, for flight planning purposes TAS is the most accurate speed, which then can be corrected by eventual tail/head wind component to obtain the aircraft's ground speed (GS).

IAS & TAS graphs (standard ICAO atmosphere)

The graph below shows how TAS changes in relation to pressure altitude. Note that the indicated airspeed (IAS) is constant along the entire servicable altitude range!



The graph below shows which indicated airspeed (IAS) must be maintained to keep the true airspeed (TAS) constant. Note that true airspeed (TAS) is constant along the entire servicable altitude range! (VRA for Virus is 250 km/h (135 kts) TAS).



WARNING! Above pressure altitude of 4000 meters (13100 ft) VNE (see previous page) **MUST** be treated as True AirSpeed (TAS). Indicated AirSpeed (IAS) **MUST** be reduced accordingly! Table with IAS, TAS relation for 302 km/h (163 kts) is below:

Altitude	0 m	2000 m	4000 m	6000 m
Altitude	0 ft	6600 ft	13100 ft	18100 ft
TAS	302 km/h (163 kts)	302 km/h (163 kts)	302 km/h (163 kts)	302 km/h (163 kts)
IAS	302 km/h (163 kts)	275 km/h (149 kts)	250 km/h (135 kts)	225 km/h (122 kts)

Engine, fuel, oil

Engine manufacturer: ROTAX

Engine type: ROTAX 912 UL (80 HP), ROTAX 912 ULS (100 HP)

Data below is data relevant for pilot. Consult the original Rotax engine manual for all other details.

The engine

TEMPERATURE °C / ROTAX ENGINE	912 UL	912 ULS
cylinder head temp. (CHT); minimum, working, highest	80; 110; 150	80; 110; 150
max. CHT difference	/	/
exhaust gas temperature (EGT); normal, max.	650-880; 900	650-880; 900
max. EGT difference	30	30
air intake temperature (AIR); highest	40	40
cooling fluids temperature (WATER); minimum, highest	50; 120	50; 120
oil temperature (OIL TEMP); minimum, normal, highest	50; 90-110; 140	50; 90-110; 140
RPM, PRESSURE	912 UL	912 ULS
oil pressure (OIL PRESS); lowest, highest	1.0; 6.0	1.0; 6.0
engine revolutions (RPM); on ground recommended	5500	5500
RPM on ground; max. allowable	5800	5800
magneto check at (RPM)	4000	4000
max. single magneto drop (RPM)	300	300

Fuel and oil

ROTAX ENGINE	912 UL	912 ULS
recommended fuel	unleaded super	unleaded super
fuel to be discouraged from using	leaded* or 100LL*	leaded* or 100LL*
recommended oil	API SJ SAE 10W-50	API SJ SAE 10W-50

***Engine life is reduced. Should you be forced to use this kind of fuel, change of engine oil every 50 flight hours is crucial. Please consult the manufacturer on which type of oil to use.**

IMPORTANT!

Four-stroke engines should only be powered by unleaded fuel, for lead sedimentation inside the engine shortens its life. Provided you are unable to use unleaded fuel, make sure engine oil and the oil filter are replaced every 50 flight hours.

Propeller

Virus 912 SW	Propeler
Virus 912 SW with Rotax 912 UL (80 HP), variable pitch	Pipistrel VARIO
Virus 912 SW with Rotax 912 ULS (100 HP), variable pitch	Woodcomp Varia
Virus 912 SW with Rotax 912 ULS (100 HP) + constant speed prop.	Woodcomp Varia CS
Virus SW with Rotax 912 UL (80 HP), fixed pitch	Pipistrel F2-80 - diameter 63 inch (1620 mm)
Virus SW with Rotax 912 UL (100 HP), fixed pitch	Pipistrel F2-100 - diameter 67 inch (1700 mm)

Engine instrument markings

Instrument	Red line (minimum)	Green arc (normal)	Yellow arc (caution)	Red line (maximum)
Tachometer (RPM)	1600	1600-5500	5500-5800	5800
Oil temperature	50°C (122°F)	90-110°C (194-230°F)	110-130°C (230-266°F)	130 (266°F)
Cylinder head temp.	/		110-120°C (230-248°F)	120°C (248°F)
Oil pressure	1.0 bar (14.5 psi)			6.0 bar (87.0 psi)

Weight limits

Virus SW weights

WEIGHT	SW 80	SW 100
empty aircraft weight (basic)	287 kg	289 kg
max. takeoff weight (MTOM)	600 kg	600 kg
fuel capacity	2 x50 l	2 x 50 l
max. fuel weight allowable	76 kg	76 kg
minimum cockpit crew weight	54kg	54 kg
maximum cockpit crew weight	236 kg	236 kg
luggage weight	typically 25 kg, see page p.51 for exact values. Allowance depends on configuration, see weight and balance.	

WARNING! Should one of the above-listed values be exceeded, other **MUST** be reduced in order to keep MTOM below 600 kg. Pay special attention to luggage weight as this is the only applicable mass on the airframe that has an influence on centre of gravity. Exceeding baggage weight limits can shift aircraft's balance to the point when the flight becomes uncontrollable! More information on baggage allowance can be found in chapter "Weight and Balance".

Centre of gravity limits

- Aircraft's safe centre of gravity position ranges between 25% and 37% of mean aerodynamic chord.
- Centre of gravity point ranges between 267 mm and 375 mm backwards of datum. Datum is wing's leading edge.

Manoeuvre limits

Virus 912 SW is certified as a Microlight/Ultralight aircraft. Therefore, all basic non-aerobatic manoeuvres are permitted within operational speed range, with respect to flap positions.

Following NON-aerobatic manoeuvres are permitted as defined:

- Power on and off stalls not below 300 meters (1000 feet) above ground level.
- Power on and off lazy eights not below 300 meters (1000 feet) above ground level.
- Steep turns with a maximum bank of 60° and initial speed of 160 km/h (85 kts).
- Chandelle maneuver not below 150 meters (500 feet) above ground level.
- Intentional spin (at most 180° in actual spinning manoeuvre).

G-load factors

max. positive wing load: + 4 G

max. negative wing load: - 2 G

Cockpit crew

- Minimum cockpit crew weight is 54 kg
- Cockpit crew may weigh at most 236 kg.
- Maximum takeoff weight (MTOM) MUST NOT, under any circumstances, exceed 600 kg

Types of operations

Virus 912 SW is built to fly under day visual flight rules (day VFR) in zero icing conditions.

WARNING! Should you find water drops on the airframe during preflight check-up at temperatures close to freezing, you may expect icing to appear in flight. Spoilers (airbrakes) are especially prone to icing under such circumstances. As water may accumulate underneath the top plate(s), spoilers may freeze to the wing surface. Should this occur, you will most definitely be unable to extend spoilers before the ice melts. Therefore, flying under circumstances mentioned above, it is recommended to extend and retract the spoilers in flight frequently to prevent its surface freezing to the airframe.

Minimum equipment list

- Airspeed indicator
- Altimeter
- Compass
- Tachometer (RPM)

Other restrictions

Due to flight safety reasons it is forbidden to:

- fly in heavy rainfalls;
- fly during thunderstorm activity;
- fly in a blizzard;
- fly according to instrumental flight rules (IFR) or attempt to fly in zero visibility conditions (IMC);
- fly when outside air temperature (OAT) reaches 40°C or higher;
- perform any form of aerobatic flying;
- take off and land with flaps retracted or set to negative (-5°) position (landing with -5° is permissible only in case of very strong winds, but is not to be performed as a normal procedure)
- take off with spoilers extended.

Placards

OPERATING SPEEDS

V _{SO}	74 km/h (40 kts)	VNE
V _{SI}	84 km/h (46 kts)	
V _{FE}	130 km/h (70 kts)	
V _A	174 km/h (94 kts)	
V _B	250 km/h (135 kts)	
V _{AE}	205 km/h (110 kts)	302 km/h 163 kts

ALT (m)	0	2000	4000	6000
FL	FL 0	FL 66	FL 131	FL 181
VNE	302 (163)	275 (149)	250 (135)	225 (122)

FLAPS

+19°	74-110 km/h (40-60 kts)
+9°	79-130 km/h (43-70 kts)
0°	84-180 km/h (46-97 kts)
-5°	92-302 km/h (50-163 kts)

TAKEOFF → **CRUISE**

PULL TO FEATHER
ALWAYS RESTART AT MINIMUM PITCH

+19°
+9°
FLAPS
0°
-5°

DN
TRIM
UP

OPEN

CLOSED

IDLE
THROTTLE
FULL
NO
CHOKE
OFF

OPEN

CLOSED

80 % ANTIFREEZE
+20 % WATER

ROCKET GAS
EXHAUST

ATTENTION!
ROCKET INSIDE

MAX 1.2 bar
MAX 18 psi

MAX 0.8 bar
MAX 12 psi

MAX 1.8 bar
MAX 26 psi

MAX 1.8 bar
MAX 26 psi

NO STEP

NO STEP

MOGAS RON95 or AVGAS 100 LL

MOGAS RON95 or AVGAS 100 LL

FUEL/WATER DRAIN VALVE
OPEN → CLOSE

MOGAS RON95 or AVGAS 100 LL

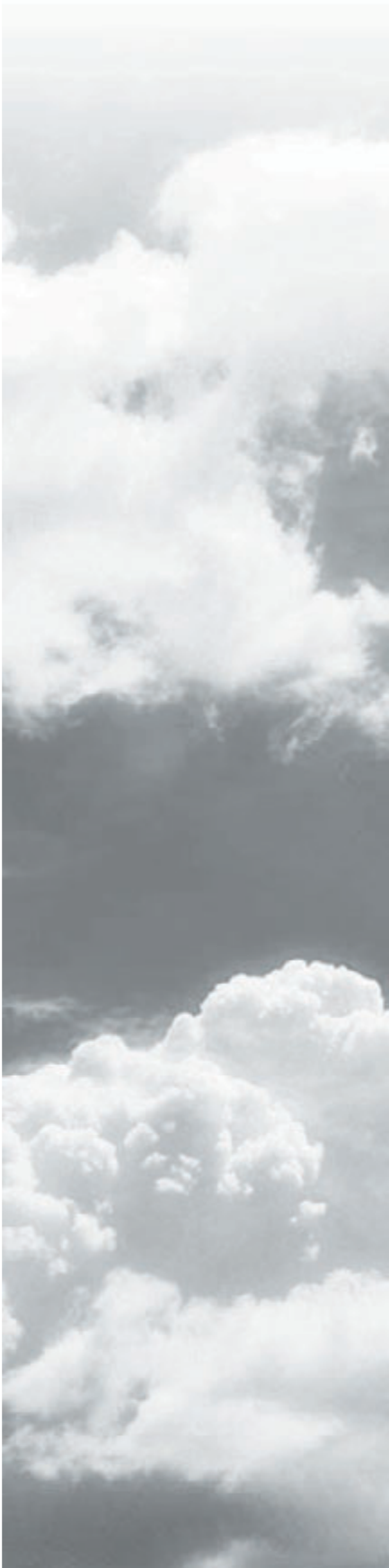
OPEN

CLOSED

WARNING
EMERGENCY PARACHUTE
equipment, see Flight Manual



Emergency procedures



Introduction

Stall recovery

Spin recovery

Engine failure

**Emergency landing /
Landing out**

Engine fire

Smoke in cockpit

Carburetor icing

Flutter

Exceeding VNE

Introduction

This chapter provides information on how to react when confronted with typical flight hazards.

Stall recovery

First reduce angle of attack by pushing the control stick forward, then

- 1. Add full power (throttle lever in full forward position).**
- 2. Resume horizontal flight.**

Spin recovery

Virus 912 SW is constructed in such manner that it is difficult to be flown into a spin. However, once spinning, intentionally or unintentionally, react as follows:

- 1. Set throttle to idle (lever in full back position).**
- 2. Apply full rudder deflection in the direction opposite the spin.**
- 3. Lower the nose towards the ground to build speed (stick forward).**
- 4. As the aircraft stops spinning neutralise rudder deflection.**
- 5. Slowly pull up and regain horizontal flight.**

Virus 912 SW tends to re-establish rightened flight by itself usually after having spinned for a mere 90°-180°.

WARNING! Keep the control stick centred along its lateral axis (no aileron deflections throughout the recovery phase! Do not attempt to stop the aircraft from spinning using ailerons instead of rudder!

WARNING! After having stopped spinning, recovering from the dive must be performed using gentle stick movements (pull), rather than overstressing the aircraft. However, VNE must not be exceeded during this manoeuvre.

When the aircraft is rightened and flies horizontally, add throttle and resume normal flight.

Engine failure

Engine failure during takeoff

Ensure proper airspeed first and land the aircraft in runway heading, avoiding eventual obstacles in your way. Shut both fuel valves and set master switch to OFF position (key full left).

WARNING! DO NOT CHANGE COURSE OR MAKE TURNS IF THIS IS NOT OF VITAL NECESSITY! After having landed safely, ensure protection of aircraft and vacate the runway as soon as possible to keep the runway clear for arriving and departing traffic.

Engine failure in flight

First ensure proper airspeed, then start analysing terrain underneath and choose the most appropriate site for landing out.

WARNING! The decision where to land when landing out is FINAL! DO NOT change your mind even if you happen to come across a different, perhaps more appropriate landing site.

Provided the engine failed aloft, react as follows:

Make sure the master switch is in the ON position (key full right), magneto switches both set to ON and both fuel valves OPEN.

Should the propeller not be windmilling ever so slightly (motor blocked!), the engine is probably seriously damaged. In this case DO NOT attempt to restart the engine. Instead begin with the landing out procedure immediately.

Should the propeller be windmilling, fuel or electrical system is probably malfunctioning. Verify on-board fuel quantity and make sure both fuel valves are open and magneto switches set to ON. Attempt to restart the engine.

Emergency landing / Landing out

1. Shut both fuel valves.
2. Master switch OFF (key in full left position).
3. Approach and land with extreme caution, maintaining proper airspeed.
4. After having landed abandon the aircraft immediately.

The landing out manoeuvre MUST be performed with regard to all normal flight parameters.

Engine fire

Engine fire on ground

This phenomenon is very rare in the field of Ultralight aviation. However, coming across engine fire on ground, react as follows:

1. Shut both fuel valves.
2. Come to a full-stop, engage starter and set throttle to full power (lever full forward).
3. Disconnect the battery from the circuit (pull battery disc. ring on the switch column)
4. Master switch OFF immediately after the engine has stopped.
5. Abandon the aircraft and start fire extinguishing.

WARNING! After the fire has been extinguished DO NOT attempt to restart the engine.

Engine fire in flight

1. Shut both fuel valves and set magnetos switches to OFF.
2. Set full power (throttle lever in full forward position).
3. Disconnect the battery from the circuit (pull battery disc. ring on the switch column)
4. Set ventilation for adequate breathing. Keep in mind that oxygen intensifies fire.
5. Perform side-slip (crab) manoeuvre in direction opposite the fire.
6. Perform emergency landing out procedure.

Smoke in cockpit

Smoke in cockpit is usually a consequence of electrical wiring malfunction. As it is most definitely caused by a short circuit it is required from the pilot to react as follows:

- 1. Master switch to I (key in central position). This enables unobstructed engine operation while at the same time disconnects all other electrical devices from the circuit.**
- 2. Disconnect the battery from the circuit (pull battery disconnection ring on the instrument panel's switch column).**
- 3. Land as soon as possible.**

In case you have trouble breathing or the visibility out of the cockpit has degraded severely due to the smoke, open the cabin door and leave it hanging freely. Flying with the door open, do not, under any circumstances exceed 90 km/h (50 kts).

Carburetor icing

First noticeable signs of carburetor icing are loud engine noises and gradual loss of power.

Carburetor icing may occur even at temperatures as high as 10°C, provided the air humidity is increased.

The carburetor air-intake in the Virus is preheated, running over the water cooling radiator before entering the carburetors. Therefore the possibility of carburetor icing is minute.

Should you be suspecting carburetor icing to take place, descent immediately into warmer and/or less humid air!

In case of complete power loss perform emergency landing out procedure.

Flutter

The flutter is defined as the oscillation of control surfaces. It is most cases caused by abrupt control deflections at speeds close or in excess of VNE. As it occurs, the ailerons, elevator or even the whole aircraft start to vibrate violently.

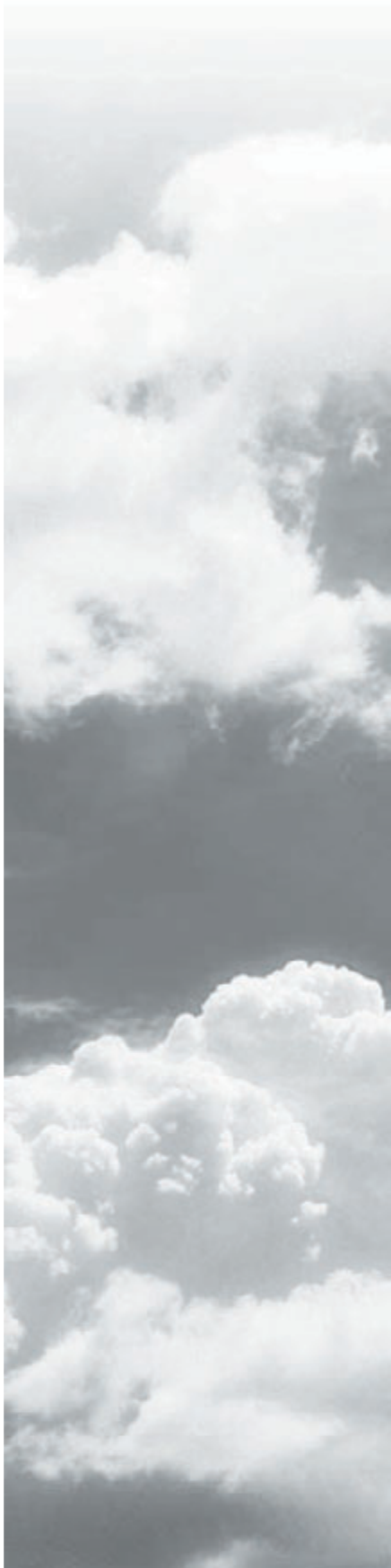
Should flutter occur, increase angle of attack (pull stick back) and reduce throttle immediately in order to reduce speed and increase load (damping) on the structure.

WARNING! Fluttering of ailerons or tail surfaces may cause permanent structural damage and/or inability to control the aircraft. After having landed safely, the aircraft **MUST** undergo a series of check-ups performed by authorised service personnel to verify airworthiness.

Exceeding VNE

Should the VNE be exceeded, reduce airspeed slowly and continue flying using gentle control deflections. Land safely as soon as possible and have the aircraft verified for airworthiness by authorised service personnel.

Normal procedures



Introduction

**Assembling and
disassembling the
aircraft**

Daily check-up

Preflight check-up

**Normal procedures and
recommended speeds**

Introduction

This chapter provides information on everything needed to fly Virus 912 SW safely.

Assembling and disassembling the aircraft

CAUTION! Prior to each assembling or disassembling action Virus 912 SW must be placed inside a closed space. Under no circumstances attempt to assemble or disassemble any parts of the aircraft in the sun or at temperatures higher or as high as 20°C for you will not be able to assemble certain parts.

Assembling the wings

Three people are needed to assemble the wings to the fuselage.

First block all three wheels for the fuselage to stay in position. If your aircraft has been delivered in a container, make sure you reapply the washers onto the tail wheel fork (Virus TW) correctly - one on the inside, one on the outside of the fork - at both sides.

Clean and grease the main wing pins and insertion openings. Inside the cockpit set the flap handle to neutral position and leave the spoilers' handle hanging down freely. Make sure you have all bolts, nuts, washers and spanners needed at a reach of a hand.

Lift one wing-half (one person at each end) and bring it closer to the fuselage. While the two are holding the wing-half high up, the third person directs their movement to put the wing's main spar into the opening on the adjacent side of the fuselage. As the wing is about 10 cm away from its final position, fit the electrical cables, fuel hose and pitostatic lines through the opening.

Now push the wing-half into its final position slowly. The person closest to the fuselage must make sure the spoiler and flap connectors have fitted into adequate fuselage fittings properly. At the same time, the person holding the wingtip must start with slight circular movements (1cm each direction) in order to assure a tight fit of the wing and its adequate bushings.

As this is done the person at the wingtip must remain in position holding the wing, whereas the other two move over to the other wing-half, lift it and bring it closer to the fuselage. Again, all cables, hoses and lines must be fitted through the openings prior the wing-half be-

ing pushed into its final position.

Do not forget to make sure the spoiler and flap connectors have fitted into adequate fittings properly on this wing-half as well.

Both wing-halves should now be in their final position but still being held at wingtips. The person not holding the wings must now open the cabin door and insert both pre-greased spar pins. First insert the pin on the right-hand side of the cockpit because of easier insertion (thinner spar in front), then the pin on the left-hand side of the cockpit.

If necessary, the two at the wingtips can assist by rocking the wings a couple of millimeters up and down.

Only when both spar pins have been inserted and secured, wingtips may be released and door fully opened and fastened to the wing. Now check all control deflections as well as flap and spoilers' extensions for smooth, unobstructed movement.

Insert all bolts and pins and secure them with self-locking nuts. Do not forget to put aluminium washers underneath the nuts! Connect all electrical cables, fuel hoses and pitostatic lines to their adequate fittings. Check for adequate fuel flow through the fuel connectors before attempting the first flight.

Screw on the pitot tube on bottom side of the right wing at approximately 2/3 of the wing-span. Be extra careful not to switch the two tubes as this causes misinterpretation of indicated airspeed!

Finally tape the gap between the fuselage and the wing using self-adhesive tape.

Disassembling the wings

Three people again are needed to disassemble the wings.

First block all three wheels for the fuselage to stay in position. Empty both fuel tanks by opening both fuel valves inside the cockpit and the drain valve beneath the bottom engine cover. Place a canister under the drain valve to intercept fuel.

While you wait for the tanks to empty, disassemble the horizontal tail surfaces, disconnect all electrical cables and pitot-static lines. Do not forget to unscrew the pitot tube on the bottom side of the right wing. Then, inside the cockpit, unscrew the middle main spar screw first, then unscrew and remove both pin bolts.

WARNING! Do not remove spar pins yet!

Once the fuel tanks are empty, disconnect the fuel hoses inside the cockpit as well.

Make sure you tape the end attached to the wing not to spill any eventual leftover fuel over the fuselage or glass surfaces as substantial damage may occur.

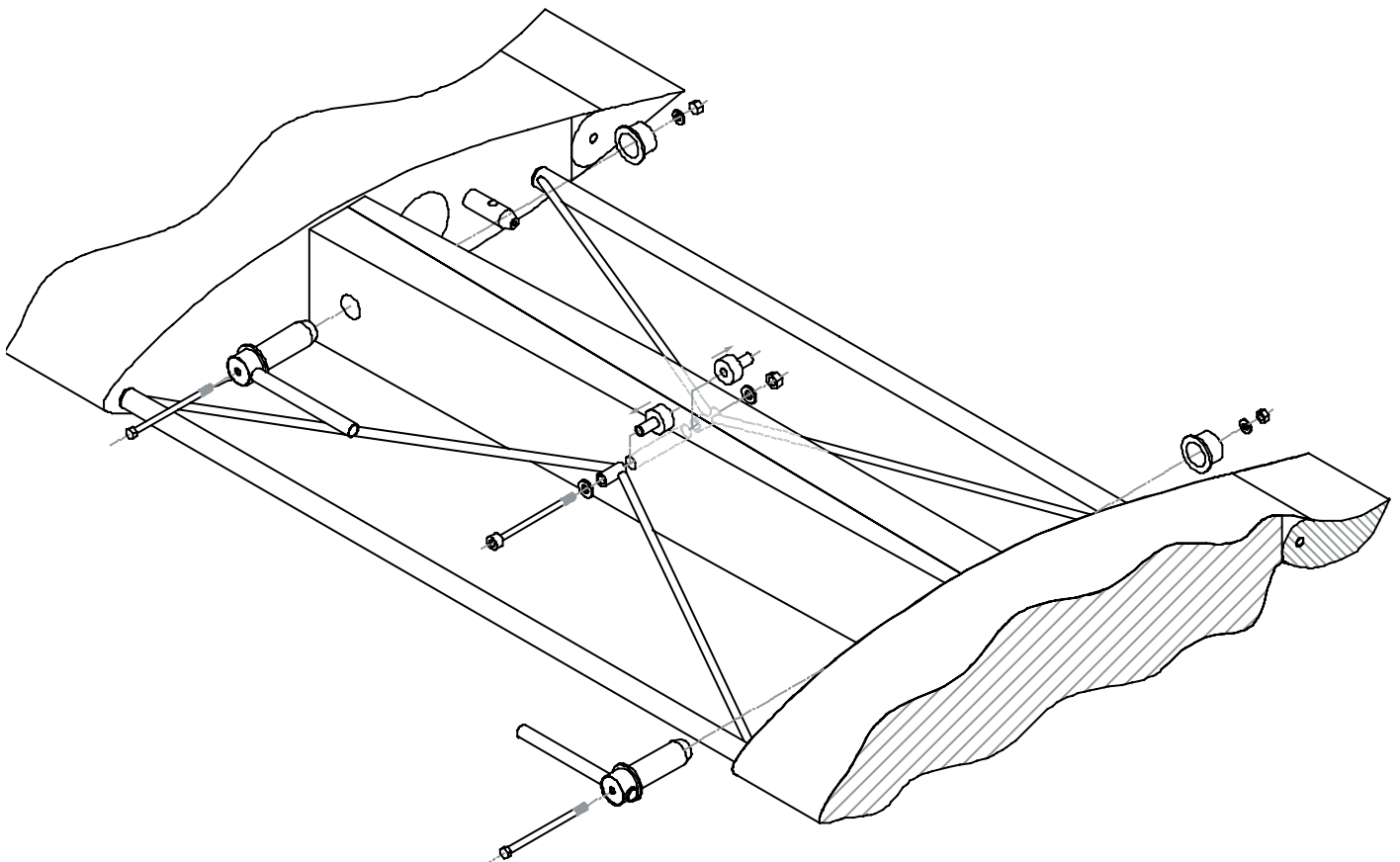
Two people must now lift the wingtips (one wingtip each) and the person in the cockpit remove the main spar pins, one by one, smoothly.

