AVIATION ARTUR TRENDAK

FLIGHT MANUAL

GYROCOPTER

TERCEL

SERIAL NUMBER: **T&S J22015S**

REGISTRATION MARKS:

NUMBER ON FILE:

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DATED …… NO. ……

"ULTRALIGHT" CATEGORY

THIS GYROCOPTER CAN BE USED IN THE "ULTRALIGHT" CATEGORY FOR LEISURE, SPORTS AND DEMONSTRATION PURPOSES AS WELL AS OTHERS, EXCLUDING AIR TRANSPORT.

USING THIS GYROCOPTER FOR TRAINING AND PRACTICE TO OBTAIN A CERTIFICATE OF QUALIFICATIONS OF AN ULTRALIGHT GYROCOPTER PILOT AS WELL AS HAVE QUALIFICATIONS ENTERED IN THIS CERTIFICATE CAN BE DONE SOLELY IN A CERTIFIED TRAINING CENTRE.

THE GYROCOPTER MUST BE USED ACCORDING TO THE RESTRICTIONS AND INFORMATION STATED IN THIS INSTRUCTION MANUAL.

THIS MANUAL MUST ALWAYS BE AVAILABLE ON BOARD THE GYROCOPTER.

The manual has been developed as per the requirements of the regulations in Annex No. 5 “Ultralight Aircraft” - of the Decree of the Minister of Infrastructure dated 25 April 2005 on Excluding the Application of Some of the Laws of the Act on Air Law for Some Sorts of Aircraft as well as Defining the Conditions and Requirements concerning the Use of this Aircraft (Official Journal 107 section 904) with subsequent amendments.

It is not allowed to make any entries and supplements in this “Flight Manual” without the consent of the Civil Aviation Authority.

In case this Manual is lost, you should notify the Civil Aviation Authority instantaneously, and when outside the border of your country - an equivalent institution.

Any person to find this manual is requested to send it in instantaneously to Urząd Lotnictwa Cywilnego (Civil Aviation Authority), 02-247 Warszawa, ul. Marcina Flisa 2, Poland, and when outside the border of your country to an equivalent institution.

Chapter 0 Organizational Information

0.1 Register of Changes

Any changes of this manual, except for the up-to-date weighing data, must be recorded in the table below as well as be approved by the Civil Aviation Authority (CAA).

A new or revised text in changed pages must be marked with a black vertical line on the margin and a change number. The number of the last change in a given page and its date must be placed in the page footer. Every time a change is entered, the pages listed in the table below must be mentioned.

Change no.	Description of change	Pages affected	Entry date	Signature

Change no.	Description of change	Pages affected	Entry date	Signature

0.2 List of Up-to-date Pages

Chapter	Page	Date	Chapter	Page	Date
	Title	21.08.2014	5	5-1	21.08.2014
	Reverse	21.08.2014		5-2	21.08.2014
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	0-2	21.08.2014		5-4	21.08.2014
	0-3	21.08.2014		5-5	21.08.2014
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3	3-1	21.08.2014		7-9	21.08.2014
	3-2	21.08.2014	8	8-1	21.08.2014
	3-3	21.08.2014		8-2	21.08.2014
	3-4	21.08.2014		8-3	21.08.2014
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	4-2	21.08.2014	9	9-1	21.08.2014
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0.3 Table of Contents

Chapter 1 General Information

1.1 Introduction

This manual has been written to provide pilots and engineers with information essential for safe and effective operation on TERCEL gyrocopter. The manual also contains basic guidelines from the gyrocopter manufacturer and also legal requirements concerning the performance of flights.

The manual is not a substitute for theoretical and practical training in respect of piloting gyrocopters.

TERCEL gyrocopter pilots must hold a qualification certificate or a valid licence for ultralight aircrafts with specialization for gyrocopters. Before flight pilots must become acquainted with the uniqueness of the gyrocopter. We recommend you read both the Flight Manual and the Service Manual to be fully familiar with the structure, all the equipment and the driving unit of the gyrocopter.

The gyrocopter can only be used for flight when it is technically operative and holds a valid authorization to perform flights. An authorization to perform flights is entered into the ultralight aircraft book, which is a document identifying an ultralight aircraft and its units as well as containing details about the history of usage.

The utilized gyrocopter should be entered into aircraft records kept by the Civil Aviation Authority as well as hold current air third-party insurance.

1.2 Basis for Airworthiness Acknowledgment

The legal basis for operating a gyroplane is provided by national law and its respective regulations. The instructions and conditions contained have to be considered when operating the gyroplane. All documented performance data and operating procedures have been identified within the certification processes for this gyroplane by means of flight test and analysis.

TERCEL gyrocopter meet German and Polish Civil Airworthiness Requirements. They comprise requirements and constitute the basis for the issue of Certificates, Permits and Approvals in accordance with the Air Navigation Order.

1.3 Description of the Gyrocopter

TERCEL is a two-seat ultralight gyrocopter. The main structural component is the fuselage which is constructed with composite material. Two metal tail booms are attached from the lower part of the fuselage to a twin vertical tail unit. This consist of twin stabilizers and rudders on which a horizontal stabilizer is attached complete with winglets of constructed composite material. A metal mast is affixed to the fuselage structure, on which the control head with the rotor is mounted.

The two-blade rotor of metal structure is manufactured and delivered as a set (blades plus a hub) by the AVIATION Artur Trendak Company. The blades, made from drawn aluminium, are entirely anodized and perfectly balanced.

The *TERCEL* is powered with a **AAT&S CA 912 ULT** engine. It is a Rotax 912 UL engine, modified by the AVIATION ARTUR TRENDAK Company by adding an Iveco turbocharger. It is equipped with a three-blade composite propeller DUC FC-R INCONEL.

The undercarriage is a stationary three-wheel one in a set with the front wheel. The main legs are elastic and made of composite. The front leg is dampened with a wheel pneumatic unit. The undercarriage is made with wheels with a diameter of 450mm.

The spacious cabin with a width of 136 cm is accessible through a large door on the left and right sides. Rich glazing ensures optimum visibility. Two ergonomic seats can be set up. Each chair is equipped with adjustable four-point belts.

1.3.1 General Data

Geometric data

Rotor diameter	8.60	m
Rotor surface	60.82	m^2
Rotor blade chord	0.22	m
Overall length (without rotor)	5.04	m
Fuselage width	2.35	m
Track of wheels	2.20	m
Cockpit width	1.36	m
Overall width	2.35	m
Overall height	2.87	m
Wheel diameter	0.45	m

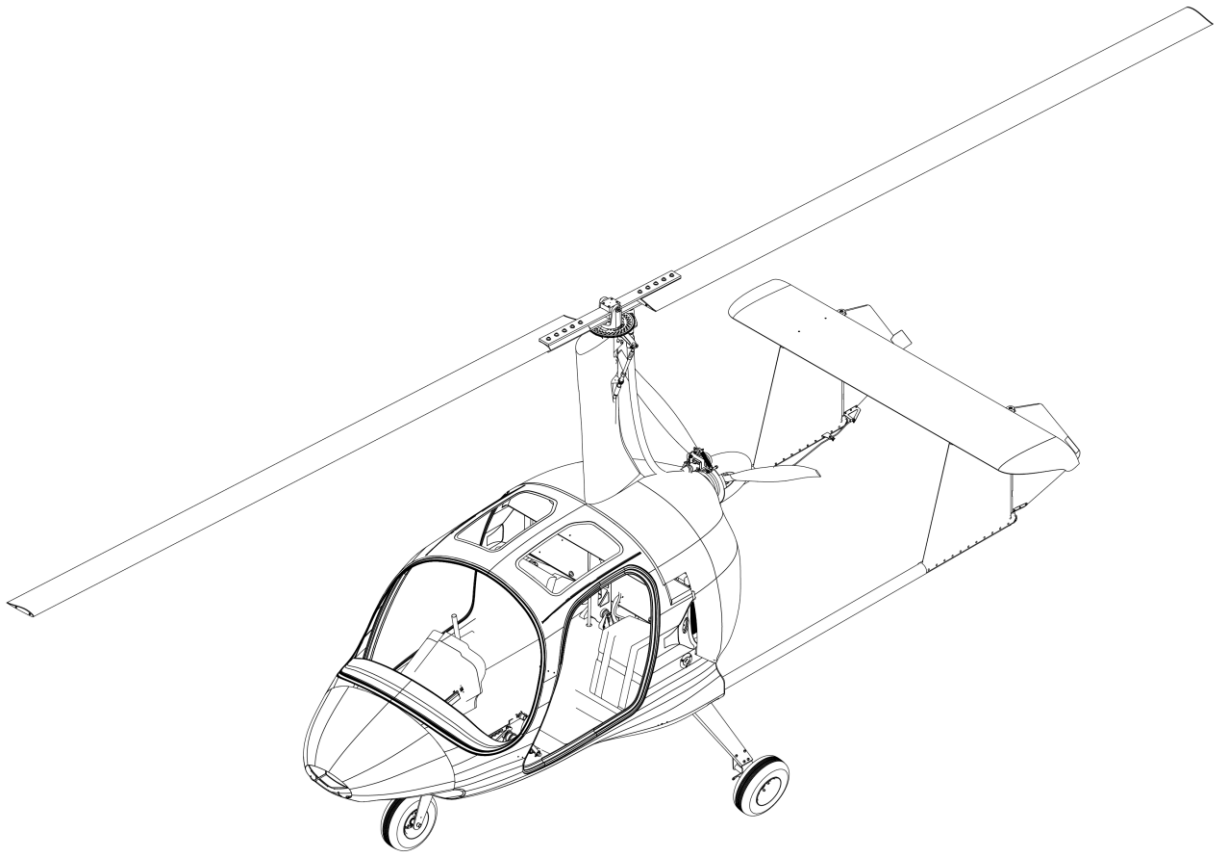
Weight data

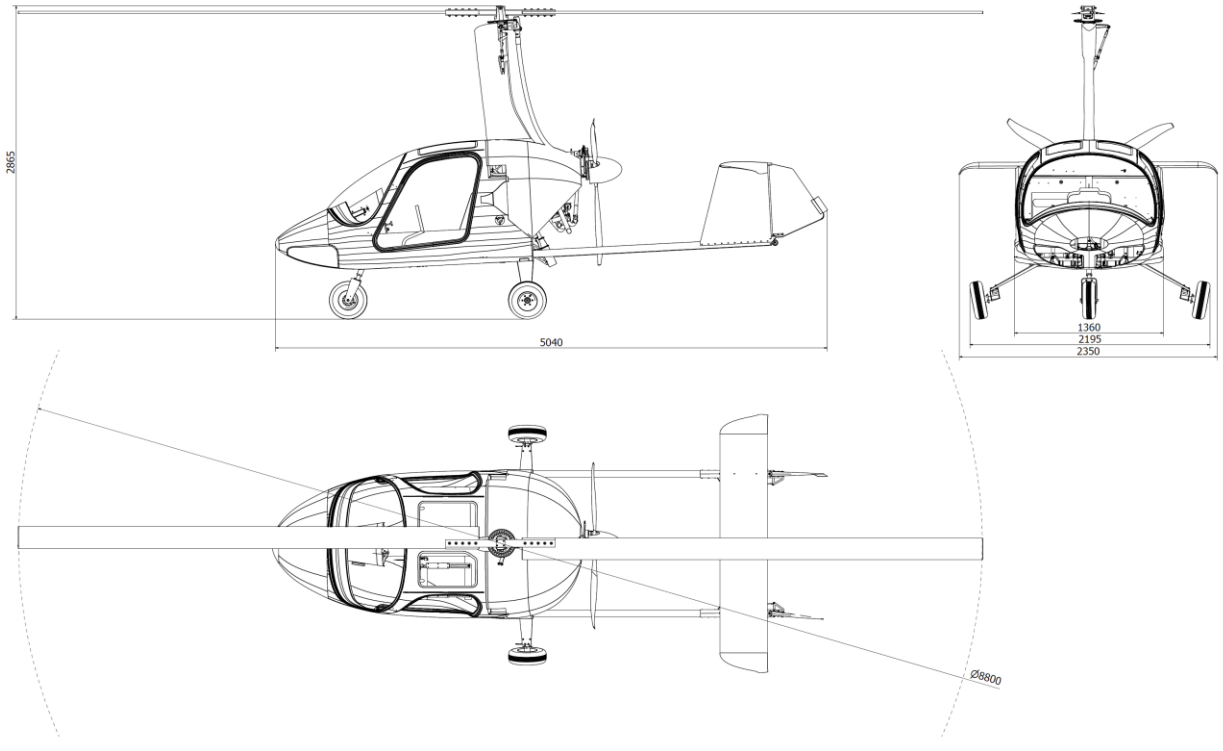
	kg	lb
Maximum take-off weight	560	1234
Empty weight*	326	718
Load capacity	265	584

Data of the power unit

Engine type	CA 912 ULT
Power	121 KM at 5800 rpm
Reducer ratio	1 : 2.43
Propeller	DUC FC-R INCONEL
Propeller diameter	1.727 m
Capacity of the fuel tanks	120 litres

*Empty weight including rotor weight(40kg)

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Chapter 2 Restrictions

2.1 Introduction

Chapter 2 embraces the restrictions of usage, markings of instruments and basic plaques, crucial to the safe usage of the gyrocopter, its engine, standard systems and standard equipment.

2.2 Flight Speed

Speed restrictions and their importance in usage are presented in the table below:

	Speed	IAS [km/h]	IAS [kt]	Notes
V_{NE}	Speed never to be exceeded	182	98	Do not exceed this speed in any usage.
V_{NO}	Maximum structural cruising speed	130	70	Do not perform full or violent movements with the control surfaces above this speed, except for tranquil atmosphere and exercising with caution.