Forcing pins out of their position may result in structural damage, therefore the wingtip holders must hold the wing-halves precisely at certain height!

Using slight circular movement at the wingtip, the wing-halves must now be pulled out of the fuselage slowly. On pulling, each wing-half must be held by two, one at the wingtip and one near the spar.

As the wing-halves have been pulled out, place them onto a soft surface to prevent their damage.

Schematic of wing (dis)assembly



Fitting the horizontal tail surfaces

Horizontal stabilizer and elevator MUST be united during the following procedure. To fit the horizontal tail surfaces first set the trim handle inside the cockpit to full forward position. Make sure the pins, their holes and bushings have been cleaned and greased!

Lift the joint stabilizer and elevator and slide them into position by pushing them backwards while the elevator is deflected DOWN fully. Now use the enclosed "T" key to push the security screw down while spinning it clockwise until the screw is completely tightened. Pull the "T" key out and make sure the safety pin holds the head of the screw, so that eventual unscrewing will not occur.

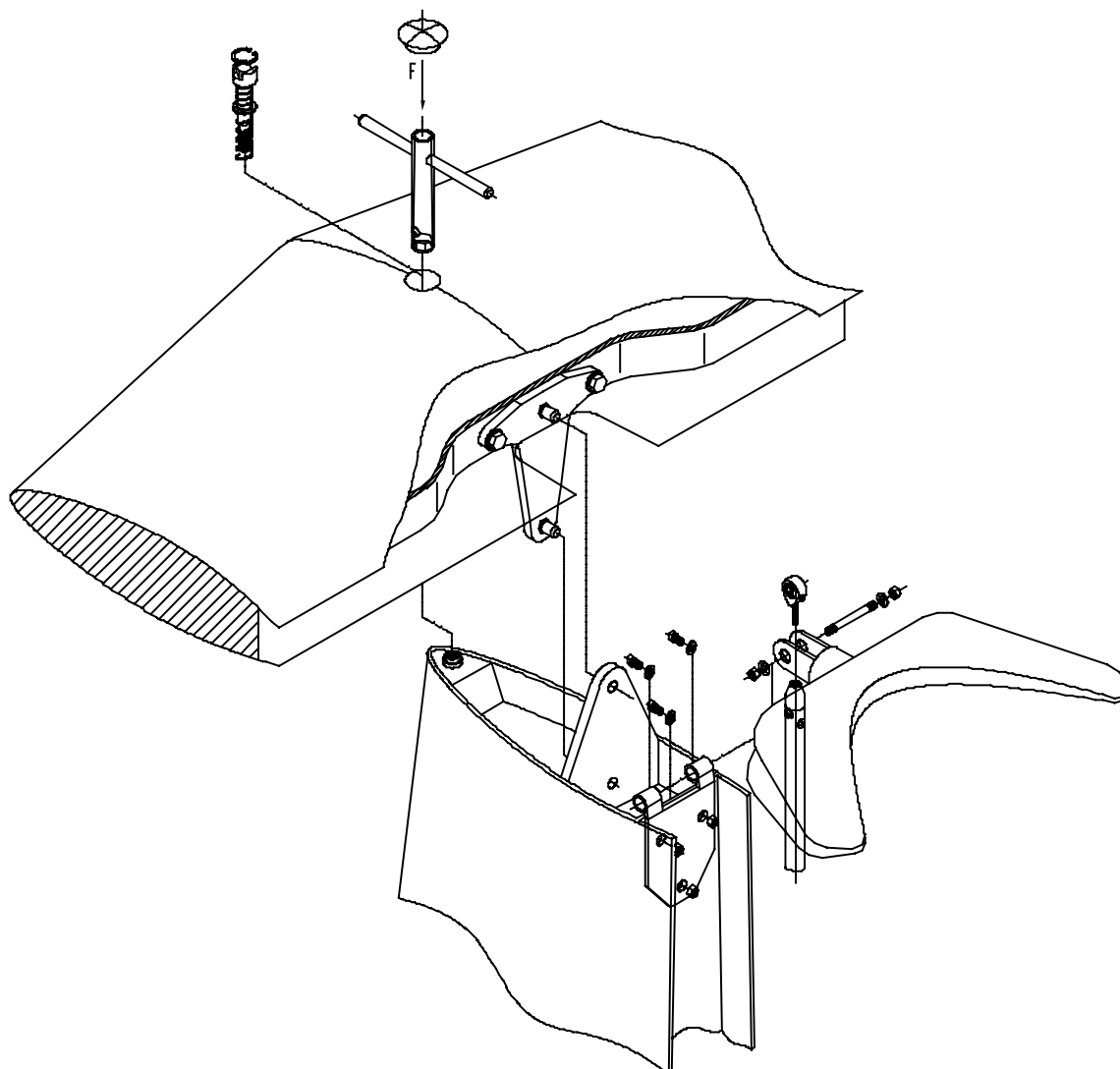
At the end tape the gap between horizontal and vertical tail surfaces and cover the hole on top of the vertical stabilizer with a sticker. Check control deflections for smooth, unobstructed movement.

Detaching the horizontal tail surfaces

Set the trim handle to full forward position and remove the safety sticker covering the hole on top of the horizontal stabilizer and the tape covering the gap between horizontal and vertical tail surfaces. Now use the enclosed "T" key to push the safety pin screw down while spinning it counter-clockwise until it is completely loose. To detach the horizontal tail unit push it forward using firm palm strokes until the unit pops out.

When detached, always place the horizontal tail unit onto a soft surface to prevent damage.

Schematic of horizontal tail surfaces (dis)assembly



Attaching the rudder

Bring the rudder close to fuselage and fit it first onto the top and then to the bottom hinge.

The rudder must then be fully deflected to one side to provide access to the rudder bolts. Use a self-securing, pre-glued M10 nut together with an aluminium washer and gently screw them onto the bolt using size 10 spanner. To reach the other rudder bolt deflect the rudder to the opposite direction and repeat the up-stated procedure.

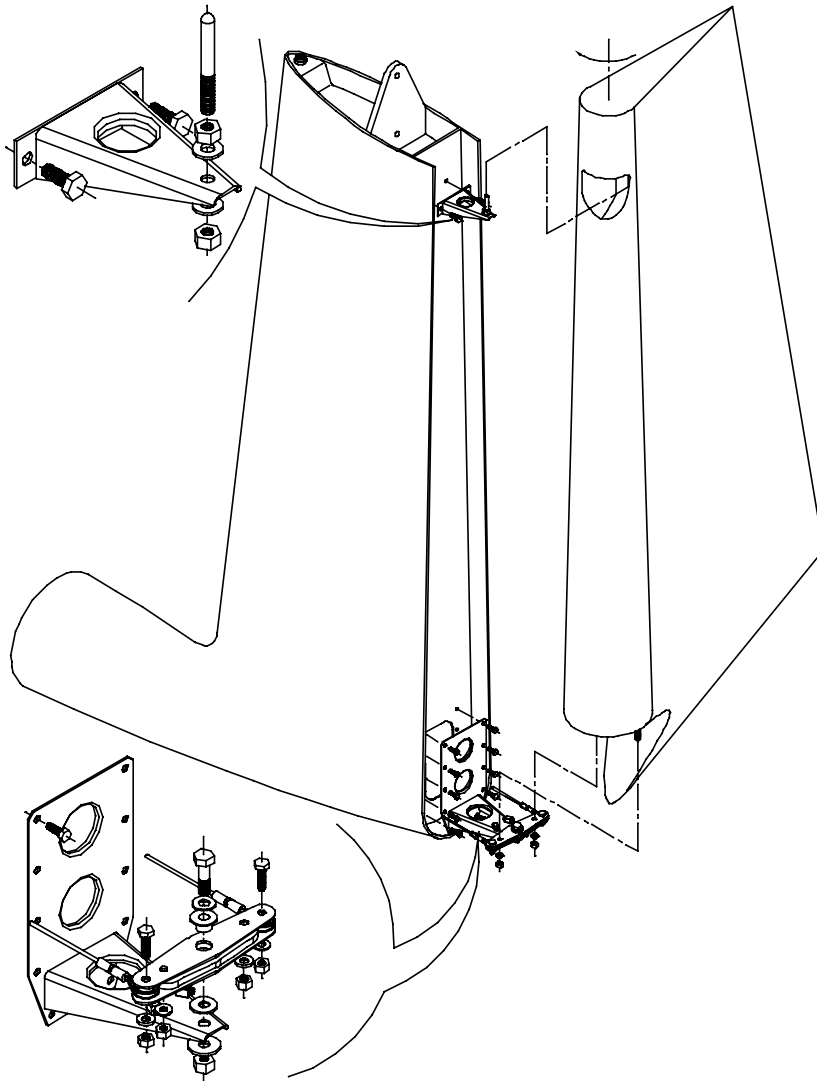
With both nuts tightened check full rudder deflections for smooth, unobstructed movement.

Detaching the rudder

Deflect the rudder to one side fully and unscrew the nut of the bolt with which the rudder is attached to the bottom hinge. This is the bolt located in-between the central bolt (axis of rotation) and the bolt holding the metal ropes. **DO NOT** touch these two bolts - unscrew the nut of the middle bolt **ONLY**. Now deflect the rudder to the opposite direction and repeat the up-stated procedure.

After both bolts have been unscrewed, lift the rudder and detach it first from the bottom, then from the top hinge.

Schematic of rudder (dis)assembly



Daily check-up

The daily check-up matches the preflight check-up.

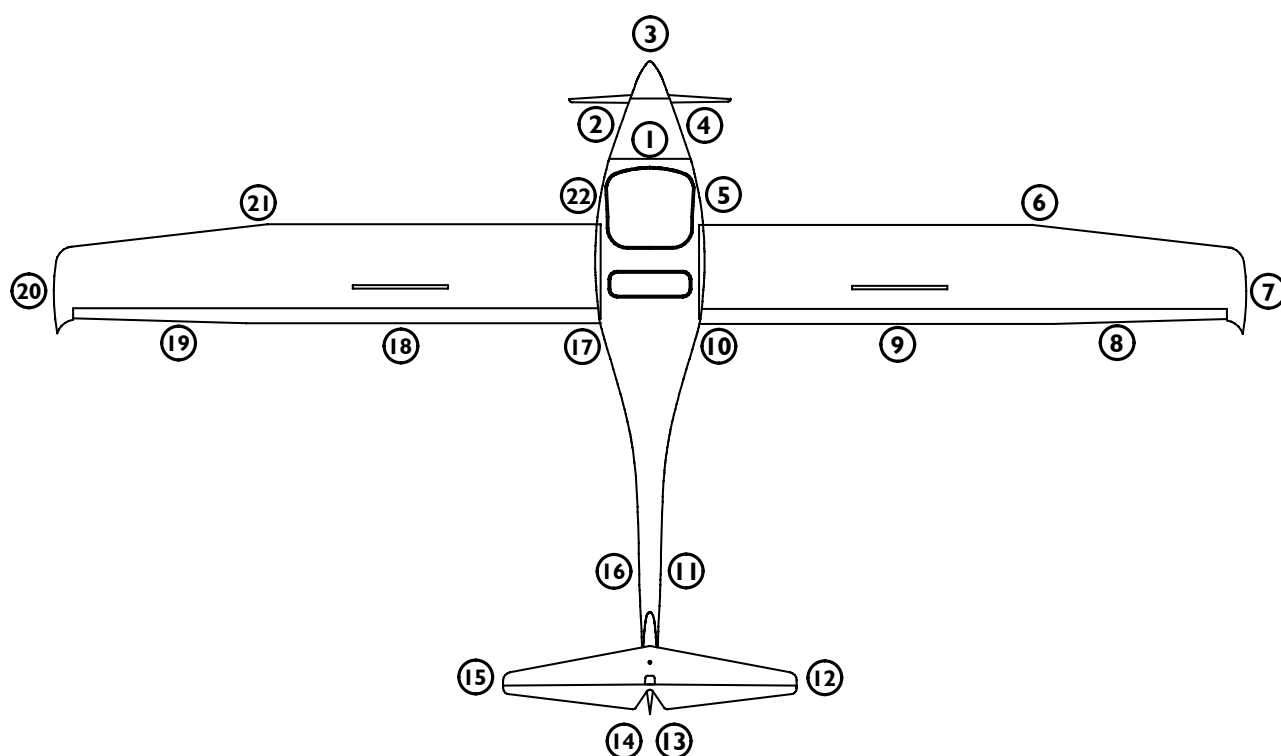
Preflight check-up

WARNING! Every single check-up mentioned in this chapter must be performed prior to EVERY FLIGHT, regardless of when the previous flight took place!

The person responsible for the preflight check-up is the pilot from whom it is required to perform the check-up in the utmost thorough and precise manner.

Provided the status of any of the parts and/or operations does not comply with conditions stated in this chapter, the damage **MUST** be repaired prior to engine start-up. Disobeying this instructions may result in serious further damage to the plane and crew, including injury and loss of life!

Schematic of preflight check-up



- | | | |
|-----------------------------|--------------------------------|-------------------------------|
| 1 Engine, engine cover | 8 Right wing - trailing edge | 15 Hor. tail surfaces (left) |
| 2 Gascolator | 9 Right spoiler | 16 Fuselage, continued (left) |
| 3 Spinner, Nose wheel | 10 Fuselage (RH side) | 17 Fuselage (LH side) |
| 4 Propeller | 11 Fuselage, continued (right) | 18 Left spoiler |
| 5 Undercarriage, RH wheel | 12 Hor. tail surfaces (right) | 19 Left wing - trailing edge |
| 6 Right wing - leading edge | 13 Vert. tail surfaces (right) | 20 Left wingtip, lights |
| 7 Right wingtip, lights | 14 Vert. tail surfaces (left) | 21 Left wing - leading edge |
| | | 22 Undercarriage, LH wheel |

Engine, engine cover ①

Cooling fluid level: half way to the top

Oil quantity: within designated limits

Throttle, choke and oil pump wires: no mechanical damage, smooth and unobstructed movement

Radiators and hoses: no mechanical data and/or leakage, air filters clean and intact

Exhaust pipes and collectors: firmly in position, no cracks, springs intact and in position, rubber dumpers intact

Eventual fuel and/or oil leakage: no spots on hoses, engine housing or engine cover

Reduction gearbox: check for eventual oil leakage, all bolts and plugs attached firmly

Fasteners and engine cover screws: tightened, engine cover undamaged

Gascolator ②

Drain approximately 1/3 decilitre of fuel (prevent gnd. pollution and intercept fuel with a canister).

Spinner ③

Spinner: no mechanical damage (e.g. cracks, impact spots), screws tightened

Bolts and nuts: secured

Nose wheel: grab aircraft's propeller and push it towards the ground to verify proper nose wheel suspension operation. Then lift the nose wheel off the ground and check for wheel's strut free play.

Bolts: fastened

Tire: no cracks, adequate pressure

Wheel fairing: undamaged, firmly attached, clean (e.g. no mud or grass on the inside)

Propeller ④

Hub and blades: no mechanical damage (e.g. cracks), both immaculately clean

Bolts and nuts: secured

VARIO propeller: smooth, unobstructed movement along propeller pitch

Undercarriage, wheels ⑤ ②②

Bolts: fastened

Landing gear strut: no mechanical damage (e.g. cracks), clean

Wheel: no mechanical damage (e.g. cracks), clean

Wheel axis and nut: fastened

Brake cable: intact, no twists or sharp curves

Oil line (hydraulic brakes): no mechanical damage and/or leakage

Tire: no cracks, adequate pressure

Wheel fairing: undamaged, firmly attached, clean (e.g. no mud or grass on the inside)

Wings' leading edge ⑥ ②1

Surface condition: pristine, no cracks, impact spots, no paint and/or edge separations

Pitot tube: firmly attached, no mechanical damage or bendings. Remove protection cover and make sure it is not blocked or full of water.

Wing drain holes: make sure they are not blocked and clean accordingly.

Wingtip, lights ⑦ ②0

Surface condition: pristine, no cracks, impact spots or bumps, no paint separations

Wings' trailing edge ⑧ ①9

Surface condition: pristine, no cracks, impact spots, no paint and/or edge separations

Mylar sealing tape between wing and aileron: undamaged and in position

Aileron: pristine surface, no cracks and/or impact spots, no paint abnormalities and edge separations, no vertical or horizontal free play, smooth and unobstructed deflections

Spoilers, fuel reservoir cap ⑨ ①8

Spoiler: firm, smooth, equal and unobstructed extension, tightly fitted when retracted, springs stiff and intact.

Fuel reservoir cap: fastened. Make sure the pipe is completely clean.

Fuselage, antenna, rescue parachute hood ⑩ ①7

Self-adhesive tape: in position, no separations

Controls' cap, antenna: firmly attached

Fuselage, continued ⑪ ①6

Surface condition: pristine, no cracks, impact spots or bumps, no paint separations

Horizontal tail surfaces ⑫ ①5

Surface condition: pristine, no cracks, impact spots or bumps, no paint and/or edge separations

Hinges: no free play in any direction

Central securing screw on top or the horizontal stabilizer: fastened and secured

Self-adhesive tape covering the gap between horizontal and vertical tail surfaces: in position

Elevator: smooth and unobstructed up-down movement, no side-to-side free play

Vertical tail surfaces ⑬ ①4

Vertical fin bottom part: no cracks, impact spots or paint separations along main chord

Surface condition: pristine, no cracks, impact spots or bumps, no paint separations

Hinges: no free play in any direction

Rudder metal rope endings: intact, bolts in position

CAUTION! Preflight check-up should be performed following stations 1 through 22!

In-cockpit preflight check-up

Instrument panel and instruments: checked

Fuses: screwed in position

Battery disconnection lever: in position for battery operation (lever deflected towards the firewall)

Master switch OFF (key in full left position): no control lights and/or electronic instrument activity

Master switch ON (key in full right position): control lights and electronic instrument active

Make sure you have set all instruments to correct initial setting.

Main wing spars and connectors: no visible abnormalities of metal parts, spars, pins and bolts; all bolts and nuts in position and tightened

Fuel hoses, pitot-static lines and electrical cables: correctly connected and in position

Transparent plastic providing visual fuel quantity monitoring: clean with no cracks

Safety harness: undamaged, verify unobstructed harness opening; fastening points intact

Glass doors and windshield: perfect closing at all three points, smooth opening, hinges firmly attached; glass immaculately clean with no cracks.

Flap handle: button spring firm, locking mechanism working properly, smooth movement along full deflections, no free play or visible damage.

Spoilers (Airbrakes) handle: full-up and locked

Radio wiring: test the switches, check connectors and headset, perform radio check

Battery (some models): firmly in position, check water level (if not dry version), joints clean with wires connected

Emergency parachute release handle (optional): safety pin removed.

Make sure unobstructed access is provided.

Normal procedures and recommended speeds

To enter the cabin first lift the glass door all the way to the bottom wing surface. The silver knob will grab and secure the glass door in position. Sit onto the cabin's edge and support your body by placing hands onto this same cabin edge. Drag yourself into the seat lifting first the inner and then the outer leg over the control stick. Immediately after having sat into the seat, check rudder pedals' position to suit your size and needs. Bring the pedals closer or further away by removing the pin in between the pedals and slide them to desired position. Do not forget to re-insert the pin in order to secure pedals in position.

To lower the door DO NOT attempt to grab and pull door's handle but gently pull the silver knob instead. To close the door securely, rotate the handle so that it locks (click here to see picture) and verify that all three closing points are secured.

Fasten the safety harnesses according to your size.

Adjust the rudder pedals according to your required legroom. If the aircraft is equipped with in-flight adjustable rudder pedals, adjust the pedals as follows:

Sit inside the cockpit and release the pressure off the pedals. Pull the black knob in front of the control stick to bring the pedals closer to you. To move the pedals further away, first release the pressure of the pedals, then pull on the knob slightly (this will release the lock in the mechanism). Now push the pedals forward using with your feet, while keeping the black adjustment knob in your hand.

WARNING! The safety harness must hold you in your seat securely. This is especially important when flying in rough air, as otherwise you may bump into the tubes and/or spars overhead. Make sure you tighten the bottom straps first, then shoulder straps.

Engine start-up

Before engine start-up

CAUTION! To ensure proper and safe use of aircraft it is essential for one to familiarise with engine's limitations and engine manufacturer's safety warnings. Before engine start-up make sure the area in front of the aircraft is clear. It is recommended to start-up the engine with aircraft's nose pointing against the wind.

Make sure the fuel quantity will suffice for the planned flight duration.

Make sure the pitot tube is uncovered and rescue parachute safety pin removed.

Engage wheel brakes.

Engine start-up

Make sure both fuel valves are open and master switch in OFF position (key full left).

Set propeller pitch to flat (prop. pitch knob screwed to the left fully).

Should the engine be cold, apply choke (lever full back).

Set master switch ON (key in full right position). Set both magneto switches ON.

Engage engine starter and keep it engaged until the engine starts.

Set throttle to 2500 RPM.

Slide the choke lever forward gradually.

CAUTION! When the engine is very cold, the engine may refuse to start. Should this occur, jerk the choke handle fully backwards and hold it there for some 20 seconds to make mixture richer.

Engine warm-up procedure

The engine should be warmed-up at 2500 RPM up to the point working temperature is reached.

Warming-up the engine you should:

1 Point aircraft's nose against the wind.

2 Verify the engine temperature ranges within operational limits.

CAUTION! Avoid engine warm-up at idle throttle as this causes sparks to turn dirty and the engine to overheat.

With wheel brakes engaged and control stick in full back position, first set engine power to 4000 RPM in order to perform the magneto check. Set the magneto switches OFF and back ON one by one to verify RPM drop of not more than 300 RPM.

When the magneto check has been completed, add full power (throttle lever full forward) and monitor engine's RPM. Make sure they range between maximum recommended and maximum allowable RPM limits.

Note that engines do not reach 5800 RPM on ground. Engines are factory set to reach maximum ground RPM of 5300 - 5500 at sea level at 20° C with propeller at minimum pitch setting. Maximum ground RPM may vary depending on the season and service elevation.

CAUTION! Should engine's RPM be lower than max. recom. RPM on ground or in excess of maximum allowable RPM on ground during this manoeuvre, check engine and wiring for correct installation.

Taxi

Taxing technique does not differ from other aircrafts equipped with a steering nose wheel. Prior to taxiing it is essential to check wheel brakes for proper braking action.

In case you expect taxiing to last, take engine warm-up time into account and begin taxiing immediately after engine start-up. Warm-up the engine during taxiing not to cause engine overheating because of prolonged ground operation.

Holding point

Make sure the temperatures at full power range within operational limits.

Make sure the safety harnesses are fastened and doors closed and secured at all three closing points.

Set flaps to 2nd position (flap handle full up).

Power idle.

CAUTION! Should the engine start to overheat because of long taxi and holding, shut down the engine and wait for the engine temperatures drop to reasonable values. If possible, point the aircraft's nose towards the wind. This will provide radiators with airflow to cool down the engine faster.

Take-off and initial climb

Before lining-up verify the following:

Spoilers (if applicable): retracted and secured

Fuel valves: fully open

Fuel quantity: sufficient

Safety harnesses: fastened

Cabin doors: closed securely

Trim handle: in neutral position or slightly forward

Flap handle: 2nd position (flap handle full up)

Propeller pitch: minimum - flat setting (propeller pitch knob rotated to the left fully)

Runway: clear

Now release brakes, line up and add full power.

Verify engine for sufficient RPM at full throttle (5300 - 5500 RPM).

CAUTION! Keep adding power gradually.

WARNING! Should engine RPM not reach 5300 - 5500 RPM when at full throttle, ABORT TAKE-OFF IMMEDIATELY, come to a standstill and verify that the propeller is at minimum pitch setting .

Start the takeoff roll pushing elevator one third backward and lift the nose wheel off the ground as you accelerate. Reaching V_R (between 70 -80 km/h; 35-40 kts), gently pull on the stick to get the aircraft airborne.

CAUTION! Crosswind (max 34 km/h (18 kts)) takeoff should be performed with ailerons deflected opposite the direction of the wind. Special attention should be paid to maintaining runway heading!

Initial climb

When airborne, engage brakes momentarily to prevent in-flight wheel spinning.

Accelerate at full power and later maintain proper speed of climb.

As you reach 110 km/h (60 kts) at above 50 meters (165 ft), set flaps to 1st stage, reaching 130 km/h (70 kts) above 100 meters (330 ft) set flaps to neutral position. Reduce RPM by 10% and continue climbing at 140 km/h (76 kts).

Adjust the trim to neutralise the stick force if necessary.

Remember to keep the temperatures and RPM within operational limits during this manoeuvre.

CAUTION! Reduce RPM and increase speed in order to cool the engine down if necessary.

Should you be climbing to a cross-country flight, consider climbing at 185 km/h (100 kts) as this will greatly increase your overall travelling speed.

Reaching cruise altitude, establish horizontal flight and set engine power to cruise.

Cruise

As horizontal flight has been established, verify on-board fuel quantity again.

Keep the aircraft balanced while maintaining desired flight parameters.

Should you desire to cruise at low speed (up to 150 km/h (80 kts)), set flaps to neutral position otherwise flaps should be set to negative position (flap handle full down).

Check engine operation and flight parameters regularly!

WARNING! Virus 912 SW is sensitive to correct flap settings. To maintain excellent and safe flight performance it is important to set flaps according to airspeed. As the pilot you must know that the higher the speed the greater the force on the flapperons. To prevent overstressing the flapperons it is of vital importance to always fly at the correct flap setting as you may otherwise damage the flapperons controls' inner structure.