V_{min}	Minimum speed	60	32	The minimum speed of established horizontal flight.

CAUTION!

Speedometer indications fluctuate during steep climbs and descents due to the changes in pitch attitude.

2.3 Speedometer Markings

Marking	value or range		Notes
	[km/h]	[kt]	
Green arch	0÷130	0÷70	Range of normal usage
Yellow arch	130÷182	70÷98	Warning range
Red line	182	98	Never-exceed speed (V_{NE})
Yellow triangle	100	54	Flight speed at the best rate of climb speed (V_Y)

Moreover, one of the speed placards below must be installed on the instrument panel in front of the pilot (corresponding with the units for scaling the speedometer):

IAS			
	V_{NE} = 182 km/h	V_Y = 105 km/h	V_{APP} = 90 km/h 1 person
	V_X = 95 km/h	V_{min} = 60 km/h	V_{APP} = 90 km/h 2 people

IAS			
	V_{NE} = 98 kt	V_Y = 57 kt	V_{APP} = 49 kt 1 person
	V_X = 51 kt	V_{min} = 32 kt	V_{APP} = 49 kt 2 people

2.4 Driving Unit

Engine model	**CA 912 ULT** Rotax 912 UL engine, modified by the AVIATION ARTUR TRENDAK company by adding the Iveco Turbo Compressor

	Power	RPM	Manifold Pressure
Maximum Take-off Power	122 hp	5800	max. 45,5 inHg
Maximum Continuous Power	115 hp	5500	max. 45,0 inHg
75% Take-off Power	90,75 hp	-	max. 40,0 inHg
Idle	-	1450	max. 31,5 inHg

Oil type	10W40		
	minimum	normal	maximum
Oil temperature	50 ºC	90-110 ºC	140 ºC
Oil pressure	0,8 bar (above 3500RPM)	2-5 bar(above 3500RPM)	7 bar

Fuel (type)	Lead-free car petrol with the minimum octane number of 91 or above
Min. fuel pressure	0,15 bar
Max. fuel pressure	0,4 bar
Maximum coolant exit temperature	120 ºC
Maximum cylinder head temperature	135 ºC
Propeller manufacturer	DUC
Propeller model	Three-blade FC-R INCONEL Std/Inc. Propulsive Left
Propeller diameter	1.72 m
Propeller blade angle	17º (in measurement section, in accordance with the propeller manual)

2.5 Rotor Rotational Speed

Rotor rotational speed	rpm
normal at maximum weight (MTOW) normal at minimum weight (~330 kg)	360 - 390 330 - 340
during autorotation	310 ÷ 340
minimum for level flight	340
minimum until the full opening of the throttle during take-off	**180**
maximum for using the rotor brake	**150**

WARNING!