At speeds in excess of VNE, even at negative flap setting this may lead to flutter, loss of control over aircraft, serious injury and even loss of life.

CAUTION! Do not, under any circumstances attempt to fly the aircraft at speeds exceeding 150 km/h (80 kts) using flap setting other than negative!

Check fuel levels regularly as well. Because of the fuel system design, the fuel tends to gradually cross-flow from the right tank to the left. To prevent this, shut the right fuel valve and open it again when the fuel level inside left tank has lowered.

Cruising in rough atmosphere

Should you experience wake turbulence, reduce airspeed and continue flying with flaps set to neutral position.

CAUTION! In rough air, reduce engine power if necessary to keep airspeed below VRA.

Descent and final approach

Descent at speeds at or below VRA and flaps in negative stage. For expedite descents use airbrakes (if applicable) and keep airspeed below VAE.

For approach reduce speed to 130 km/h (70 kts), set propeller to minimum pitch setting (turn propeller pitch knob to the left fully) and set flaps to 1st position when turning to base leg.

Adjust engine power to maintain proper airspeed. Set trim to neutralise stick force if necessary.

During the descent monitor temperatures and keep them within operational limits.

CAUTION! When descending, make sure the propeller is set to minimum pitch!

CAUTION! During the descent engine power **MUST** be reduced. Should you be forced to descend at idle power, make sure you keep adding throttle for short periods of time, not to turn the sparks dirty.

CAUTION! With flaps in 2nd position only half way aileron deflections are permitted.

On final, set flaps to 2nd position.

Align with the runway and reduce power to idle.

Extend airbrakes (if applicable) and maintain an airspeed of 100 km/h (54 kts).

Instead of throttle use airbrakes (if applicable) to control your descent glide path, otherwise control your attitude and crab if necessary.

CAUTION! Crosswind landings require higher final approach speeds to ensure aircraft's safe manoeuvrability.

Roundout and touchdown

CAUTION! See chapter "Performance" for landing performance.

Roundout and touchdown (flare) occurs at following airspeeds:

Calm air, aircraft at MTOM	75 km/h (40 kts) IAS
Rough air, aircraft at MTOM (incl. strong crosswinds up to 34 km/h (18 kts))	78 km/h (42 kts) IAS

CAUTION! Land the aircraft in such a manner that the two main wheels touch the ground first, allow the nose-wheel touchdown only after speed has been reduced below 30 km/h (18 kts).

When touching down, rudder **MUST NOT** be deflected in any direction (rudder pedals centred).

When on ground, start braking action holding the control stick in full back position. Steer the aircraft using brakes and rudder only. Provided the runway length is sufficient, come to a complete standstill without engaging the brakes holding the control stick slightly backwards as you decelerate.

WARNING! After touchdown, **DO NOT** retract airbrakes (if applicable) immediately, as this causes sudden lift increase and the aircraft may rebound off the ground. Should this occur, hold the elevator steady; under no circumstances attempt to follow aircraft's movement with elevator deflections, for Virus 912 SW tends to attenuate rebounding by itself. However, it is important to maintain runway heading using the rudder at all times. Retract spoilers only after the aircraft has come to a complete standstill.

CAUTION! Should you be performing the touch-and-go manoeuvre, retract spoilers carefully before re-applying full power.

Crosswind approach and roundout

CAUTION! Crosswinds prolong landing runway length (see chapter “Performance”).

Performing a crosswind landing, the wing-low method should be used. When using the wing-low method it is necessary to gradually increase the deflection of the rudder and aileron to maintain the proper amount of drift correction.

WARNING! If the crab method of drift correction has been used throughout the final approach and roundout, the crab must be recovered before touchdown by applying rudder to align the aircraft’s longitudinal axis with its direction of movement.

Parking

Come to a complete standstill by engaging brakes. Re-check RPM drop by switching magnetos OFF and back ON, one by one. Leave the engine running at idle RPM for a minute in order to cool it down. Set master switch and magneto switches OFF. Set propeller pitch to flat (prop. pitch screw to the left fully). Unlock spoilers (handle hanging down freely) and insert parachute rescue system handle’s safety pin (if rescue system installed). Open cabin door, unfasten safety harnesses and exit the cockpit (watch for the wheel fairings!). Block the wheels and secure the pitot tube by putting on a protection cover.

Apply the tubes onto fuel line vents so that fuel would not spill onto the wing in event of full fuel tanks, temperature expansion of fuel and/or parking on a slope.

CAUTION! Should the aircraft be parked on a slope it is recommended to shut one of the fuel valves to prevent overflowing of the adjacent fuel tank.

Restarting the engine in flight

This procedure applies only for restarting the engine following an intentional unpowered flight.

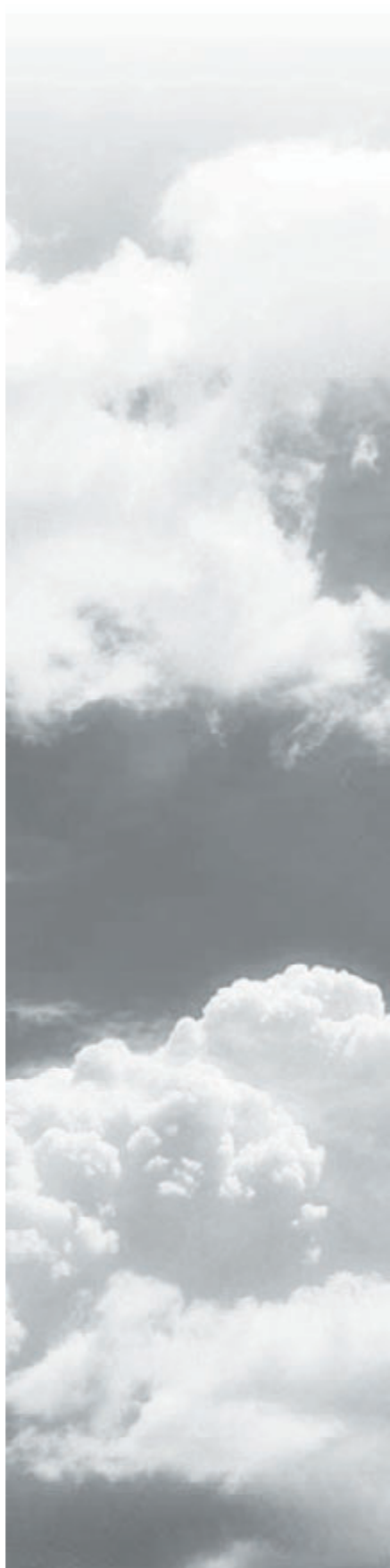
Reduce speed to 110 km/h (60 kts)
Master switch ON (key in full right position)
Magnetos ON

WARNING! Before you activate the starter make sure the propeller is not feathered any more but at minimum pitch setting (propeller pitch knob full forward and screwed left fully).

Should the engine cool down during unpowered flight, apply choke. Always start the engine at idle throttle.

CAUTION! Do not add full power while the engine is still cool. Fly at lower airspeeds at low power engine setting to warm it up instead (e.g. 90 km/h (50 kts) at 3000 RPM).

Performance



Introduction

**Airspeed indicator
calibration**

Take-off performance

Climb performance

Cruise

Descent

Landing performance

Vg diagram

Speed polar

Additional technical data

Noise levels

Introduction

This chapter provides information on aircraft's airspeed calibration, stall speeds and general performance. All data published was obtained from test flight analysis using average flying skills.

Airspeed indicator calibration (IAS to CAS)

Pitot tube's mounting point and construction makes IAS to CAS correction values insignificant. Therefore pilots should regard IAS to be same as CAS. **IAS = CAS.**

Stall speeds

Stall speeds at MTOM for all models of Virus SW are as follows:

flaps in negative position; -5° (up):	91 km/h (49 kts)
flaps in neutral position; 0° (neutral):	84 km/h (46 kts)
flaps in 1 st position; +9° (down):	79 km/h (43 kts)
flaps in 2 nd position; +19° (down):	74 km/h (40 kts)

Take-off performance

All data published in this section was obtained under following conditions:

aircraft at MTOM
 elevation: 100 meters (330 feet)
 wind: calm
 runway: dry grass runway with low-cut grass
 Data extrapolated for ICAO standard atmosphere

Virus SW	SW 80	SW 100
takeoff runway length at MTOM	175 m (580 ft)	140 m (460 ft)
takeoff runway length (over 15 m obstacle)	280 m (920 ft)	230 m (760 ft)

Note: in order to meet the data for takeoff runway length over 15 m obstacle maintain V_x after take-off.

Takeoff runway length may vary depending on the wind, temperature, elevation and wing & propeller surface condition.

Effect of elevation

The table below provides data about the effect of elevation on takeoff runway length.

elevation (m)	0	500	1000	1500
atmosph. pressure (hPa)	1012	954	898	845
outside temperature (°C)	15,0	11,7	8,5	5,2
Takeoff runway length [m (ft)]				
SW 80	175 (580)	210 (688)	240 (787)	285 (935)
SW 100	140 (460)	175 (574)	215 (705)	250 (820)

WARNING: If the outside temperature is higher than the standard value it is mandatory to consider the takeoff runway length prolongs as follows: $L = 1,10 \cdot (L_h + L_t - L_0)$.

Abbreviations are as follows:

L_h = takeoff runway length at present elevation,

L_t = takeoff runway length at sea level at same atmospheric conditions,

L_0 = takeoff runway length at 15°C.

Effect of the wind

Wind (head, cross or downwind - also called tailwind) affects aircraft's ground speed (GS).

Headwind on takeoff and landing causes the Takeoff and Landing runway length to shorten as the GS is smaller during these two flight stages. The opposite stands for tailwind on takeoff and landing as tailwind prolongs Takeoff and Landing runway length significantly.

The data on the next page was obtained through testing and therefore serve as informative values only.

Headwind shortens Takeoff and Landing runway length by 8 meters (25 feet) with every 5 km/h (3 kts) of wind increase (e.g. provided there is a 10 km/h (6 kts) headwind on takeoff and landing, distances will be approximately 16 meters (50 feet) shorter than ones published in the manual).

Tailwind prolongs Takeoff and Landing runway length by 18-20 meters (60-65 feet) with every 5 km/h (3kts) wind increase (e.g. provided there is a 10 km/h (6kts) tailwind on takeoff and landing, distances will be approximately 36-40 meters (120-130 feet) longer than ones published in the manual).

WARNING! Tailwind affects takeoff and landing performance by more than twice as much as headwind does.

The table below provides data about the effect of headwind (+) and tailwind (-) on takeoff runway length.

windspeed (kts)	-6	-4	-2	0	4	8	12
Takeoff runway length [m (ft)]							
SW 80	233 (764)	209 (685)	188 (616)	175 (582)	164 (537)	156 (511)	150 (492)
SW 100	198 (650)	174 (570)	153 (501)	140 (460)	129 (423)	121 (395)	115 (378)

The graph below indicates how takeoff runway length changes when affected by wind.

Effect of outside temperature

The table below provides data about the effect of outside temperature on takeoff runway length.

temperature (°C)	13	20	25	30	35
Takeoff runway length [m (ft)]					
SW 80	175 (580)	204 (669)	222 (728)	239 (784)	254 (833)
SW 100	140 (460)	169 (554)	187 (613)	204 (670)	219 (720)

Climb performance

Virus SW	SW 80	SW 100
best climb speed	148 km/h (79 kts)	148 km/h (79 kts)
best climb rate at MTOM	5.3 m/s (1060 fpm)	6.6 m/s (1320 fpm)
climb rate at 185 km/h (100 kts)	4.4 m/s (880 fpm)	5.2 m/s (1040 fpm)

Effect of elevation

The table below provides data about the effect of elevation on climb rate at best climb speed V_y .

Virus SW	SW 80	SW 100
0 m (0 ft)	5.3 m/s (1060 fpm)	6.6 m/s (1320fpm)
500 m (1600 ft)	4.9 m/s (980 fpm)	6.2 m/s (1240 fpm)
1000 m (3300 ft)	4.4 m/s (880 fpm)	5.4 m/s (1080 fpm)
1500 m (5000 ft)	3.8 m/s (760fpm)	4.0 m/s (1800 fpm)

Note: climb rate is measured at max continuous power (5500 RPM) of the engine with flap in neutral position (0 degrees).

Climb performance may vary depending on, temperature, altitude, humidity and wing & propeller surface condition.

Cruise

Aircraft at MTOM, 75% engine power in ISA conditions at sea level altitude, flaps set to negative position (-5 degrees):

Virus SW	SW 80	SW 100
cruise airspeed (tailwheel version)	241 km/h (130 kts)	268 km/h (143 kts)
cruise airspeed (nosewheel version)	234 km/h (126 kts)	254 km/h (137 kts)

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Best performance cruising level is 1800 m (6000 ft) for SW 80 and 2300 m (7500 ft) for SW 100.

There, cruise performance is equivalent or better than above due to IAS-TAS relation, but fuel consumption is lower.

75% Cruise is 27.2 InHg - 5000 RPM for Rotax 912 UL and 26 InHg - 5000 RPM for the Rotax 912 ULS.

Descent

The rate of descent and by that descent glide path is adjusted using airbrakes (if applicable).

Typical sink rate, with flaps set to 2nd position and airbrakes fully extended, measures 5.2 m/s at 90 km/h and 6.3 m/sec at 110 km/h.

Virus SW	all models
max. sink rate with airbrakes extended at 90 km/h (48 kts), full flaps	5.8 m/s (1160 fpm)
sink rate at 90 km/h (48 kts), no airbrakes, full slaps	2.2 m/s (440 fpm)

The glide

The glide is defined as unpowered rightened flight at speed providing best lift over drag ratio or minimum sink rate.

Should the engine become inoperative in flight, as a result of either intended or unintended action, and it cannot be restarted, react as follows:

establish rightened flight at the speed providing best lift over drag ratio, if you desire to overcome greatest distance at reach from initial altitude.

establish rightened flight at speed providing minimum sink rate, if you desire do stay airborne the longest. This may come in handy in case you will be forced to give way to other aircraft or if you simply need time to determine the most appropriate site to land out on.

Virus SW	all models
minimum sink speed	108 km/h (58 kts)
minimum sink rate (SW 100, unfeathered propeller), flaps +9 deg	2.15 m/sec (430 fpm)
minumum sink rate (SW 80, feathered propeller), flaps +9 deg	1.87 m/sec (375 fpm)
best lift/drag ratio speed	118 km/h (64 kts)
best lift over drag ratio (SW 100, unfeathered propeller), , flaps +9 deg	1:17
best lift over drag ratio (SW 80, feathered propeller), flaps +9 deg	1:15

CAUTION: When the engine fails, especially in climb, the aircraft always loses some 30 meters (100 feet) of altitude before reaching best glide speed in rightened unpowered flight.

Landing performance

CAUTION! Check if your Virus SW is equipped with airbrakes. There is major difference in landing performance with or without airbrakes.

Final approach speed should always be 100 km/h (54 kts) with full flaps, regardless of the approaching with or without airbrakes. Landing runway length may also vary depending on the elevation, gross weight, touchdown velocity, wind direction and how aggressive the braking action is.

In following conditions: aircraft at MTOM with full airbrakes, airport elevation 100 meters (300 feet), wind calm; the landing runway length measures 125 meters (410 feet). Should you be flying solo, the length shortens by another 10 meters (30 feet).

With aircraft at MTOM, no airbrakes, airport elevation 100 meters (300 feet), wind calm; the landing runway length measures 210 meters (670 feet). Should you be flying solo, the length shortens by another 10 meters (30 feet).

WARNING! Runway proportions must be in excess of 350 x 30 meters (820 x 100 feet) with no obstacles in 4° range off runway heading in order ensure safe flying activity. Use of shorter strips should be considered a major exception and is allowed to experienced pilots at own risk only.

WARNING! Minimum recommended runway length for approaches without airbrakes is 500 m (1640 feet) with no obstacles in 4° range off runway heading in order ensure safe flying activity. Use of shorter strips should be considered a major exception and requires a lot of skill, heavy use of crabbing until the last moment before touchdown and is performed at own risk.

Crosswind landing limitations

Maximum allowed crosswind speed on takeoff and landing with flaps in 2nd position is 34 km/h (18 kts).

Additional technical data

Virus SW (at 600 kg)	SW 80	SW 100
stall speed (flaps extended)	74 km/h (40 kts)	74 km/h (40 kts)
stall speed (flaps retracted)	84 km/h (46 kts)	84 km/h (46 kts)
cruise speed (75% power)	241 km/h (130 kts)	264 km/h (143 kts)
max. speed with spoilers extended	205 km/h (110 kts)	205 km/h (110 kts)
max. speed with flaps in 1 st position	130 km/h (70 kts)	130 km/h (70 kts)
max. speed with flaps in 2 nd position	110 km/h (59 kts)	110 km/h (59 kts)
manoeuvring velocity V_a	174 km/h (94 kts)	174 km/h (94 kts)
turbulence penetration velocity V_b	250 km/h (135 kts)	250 km/h (135 kts)
VNE	302 km/h (163 kts)	302 km/h (163 kts)
best climb-over-distance ratio speed V_x	105 km/h (57 kts)	105 km/h (57 kts)
best climb rate speed V_y	148 km/h (79 kts)	148 km/h (79 kts)
max. climb rate at MTOM	5.3 m/s (1060 fpm)	6.6 m/s (1320 fpm)
climb rate at 185 km/h (100 kts)	4.4m/s (880 fpm)	5.2 m/s (1040 fpm)
minimum sink speed	108 km/h (58 kts)	108 km/h (58 kts)
minimum sink rate (propeller flat)	2.25 m/sec (450 fpm)	2.25 m/sec (450 fpm)
minimum sink rate (propeller feathered)	1.95 m/sec (390 fpm)	not applicable
max. sink rate with spoilers extended for ldg.	5.8 m/s (1160 fpm)	5.8 m/s (1160 fpm)
best lift-over-drag ratio speed	123 km/h (66 kts)	123 km/h (66 kts)
best lift-over-drag ratio (propeller flat)	1:15	1:15
best lift-over-drag ratio (propeller feathered)	1:17	not applicable
takeoff runway length at MTOM	175 m (580 ft)	140 m (460 ft)
takeoff runway length at MTOM over 15 m obst.	280 m (920 ft)	230 m (760 ft)
service ceiling at MTOM	5600 m (FL 185)	6800 m (FL 225)
45° left to 45° right - bank to bank time	1.6 s	1.6 s
endurance (incl. 45 min reserve)	6.9 h	5.3 h
fuel flow at cruise speed	13.6 l/h (3.6 gph)	17.8 l/h (4.7 gph)
range at cruise speed + 45 min loiter reseve	1650 km (890 NM)	1450 km (785 NM)
max. wing load factors	+4 G -2 G	+4 G -2 G

WARNING! Wing and propeller surfaces must be immaculately clean, dry and undamaged at all times. As all airfoils are laminar any impact spots, bumps and even a dirty (incl. water, snow...) surface may significantly lower flight performance. Stall speed, takeoff and landing runway length, sink rates and fuel consumption increase, while climb rates, ceiling, lift-over-drag ratio and endurance decrease. Some of the these are effected by as much as 30%!
Performance is valid for ISA sea-level conditions.

Noise levels

Noise levels are measured from the ground. The aircraft at MTOM must fly over the microphone at a height of 150 meters (500 feet), exactly at VNE, with engine set at maximum continous power. Noise levels for all versions of Virus 912 SW have been measured in this way and assted to be below 65 dB.



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Weight and balance



Introduction

Weighing procedure

Equipment list

Determination of CG

Sample CG calculation

Introduction

This chapter provides information on aircraft's weight and balance, which is essential for safe flying activity.

Weighing procedure

How to weigh the aircraft and later determine the CG correctly:

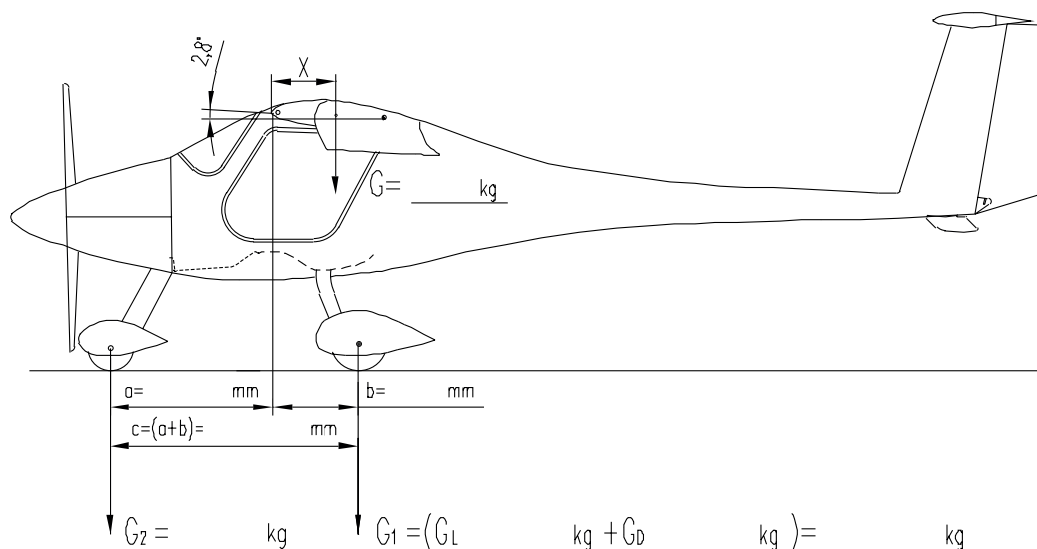
- Make sure all listed aircraft parts and appliances are installed and in position.
- Remove all other objects (e.g. tools, mops ...).
- Empty fuel tanks except for the unusable fuel.
- Fill up engine oil to the top marking.
- Retract flaps and spoilers, leave control surfaces centred.
- Level the aircraft inside a closed space.
- To do this, use the provided airfoil template at lower side of the wing close to the wing root and make sure its straight edge is level (horizontal).
- Once leveled, read the scale readings and subtract eventual tare weight.
- Now measure and record all readings and fill out the bottom schematic.

Datum is wing's leading edge at wing root. Calculate the lever arm of CG using this formula:

$$\text{Lever arm of CG (X)} = ((G_1 / G) \times c) - a$$

Weighing form

Weighing point and symbol	Scale reading	Tare	Nett
right main wheel (G _D)			
left main wheel (G _L)			
nose wheel (G ₂)			
total (G = G _D + G _L + G ₂)			



Equipment list

Aircraft's empty weight data is unique for each and every Virus 912 SW produced.

Virus model:

Serial number:

Registration number:

Installed appliances:

Determination of CG

	Weight (kg)	Weight's lever arm (cm)	Torque (kgcm)	Remarks
Basic cfg. empty weight				
Baggage		116		
Instruments		- 31		minus!!!

CAUTION! Each newly installed part or appliance must be registered in the upper table. Also, new total weight and lever arm of CG values must be entered and position of CG re-determined. Furthermore, the moment must be recalculated. This is rather unchanging to do. First multiply the new part's weight by it's lever arm measured from the reference point (wing's leading edge). Then sum up all momentums and divide the sum by the new total weight.

WARNING! Aircraft's safe center of gravity position ranges between 25% and 37% of mean aerodynamic chord and is not affected by cockpit crew weight or weight of fuel on board in any way.

WARNING! Absolute safe measure for the amount of luggage is 10 kgs. The actual amount of luggage you can safely transport depends on the centre of gravity of empty aircraft. See next pages.

Sample c.g. calculation

Guidelines

G_{total} is the total mass of empty aircraft. All calculations can be performed with aircraft empty weight and empty weight centre of gravity (c.g.), as the pilots sits directly below the centre of gravity and do not cause the c.g. to be shifted. The amount of fuel quantity also has no impact on the c.g..

WARNING! Both pilots' weight and weight of fuel do not influence c.g. or their influence is insignificant. However, baggage can influence the c.g. severely and may cause the aircraft to become uncontrollable!

Basic CG formulas and calculation

The below instructions are valid for Virus Tail Wheel and Nose Wheel editions. Read thoroughly. Note also that the basic c.g. at 287 mm will be used purely as an example.

First, weigh the aircraft according to the procedure described in this chapter and write down values of G₁ (sum of scale readings at main wheels) and G₂ (scale reading at tail/front wheel). Then calculate the position of c.g. in millimeters (mm) from the datum (wing's leading edge at wing root).

For Tail wheel edition of Virus use the following formula:

$$CG_{mm} = \frac{G_{2tail} \cdot b}{G_{total}} + a = \frac{G_{2tail} \cdot 4300mm}{G_{total}} + 110mm = 287mm$$

where:

G_{2tail} is the scale reading at the tail wheel,

G_{total} is the sum of G₁ and G_{2tail} (G₁+G_{2tail}), a.k.a. aircraft empty weight

a is the distance from main wheel axis to wing's leading edge,

b is the distance between main and tail wheel axis.

For Nose wheel edition of Virus use the following formula:

$$CG_{mm} = \frac{G_{1back} \cdot c}{G_{total}} - a = \frac{G_{1back} \cdot 1525mm}{G_{total}} - 1020mm = 287mm$$

where:

G_{2back} is the sum of scale readings at both main (back) wheels,

G_{total} is the sum of G₁ and G_{2back} (G₁+G_{2back}), a.k.a. aircraft empty weight

a is the distance from nose wheel axis to wing's leading edge,

b is the distance from main wheel axis to wing's leading edge,

c = (a+b) is the sum of both distances above.

Second, determine the c.g. position in percentage (%) of Mean Aerodynamic Chord (MAC) with following the formula:

$$CG_{\%MAC} = \frac{CG_{mm} - R}{MAC} \cdot 100 = \frac{287mm - 43mm}{897mm} \cdot 100 = 28.4\%$$

where:

CG_{mm} is the position of CG in millimeters (mm),

R is the difference between wing's leading edge and MAC's leading edge (43 mm),

MAC is the Mean Aerodynamic Chord (897 mm).