Load Factor below 1g during flight cause the rotor rotational speed to fall and if maintained, it can lead to disaster.

2.6 Rotor Tachometer Markings

Marking	Value or range [rpm]	Notes
Red arch	0÷200	Warning range
Green arch	200÷420	Normal range
Red arch	420÷500	Warning range

2.7 Weights

Maximum take-off weight (MTOW)	560kg	1234 lb
Nominal proper weight *	326 kg	718lb
Minimum crew weight	60 kg	132 lb
Maximum crew weight	220 kg	485 lb
Maximum one person weight	110 kg	243 lb
Maximum fuel weight	93 kg	205 lb

* - the actual proper weight for a particular model is written in the current weighing report and in subsection 6.4 of this manual.

The current take-off weight is equal to the sum of the empty gyrocopter weight and the weights of the crew, luggage and fuel. Under no circumstances, do not exceed the approved maximum take-off weight (MTOW) equal to 560 kg (1234 lb). Proposed load sheet is presented below.

	Weight	Minimum	Maximum
Empty weight		----------	----------
Crew weight			
Fuel weight			
Luggage weight			
Total			

WARNING!

Exceeding the maximum weight published is prohibited.

Space behind the seats is limited to 10 kg (22 lb).

During solo flights, it is recommended to place a ballast on the board (on the seat fastened with seat belts) to ensure the appropriate balancing of the machine. A ballast in the form of a sack of sand or a can of water is recommended. The ballast must be protected against movement. Ballast size is specified below:

Pilot left seat weight [kg]	Ballast right seat [kg]	Ballast right seat [lb]
50 ÷ 60 kg	12 kg	26 lb
60 ÷ 80 kg	10 kg	22 lb
80 ÷ 100 kg	8 kg	18 lb

2.8 Position of the Centre of Gravity

The position of the centre of gravity of the gyrocopter (a sideways view) is specified through the value of the angle whose apex is located on the transverse axle for rotor head suspension on the mast, one arm is parallel to the vertical axis of the coordinate system related to the fuselage, and the other arm passes through the centre of gravity of the gyrocopter. (See subsection 6.3).

The admissible range of the position of the centre of gravity of the gyrocopter in flight:

+1,5º ÷ +8,5º

Operating gyrocopter outside the load limits is prohibited.

2.9 Manoeuver Limitations

The *TERCEL* gyrocopter has been classified in the ultralight aircraft category and is subject to the limits below.

It is forbidden to perform:

- aerobatics,
- turns in which the roll angle exceeds 60º,
- flights in the icing conditions,
- flights when wind speed exceeds 60 km/h,
- flights in the conditions of severe turbulence,
- excessive side slip
- low-G manoeuvers (maintain below 1 g)

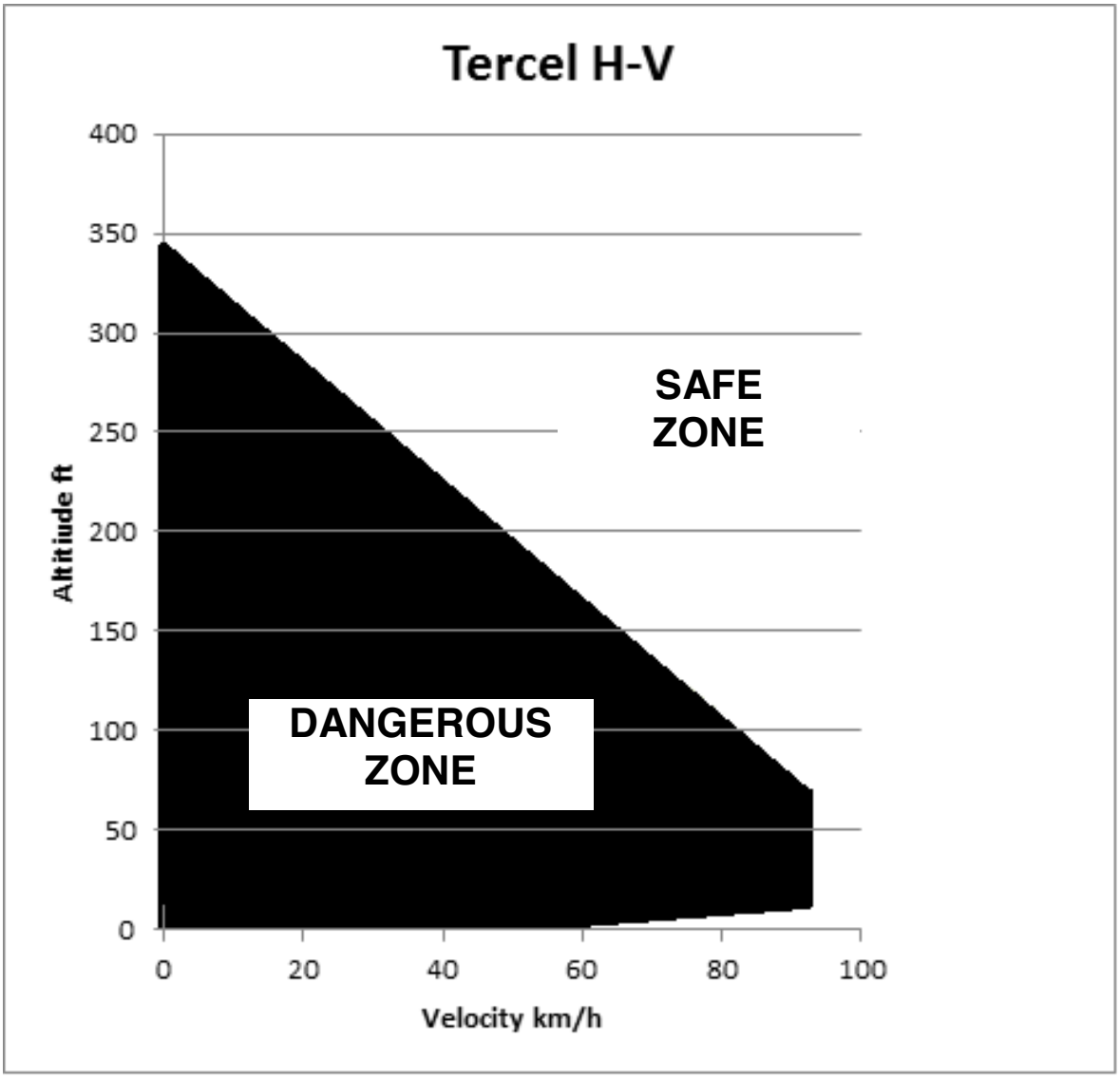
WARNING!