Baggage and CG

The amount of baggage you can carry in the solid baggage compartment or in the baggage pouch behind the seats is limited by the centre of gravity of the empty aircraft (pilots' and fuel weight do not influence c.g.) and the MTOM.

To calculate how much the c.g. shifts because of added baggage into the solid baggage compartment or the baggage pouch behind the seats use the following formula:

$$CG_{with.bags} = \frac{(G_{total} \cdot CG_{mm}) + (G_{bags} \cdot L_{mm})}{G_{total} + G_{bags}} = \frac{(292kg \cdot 287mm) + (10kg \cdot 1160mm)}{292kg + 10kg} = 316mm$$

where:

Gtotal is the aircraft empty weight,

CGmm is the position of CG of empty aircraft in millimeters (mm),

Gbags is the weight of the baggage,

Lbags is the lever arm from the datum to baggage area (1160 mm).

Again, express the new c.g. in percentage of MAC:

$$CG_{(+bags)\%MAC} = \frac{CG_{with.bags} - R}{MAC} \cdot 100 = \frac{316mm - 43mm}{897mm} \cdot 100 = 31.6\%$$

where:

CGwith.bags is the position of CG now with bags in millimeters (mm),

R is the difference between wing's leading edge and MAC's leading edge (43 mm),

MAC is the Mean Aerodynamic Chord (897 mm).

We now have the data of c.g. of the sample aircraft with 10 kgs of baggage. You can recalculate the formulas using the weights and c.g. of your empty aircraft and the planned amount of baggage for your flight.

CAUTION: The baggage weight limitations mentioned on page 15 of this manual represent fool-proof limits for safe operation, even without special c.g. calculation. However, the actual baggage weight limitation is different of each individual aircraft and can be determined using the above formulas. The decision of how much baggage to carry on a flight is at pure responsibility of the pilot in command!

WARNING! Always make sure that the baggage is placed fixed inside the baggage area. Movements of baggage in-flight will cause shifts of centre of gravity!

WARNING! Do not, under any circumstances attempt to fly the aircraft outside the allowable c.g. limits! Allowable c.g. range is between 267 mm and 375 mm, measured from the wing's leading edge backwards which corresponds to 25% - 37% MAC)

WARNING! Maximum takeoff weight (MTOM) MUST NOT, under any circumstances, exceed 600 kg.



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Aircraft and systems on board



Introduction

Cockpit levers

Instrument panel

Undercarriage

**Seats and safety
harnesses**

Pitot-static lining

Air brakes (spoilers)

Power plant and propeller

Fuel system

Electrical system

Engine cooling system

Engine lubrication system

Wheel brake system

Introduction

Virus 912 SW is a 10.71-meter-wingspan, two-seat T-tail motorplane made almost entirely of composite materials. Its low-drag, high-wing-monoplane, engine-at-the-front construction makes it efficient even when flying unpowered. In fact, the propeller can be feathered to reduce drag even more.

The undercarriage is a tricycle type with two main, brake equipped, wheels mounted on struts and a steerable nose wheel.

Virus 912 SW features flaperons, interconnected flaps and ailerons presented in the same deflecting surface. Flaps offer 4 settings: neutral, 1st, 2nd and the negative position of which none have any impact on aileron deflections whatsoever. What is more, individual main flight control levers make Virus ideal for initial as well as for advanced flight training. All aileron, elevator and flap controls are connected to the cabin controls using self-fitting push-pull tubes. Rudder deflects via cables. The elevator trim is mechanical, spring type.

Airbrakes are available as an option, they reduce the requirements for runways size for landing and provide for steeper approaches and expedite descents.

All aircrafts ship with H type safety harness attached to the fuselage at three mounting points. Rudder and belonging brake pedals can be adjusted to suit your size and needs.

Fuel tanks are located inside the wings. Fuel selector is in the form of two separate valves,

located on the left and right upper wall of the cabin. Fuel hose connectors are self securing; this prevents fuel spills when disassembling the aircraft. The gascolator is located beneath the lower engine cover. Refuelling can be done by pouring fuel through the reservoir openings on top of the wings or by using an electrical fuel pump instead. Also featured are low-fuel signal lights on the instrument panel.

All glass surfaces are made of 2 mm anti UV GE Lexan, which was specially developed not to shatter or split on impact.

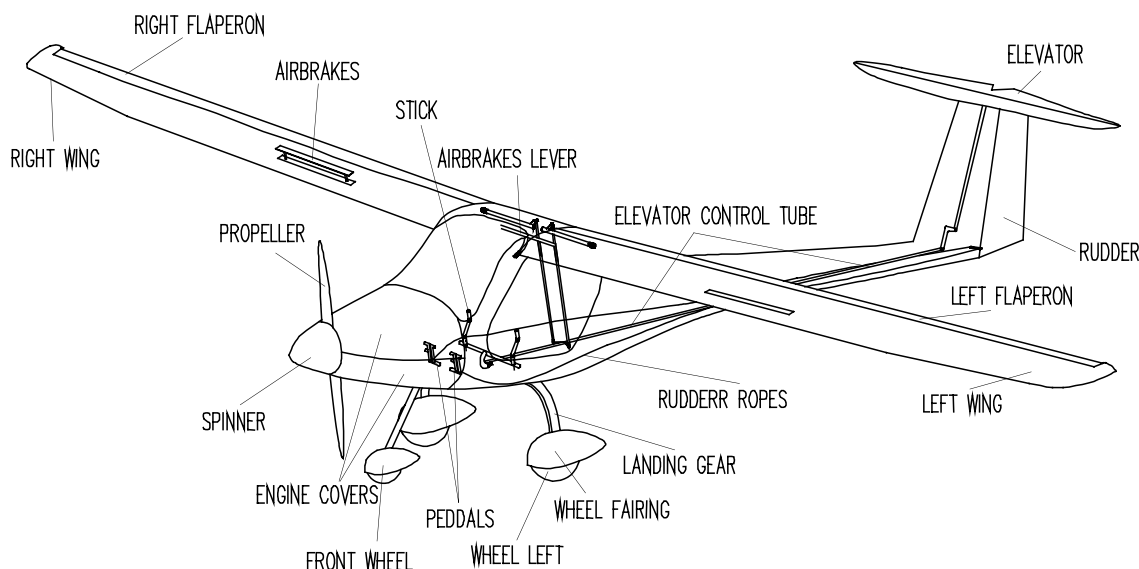
Main wheel brakes are hydraulically driven disc type. The hydraulic brake fluid used is DOT 3 or DOT 4. Cabin ventilation is achieved through special ducts fitted onto glass doors, cabin heating, however, is provided utilizing of hot air from the engine.

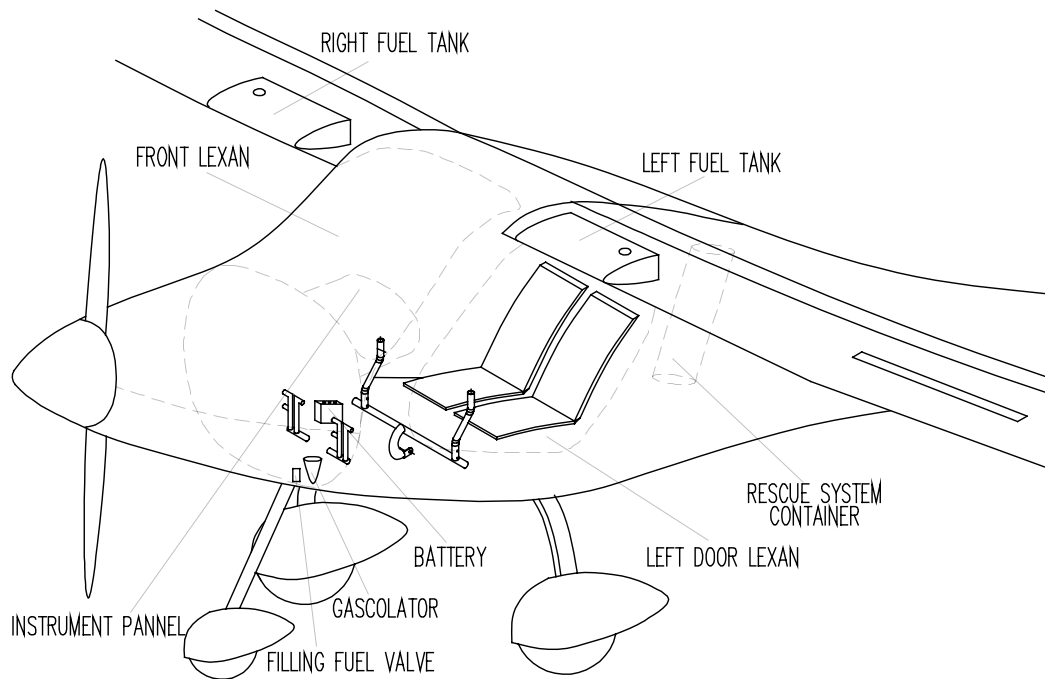
To enhance aerodynamics even more, every Virus 912 SW comes equipped with special wheel fairings and the propeller spinner. The propeller is variable pitch, the 80 HP version also has feathering capability.

Electric circuit enables the pilot to test individual circuit items and to disconnect the entire wiring but leave the engine running, should there come to a distress situation. Navigational (NAV), anti collision (AC) and landing (LDG) lights are an option. The firewall is enforced by heat and noise insulation.

Basic instruments come installed with operational limits pre-designated.

Parachute rescue system is an option.





Composite parts are made of:

fabric:	GG160, GG200, 90070, 92110, 92120, 91125, 92140, 92145, KHW200
roving:	NF24
foam:	75 kg/m ³ PVC 3mm, PVC 5 mm, PVC 8mm
GFK:	3 mm, 5 mm, 7 mm of thickness
paint:	gelcoat
heat resistant protection	glass-aluminium sandwich

Medal parts used are:

tubes:	materials: Fe0146, Fe 0147, Fe0545, Fe1430, AC 100, CR41 in LN9369
sheet metal:	materials: Fe0147 in Al 3571
rods:	materials: Fe 1221, Fe 4732, Č4130, Al 6082, CR41 in Al 6362
cable:	AISI 316
bolts and nuts:	8/8 steel

All composite parts are made of glass, carbon and kevlar fiber manufactured by Interglas GmbH.

All parts have been tested at safety factor of a minimum 1.875.

All parts are made in moulds, therefore no shape or structural differences can occur.

All desinging, manufacturing and testing complies with following regulations:

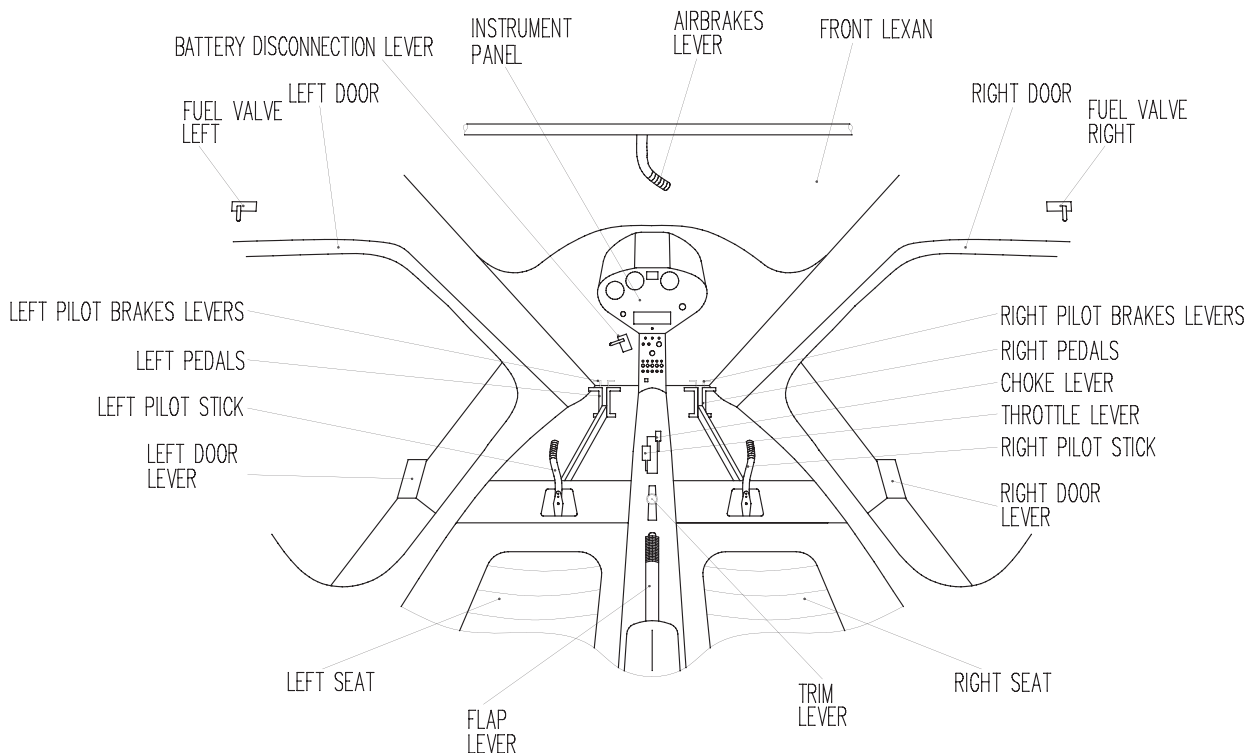
- Bauvorschriften für Ultraleichtflugzeuge des Deutschen Aero Club e.V. Beauftragter des Bundes-ministeriums für Verkehr
- EASA CS-22 - certain sections
- EASA CS-VLA –certain sections

for Slovenian market also: Pravilnik o ultralahkih napravah Republike Slovenije.

All parts and materials presented in Virus 912 SW are also being used in glider and general aviation industry and all comply with aviation standards.

Cockpit levers

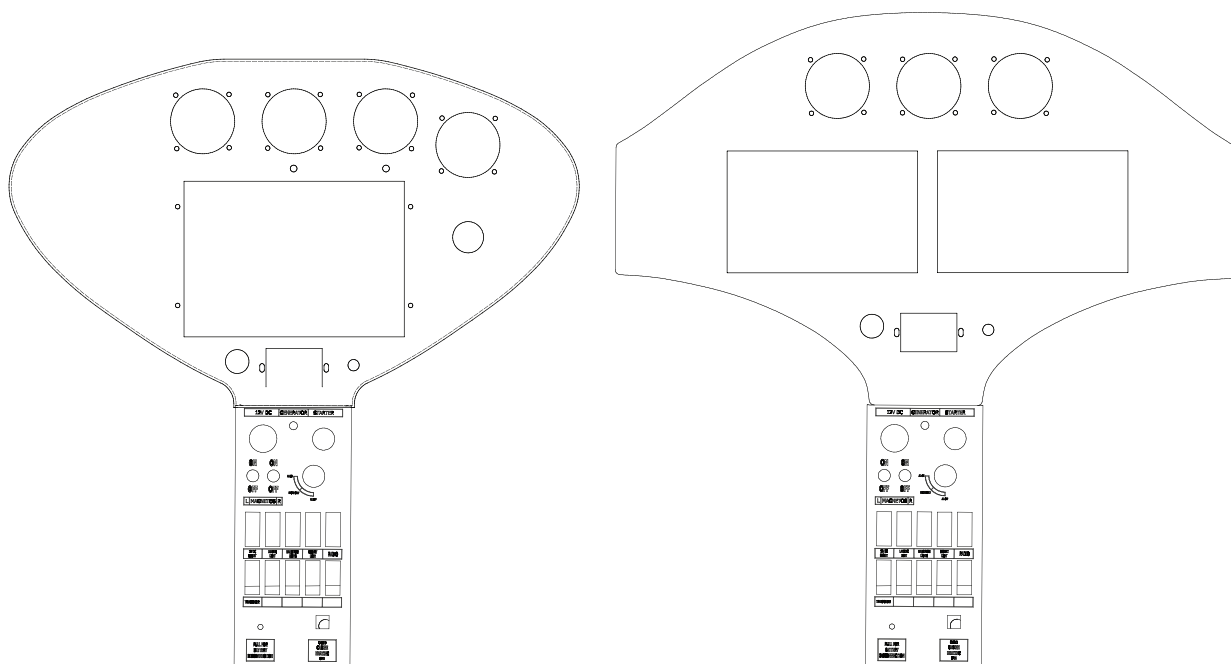
Virus 912 SW's cockpit levers are divided into two groups:



Individual control levers: pilot stick and rudder with belonging brake levers

Joint control levers: throttle lever, chock lever, flap lever, trim lever, airbrakes lever (if applicable), fuel valves, door levers, battery disconnection lever/ring and emergency parachute release handle.

Instrument panel



Small instrument panel (left) with Brauniger as the middle screen - Large instrument panel with two screen setup (Dynom D100 and EMS 120). Both are for illustration purpose only!

There are two types of instrument panels, the big and small version. Both have enough space to host the Brauniger Alpha MFD as the standard multifunction instrument. Factory approved options are a single Dynon D180 EFIS/EMS as the main instrument or dual screen efis setup with Dynon D100 and EMS120. All instruments have flight data recording capabilities and display all necessary flight and engine data to the pilot.

Notes on Brauniger Alpha MFD multifunction instrument

- The new version of Brauniger AlphaMFD multifunction instrument (V315) also features an acoustic vario-meter and an acoustic VNE alarm.
- Certain Brauniger AlphaMFD instalations require the multifunction instrument to be switched ON seperately from the aircraft's master switch.
- Always make sure the instrument is switched OFF when you leave the aircraft not to discharge its internal battery.

Undercarriage

The undercarriage is a tricycle type with two main, brake equipped, wheels mounted on struts and a steerable nose wheel.

distance between main wheels:	1.60 m
distance between main and nose wheel:	1.52 m
tire:	4,00" x 6" (main wh.), 4,00" x 4" (nose wh.)
tire pressure	1,0 - 1,2 kg/cm ² (main wh.), 1,0 kg/cm ² (nose wh.)
brakes:	disk type, driven by brake pedals located on both rudder pedals
brake fluid:	DOT 3 or DOT 4

Seats and safety harnesses

Seats have no stiff internal structure and do not offer different settings. All Virus 912 SW ship with H type safety harness attached to the fuselage at three mounting points.

Pitot-Static lining

The pitot tube is attached to the bottom side of the right-hand wing. Pitot lines made of composite materials lead through the inside of the wing all the way to the instrument panel.

Air brakes (spoilers)

Spoilers are most commonly used to increase drag and steepen the final approach. They are optional equipment.

During takeoff, climb and cruise spoilers **MUST** be retracted and locked (handle in cockpit in full up position). To unlock and extend spoilers, press on the release cock and pull the handle downwards.

Power plant and propeller

Virus is equipped with Rotax 912 UL engine or Rotax 912 ULS engine

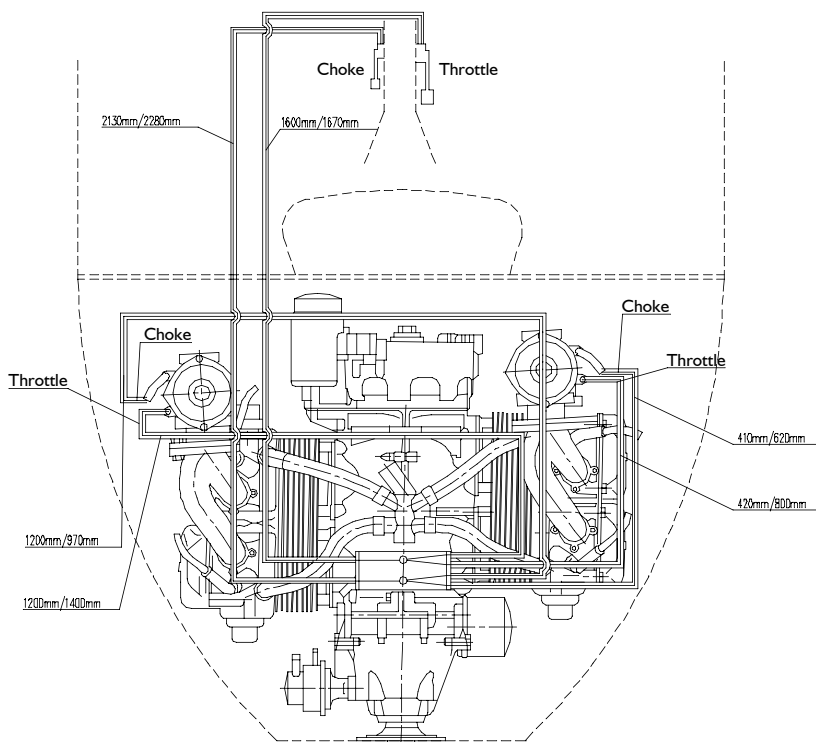
Engine description:

Engine:	ROTAX 912UL (4-stroke boxer, four cylinders, 1211 cm³) twin carburated - double electronic ignition
cooling:	housing aircooled, cylinder heads watercooled - own radiator and pump, other moving parts oilcooled - own radiator and pump
lubrication:	centrally oiled - own oil pump and radiator
reduction gearbox:	integrated
reduction ratio:	1 : 2,27
el. generator output power:	250 W at 5500 RPM
starter:	electric
engine power:	80 HP at 5800 RPM
battery:	12 V, 8 Ah

Engine:	ROTAX 912ULS (4-stroke boxer, four cylinders, 1352 cm³) twin carburated - double electronic ignition
cooling:	housing aircooled, cylinder heads watercooled - own radiator and pump, other moving parts oilcooled - own radiator and pump
lubrication:	centrally oiled - own oil pump and radiator
reduction gearbox:	integrated
reduction ratio:	1 : 2,43
el. generator output power:	250 W at 5500 RPM
starter:	electric
engine power:	100 HP at 5800 RPM
battery:	12 V, 8 Ah

All metal ropes used are fire resistant, kept inside metal, self-lubricating flexible tubes.

Schematic of throttle and choke control



Use of variable pitch propeller

A variable pitch propeller significantly increases aircraft's takeoff, cruise and gliding performance.

CAUTION! Always fly in such a manner that you are able to reach at least one landing-out site every moment of the flight. This especially applies to unpowered flight as ignition, engine and/or propeller malfunction may prevent you from restarting the engine and by that resuming normal flight.

Propeller feathering (only with Pipistrel VARIO - Rotax 912 UL 80 HP)

WARNING! Feather propeller only after the engine has stopped and at minimum pitch.

To feather the propeller, first reduce airspeed to 90 km/h (50 kts), then pull the propeller pitch knob's metal base backwards fully and then rotate it 20° clockwise. A propeller pitch of approximately 70° is reached by doing so. To feather the propeller fully (90°), rotate the knob clockwise a couple of times until it stops.



decreasing propeller pitch

increasing propeller pitch

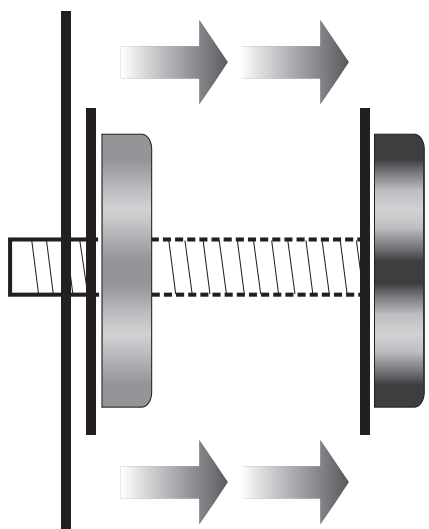
The screw in the middle of the knob indicates propeller pitch status. The screw is deep inside the knob when at minimum pitch and slides out as propeller pitch is increased.

When taking-off, always make sure propeller is set to minimum pitch to ensure maximum engine efficiency. To set the propeller to minimum pitch, screw the propeller pitch knob located on the instrument panel counter clockwise completely. Prior to taking-off, engine and propeller ground check must be performed. At full power and propeller pitch at minimum, RPM must not exceed designated limits. Verify also, that the RPM drop significantly when setting propeller pitch to maximum setting (knob screwed to the right fully, but not feathered!). When returning propeller pitch back to minimum setting, the RPM must reach same initial value as before engine and propeller ground check!

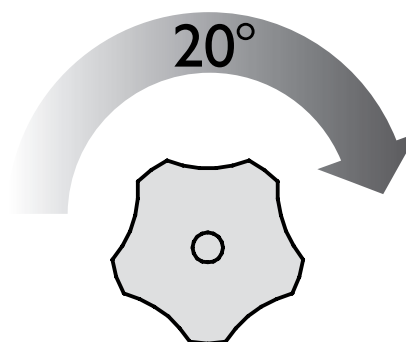
CAUTION! Verify RPM and engine parameters multiple times.

If propeller pitch is increased (rotate knob clockwise), engine's RPM will drop. Do not, under any circumstances, allow engine underrotation. Should this occur, immediately decrease prop. pitch to regain proper engine cruise parameters.

WARNING! Both engine under- and overrotation may cause significant damage to the engine and propeller.



1. propeller feathering



2. secure feathered position

Propeller unfeathering

To unfeather the propeller, first reduce airspeed to 90 km/h (50 kts) and screw the propeller pitch knob to the left fully. Then pull the propeller pitch knob's metal base slightly, rotate it counter clockwise for 20° and gently push it all the way to the instrument panel.

WARNING! Do not, under any circumstances, attempt to restart the engine while the propeller is feathered. This would most definitely result in engine, propeller and/or aircraft's structural damage.

Fuel system

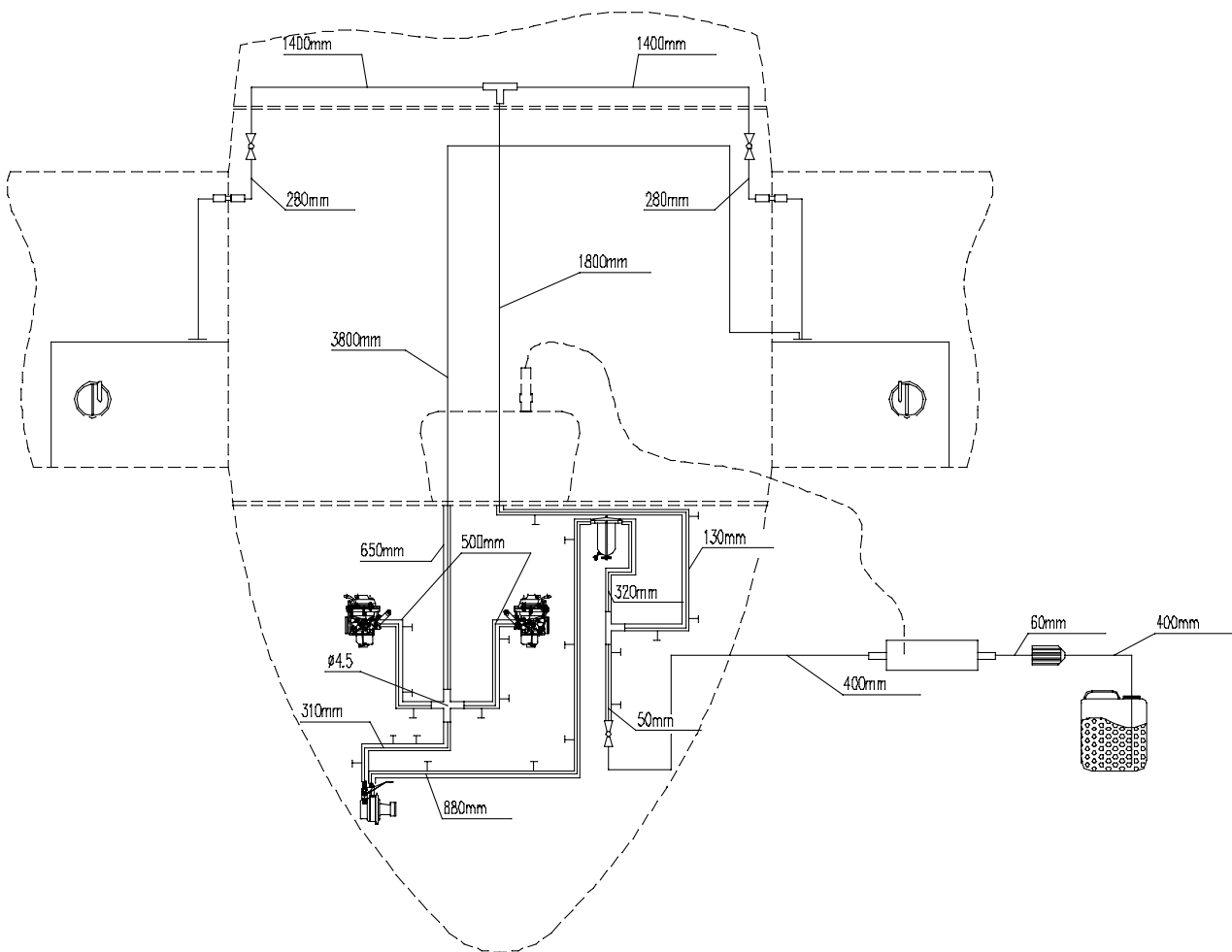
description:	vented wing fuel tanks with refueling aperture on top of the wings
fuel selector valves:	separated, one for each fuel tank
gascolator:	filter equipped with drain valve
fuel capacity:	50 + 50 litres
unusable fuel (per reservoir):	4 litres
fuel filter:	metal, inside the gascolator

All fuel hoses are protected with certified glass-TEFLON cover. Virus 912 SW's fuel system features fuel return circuit.

WARNING! Visual fuel quantity indicator (tubes) in cockpit do not always provide relevant information about the actual fuel quantity on board. Due to reasons of wing dihedral, angle of attack, sideslip and reservoir supply point the readout may be incorrect. Flying with less than 3 cm (1 Inch) of indicated fuel (measured from the bottom of the tube upwards in any of the reservoirs) is therefore regarded as hazardous any may result in engine fuel starvation and/or engine failure.

CAUTION! Due to the position of the fuel reservoir supply point, flying in considerable sideslip for a longer time may result in fuel starvation to the engine if the fuel tank in the opposite direction of the sideslip is closed. Should this occur, righten the flight and re-open the fuel tank in question immediately to prevent engine failure.

Schematic of fuel system (fuel return circuit)



Electrical system

description:	Double separated magneto ignition. Standard, 12 V circuit charges the battery and provides power to all appliances and instruments.	
master switch:		key type
magneto switches:	separated for each magneto	
other switches:	fused and equipped with control lights	
battery:	12 V, 8 Ah or 5 Ah	
measured power consumption of some circuit breakers:	Landing light: 4.5 A, Nav/Strobe lights: 1 (steady) - 2 (peak) A, Cockpit light: 0.5 A, Radio & Transponder: Please consult item's operating manual	

Battery disconnection system

On the Virus SW, the main battery can be disconnected from the circuit.

There are two handles in the cockpit used to operate the battery disconnection, the battery disconnection lever and the battery disconnection ring. The battery disconnection lever, which is a red flag-type lever is found on the firewall above the main battery on the left-hand side of the cockpit. This lever has an attached wire which leads to the battery disconnection ring on the instrument panel's switch column.

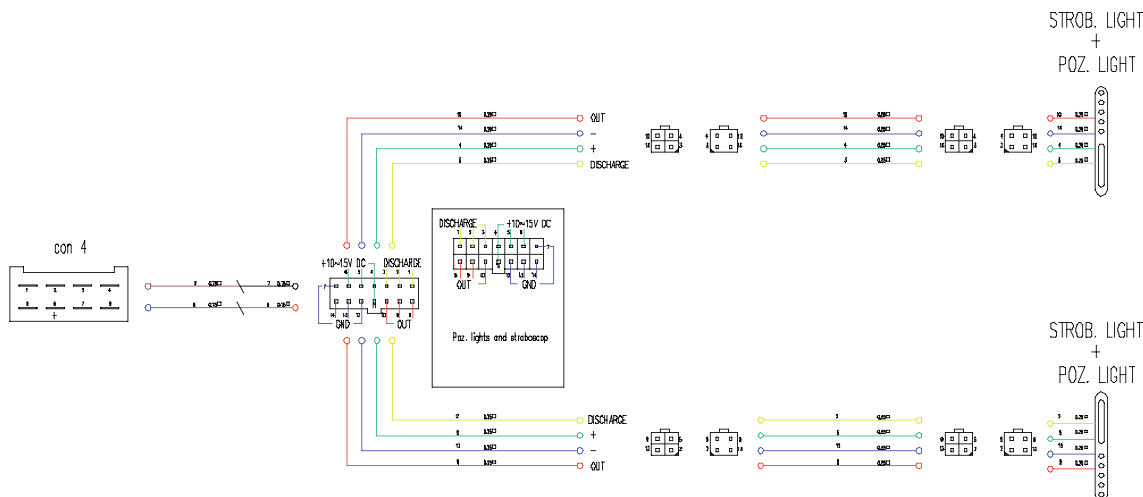
To disconnect the battery from the circuit, simply pull the battery disconnection ring on the instrument panel's switch column.

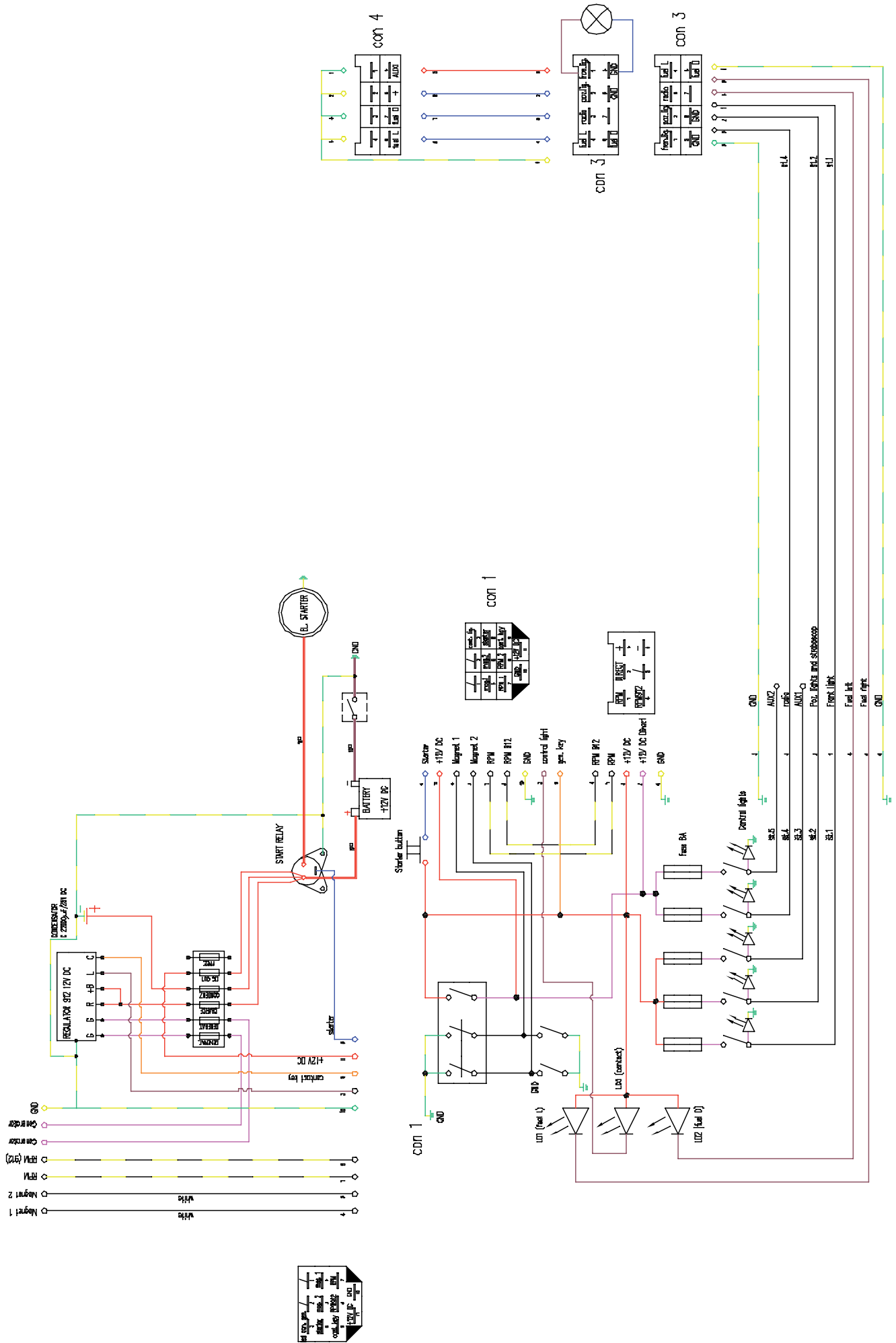
To reconnect the battery back to the circuit, use the flag-type lever on the firewall.

Deflect the lever so that its flag end points towards the firewall. Having done this correctly, you will feel the flag-lever jam into position.

Battery reconnection can be done in-flight as well (e.g. following a successfully rectified emergency situation) but only from the left-hand seat, since you cannot reach the flag-lever from the right-hand side of the cockpit.

Schematic of electrical system





Engine cooling system

Rotax 912 UL and ULS cooling system

The Rotax 912 engine's cylinders are watercooled. The cooling-air intake is located on the right-hand bottom part of the engine cover.

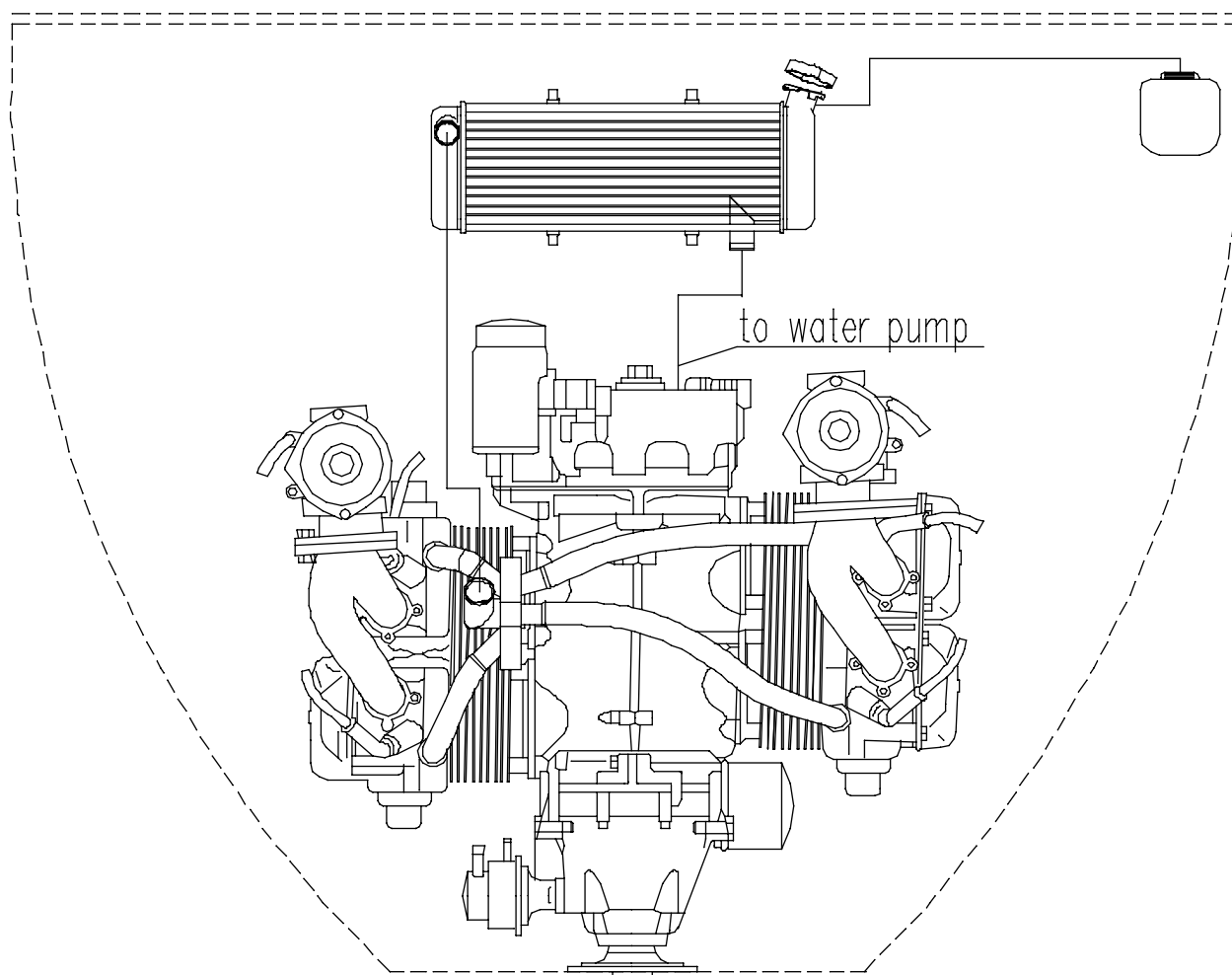
Cylinder heads are watercooled. Own water pump forces water through the radiator, placed behind the air intake opening on the top engine cover. The engine does not feature a thermostat valve. The system is pressurised with a pressurised valve placed on one of the hoses. The overflow tank fluid level must always be inside the designated limits!

The engine does not offer cooling water temp. monitoring. Only CHT is displayed in the cockpit. The engine does not feature a cooling fan, therefore cooling it is entirely dependant on moving air currents and airspeed.

CAUTION! You are strongly discouraged from leaving the engine running at idle power when on ground.

The manufacturer recommends use of cooling fluids used in car industry diluted in such a manner that it withstands temperatures as low as - 20°C.

Schematic of engine cooling system

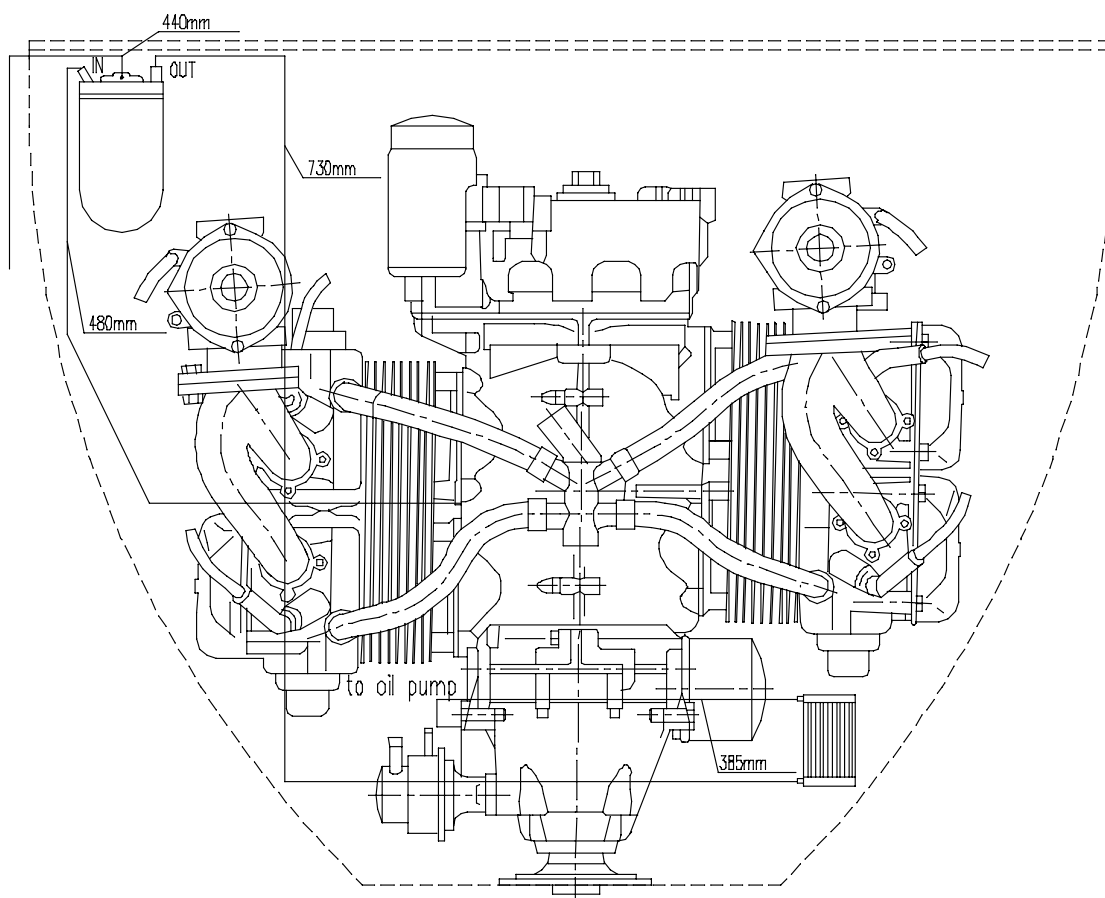


Engine lubrication system

Rotax 912 is a four-stroke engine, equipped with a dry carter and lubricated centrally with use of own oil pump. All the oil needed is located inside an outer canister. When the engine is running, the oil cools itself passing through a radiator, located on the left-hand side of the bottom engine cover. Oil quantity can be checked visually with a oil level bar. Make sure the oil quantity is sufficient limits at all times.

CAUTION! Oil temperature, pressure and quality is strictly defined and must not, under any circumstances, vary from its safe values.

Schematic of engine lubrication system



Wheel brake system

Wheel brake system features separate braking action for each of the main landing gear. Wheel brakes are drum or disc, wire driven (old type) or hydraulic type (new type). Wheel brake levers are operated by pressing the levers mounted on top of the rudder pedals.

Hydraulic brake fluid used for hydraulic type brakes is DOT 3 or DOT 4.

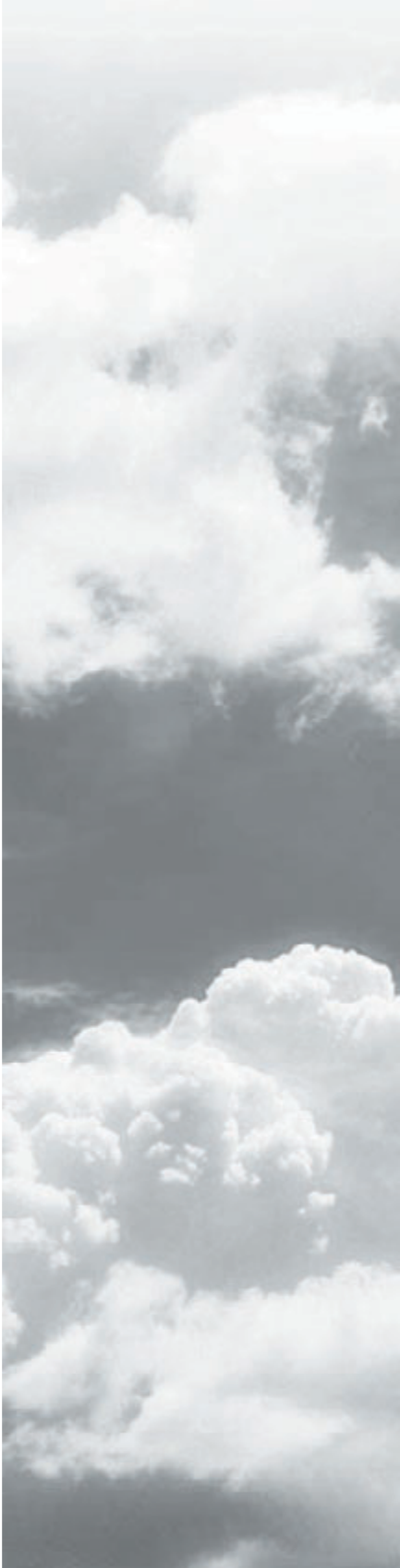
To learn how to vent hydraulic brakes' lining please see page 68 of this manual.

If the braking action on your aircraft is poor whilst the fully depressed wheel levers, please see page 69 of this manual to learn how to rectify this problem.



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Handling and maintenance



Introduction

Inspection periods

**Repairs and
spare part replacements**

Preventative maintenance

Special check-ups

Draining and refuelling

**Connecting Auxiliary
power supplies**

Tie down

Storage

Cleaning

**Keeping your aircraft in
perfect shape**

Introduction

This chapter determines handling and (preventative) maintenance terms. Also, recommended ground handling is presented.

Inspection periods

See "Service manual".

Repairs, spare part replacements and preventative maintenance

All major repairs and spare part replacements MUST be done by authorised service personnel.

However, you are encouraged to take care of preventative maintenance yourself. This includes: **tire and wheel bearings replacements, safety wire replacements, door and safety harness replacement, light bulb replacements, fuel hose replacements, battery servicing and replacement, sparks and spark plugs replacements and air filter replacements.**

The table below indicates recommended maintenance periods (see Service manual for detailed information).