All aerobatic manoeuvres and turns with a roll angle of more than 60º are forbidden!

WARNING!

Load Factor below 1g during flight cause the rotor rotational speed to fall and if maintained, it can lead to disaster.

DIAGRAM: HEIGHT - SPEED



2.10 Manoeuvre Load Factor

Admissible manoeuvre load factor: **0/+3**

2.11 Crew

The gyrocopter is a two-seater with an option with single or a double flight control system.

Minimum crew: 1 pilot.

2.12 Sorts of Usage

This gyrocopter can be used for leisure, sports, display purposes, for training, practice, exclusive of air carriage and other reasons. Flights can be performed in the Visual Meteorological Conditions(VMC) covered by Visual Flight Rules(VFR). Specific usage of gyrocopter is described in Certificate of Registration given by Aviation Authority of country of registration.

2.13 Fuel

capacity of the fuel tanks		120 dm^3
admissible quantity of fuel in the tanks		120 dm^3
including	consumable fuel	118 dm^3
	non-consumable fuel	2 dm^3

2.14 Wind speed restrictions

The admissible values of wind speed during flight and landing:

direction of wind	speed
headwind	60 km/h
crosswind (90º)	30 km/h
tailwind	0 km/h

Chapter 3 Emergency Procedures

3.1 Introduction

Chapter 3 contains activities to take if an emergency condition occurs during ground operation, take-off or in-flight. These procedures are suggested as the best course of action for coping with the particular condition described, but are not a substitute for sound judgment and common sense. Since emergencies rarely happen in modern gyrocopter, if proper pre-flight inspections and equipment maintenance are applied, their occurrence is usually unexpected and the best corrective action may not always be obvious. Pilots should familiarize themselves with the procedures given in this section and be prepared to appropriate action when an emergency arise.

Most basic emergency procedures, such as power off landings are a part of normal pilot training. However, these emergency situations are also discussed here. This information is not intended to replace such training, but only to provide a source of reference and review, and to provide information on procedures which are not the same for all gyrocopters. It is suggested that the pilot review standard emergency procedures periodically to remain proficient in them.

CAUTION:

Plan the flight route so as to allow for potential emergency landing.

3.2 Engine Failure

3.2.1 During Take-off

- Evaluate the flight level. If you are above 250 ft (80 m), you can turn back to land. If are lower, keep up the direction straight ahead.
- Reset the throttle to the “minimum” position.
- Deactivate the magnetos and the electrical master switch(red key).
- Land, attempting to avoid both possible obstacles and violent manoeuvres resulting with loss of rotor rotational speed.

3.2.2 During Flight

- If you have the sufficient flight height, attempt to start the engine in flight (subsection 3.3).
- If the height is too small or attempts to restart the engine have not succeeded, perform emergency landing (subsection 3.6).

3.3 Starting the Engine in Flight

- Proceed to gliding.
- Make sure all the switches are in an appropriate position - the master switch and the magnetos are ON.
- To start the engine, reset the throttle lever to the “minimum” position.
- Activate the starter.
- After starting the engine, boost the throttle gradually.

3.4 Smoke or Fire

3.4.1 During Taxiing

- Reset the throttle lever to the “minimum” position.
- Close Fuel Shut-off valve.
- Deactivate the magnetos and the master switch(red key).
- Stop the machine and leave it as fast as possible.
- Use an appropriate fire extinguisher if available.

3.4.2 During Flight

- Close Fuel Shut-off valve.
- Deactivate the magnetos and the master switch(red key).
- Use an appropriate fire extinguisher if available.
- Perform Emergency Landing(subsection 3.6)

3.5 Gliding

Flight with engine shut-off can be safely performed in the full speed range. However, approaching the ground, observe the restrictions following from the “height - speed” diagram (page 2-7). In case of a vertical descent, commence accelerating the gyrocopter at a height of 80-100 m above the ground to be able to land safely.

The highest glide ratio equals 3:1 at speed 100 km/h (54 kt); then the machine heads for an area seen in the bottom window.

3.6 Emergency Landing

- Maintain 100 km/h (54 kt) to achieve best glide ratio.
- Chose landing spot.
- Land, attempting to avoid both possible obstacles and violent manoeuvres resulting with loss of rotor rotational speed.
- Engage rotor brake as fast as possible after touchdown.
- Stop the machine, apply full rotor brake and prepare to leave.
- Leave the machine as soon as the rotor stops.

3.7 Flat Tyre at Landing/Taxi

- Deactivate the magnetos and the master switch.
- Interrupt the take-off.
- Attempt to keep up the direction by means of the pedals and the brake.

3.8 Jamming of the Throttle Lever during Flight

- Attempt to move the lever in order to release it.
- Choose an appropriate spot for landing.
- Deactivate the magnetos when you are within reach of places for touchdown.
- Perform emergency landing.

Chapter 4 Normal Procedures

4.1 Introduction

Chapter 4 contain a list of activities and a description of procedures for performing normal operation. Normal procedures related to the optional systems are included in Chapter 9.

4.2 Attaching the Rotor

The blades and the hub are provided with the numbers specifying their orientation in the assembly kit. By matching the alphanumeric markings, insert the rotor blades into the sockets in the hub. Install using five M8x65 bolts each (with the washers on both sides) clipping the hub beams with each blade. Next, screw all ten nuts to the first contact.

Even out the rotor blades by using stretched string, going through the centre of the hub and along the grooves at the blade tips. The rotor must be placed on two supports with a soft surface (to avoid damage) so that the strained string goes about 1 cm above the central opening in the hub. If the engine is not aligned properly, it will result in vibrations in flight. The better the alignment of the rotor, the greater the comfort of flight, the smaller the vibrations and the longer the life of the machine and its subassemblies. When the string does not overlap the hub axle, two people are needed for help: hold down the blade tips, then push the hub in the right direction. After alignment, tighten the nuts with a torque spanner, first 18 Nm, next 24 Nm.

The correctness of alignment must be checked in the first flight.

CAUTION: In order to mount the rotor on gyrocopter use a ladder and help of another person!

Installation of the Rotor on the Gyrocopter:

- Make sure the wheel brakes are activated.
- Fix the control stick in the extreme front position so that the rotor head disc rests on the brake.
- Lubricate the pin for rotor hub suspension on the head (teeter bolt) and the slip sleeves with a dedicated lubricant (WHS2002).
- With the help of another person (and a ladder), raise the rotor and place it on the head.
- Insert the pin through the head and the hub (making sure the sleeves remain in their places) and press it down to the end.
- Tighten the nut, next unscrew it by 1/4 of a rotation and pass the safety cotter pin through the opening at the end of the pin.
- Check rotor head movement range.

4.3 Daily Inspection

Most of technical faults can be detected during a careful check before flight. The safety of operation depends on regular and detailed inspections and services. An inspection should, according to the plan below, be conducted before the first flight on a given day, if possible in the presence of a qualified person (e.g. a pilot) to operate the machine correctly and avoid an accidental start.

General	• Check overall condition. • Check the magneto switches operate correctly (mechanically) and set them up in the deactivated position (OFF). • Remove frost, snow, ice or mud, if any. • Check the gyrocopter documents validity and proper maintenance performed. • Loose equipment is properly secured. • If the gyrocopter has not been flown recently and before the next flight make sure any discrepancies that would affect the flight have been cleared with maintenance.
Glazing	• Check overall condition (clean if necessary). **CAUTION: Cleaning fluids containing alcohol are not allowed!**
Fuselage	• Check the outside surfaces, tail beam pipes and their mounting in the fuselage, the rotor mast and its mounting in the fuselage, available inside structure of the fuselage for damage, corrosion, cracks and ensure all components are protected and secured. • Check the drainage and ventilation holes are not clogged. • Check the radio antennas are not damaged and are secured.
Tail	• Check the stability of the vertical stabilizers to the tail beams and the horizontal stabilizer to the vertical stabilizers. • Check the condition of the composite surfaces of the stabilizers and rudders for delamination or other damage. • Check the condition of the Bowden cables and their connection to the control surfaces. • Check the rudder hinges. • Check the tail wheels.
Undercarriage	• Check the static deflectors on the undercarriage are intact. • Check the condition of the undercarriage for damage, corrosion and cracks of all components. • Check connection undercarriage legs attached to the fuselage structure for cracks and excessive play. • Check the tyres are properly inflated (2.5-4 bars), are not damaged or worn-out. • Check if the braking system is not damaged and has no signs of leaks. • Check the brake fluid level. • Check the bolts fixing the brake discs (2x4 pieces) are tightened. • Check the front leg rotates freely and the pushers are fixed correctly.