Table legend:

- C** Check-up - visual only, check for free play and whether everything is in position - **DO IT YOURSELF**
- CL** Cleaning - **DO IT YOURSELF**
- LO** Lubricating, oiling - lubricate all designated parts and spots using proper lubricant - **DO IT YOURSELF**
- R** Replacement - replace designated parts regardless of state and condition.
You are encouraged to **DO** undemanding replacements **YOURSELF**, otherwise have replacements done by **AUTHORISED SERVICE PERSONNEL**
- SC** Special check-up - measuring, verifying tolerances and functionality - **DONE BY AUTHORISED SERVICE PERSONNEL ONLY**
- O** Overhaul

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
WING AND TAIL SURFACES							SC	O
surface and structure condition	C				SC			
deflections without free play	C			SC				
bearings - moving parts' bushings	C					SC		
lights	C							
self-adhesive sealing tape	C	C			SC			
horizontal tail mount	C	C		SC				
drain holes	CL							

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
FUSELAGE							SC	O
surface and structure condition	C						SC	
elevator control tube bearing				C		SC		
undercarriage struts attaching points		C	C	SC				
doors, hinges	C	C		SC	LO			
rudder control wires and hinges		C	C			SC		

							SC	O
CABIN								
control levers, instr. panel, seats	C			SC				
control levers' free play	C	C		SC				
instruments and pitot-static	C			check yearly				
glass surfaces: clean, attached	C	C		SC				
rivet condition	C					SC		
safety harnesses and attach. points	C			SC				
parachute rescue sys. activation handle	C					SC		
wing connectors: fuel, electrical	C	C		SC				
bolts and spar pins	C	C		SC				
wing main bushings, control connectors				SC				

								O
UNDERCARRIAGE								
tires	C		replace on condition or every 5 years					
main strut, tail /nose wh. strut condition	C	C		SC				
wheel axis and wheels				C				
hyd. brake lines	C			SC			R	
brake fluid	C				SC		R (500 hrs or 5 years)	
brake discs					SC		(R on condition)	
wheel bearings			C		SC		R	
tail wheel main bolt			C				R	
wheel fairings	C	C	C					
tail wheel mounting bolt	C			SC				

								R
CONTROLS (LO every 200 hrs or yearly)								
general free play	C	C		SC				
control stick	C			LO		SC		
rudder pedals (damage, centered, paral.)	C	C		C				
rudder wire rope	C			SC				
bolts, visible bearings (tail, fuselage)				SC				
difficult-to-reach bearings (wings, under cabin floor)						LO+SC		
aileron, elevator and rudder hinges				SC				
equal spoiler extension, undisrupted m.	C			SC		LO+SC		
spoiler plate springs stiffness	C		LO					
flap handle	C			SC				
elevator trim			C		R cable every 500 hrs			
springs: flaps, rudder, el. trim, stablizer main fastening bolt				LO	C	R		
spoilers' (airbrakes') drive fine adjustment				see page 71 for detailed description				

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
ENGINE								
see enclosed Rotax engine manual for detailed engine maintenance information.								
In addition to Rotax manual:								
two-stroke engines (overhaul every 300 hours)			C					
four-stroke engines (overhaul every 1,500 hours)			from engine serial number 4404718					
engine cover screws	C	C		C				
engine mount	C	C		SC				
engine mount dumpers and other rubber parts			C	SC			R every 500 hrs or every 5 years	
air filters	C	C		CL			SC	
elect. terminals, joints and connectors, hoses, radiator mount	C	C		SC				
exhaust muffler	C	C		SC			SC	
exhaust pipe springs and fire protect.	C	C		SC			R	
throttle, choke, propeller wire drive				SC			R	
ENGINE CONTROL								O
choke and throttle lever wire ropes	C	C		SC			R	
levers	C			SC				
PROPELLER AND SPINNER						SC	O	
surface condition	C							
fastening bolts					R			
propeller bushings					R			
propeller pitch	C				SC			
propeller balance	C				SC			
FUEL SYSTEM						O every 1000 hrs or 5 years		
general leakage	C	C		SC				
water inside gascolator	C							
dirt and gascolator filter			CL	CL	CL		R	
wing fuel tank caps	C							
fuel tank caps o-ring							R every 500 hrs or 5 years	
fuel valves and leakage	C							
ELECTRICAL WIRING							SC	R
battery	C	C		SC				
battery fluids		C	C	SC				
instr. panel wires and connectors		C		C				
NAV, AC and LDG lights	C	C						
fuses		C		C				

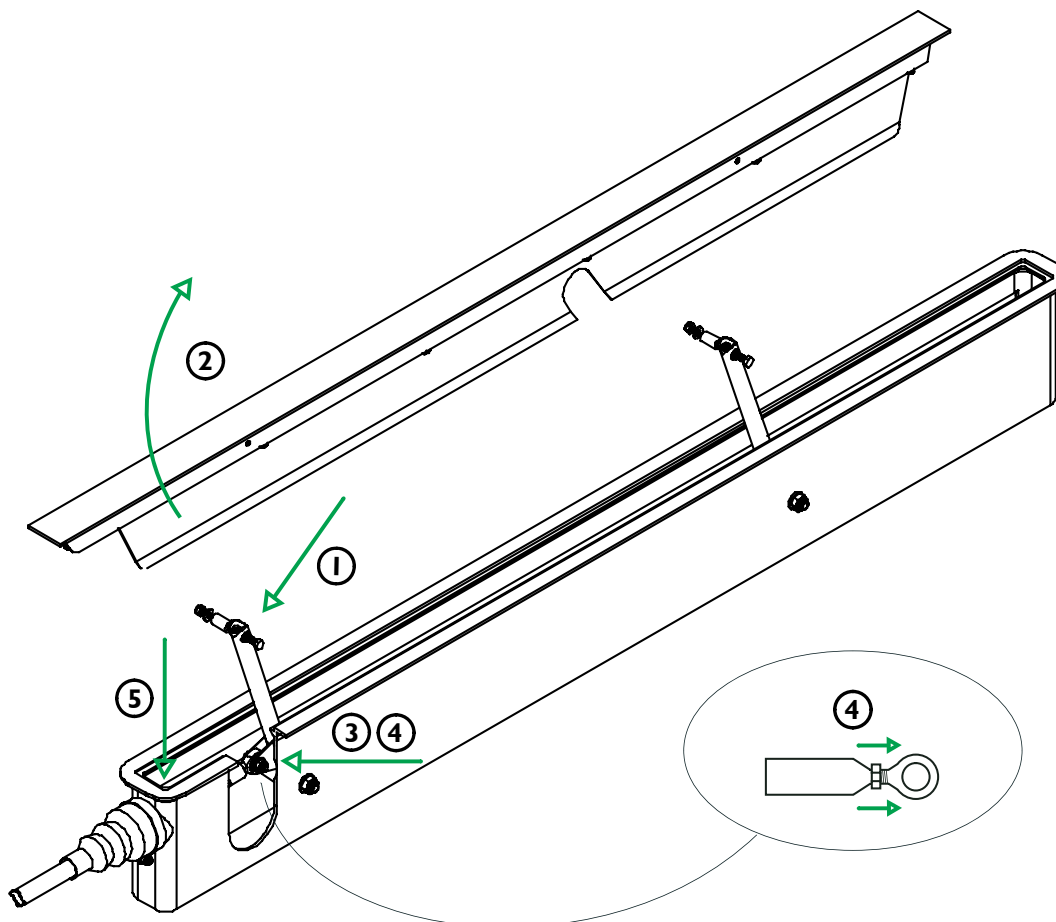
	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
OIL AND WATER LINES		O every 500 hrs or 5 years						
oil and cooling fluids level	C	C						
oil and cooling fluids leakage	C	C						
four stroke engine oil (and engine filter) first 25 hours +								refer to engine manual
cooling fluid (level)								refer to engine manual
hoses	C	C					R	
radiators	C	C						
water radiator pressure cap								refer to engine manual
PITOT-STATIC LINING							SC	O
instrument to pitot tube lining		C		C				
instrument setting	C	C						
pitot tube condition (clean, firmly att.)	C	C						
whole pitot-static lining		C		C				

Spoilers' (airbrakes') drive fine adjustment

CAUTION! Perform this operation only once after first 50 flight hours! Check spoilers thoroughly for unobstructed, smooth and even extension every 200 flight hours!

Schematic of spoilers' (airbrakes') drive fine adjustment

(see next page for detailed description)



Perform the adjustment as follows:

- ① **Unscrew and remove the inner horizontal bolt of the airbrake's plate. Do not lose any parts!**
- ② **Lift the airbrake in order to make room for further operation.**
- ③ **Unscrew and remove the bolt attaching the rod-end bearing to the airbrake's plate lever. Do not lose any parts!**
- ④ **Rotate the rod-end bearing fine-setting nut 360° so that the rod end moves towards the other end of the airbrake's box (length of rod increases). Make sure you secure this nut after turning it for 360°!**
- ⑤ **Grease the drive around the rubber sleeve inside the airbrake's box using rubber-non-aggressive lubricant spray.**

Once you have accomplished this, repeat steps 1-3 in opposite order (3,2,1). Make sure you apply adhesive (e.g. Loctite) on all screws when reattaching!

Perform the procedure at the other airbrake as well. In the end verify airbrakes for equal extension.

WARNING! Should the airbrakes not retract evenly, apply step action 4 again for the airbrake, which remains higher when retracting.

Clicking noise overhead

The wings are factory fitted to the fuselage to make a tight fit at approximately 20° Celsius. When exposed to low temperatures, materials shrink. Therefore, flying in the winter or in cold temperatures, you may encounter "click-clack" like noises above your head. The remedy for this unpleasant noises is to add washers, typically of 0,5 mm thickness in-between wing and fuselage. Washers must be added both at rear and front bushings at one side of the fuselage only!

WARNING! It is mandatory to consult the manufacturer or authorised service personnel before applying washers!

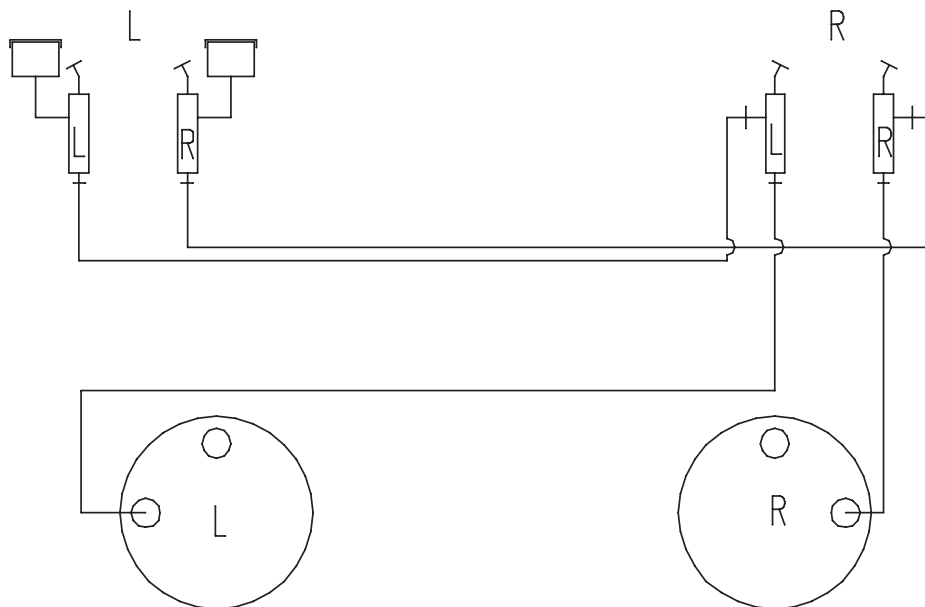
Venting the hydraulic brakes' lining

In case you notice poor braking action even when hydraulic brake levers are depressed fully, it is most definitely necessary to vent the hydraulic lining. To do so, first unscrew the caps of small fluid reservoirs (behind rudder pedals on one side of the cockpit) and remove the inner seal cap.

At the side where there are no fluid reservoirs grab the whole rudder pedal and deflect it back fully, so that it becomes level with the cockpit's floor beneath. Now, at the side where there are fluid reservoirs, jerk brake levers back and forth a couple of times - this will push air bubbles towards the reservoir and out of the lining. When convinced air bubbles are no more, put seal caps back onto the reservoirs and screw the caps on as well. Repeat the procedure for the other brake lever.

WARNING! Should you encounter any difficulties during this procedure or the air bubbles would not vent, please consult the manufacturer or authorised service personnel for further instructions.

Schematic of hydraulic brakes' lining

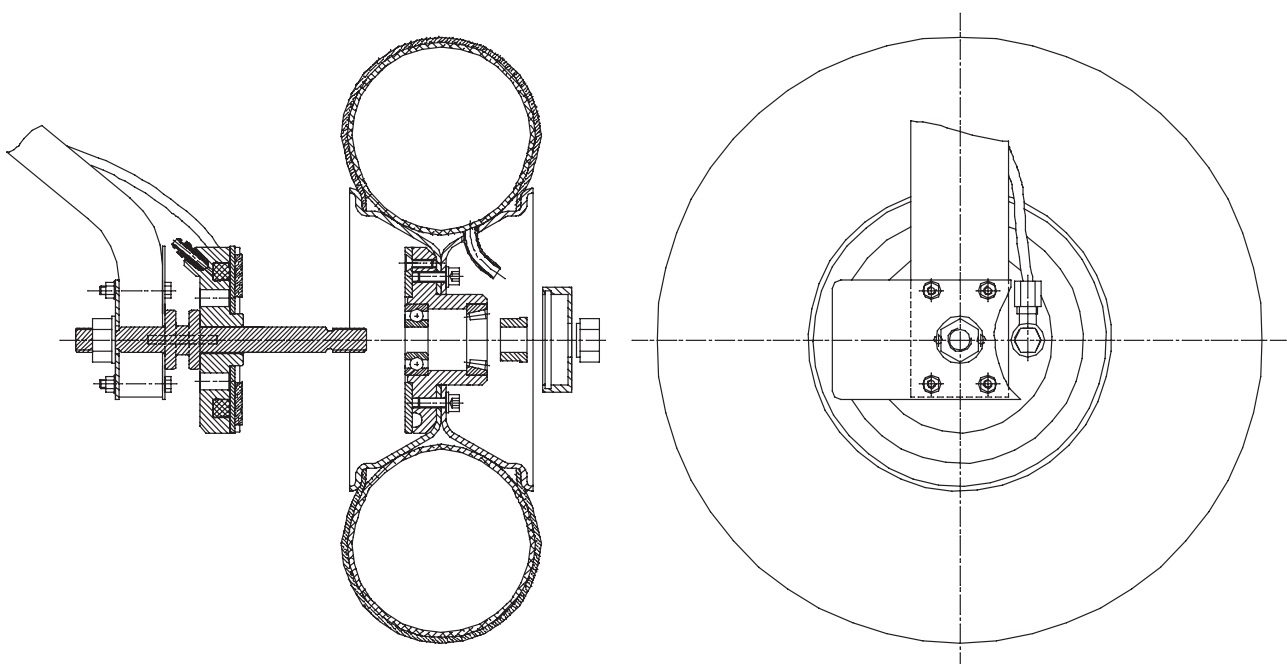


Poor braking action

In case you notice poor braking action even when hydraulic brake levers are depressed fully, it is not necessary the air bubbles in the hydraulic lining, which is causing the problem.

The main wheel's main axis' nut (especially after a wheel and/or axis replacement nut) may be tightened incorrectly so that the brake shims do not make contact with the brake plate. Please consult the manufacturer or authorised service personnel for further information.

Schematic of wheel and wheel brakes



Special check-ups

After having exceeded VNE or landed in a rough manner:

check the undercarriage, fuselage & wing surfaces and main spars for abnormalities. It is highly recommended to have the aircraft verified for airworthiness by authorised service personnel.

Draining and refuelling

Whenever draining or refuelling make sure master switch is set to OFF (key in full left position).

Draining the fuel system

The gascolator is located beneath the bottom engine cover on the left hand side of the fuselage. To drain the fuel system, open the drain valve on the gascolator. Drain no more than a couple of spoonfuls of fuel. Try to prevent ground pollution by intercepting the fuel with a canister. To close the valve simply turn it in the opposite direction. **Do not use force or special tools!**

CAUTION! Always drain the fuel system before you have moved the aircraft from a standstill to prevent mixing of the fuel and eventual water or particles.

Refuelling

CAUTION! Before refuelling it is necessary to ground the aircraft!

Refuelling can be done by pouring fuel through the reservoir openings on top of the wings or by using an electrical fuel pump.

Refuelling using the electrical fuel pump:

First make sure the fuel hoses are connected to wing connectors and that both fuel valves are open. Connect one end of the fuel pump to the valve on behind the main wheel mounting struts or to the valve beneath the bottom engine cover (this depends on the version of Sinus ultralight motorglider). Submerge the other end of the fuel pump, which has a filter attached, into the fuel canister. Engage the fuel pump by flipping the switch on the instrument panel. After refuelling it is recommended to eliminate eventual air pockets from inside the fuel system. To do that, drain some fuel with both fuel valves fully open. Also, leave the engine running at idle power for a couple of minutes prior to taking-off.

Should you be experiencing slow refuelling with the provided electrical fuel pump, you should replace the filter below the pump casing. You can use any fuel filter for this application.

CAUTION! Use authorised plastic canisters to transport and store fuel only! Metal canisters cause for water to condensate on the inside, which may later result in engine failure.

Connecting Auxilliary power supplies

Should you be unable to start the engine due to a weak battery, auxilliary power supplies can be connected to help starting the engine.

Battery's & Relay's location



Battery (black) & Relay (top-right)



Top-left nipple (c. positive (+) wire here)



Exhaust (connect negative (-) wire here)



To connect an auxilliary power supply use battery connector cables with clamps at either ends. Connect the negative (-) wire to aircraft's exhaust (sticking out below the engine cowlings). The positive (+) wire leads inside the cockpit to the relay mounted top-right of the aircraft's battery on the firewall. This relay has 3 nipples; the positive (+) wire must be connected to the upper-left nipple, the only one to which 2 cables are connected to. After you have connected the wires correctly, start the engine normally by pressing the starter button in the cockpit.

WARNING! The pilot must be in cockpit when starting the engine. The person who will disconnect the cables after the engine has started must be aware of the danger of spinning propeller nearby.

Tie down

Head the aircraft against the wind and retract flaps fully. Block all three wheels. Remove the caps covering mounting holes on the bottom part of the wing (located 450 cm from the fuselage) and carefully screw in the two screw-in rings provided.

Secure tie-down ropes to the wing tie-down rings at an approximately 45-degree angle to the ground. When using rope of a non-synthetic material, leave sufficient slack to avoid damage to the aircraft, should the ropes contract. To tie down the tail, tie a rope around the fuselage at the rear and secure it to the ground. At the end, cover the pitot tube with a protection cover.

Storage

The aircraft is ideally stored in a hangar. For increased in-hangar manoeuvrability use of original push-cart is recommended.

Even for over-night storage it is recommended to leave the spoilers' (airbrakes') handle unlocked - hanging down freely in order to reduce pressure on plate springs and maintain their original stiffness.

If a parachute rescue system is installed in your aircraft, make sure the activation handle safety pin is inserted every time you leave the aircraft.

Apply the tubes onto fuel line vents so that fuel would not spill onto the wing in event of full fuel tanks, temperature expansion of fuel and/or parking on a slope.

Also, disconnect the battery from the circuit to prevent battery self-discharge (pull battery disconnection ring on the instrument panel's switch column) during storage period.

CAUTION! Should the aircraft be stored and/or operated in areas with high atmospheric humidity pay special attention to eventual corrosion of metal parts, especially inside the wings. Under such circumstances it is necessary to replace the spoilers' (airbrakes') connector rod every 2 years.

Cleaning

Use pure water and a soft piece of cloth to clean the aircraft's exterior. If you are unable to remove certain spots, consider using mild detergents. Afterwards, rinse the entire surface thoroughly.

Lexan glass surfaces are protected by an anti-scratch layer on the outside and an anti-fog coating on the inside of the cabin. Always use pure water only to clean the glass surfaces, not to damage these protection layers and coatings.

To protect the aircraft's surface (excluding glass surfaces) from the environmental contaminants, use best affordable car wax.

The interior is to be cleaned with a vacuum cleaner.

Keeping your aircraft in perfect shape

Precautions

- 1) Eliminate the use of ALL aggressive cleaning solutions and organic solvents, also the window cleaning spray, benzene, acetone, aggressive shampoos etc.
- 2) If you must use an organic solvent (acetone) on small areas remove certain glue leftovers or similar, the surface in question **MUST** be polished thereafter. The only section where polishing should be avoided is the edge on the wing where the sealing gasket is applied.
- 3) When flying in regions with a lot of bugs in the air, you should protect the leading edges of the airframe before flight (propeller, wings, tail) with Antistatic furniture spray cleaner: "Pronto (transparent), manufacturer: Johnson Wax (or anything equivalent) – Worldwide", approximate price is only \$3 USD / €3 EUR for a 300 ml spray bottle. Using such spray, do not apply it directly onto the wing but into a soft cloth instead (old T-shirts are best).
- 4) After having finished with flight activity for the day, clean the leading edges of the airframe as soon as possible with a lot of water and a drying towel (chamois, artificial leather skin). This will be very easy to do if you applied a coat of Pronto before flight.

Detailed handling (Airframe cleaning instructions)

Every-day care after flight

Bugs, which represent the most of the dirt to be found on the airframe, are to be removed with clean water and a soft mop (can be also drying towel, chamois, artificial leather skin). To save time, soak all the leading edges of the airframe first. Make sure to wipe ALL of the aircraft's surface until it is completely dry at the end.

Clean the propeller and the areas with eventual greasy spots separately using a mild car shampoo with a wax.

CATUION! Do not, under any circumstances attempt to use aggressive cleaning solutions, as you will severely damage the lacquer, which is the only protective layer before the structural laminate.

When using the aircraft in difficult atmospheric conditions (intense sunshine, dusty winds, coastline, acid rains etc.) make sure to clean the outer surface even more thoroughly.

If you notice you cannot remove the bug-spots from the leading edges of the aircraft, this means the lacquer is not protected any more, therefore it is necessary to polish these surfaces.

CAUTION! Do not, under any circumstances attempt to remove such bug-spots with abrasive sponges and/or rough polishing pastes.

Periodical cleaning of all outer surfaces with car shampoo

Clean as you would clean your car starting at the top and working your way downwards using a soft sponge. Be careful not to use a sponge that was contaminated with particles (e.g. bud, fine sand) not to grind the surface. While cleaning, do soak the surface and the sponge many, many times. Use a separate sponge to clean the bottom fuselage, as it is usually more greasy than the rest of the airframe. When pouring water over the airframe, be careful not to direct it over the fuel reservoir caps, wing-fuselage joining section, parachute rescue system straps and cover, pitot tube, tail static probe and engine covers.

Always water the shampooed surfaces again before they become dry! Thereafter, wipe the whole of the aircraft dry using a drying towel, chamois or artificial leather skin.

Also, clean the Mylar wing and tail control surfaces gaskets. Lift the gaskets gently and insert ONE layer of cloth underneath, then move along the whole span of the gasket. Ultimately, you may wish to apply Teflon grease (in spray) over the area where the gaskets touch the control surfaces.

Polishing by hand

Use only the highest quality polishing pastes WITHOUT abrasive grain, such as Sonax Extreme or similar. Start polishing on a clean, dry and cool surface, never in the sunshine!

Machine polishing requires more skills and has its own particularities, therefore it is recommended to leave it to a professional.

Cleaning the Lexan transparent surfaces

It is most important to use really clean water (no cleaning solutions are necessary) and a really clean drying towel (always use a separate towel ONLY for the glass surfaces). Should the glass surfaces be dusty, remove the dust first by purging water (not spraying!) and gliding your hand over the surface. Using the drying towel, simply glide it over the surface, then squeeze it and soak it before touching the glass again. If there are bugs on the windshield, soak them with plenty of water first, so less wiping is necessary. Ultimately, dry the whole surface and apply JT Plexus Spray (\$10 USD / €10 EUR per spray) or at least Pronto antistatic (transparent) spray and wipe clean with a separate soft cotton cloth."

Appendix



**Parachute rescue system:
use, handling and
maintenance**

How fast is too fast

**Myth: I can fully deflect
the controls below
maneuvering speed!**

Aircraft familiarisation

Conversion tables

Preflight check-up pictures

Virus SW checklist

Parachute rescue system: use, handling and maintenance

System description

The GRS rocket charged parachute rescue system provides you with a chance to rescue yourself and the aircraft regardless of the height, velocity and nose attitude.

The system is placed inside a durable cylinder mounted on the right hand side of the baggage compartment. Inside this cylinder is the parachute which stored inside a deployment bag with a rocket engine underneath.

Its brand new design presents a canopy that is not gradually frown from the container, exposed to distortion by air currents, but it is safely open after 0,4 to 0,7 seconds in distance of 15-18 metres above the aircraft. It is fired there in a special deployment bag, which decreases the risk of aircraft debris breaching the canopy.

The parachute rescue system is activated manually, by pulling the activation handle mounted on the back wall above. After being fired, the man canopy is open and fully inflated within 3,2 seconds.

WARNING! Activation handle safety pin should be inserted when the aircraft is parked or hangared to prevent accidental deployment. However, the instant pilot boards the aircraft, safety pin **MUST** be removed!

Use of parachute rescue system

In situations such as:

- structural failure
- mid-air collision
- loss of control over aircraft
- engine failure over hostile terrain
- pilot incapacitation (incl. heart attack, stroke, temp. blindness, disorientation...)

the parachute **MUST** be deployed. Prior to firing the system:

- shut down the engine and set master switch to OFF (key in full left position)
- shut both fuel valves
- fasten safety harnesses tightly
- protect your face and body.

To deploy the parachute **jerk the activation handle hard** a length of at least **30 cm** towards the instrument panel.

Once you have pulled the handle and the rocket is deployed, it will be less than two seconds before you feel the impact produced by two forces. The first force is produced by stretching of all the system. The force follows after the inflation of the canopy from opening impact and it will seem to you that the aircraft is pulled backwards briefly. The airspeed is reduced instantly and the aircraft now starts do descent to the ground underneath the canopy.

As a pilot you should know that the phase following parachute deployment may be a great unknown and a great adventure for the crew. You will be getting into situation for the first time, where a proper landing and the determination of the landing site are out of your control.

CAUTION! Should you end up in power lines (carrying electrical current), DO NOT under any circumstances touch any metal parts inside or outside the cockpit. This also applies to anyone attempting to help or rescue you. Be aware that anyone touching a metal part while standing on the ground will probably suffer mayor injury or die of electrocution. Therefore, you are strongly encouraged to confine your movements until qualified personal arrives at the site to assist you.

After the parachute rescue system has been used or if you suspect any possible damage to the system, do not hesitate and immediately contact the manufacturer!

Handling and maintenance

Prior to every flight all visible parts of the system must be checked for proper condition. Special attention should be paid to eventual corrosion on the activation handle inside the cockpit. Also, main fastening straps on the outside of the fuselage must undamaged at all times.

Furthermore, the neither system, nor any of its parts should be exposed to moisture, vibration and UV radiation for long periods of time to ensure proper system operation and life.

CAUTION! It is strongly recommended to thoroughly inspect and grease the activation handle, preferably using silicon oil spray, every 50 flight hours.

All major repairs and damage repairs MUST be done by the manufacturer or authorised service personnel.

For all details concerning the GRS rescue system, please see the "GRS - Galaxy Rescue System Manual for Assembly and Use".

How fast is too fast?

Based on two recent unfortunate events, where two pilots lost their newly acquired Sinus and Virus aircraft, the team of Pipistrel's factory pilots decided to stress the importance of airspeed even more. Do read this passage thoroughly as everything mentioned below affects you as the pilot directly!

The two events

Both the events took place **during the first couple of hours** pilots flew with their new aircrafts. Therefore it is definite they had not become completely familiar with all the flight stages Sinus and Virus offer. The circumstances of both the events were remarkably similar. Soon after the pilots picked up their new aircraft at the distributor's, the aircraft were severely damaged aloft. One during the first home-bound cross country flight and the other during the first flights at domestic airfield. Please note the distributor independently tested both mentioned aircraft up to VNE at altitudes reaching 300 to 500 metres (900 to 1500 feet) with great success.

Pilots flew their machines at reasonably **high altitudes** but at **very high speeds**. One of them deployed airbrakes (spoilers) at the speed of 285 km/h (155 kts) - where the VNE of the aircraft is 225 km/h (122 kts), the other was flying at 3000 m (10.000 ft) at 270 km/h (145 kts) IAS - where the VNE of the aircraft was 250 km/h (135 kts).