Flight control systems	• Check the pedals. To check free movement of the rudder, raise the front wheel, by pressing down on the horizontal stabilizer (where is joined to the vertical stabilizer). • Check the condition of rudder pedals, ensuring they are securely attached and there is no cracks in the welds and no jamming of the controls within the movement limitations. • Check the control stick moves freely in the full movement range (between the stops) and the stick and rotor are in alignment. • Check mechanical connections of the control stick and the rotor head ensuring no loos bearings or components. Ensure the pushers are not bent and move freely. • Check the condition and operation of the electric trimmer.
Driving system	• Replenish (if necessary) the oil tank and the cooling fluid tank with appropriate fluids. • Check the cooling lines (water and oil) are not cracked. • Check the fixing of exhaust system and turbocharger and all safety wires are secure. • Check overall condition of exhaust system and turbocharger. • Check the air filters are clean and securely fixed. • Check the engine suspension for secure attachment and rubber components for cracks and excessive wear. • Check the spark plugs and their caps are securely fixed. • Check the condition of the water and oil coolers, their fixing and make sure there are no leaks. • Check the full and free movement of the engine control system ensuring that it mover in the right direction. • Check the security of all wiring around the engine. • Make sure both covers of the inspection panels are secure and locked.
Propeller	• Check propeller blades and the hub for cracks and damage. • Check if propeller blades are securely attached to the hub, and hub to the engine (all the bolts/nuts are secured with safety wire). • Check rotation of propeller and engine ensuring no unusual noises during rotation. **Caution! The engine can start! Ensure ignition is off, magnetos are off, throttle idle, brake on, and chocks in place.**
Fuel system	• Check both fuel tanks for condition ensuring the attachments are secure, no leaks, filler caps secure and fuel level in the tanks corresponds to the fuel level on the gauge. Ensure operation of the fuel shut-off valve and check there is no water in the fuel setting tank. • Check if fuel system conduits for overall condition. • Check if fuel filters are not polluted with water.
Rotor	• Check the rotor head, its condition and freedom of movement. • Check the security of bolts and nuts securing the rotor blades to the hub. • Check visually blades for scratches, nicks, signs of cracks or other damage (the blades must be clean!). • Check the rotor swings freely against the head and in the full range between stops.

Prerotation mechanism	• Check the V-belts for damage / delamination. • Check the pretoration sheave for damage / cracks. • Check the rotor drive transmission rotates freely and is lubricated. • Check the overall condition of prerotation mechanism, no cracks or other damage. • Check the prerotation brake operates correctly - it should stop the movement when pulling down the V-belts on the left side. The clutch cable should have several millimetres of clearance, no tension.
Cabin	• Check the doors opening and closing – to ensure hinges operates correctly. • Check the seat belts overall condition. • Check seats for proper attachment to the cabin floor. • Check the readings of instruments that correspond with the present weather conditions. • Check the wiring harness for traces of overheating or other damage. • Check the operation of the electrical circuits. • Check battery is charged, radio is working and check other electrical instruments. • Check the stickers and placards are legible.

Pre-flight Inspection

Before every flight, the pilot must perform an overall visual check of the whole gyrocopter. Check of the gyrocopter, any faults or mechanical issues should be cleared before flight.

Moreover, it is essential to:

- Check Weight and Balance for flight to make sure it is in limits.
- Specify the fuel level (replenish if necessary).
- Adjust the chairs, check security of luggage - there can be no loose objects in the cockpit.
- In case of solo flight - close the doors and fasten the seat belt on the empty seat.
- Check the freedom of movement of the flight controls (when checking the rudder pedals, lift the front wheel by pressing down the horizontal stabilizer).

4.4 Before Starting the Engine

If the engine is cold, all the oil drains to the bottom of the engine so oil has to be moved around the engine. In order to do it perform as follows:

- make sure the magnetos are deactivated;
- the throttle is on idle;
- brake set;
- rotate the propeller manually anti-clockwise until you hear the first burbin from the oil tank;
- perform 10 more rotations to fully remove the air from the oil circulation;
- from the cockpit: (check propeller area clear, magnetos off) activate the starter for a maximum of 10 seconds, checking the value of oil pressure - it should indicate minimum 1 bar;
- if the pressure is too low, repeat the previous operations if not helps, contact AAT certified gyrocopter mechanic.

4.5 Starting the Engine

CAUTION!

Only qualified personnel can start the engine.

- Block the control stick with strap in the extreme front position.
- Activate the master switch.
- Activate the electric fuel pump.
- Set the throttle (the black lever) in the idle position (entirely backwards).
- Activate both magnetos (upwards).
- Make sure all the other electronic switches and instruments are deactivated.
- Make sure the wheel brakes are activated.
- Pull the choke lever (blue) if necessary (depending on air temperature). To start the cold engine, use full choke and the throttle in the maximum position; otherwise choke does not operate properly. When the engine is warm do not use choke.
- Call “Propeller clear”
- Press the starter button (max 10 seconds).
- After starting the engine all the necessary devices can be activated.
- Deactivate choke.
- Warm up the engine at about 2000 rpm, next at 2500 rpm until the oil temperature in the engine reaches 50°C.

4.6 Check after Starting the Engine

- If any of the parameters is outside the normal range, turn off the engine and check the cause.
- Check the oil pressure. If it does not raise to the normal value (2-5 bars), shut down the engine and check the reason.

  Engine Check:
- Magnetos check: at about 3000 RPM, turn off one of the magnetos. The maximum expected drop should be 200 RPM. Turn magneto on. Repeat analogically for the second magneto

4.7 Taxiing

- For safety reasons, it is recommended to stop the rotor during taxiing.
- During taxi do not exceed a fast walking speed (15 km/h).
- Make sure the pedals operate correctly. Left pedal turn left, right pedal turn right.
- Check the brakes. Avoid using brakes during turns, because it causes the hindered operation with the pedals and leads to the unnecessary overload on the front wheel and the pedals.

4.8 Check before Take-off

Make sure:

- quantity of fuel is sufficient (recommended visual inspection of fuel in tank);
- doors are closed;
- seats are set up appropriately and the belts fastened;
- choke disengaged;
- trimmer is loose;
- the gyrocopter is set up against the wind;
- condition of the runway and its length are appropriate;
- radio is operative.