They both encountered **severe vibrations** caused by **flutter**. Because of this one aircraft's fuselage was shredded and broken in half just behind the cabin (the crew saw saved thanks to the parachute rescue system), other suffered inferior damage as only the flapperon control tubes went broken. The pilot of the second machine then landed safely using elevator and rudder only. Fortunately both pilots survived the accident without being even slightly injured.

Thanks to the Brauniger ALPHAmfd's integrated Flight Data Recorder, we were able to reconstruct the flights and reveal what had really happened.

What was the reason for the flutter causing both accidents?

Both pilots greatly exceeded speed which should never be exceeded, the VNE. With the IAS to TAS correction factor taken into consideration, they were both flying faster than 315 km/h (170 kts)!

You might say: "Why did they not keep their speed within safe limits? How could they be so thoughtless to afford themselves exceeding the VNE?" Speaking with the two pilots they both confessed they went over the line unwarily. "**All just happened so suddenly!**" was what they both said. Therefore it is of vital importance to be familiar to all factors that might influence your flying to the point of unwarily exceeding the VNE.

Human factor and performance

The human body is not intended to be travelling at 250 km/h (135 kts), nor is it built to fly. Therefore, in flight, the **human body** and its signals **should not be trusted** at all times!

To determine the speed you are travelling at, you usually rely on two senses – the ear and the eye. The faster the objects around are passing by, the faster you are travelling. True. The stronger the noise caused by air circulating the airframe, the faster the airspeed. True again. But let us confine ourselves to both events' scenarios.

At higher altitudes, human eye loses it's ability to determine the speed of movement precisely.

Because of that pilots, who are flying high up feel like they are flying terribly slow. At high speeds the air circulating the airframe should cause tremendous noise. Wrong! In fact the noise is caused by drag. **Modern aircrafts like Sinus and Virus**, manufactured of composite materials, have so little drag, that they actually **sound quieter than you would expect**. Especially if you are used to wearing a headset when flying **you must not rely on your ear** as the instrument for determining speed.

REMEMBER! When flying high the only reliable tool to determine airspeed is the cockpit instrument - the airspeed indicator!

How to read and understand what the airspeed indicator tells you?

Let us first familiarise with the terms used below:

IAS: stands for Indicated AirSpeed. This is the speed the airspeed indicator reads.

CAS: stands for Calibrated AirSpeed. This is IAS corrected by the factor of aircraft's attitude. No pitot tube (device to measure pressure used to indicate airspeed) is positioned exactly parallel to the air-flow, therefore the input speed – IAS – must be corrected to obtain proper airspeed readings. With Sinus and Virus, IAS to CAS correction factors range from 1,00 to 1,04.

TAS: stands for True AirSpeed. TAS is often regarded as the speed of air to which the aircraft's airframe is exposed. To obtain TAS you must have CAS as the input value and correct it by pressure altitude, temperature and air density variations.

The maximum structural speed is linked to **IAS**. But light planes, manufactured of carbon reinforced plastics, with long, slick wings are more prone to flutter at high speeds than to structural failure. So **flutter is the main factor of determining VNE** for us and most other carbon-reinforced-plastic aircraft producers. **Flutter speed is linked to TAS**, as it is directly caused by small differences in speed of air circulating the airframe. Hence air density is not a factor. For all who still doubt this, here are two quotes from distinguished sources on flutter being related to TAS:

"Suffice to say that flutter relates to true airspeed (TAS) rather than equivalent airspeed (EAS), so aircraft that are operated at or beyond their VNE at altitude - where TAS increases for a given EAS – are more susceptible to flutter..."

New Zealand CAA' Vector Magazine (full passage at page 5 of <http://www.caa.govt.nz/fulltext/vector/vec01-4.pdf>)

"The critical flutter speed depends on TAS, air density, and critical mach number. The air density factor is almost canceled out by the TAS factor; and most of us won't fly fast enough for mach number to be a factor. So TAS is what a pilot must be aware of!"

Bob Cook, Flight Safety International

The airspeed indicator shows you the IAS, but this is sadly NOT the speed of air to which the aircraft's airframe is exposed.

IAS and TAS are almost the same at sea level but **can greatly differ** as the altitude increases. So flying at high altitudes, where the air is thinner, results in misinterpreting airspeed which is being indicated. The indicated airspeed value may actually be pretty much lower than speed of air to which the aircraft is exposed, the TAS.

So is VNE regarded as IAS or TAS? It is in fact regarded as TAS above 4000m/13100 ft!!! You should be aware of that so that you will not exceed VNE like the two pilots mentioned have.

How much difference is there between IAS and TAS in practical terms?

Data is for standard atmosphere. To obtain correct speeds for particular atmospheric conditions please take advantage of the table on page 85 of this manual.

The table below indicates how fast you may fly at a certain altitude to maintain constant True AirSpeed (TAS).

		TAS [km/h (kts)]	IAS [km/h (kts)]	TAS [km/h (kts)]	IAS [km/h (kts)]
1000 m	3300 ft	250 (135)	237 (128)	270 (145)	256 (138)
2000 m	6500 ft	250 (135)	226 (122)	270 (145)	246 (133)
3000 m	10000 ft	250 (135)	217 (117)	270 (145)	235 (126)
4000 m	13000 ft	250 (135)	206 (111)	270 (145)	226 (121)
5000 m	16500 ft	250 (135)	195 (105)	270 (145)	217 (117)
6000 m	19700 ft	250 (135)	187 (101)	270 (145)	205 (110)
7000 m	23000 ft	250 (135)	178 (96)	270 (145)	196 (103)
8000 m	26300 ft	250 (135)	169 (91)	270 (145)	185 (98)

The table below indicates how TAS increases with altitude while keeping IAS constant.

		IAS [km/h (kts)]	TAS [km/h (kts)]	IAS [km/h (kts)]	TAS [km/h (kts)]
1000 m	3300 ft	250 (135)	266 (144)	270 (145)	289 (156)
2000 m	6500 ft	250 (135)	279 (151)	270 (145)	303 (164)
3000 m	10000 ft	250 (135)	290 (157)	270 (145)	316 (171)
4000 m	13000 ft	250 (135)	303 (164)	270 (145)	329 (178)
5000 m	16500 ft	250 (135)	317 (171)	270 (145)	345 (186)
6000 m	19700 ft	250 (135)	332 (179)	270 (145)	361 (195)
7000 m	23000 ft	250 (135)	349 (188)	270 (145)	379 (204)
8000 m	26300 ft	250 (135)	366 (198)	270 (145)	404 (218)

As you can see from the table above the **differences between IAS and TAS are not so little and MUST be respected at all times!**

REMEMBER!

- Do not trust your ears.
- Do not trust your eyes.
- Trust the instruments and be aware of the IAS to TAS relation!

**Always respect the limitations prescribed in this manual!
Never exceed the VNE as this has proved to be fatal!**

Keep that in mind every time you go flying. Pipistrel wishes you happy landings!

Myth: I can fully deflect the controls below maneuvering speed!

WRONG! BELIEVE THIS AND DIE!

The wing structure in light planes is usually certified to take +3.8 G's, -1.52 G's (plus a certain safety factor). Put more load on the wing than that and you should consider yourself dead.

But here is the nice part: Below a certain speed, the wing simply cannot put out a full 3.8 G's of lift! It will **stall** first! This speed is called **Maneuvering Speed** or **Va**.

Maneuvering Speed is defined as the maximum speed the plane can be flying at and still **stall** before the **wing breaks** no matter how much you pull back on the stick. If you are going **slower** than the **Va** and you pull the stick all the way back, the wing will stall **without braking physically**. If you are going **faster** than the **Va** and you pull the stick all the way back, the wing can put out **so much lift** that it can be expected to **break**. Therefore people think they can deflect the stick as much as they desire below Maneuvering Speed and stay alive.

Wrong! The Maneuvering Speed is based on pulling back on the stick, not pushing it forward!

Note what was said above: The Va is defined as how fast you can fly and not be able to put out more than 3.8 G's of lift. But while the plane is certified for **positive 3.8 G's**, it is only certified for a **negative G-load of 1.52 G's!** In other words, **you can fail the wing** in the negative direction **by pushing forward** on the stick well **below the Va!** Few pilots know this.

Also, for airliners, certification basis require that the rudder can be fully deflected below Maneuvering Speed, but only if the plane is not in a sideslip of any kind! (e.g. crab method of approach) Does this make sense at all? Why would you need to fully deflect the rudder if not to re-establish rightened flight?

In a wonderfully-timed accident shortly after Sept. 11th, 2001 of which everybody thought might be an act of terrorism, an Airbus **pilot stomped the rudder** in wake turbulence while the plane was **in a considerable sideslip**. The **combined loads** of the **sideslip** and the **deflected rudder** took the vertical stabilizer to it's **critical load**. A very simple numerical analysis based on the black box confirmed this. The airplane lost it's vertical stabilizer in flight and you know the rest.

Also, if you are at your **maximum allowable g-limit** (e.g. 3.8) and you **deflect the ailerons even slightly**, you are actually asking for **more lift from one wing than the allowable limit!** **Therefore combined elevator and aileron deflections can break the plane, even if the elevator is positive only!**

SO, WHEN YOU THINK THAT YOU CAN DO AS YOU PLEASE WITH THE CONTROLS BELOW MANEUVERING SPEED, YOU ARE WRONG!

Please reconsider this myth and also look at the Vg diagram and the aircraft's limitations to prove it to yourself.

Aircraft familiarisation

This chapter has been written to assist owners/pilots of Virus on their quest to learn how to safely and efficiently fly this aircraft. It will cover most operations the aircraft can offer in an order established in Pilot and maintenance manual's chapter Normal procedures and recommended speeds. Please consider what follows as an add-on to that chapter.

I am quite convinced that even experienced Virus pilots will discover something new browsing through the following passages.

Tine Tomazic

Engine start-up

First and foremost **make sure you have sufficient fuel quantity on board** for the desired length of flight. If you are not completely confident there is enough, better step out of the aircraft and add a couple more liters into the tanks. There is an old aviators' saying: *"The only time you have too much fuel is when you are on fire."*

When pressing the engine starter button, wheel brakes MUST be engaged. The aircraft is not to move before you receive your taxi clearance. To keep your propeller untouched, avoid starting up on areas where there are small stones on the ground. Those little stones can easily be picked up by the propellers causing marks and even little holes on it.

Warming up must be conducted below 2500 RPM. When reaching safe operational engine temperatures, it is time to verify maximum engine ground RPM. **Hold the stick back completely and slowly(!) add throttle to full power, then verify RPM.**

Taxi

Taxiing with the Virus is rather simple considering the steerable nose wheel. **For sharper turns** on the ground you can also **use wheel brakes** to assist yourself. I would recommend you **taxi slow**, up to 10 km/s (5 kts), while holding the stick back fully to ease the pressure of the nose wheel.

During taxiing monitor engine temperatures. Due to low airflow around the radiators the CHT and Oil temperature will rise during long taxi periods. If you are holding position, do not leave throttle at idle. It is better you have some 2500 RPM as this will provide some airflow from the propeller to the radiators and the temperatures will not rise so quickly. **Should you see engine temperatures exceed safe operational values, shut off the engine, point the aircraft's nose against the wind and wait for the temperatures to drop.**

Take off and initial climb

Having checked and set all engine and aircraft parameters, you should be ready for take off by now. **Reverify both fuel valves be open and the spoilers (airbrakes) retracted and locked (handle full up).** Trim lever should be in the middle.

I would suggest you **start the take-off roll gradually.** Keep adding throttle to full power while counting 21, 22, 23, 24, 25. There are two reasons for this. First, you change flight stage from zero movement to acceleration slowly; this provides you with time to react to eventualities. Second, especially if taking-off from a gravel runway, this method of adding full throttle will prevent the little stones on the runway to damage the propeller. Extremely short runways are an exception. There you should line up the aircraft, set flaps to 2nd stage, step on the brakes, apply full power and release the brakes.

As you start to move, pull the stick 1/3 of elevator's deflection backwards to ease the pressure on the nose wheel and lift it off the runway slightly. **Do not use full back deflection as this will cause the aircraft's tail to touch the ground.**

When the nose wheel is lifted off the ground correctly, there is nothing else but to hold the same angle of attack and the aircraft will become airborne. Crosswind take-offs, depending on wind strength, require a little bit of aileron deflection into the wind. **Remember, wings must stay level throughout ground-roll, rotation and initial climb!**

Having lifted off the ground, gently push the stick forward just a bit to accelerate. At some 110 km/h (60 kts) set flaps to 1st stage, at 130 km/h (70 kts) set them to neutral.

Climb

A comfortable setting for climb is flaps in neutral position, speed of 140 km/h (75 kts) at some 5000 RPM. In summer time or **when outside temperature exceeds 30°C** you should **consider climbing at some 160 km/h (85 kts)** to provide more airflow to the engine radiators. Trim the aircraft for comfortable stick forces.

Cruise

Passing through 150 km/h (80 kts), set flaps to negative position (handle full down). A comfortable cruise setting is 25 InHg manifold pressure with 4500 engine RPM. Take advantage of the variable pitch propeller to meet these settings. For those who do not have a manifold pressure gauge installed, set engine to 5000 RPM at flat pitch and then screw the propeller pitch knob to the right to meet 4500 RPM. Of course, cruising can be conducted at various power, propeller and flap settings. **As the Virus is sensitive to flap setting, ALWAYS use negative stage of flaps beyond 150 km/h (80 kts) and neutral below 130 km/h (70 kts).**

Cruising fast, do not kick-in rudder for turns! Above 160 km/h (85kts) the rudder becomes almost insignificant in comparison to aileron deflections when it comes to making a turn. **Cruising fast, it is extremely important to fly coordinated (ball in the middle) as this increases efficiency and decreases side-pressure onto vertical tail surfaces. Also, pay attention to turbulence. If you hit wake turbulence, reduce power immediately and increase angle of attack to reduce speed.**

If flying a traffic pattern, keep flaps in neutral position and set engine power so that airspeed does not exceed 150 km/h (80 kts).

Descent

Descending with the Virus is the stage of flight where perhaps most care must be taken. As the aircraft is essentially a glider, it is very slippery and builds up speed very fast.

Start the descent by reducing throttle and setting propeller pitch back to flat (screw propeller pitch knob fully to the left). **Do not, under any circumstances, increase speed or use airbrakes to descend at high speeds.**

If you have cruised at 250 km/h (135 kts) this is your top descent speed. During initial descent I would recommend you trim for a 30 km/h (15 kts) lower speed than the one you decided to descend at. Do this for safety. In case you hit turbulence simply release forward pressure on the stick and the aircraft will slow down.

Also, keep in mind you need to begin your descent quite some time before destination. A comfortable rate of descent is some 2,5 m/s (500 fpm). So it takes you some 2 minutes for a 300 meter (1000 feet) drop. At 200 km/h (105 kts) this means 6,7 km (3,6 NM) for each 300 meter (1000 feet drop).

Entering the traffic pattern the aircraft must be slowed down. In order to do this, hold your altitude and reduce throttle to idle. When going below 150 km/h (80 kts), set flaps to neutral position. Set proper engine RPM to maintain speed of some 130 km/h (70 kts). Trim the aircraft for comfortable stick forces.

Just before turning to base-leg, reduce power to idle and set flaps to 1st stage at 130 km/h (70 kts). Once out of the turn, reduce speed towards 110 km/h (60 kts). Power remains idle from the point of turning base all the way to touch-down. If you plan your approach this way, you will always be on the safe side - even if your engine fails, you will still be able to safely reach the runway!

Turn to final at 90 km/h (50 kts). When in runway heading, set flaps to 2nd stage. Operate the airbrakes to obtain the desired descent path.

How to determine how much airbrakes you need for a certain angle of attack? (if applicable)

Open them half-way and observe the runway. If the runway treshold is moving up, you are dropping too fast - retract the airbrakes a little. If the runway treshold is disappearing below your aircraft, you are dropping too slowly - extend airbrakes further. **When working on airbrakes, it is important to keep the angle of attack constant throughout final all the way to flare! The airbrakes will not impact your speed, just rate (angle) of descent.** For pilots who are not used to operate airbrakes but throttle instead, let me tell you that airbrakes in Virus work just like throttle does: handle back equals less throttle, handle forward equals more throttle.

CAUTION! Never drop the spoilers' (airbrakes') handle when using them, keep holding the handle even if you are not moving it!

Roundout (Flare) and touchdown

Your speed should be a constant 90 km/h (50 kts) throughout the final with the descent path constant as well. At a height of 10 meters (25 feet) start a gentle flare and make the **aircraft must touch down with the main (back) wheels first**, so you will not bounce from the runway. After touchdown, operate the rudder pedals if necessary to maintain runway heading and try to have the nose wheel off the ground for as long as possible. When the nose wheel is to touch the ground, rudder pedals **MUST** be exactly in the middle not to cause damage to the steering mechanism. **While braking, hold the stick back fully!** Once you have come to a standstill, retract flaps all the way to negative position (handle full down) and retract and lock the spoilers (airbrakes) - handle full up.

Should you bounce off the runway after touch-down, do not, under any circumstances, push stick forward or retract spoilers (airbrakes). Spoilers (airbrakes) stay fully extended, the stick goes backwards slightly. Bouncing tends to attenuate by itself anyhow.

Crosswind landings, depending on the windspeed, require some sort of drift correction. Most efficient is the low-wing method, where you are to lower the wing into the wind slightly and maintain course by applying appropriate rudder deflection. You can also try the crab method.

Crosswind landings on paved runways (asphalt, concrete, tarmac...)

In this case, special attention must be paid to straightening the aircraft before touchdown in order not to damage the undercarriage because of increased surface grip on impact. Should the crosswind component be strong (15 km/h, 8 kts and over), I would recommend to gently flare in such a manner, that one of the main wheels touches-down an instant before the other (e.g. if there is crosswind from your left, left wheel should touch down just before the right wheel does). This way undercarriage almost cannot be damaged due to side forces on cross-touch-down.

Landing in strong turbulence and/or gusty winds

First of all **airspeed must be increased** for half of the value of wind gusts (e.g. if the wind is gusting for 10 km/h (6 kts), add 5 km/h (3 kts) to the final approach speed). In such conditions I would also recommend to only use **1st stage of flaps for increased manouvrebility**.

Parking

Nothing special to add here. Taxi to the apron with flaps in negative position (minimum lift) and spoilers retracted. Again, taxi slow for reasons mentioned under "Taxi". **Come to a standstill, shut down the engine, insert the parachute rescue system activation handle's safety pin, unlock and leave the spoilers' (airbrakes') handle hanging down freely** (this reduces stress to airbrake plate's springs and maintains their stiffness).

Conversion tables

kilometers per hour (km/h) - knots (kts) - metres per sec. (m/s)

km/h	kts	m/s	km/h	kts	m/s	km/h	kts	m/s
1,853	1	0,37	63,00	34	18,34	124,16	67	36,15
3,706	2	1,07	64,86	35	18,88	126,01	68	36,69
5,560	3	1,61	66,71	36	19,42	127,87	69	37,23
7,413	4	2,15	68,56	37	19,96	129,72	70	37,77
9,266	5	2,69	70,42	38	20,50	131,57	71	38,31
11,11	6	3,23	72,27	39	21,04	133,43	72	38,86
12,97	7	3,77	74,12	40	21,58	135,28	73	39,39
14,82	8	4,31	75,98	41	22,12	137,13	74	39,93
16,67	9	4,85	77,83	42	22,66	138,99	75	40,47
18,53	10	5,39	79,68	43	23,20	140,84	76	41,01
20,38	11	5,93	81,54	44	23,74	142,69	77	41,54
22,23	12	6,47	83,39	45	24,28	144,55	78	42,08
24,09	13	7,01	85,24	46	24,82	146,40	79	42,62
25,94	14	7,55	87,10	47	25,36	148,25	80	43,16
27,79	15	8,09	88,95	48	25,90	150,10	81	43,70
29,65	16	8,63	90,80	49	26,44	151,96	82	44,24
31,50	17	9,17	92,66	50	26,98	153,81	83	44,78
33,35	18	9,71	94,51	51	27,52	155,66	84	45,32
35,21	19	10,25	96,36	52	28,05	157,52	85	45,86
37,06	20	10,79	98,22	53	28,59	159,37	86	46,40
38,91	21	11,33	100,07	54	29,13	161,22	87	46,94
40,77	22	11,81	101,92	55	29,67	163,08	88	47,48
42,62	23	12,41	103,77	56	30,21	164,93	89	48,02
44,47	24	12,95	105,63	57	30,75	166,78	90	48,56
46,33	25	13,49	107,48	58	31,29	168,64	91	49,10
48,18	26	14,03	109,33	59	31,83	170,49	92	49,64
50,03	27	14,56	111,19	60	32,37	172,34	93	50,18
51,80	28	15,10	113,04	61	32,91	174,20	94	50,72
53,74	29	15,64	114,89	62	33,45	176,05	95	51,26
55,59	30	16,18	116,75	63	33,99	177,90	96	51,80
57,44	31	16,72	118,60	64	34,53	179,76	97	52,34
59,30	32	17,26	120,45	65	35,07	181,61	98	52,88
61,15	33	17,80	122,31	66	35,61	183,46	99	53,42

knots (kts) - metres per second (m/s)

	0	1	2	3	4	5	6	7	8	9
0	0	0,51	1,02	1,54	2,05	2,57	3,08	3,60	4,11	4,63
10	0,51	5,65	6,17	6,66	7,20	7,71	8,23	8,74	9,26	9,77
20	10,28	10,80	11,31	11,83	12,34	12,86	13,37	13,89	14,40	14,91
30	25,43	15,94	16,46	16,97	17,49	18,00	18,52	19,03	19,54	20,06
40	20,57	21,09	21,60	22,12	22,63	23,15	23,66	24,17	24,69	25,20
50	25,72	26,23	26,75	27,26	27,76	28,29	28,80	29,32	29,83	30,35
60	30,86	31,38	31,89	32,41	32,92	33,43	33,95	34,46	34,98	35,49
70	36,00	36,52	37,04	37,55	38,06	38,58	39,09	39,61	40,12	40,64
80	41,15	41,67	42,18	42,69	43,21	43,72	44,24	44,75	45,27	45,78
90	46,30	46,81	47,32	47,84	48,35	48,87	49,38	49,90	50,41	50,90

metres per second (m/s) - feet per minute (100 ft/min)

m/sec.		100 ft/min	m/sec.		100 ft/min	m/sec.		100 ft/min
0,50	1	1,96	10,66	21	41,33	20,82	41	80,70
1,01	2	3,93	11,17	22	43,30	21,33	42	82,67
1,52	3	5,90	11,68	23	45,27	21,84	43	84,64
2,03	4	7,87	12,19	24	47,24	22,35	44	86,61
2,54	5	9,84	12,75	25	49,21	22,86	45	88,58
3,04	6	11,81	13,20	26	51,18	23,36	46	90,53
3,55	7	13,78	13,71	27	53,15	23,87	47	92,52
4,06	8	15,74	14,22	28	55,11	24,38	48	94,48
4,57	9	17,71	14,73	29	57,08	24,89	49	96,45
5,08	10	19,68	15,24	30	59,05	25,45	50	98,42
5,58	11	21,65	15,74	31	61,02	25,90	51	100,4
6,09	12	23,62	16,25	32	62,92	26,41	52	102,3
6,60	13	25,51	16,76	33	64,96	26,92	53	104,3
7,11	14	27,55	17,27	34	66,92	27,43	54	106,2
7,62	15	29,52	17,78	35	68,89	27,94	55	108,2
8,12	16	31,49	18,28	36	70,86	28,44	56	110,2
8,63	17	33,46	18,79	37	72,83	28,95	57	112,2
9,14	18	35,43	19,30	38	74,80	29,46	58	114,1
9,65	19	37,40	19,81	39	76,77	29,97	59	116,1
10,16	20	39,37	20,32	40	78,74	30,48	60	118,1

ICAN (international comitee for air navigation) temperatures, relative pressure, relative density and CAS to TAS correction factors as related to altitude

Altitude		Temperature		Relative pressure	Relative density	Cor. factors
feet	metres	°C	°F			
-2.000	-610	18,96	66,13	1,074	1,059	0,971
-1	-305	16,98	62,56	1,036	1,029	0,985
0	0	15	59	1	1	1
1.000	305	13,01	55,43	0,964	0,971	1,014
2.000	610	11,03	51,86	0,929	0,942	1,029
3.000	914	9,056	48,30	0,896	0,915	1,045
4.000	1219	7,075	44,73	0,863	0,888	1,061
5.000	1524	5,094	41,16	0,832	0,861	1,077
6.000	1829	3,113	37,60	0,801	0,835	1,090
7.000	2134	1,132	34,03	0,771	0,810	1,110
8.000	2438	-0,850	30,47	0,742	0,785	1,128
9.000	2743	-2,831	26,90	0,714	0,761	1,145
10.000	3090	-4,812	23,33	0,687	0,738	1,163
11.000	3353	-6,793	19,77	0,661	0,715	1,182
12.000	3658	-8,774	16,20	0,635	0,693	1,201
13.000	3916	-10,75	12,64	0,611	0,671	1,220
14.000	4267	-12,73	9,074	0,587	0,649	1,240
15.000	4572	-14,71	5,507	0,564	0,629	1,260
16.000	4877	-16,69	1,941	0,541	0,608	1,281
17.000	5182	-18,68	-1,625	0,520	0,589	1,302

metres (m) to feet (ft) conversion table

metres (m)		feet (ft)	metres (m)		feet (ft)	metres (m)		feet (ft)
0,304	1	3,280	10,36	34	111,5	20,42	67	219,81
0,609	2	6,562	10,66	35	114,8	20,72	68	223,09
0,914	3	9,843	10,97	36	118,1	21,03	69	226,37
1,219	4	13,12	11,27	37	121,3	21,33	70	229,65
1,524	5	16,40	11,58	38	124,6	21,64	71	232,94
1,828	6	19,68	11,88	39	127,9	21,91	72	236,22
2,133	7	22,96	12,19	40	131,2	22,25	73	239,50
2,438	8	26,24	12,49	41	134,5	22,55	74	242,78
2,743	9	29,52	12,80	42	137,7	22,86	75	246,06
3,048	10	32,80	13,10	43	141,1	23,16	76	249,34
3,352	11	36,08	13,41	44	144,3	23,46	77	252,62
3,657	12	39,37	13,71	45	147,6	23,77	78	255,90
3,962	13	42,65	14,02	46	150,9	24,07	79	259,18
4,267	14	45,93	14,32	47	154,1	24,38	80	262,46
4,572	15	49,21	14,63	48	157,4	24,68	81	265,74
4,876	16	52,49	14,93	49	160,7	24,99	82	269,02
5,181	17	55,77	15,24	50	164,1	25,29	83	272,31
5,48	18	59,05	15,54	51	167,3	25,60	84	275,59
5,791	19	62,33	15,84	52	170,6	25,90	85	278,87
6,096	20	65,61	16,15	53	173,8	26,21	86	282,15
6,400	21	68,89	16,45	54	177,1	26,51	87	285,43
6,705	22	72,17	16,76	55	180,4	26,82	88	288,71
7,010	23	75,45	17,06	56	183,7	27,12	89	291,99
7,310	24	78,74	17,37	57	187,0	27,43	90	295,27
7,620	25	82,02	17,67	58	190,2	27,73	91	298,55
7,948	26	85,30	17,98	59	193,5	28,04	92	301,83
8,220	27	88,58	18,28	60	196,8	28,34	93	305,11
8,530	28	91,86	18,59	61	200,1	28,65	94	308,39
8,830	29	95,14	18,89	62	203,4	28,90	95	311,68
9,144	30	98,42	19,20	63	206,6	29,26	96	314,96
9,448	31	101,7	19,50	64	209,9	29,56	97	318,24
9,750	32	104,9	19,81	65	213,2	29,87	98	321,52
10,05	33	108,2	20,12	66	216,5	30,17	99	324,80

air pressure as related to altitude

altitude (m)	pressure (hPa)	pressure (inch Hg)	altitude (m)	pressure (hPa)	pressure (inch Hg)
-1000	1139,3	33,6	1300	866,5	25,6
-950	1132,8	33,5	1350	861,2	25,4
-900	1126,2	33,3	1400	855,9	25,3
-850	1119,7	33,1	1450	850,7	25,1
-800	1113,2	32,9	1500	845,5	25,0
-750	1106,7	32,7	1550	840,3	24,8
-700	1100,3	32,5	1600	835,2	24,7
-650	1093,8	32,3	1650	830	24,5
-600	1087,5	32,1	1700	824,9	24,4
-550	1081,1	31,9	1750	819,9	24,2
-500	1074,3	31,7	1800	814,8	24,1
-450	1068,5	31,6	1850	809,8	23,9
-400	1062,3	31,4	1900	804,8	23,8
-350	1056,0	31,2	1950	799,8	23,6
-300	1049,8	31,0	2000	794,9	23,5
-250	1043,7	30,8	2050	790,0	23,3
-200	1037,5	30,6	2100	785,1	23,2
-150	1031,4	30,5	2150	780,2	23,0
-100	1025,3	30,3	2200	775,3	22,9
-50	1019,3	30,1	2250	770,5	22,8
0	1013,3	29,9	2300	165,7	22,6
50	1007,3	29,7	2350	760,9	22,5
100	1001,3	29,6	2400	756,2	22,3
150	995,4	29,4	2450	751,4	22,2
200	989,4	29,2	2500	746,7	22,1
250	983,6	29,0	2550	742,1	21,9
300	977,7	28,9	2600	737,4	21,8
350	971,9	28,7	2650	732,8	21,6
400	966,1	28,5	2700	728,2	21,5
450	960,3	28,4	2750	723,6	21,4
500	954,6	28,2	2800	719	21,2
550	948,9	28,0	2850	714,5	21,1
600	943,2	27,9	2900	709,9	21,0
650	937,5	27,7	2950	705,5	20,8
700	931,9	27,5	3000	701,0	20,7
750	926,3	27,4	3050	696,5	20,6
800	920,0	27,2	3100	692,1	20,4
850	915,2	27,0	3150	687,7	20,3
900	909,0	26,9	3200	683,3	20,2
950	904,2	26,7	3250	679,0	20,1
1000	898,7	26,5	3300	674,6	19,9
1050	893,3	26,4	3350	670,3	19,8

ICAO standard atmosphere

h (m)	h (ft)	T (°C)	T (°K)	T/T ₀	P (mmHg)	P (kg/m ²)	p/p ₀	r (kgs ² /m ⁴)	g (kg/m ⁴)	d	l/S d	V _s	n*10 ⁶ (m ² /s)
-1000	-3281	21,5	294,5	1,022	854,6	11619	1,124	0,137	1,347	1,099	0,957	344,2	13,4
-900	-2953	20,8	293,8	1,020	844,7	11484	1,111	0,136	1,335	1,089	0,958	343,9	13,5
-800	-2625	20,2	293,2	1,018	835	11351	1,098	0,134	1,322	1,079	0,962	343,5	13,6
-700	-2297	19,5	292,5	1,015	825,3	11220	1,085	0,133	1,310	1,069	0,967	343,1	13,7
-600	-1969	18,9	291,9	1,013	815,7	11090	1,073	0,132	1,297	1,058	0,971	342,7	13,8
-500	-1640	18,2	291,2	1,011	806,2	10960	1,060	0,131	1,285	1,048	0,976	342,4	13,9
400	-1312	17,6	290,6	1,009	796,8	10832	1,048	0,129	1,273	1,039	0,981	342	14,0
300	-984	16,9	289,9	1,006	787,4	10705	1,036	0,128	1,261	1,029	0,985	341,6	14,1
200	-656	16,3	289,3	1,004	779,2	10580	1,024	0,127	1,249	1,019	0,990	341,2	14,3
100	-328	15,6	288,6	1,002	769,1	10455	1,011	0,126	1,237	1,009	0,995	340,9	14,4
0	0	15	288	1	760	10332	1	0,125	1,225	1	1	340,5	14,5
100	328	14,3	287,3	0,997	751,0	10210	0,988	0,123	1,213	0,990	1,004	340,1	14,6
200	656	13,7	286,7	0,995	742,2	10089	0,976	0,122	1,202	0,980	1,009	339,7	14,7
300	984	13,0	286,0	0,993	733,4	9970	0,964	0,121	1,191	0,971	1,014	339,3	14,8
400	1312	12,4	285,4	0,991	724,6	9852	0,953	0,120	1,179	0,962	1,019	338,9	14,9
500	1640	11,1	284,7	0,988	716,0	9734	0,942	0,119	1,167	0,952	1,024	338,5	15,1
600	1969	11,1	284,1	0,986	707,4	9617	0,930	0,117	1,156	0,943	1,029	338,1	15,2
700	2297	10,4	283,4	0,984	699,0	9503	0,919	0,116	1,145	0,934	1,034	337,8	15,3
800	2625	9,8	282,8	0,981	690,6	9389	0,908	0,115	1,134	0,925	1,039	337,4	15,4
900	2953	9,1	282,1	0,979	682,3	9276	0,897	0,114	1,123	0,916	1,044	337	15,5
1000	3281	8,5	281,5	0,977	674,1	9165	0,887	0,113	1,112	0,907	1,049	336,6	15,7
1100	3609	7,8	280,8	0,975	665,9	9053	0,876	0,112	1,101	0,898	1,055	336,2	15,8
1200	3937	7,2	280,2	0,972	657,9	8944	0,865	0,111	1,090	0,889	1,060	335,8	15,9
1300	4265	6,5	279,5	0,970	649,9	8835	0,855	0,110	1,079	0,880	1,065	335,4	16,0
1400	4593	5,9	278,9	0,968	642,0	8728	0,844	0,109	1,069	0,872	1,070	335	16,2
1500	4921	5,2	278,2	0,966	634,2	8621	0,834	0,107	1,058	0,863	1,076	334,7	16,3
1600	5249	4,6	277,6	0,963	626,4	8516	0,824	0,106	1,048	0,855	1,081	334,3	16,4
1700	5577	3,9	276,9	0,961	618,7	8412	0,814	0,106	1,037	0,846	1,086	333,9	16,6
1800	5905	3,3	276,3	0,959	611,2	8309	0,804	0,104	1,027	0,838	1,092	333,5	16,7
1900	6234	2,6	275,6	0,957	603,7	8207	0,794	0,103	1,017	0,829	1,097	333,1	16,9
2000	6562	2	275	0,954	596,2	8106	0,784	0,102	1,006	0,821	1,103	332,7	17,0
2100	6890	1,3	274,3	0,952	588,8	8005	0,774	0,101	0,996	0,813	1,108	332,3	17,1
2200	7218	0,7	273,7	0,950	581,5	7906	0,765	0,100	0,986	0,805	1,114	331,9	17,3
2300	7546	0,0	273,0	0,948	574,3	7808	0,755	0,099	0,976	0,797	1,120	331,5	17,4
2400	7874	-0,6	272,4	0,945	576,2	7710	0,746	0,098	0,967	0,789	1,125	331,1	17,6
2500	8202	-1,2	271,7	0,943	560,1	7614	0,736	0,097	0,957	0,781	1,131	330,7	17,7
2600	8530	-1,9	271,1	0,941	553,1	7519	0,727	0,096	0,947	0,773	1,137	330,3	17,9
2700	8858	-2,5	270,4	0,939	546,1	7425	0,718	0,095	0,937	0,765	1,143	329,9	18,0
2800	9186	-3,2	269,8	0,936	539,3	7332	0,709	0,094	0,928	0,757	1,149	329,6	18,2
2900	9514	-3,8	269,1	0,934	532,5	7239	0,700	0,093	0,918	0,749	1,154	329,2	18,3

Engine cover

①



Gascolator

②



Propeller, Spinner

③



④



Undercarriage

⑤



Undercarriage, RH wheel

⑤



Right wing - leading edge

⑥



Right wingtip - lights

⑦



Right wing - trailing edge

⑧



Right spoiler

9



Fuselage (RH side)

10



Fuselage

10



Fuselage, continued

11



Horizontal tail surfaces

12



Vertical tail surfaces

13



Incorrect - door not secured

X



Correct - door secured

OK





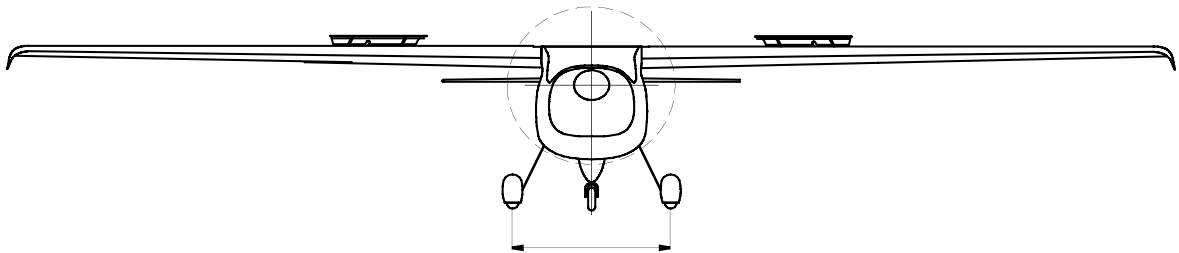
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Supplemental sheet

for

Virus 912 SW tail-wheel edition



**This supplemental sheet provides changes and additions to
Virus 912 SW Flight manual and Maintenance manual.**

This supplemental sheet contains four (4) valid pages.

This is the original document issued by Pipistrel d.o.o. Ajdovscina.
Should third-party translations to other languages contain any inconsistencies,
Pipistrel d.o.o. Ajdovscina denies all responsibility.

WARNING!

This leaflet **MUST** be present inside the cockpit at all times!
Should you be selling the aircraft make sure this supplemental sheet is handed over to the new owner.

Understanding the Supplemental sheet

The following Supplemental Sheet contains additional information needed for appropriate and safe use of Virus 912 SW tail-wheel edition.

DUE TO THE SPECIFIC NATURE OF THE AIRCRAFT IT IS MANDATORY TO STUDY THE Virus 912 SW PILOT AND MAINTENANCE MANUAL AS WELL AS THIS SUPPLEMENTAL SHEET VERY CAREFULLY PRIOR TO USE OF AIRCRAFT

In case of aircraft damage or people injury resulting from disobeying instructions in this document PIPISTREL d.o.o. denies any responsibility.

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Notes and remarks

Safety definitions used in the manual

WARNING! Disregarding the following instructions leads to severe deterioration of flight safety and hazardous situations, including such resulting in injury and loss of life.

CAUTION! Disregarding the following instructions leads to serious deterioration of flight safety.

Markings

All **changes** to the manual are marked in **red**, all **additions** in **blue**.

Normal procedures

Page 30. - Preflight check-up

Vertical tail surfaces, tail wheel (13) (14)

Tail wheel

Neutral positioning ball bolt: tightened

Wheel fairing: undamaged, firmly attached, clean (e.g. no mud or grass on the inside)

Tire: no cracks, adequate pressure

Wheel fork and fork base: nut tightened, no abnormalities, bearing and positioning ball in position
Should the aircraft be equipped with a steerable tail wheel, check the spring and release mechanism condition.

Lift the tail high enough so that the tail wheel is not touching the ground and make sure the wheel side-to-side deflections are smooth and unobstructed.

Page 33, 35. - Normal procedures and recommended speeds

Taxi

Taxing technique does not differ from other taildragging aircraft equipped with a steerable tail wheel. Prior to taxiing it is essential to check wheel brakes for proper braking action.

Take-off and initial climb

Start the takeoff roll pushing the elevator one third forward and lift the tail wheel of the ground as you accelerate. Reaching V_{R1} gently pull on the stick to get the aircraft airborne.

Roundout and touchdown

CAUTION! Land the aircraft in such a manner that all three wheels touch the ground at exactly the same time. When touching down, rudder MUST NOT be deflected in any direction (rudder pedals centred).

When on ground, start braking action holding the control stick in full back position. Stear the aircraft using brakes and rudder only. Provided the runway length is sufficient, come to a complete standstill without engaging the brakes but holding the control stick slightly forward not to overstress the tail wheel.

Weight and balance

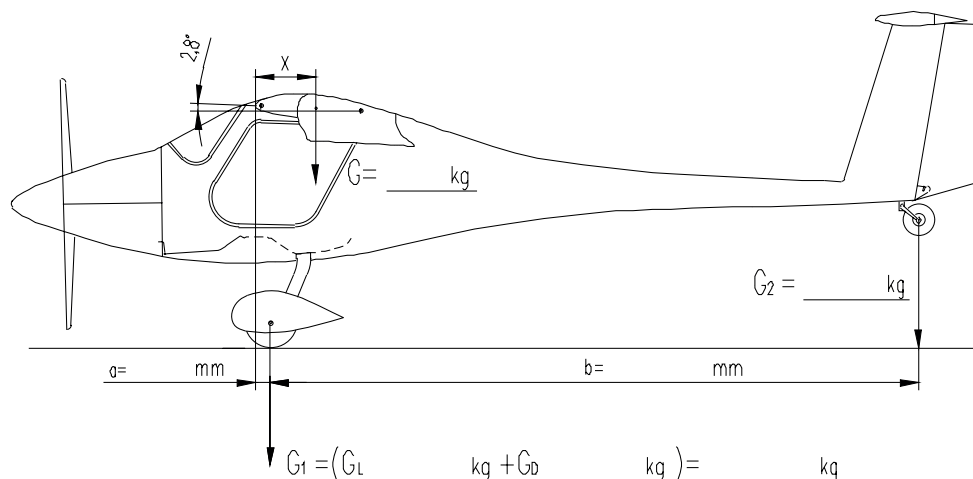
Page 46. - Weighing procedure

Calculate the lever arm of CG using this formula:

$$\text{Lever arm of CG (X)} = ((G_1 \times a) + (G_2 \times (a+b))) / G$$

Weighing form

Weighing point and symbol	Scale reading	Tare	Nett
right main wheel (G_D)			
left main wheel (G_L)			
tail wheel (G_2)			
total ($G = G_D + G_L + G_2$)			



Aircraft and systems on board

Page 53. - Undercarriage

The undercarriage is a taildragger type with two main brake-equipped wheels mounted on struts and a free-spinning or rudder-guided tail wheel.

distance between main wheels	1,60 m
distance between main and tail wheel	4,27 m
tire	4,00" x 6" (mail wh.), 2,50" x 4" (tail wh.)
tire pressure:	1,0 - 1,2 kg/cm ² (main wh.), 0,6 kg/cm ² (tail wh.)
brakes	drum or disk type, driven by brake pedals located on both rudder pedals
brake fluid	DOT 3 or DOT 4
main wheel axis to tail wheel distance	4,25 m

Handling and maintenance

page 65. -Undercarriage

	daily	first 5 hours	50 hours	100 hours	250 hours	500 hours	1.000 hours	10.000 hours
main strut, rear fork condition	C	C	SC					
tail wheel main bolt			C			R		
tail wheel mounting bolt	check and fasten every 50 landings							

Adjustment of tail wheel steering clutch stiffness

To adjust the stiffness of tail wheel steering clutch you need two allen keys (a.k.a. hex-wrench, inbus-key). On top of the wheel fork you will notice a ring with two tubes welded to each side with hex-bolts inside. First disconnect the springs at the tubes, then use an allen key into each of these tubes to tighten or loosen the screw inside. Tightening or loosening, make sure you apply equal number of screw rotations at both sides. To check if the steering clutch is stiff enough, lift the tail and rotate the fork left and right. At the end reattach both springs to the tubes again.

Appendix

Page 80. - Aircraft familiarisation

Taxi

Taxiing with the Virus 912 SW tail-wheel edition is rather simple considering the steerable tail wheel. For sharper turns on the ground you can also use wheel brakes to assist yourself.

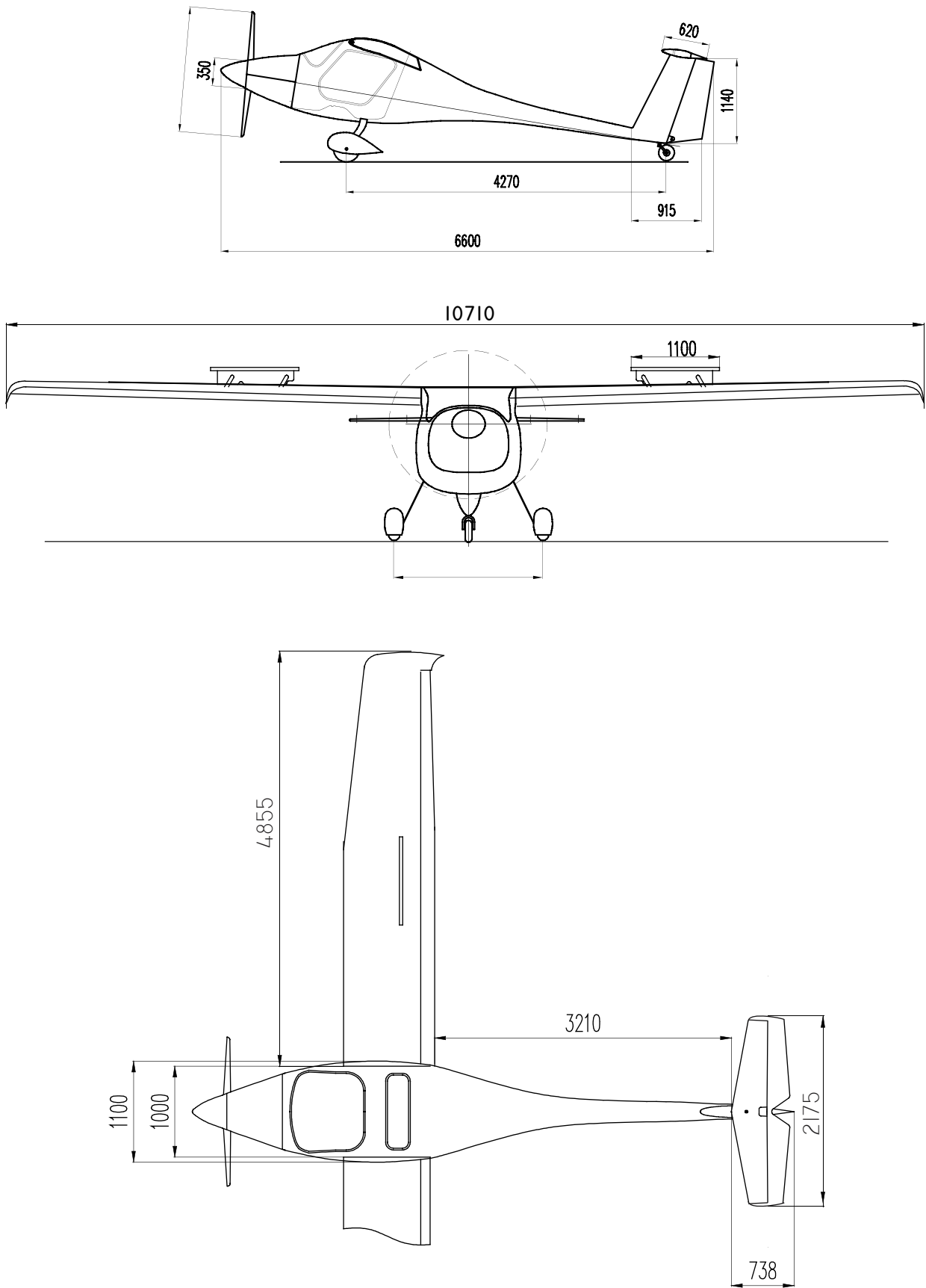
I would recommend you taxi slow, up to 10 km/s (5 kts). Virus 912 SW tail-wheel edition's long wings cause quite a bit of inertia if turning too quickly on the ground. Ground loops are virtually unknown to Virus 912 SW tail-wheel edition pilots, but pilots with little or no tail-dragger experience, who attempt to taxi fast

(20 - 30 km/h, 10 - 15 kts) are still subject to ground looping. Fortunately, due to the steerable tail wheel, this is not dangerous for aircraft's structure. You will recognise the beginning of a ground loop by seeing the aircraft rapidly increase its angular velocity while turning on ground.

To prevent ground looping simply apply full opposite rudder and both wheel brakes while holding the stick back fully.

What makes pilots wonder how they will move around safely is ground visibility. To see forward simply lean your head and press it against the window. This will provide you with straight-forward visibility.

3-view drawing





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Virus 912 SW checklist

Before start-up

Fuel system drain	PERFORMED
Doors	CLOSED
Rudder pedals & hear rest position	SET
Harnesses	FASTENED
Parachure rescue system safety pin	REMOVED
Pitot tube protection cover	REMOVED
Spoilers	RETRACTED
Brakes	SET
Flaps	2 nd POSITION
VARIO propeller lever	MINIMUM PITCH
Battery switch	ON (PUSH)
Instruments	CHECKED
COM, NAV	SET

Engine start-up

Area in front of aircraft	CLEAR
Fuel valves	BOTH OPEN
Throttle	IDLE
Choke	AS REQUIRED
Master switch	ON
Magnetos	ON
AC lights	ON

After start-up

Warm up at	2500 / 3500 RPM
Magneto RPM drop	VERIFIED
Engine & Propeller check	RPM within limits

Before takeoff

Fuel valves	BOTH OPEN
Spoilers (if applicable)	RETRACTED
Doors	CLOSED
Flight controls	CHECKED
Flaps	2 nd POSITION
Elevator trim	SET
Propeller pitch	SET

After takeoff

Elevator trim	SET
Flaps	UP

Descent - Approach

Throttle	IDLE
Flaps	NEGATIVE
Instruments	SET
Spoilers (if applicable)	AS DESIRED

Landing

Throttle	IDLE
Flaps	2 nd POSITION
Spoilers	AS DESIRED

Shutdown

Brakes	SET
Spoilers	RETRACTED
Flaps	UP
AC lights	OFF
Magnetos	OFF
Master switch	OFF
Fuel valves	CLOSED

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fold here



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Warranty statement

Warranty applies to individual parts and components only.

The warranty does not include costs related to the transport of the product, goods and spare parts as well as costs related to the merchandise' temporary storage. Pipistrel d.o.o. does not offer guarantee for the damage caused by every day use of the product or goods. Pipistrel d.o.o. does not guarantee for the lost profit or other financial or non-financial damage to the client, objects or third party individuals .

Warranty voids:

- in case that the customer has not ratified the General Terms of ownership with his/her signature;
- in case the aircraft or the equipment is not used according to the Pipistrel d.o.o.'s instructions or aircraft's manual and eventual supplemental sheets;
- in case when the original additional and/or spare parts are replaced with non-original parts;
- in case additional equipment is built-in without Pipistrel d.o.o.'s prior knowledge;
- in case the purchased goods were changed or modified in any way;
- in case when the defect is caused by user's deficient maintenance, inappropriate care and/or cleaning, user's negligent handling, user's inexperience, due to use of product and/or its individual parts or components in inadequate conditions, due to prolonged use of the product or goods, due to product and/or parts' over-stressing (even for a short duration), due to the fact a repair was not carried out neither by Pipistrel d.o.o. nor by its authorised personnel;
- in case parts that become worn out by every day use (e.g. the covers, pneumatics, electric instruments, electric installation, bonds and bindings, cables, brake plates, capacitors, cooling devices, various pipes, spark-plugs, exhaust systems...)
- the owner must ensure regular engine check-outs and maintenance. Some maintenance works that are demanded by the engine manufacturer must be carried out at Rotax's authorised service centres.

In case the written above is not fulfilled, warranty voids.



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