4.9 Prerotation and Take-off

- (If prerotation belts were replaced, it is recommended to powder them with talc)
- Set brakes on
- Unlock control stick
- Check control stick movement range
- Set control stick in neutral position
- Set throttle to idle
- Pull prerotation engaged until Bendix turn on (characteristic sound)
- After Bendix turns on, hold prerotation lever on in position until rotor accelerate to 100 RPM
- Firmly continue pulling prerotation lever until rotor RPM stop accelerate(this means prerotation system has been synchronized)
- Set prerotation to fully engaged
- Set throttle lever so the rotor RPM reach 150RPM and then pull the control stick ~10cm and hold on until rotor reach 180-200RPM
- Set prerotation to fully disengaged
- Make sure the prerotation mechanism is deactivated.
- Release the wheel brake.
- Pull the control stick backwards and gradually accelerate.
- At a speed of 40 km/h (22 kt) gently lift the front wheel, observing attitude of gyrocopter.

Prerotation lever is a red lever in central console. Bendix mounted on gyrocopter is mechanical type.

CAUTION:

After setting prerotation lever to prerotation position, prerotation clutch is engaged Bendix is turned on and rotor is accelerating. It is forbidden to apply prerotation.

CAUTION:

The gyrocopter tends to lift off the ground prematurely. Attempt to keep the front wheel about 10 cm above the ground. The front wheel lifted too high can lead to an unintended take-off at insufficient speed and too large rotor angle, which can lead to an ascent at a dangerous angle. The machine nose has a low projection(below horizon line), therefore it is essential to watch the height above the ground.

- Increasing the throttle, watch for the momentum from the propeller and compensate it by using the rudder pedals.
- The lift-off speed is about 85÷90 km/h (46÷49 kt). After lift-off, accelerate the gyrocopter just above the ground to the speed of 105÷110 km/h (57÷60 kt).

- Start an ascent, controlling the position of the gyrocopter and the engine parameters.

CAUTION:

Pay attention to optical parallax, as you do not sit at the aircraft axis. Move the stick in the right manner. Do not move it diagonally if you want to make a move forwards or backwards. It is recommended to practise this reflex on the ground with an instructor.

4.10 Climb, Cross-Country Flight, Descent

- Controlling climb and descent is performed by moving the throttle lever coordinated with the movement of the control stick. An optimal climb speed is 105 km/h.
- Climb: increase the engine rotational speed, by moving the throttle lever forwards.
- Descending: decrease the engine rotational speed, by moving the throttle lever backwards.
- A cross-country speed depends on the take-off weight, the engine rotational speed and atmospheric conditions.
- Trim: Trim the gyrocopter till it fly straight and level.
- The *TERCEL* is designed so as to react to the pilot's instructions in an intuitive and normal manner: increasing throttle causes climb, reducing throttle causes descent.

4.11 Approach and Landing

- Choose an appropriate area for landing, check the movement of other aircrafts around, by using a radio, and specify the direction and speed of wind.
- Check the descent speed by using the throttle lever and control stick.
- Maintain the appropriate approach speed (about 95 km/h (51 kt)).
- It is crucial to avoid sudden sideways movements.
- Make sure the front wheel is straight.
- On an appropriate level, initiate roundout so as to align just above the ground and touch down gently.
- Remember landing **does not finish** when all the wheels touch the ground.
- Perform the landing run along the straight line until you stop; do not turn during the landing run!
- Check the rotor until it stops completely.
- Use the rotor brake below the speed of 150 rpm until it stops.

CAUTION!

In case of strong sideways wind, plan the landing with the shortest possible landing run, and during the landing run tilt the control stick in the direction against the wind (the wind from the left - the stick to the left)

4.12 Turning off the Engine

CAUTION!

Every engine with the turbocompressor must be cooled after flight.

- Allow the engine to work at low rpm (1650 rpm) for about 5 minutes (all the parameters must stabilize).
- Deactivate the magnetos and the master switch.

4.13 Post-flight Inspection

After flying, the pilot should perform an overall visual check of the whole gyrocopter. All disturbing observations should be passed to competent people. Also, if there are any abnormal situations during flight, it is important to notify competent people and perform adequate actions.

4.14 Detaching the Rotor

The rotor must be detached from the gyrocopter for transportation, and in case of longer hangar storage.

NOTE: **When detaching the rotor, you must stand on the fuselage only in the spots assigned for this purpose!**

- Make sure the wheel brakes are activated (position 1).
- Set up and immobilize control stick using strap in the extreme front position so that the rotor head disc rests on the brake.
- Remove the safety cotter pin and unscrew the nut from the pin for rotor hub suspension in the hub (teeter bolt).
- With the help of another person holding down the rotor, tuck out the pin (making sure the sleeves remain in their places) and remove the rotor from the head.
- Unscrew the nuts, withdraw the M8x65 bolts (10 pieces) and tuck out the blades from the sockets in the hub.
- Piece together and assemble back the hub, sockets, M8×65 bolts, washers and nuts.
- Place the pin (teeter bolt) in the hub with washers, screw on a nut and pass through the cotter pin (safety pin).

The removed blades, for storage or transportation, must be appropriately fastened and protected against damage.

Chapter 5 Performance

5.1 Introduction

Chapter 5 includes information regarding flight speed and performance during take-off, climb, cross-country flight and landing, and also data about noise.

Unless stated otherwise, the values refer to take-off weight equal to 560 kg and standard atmosphere conditions.

5.2 Characteristic Speeds [IAS]

		[km/h]	[kt]
Never-Exceed Speed	V_{NE}	182	98
Maximum structural cross-country speed	V_{NO}	130	70
Flight speed at the best ascent speed	V_{Y}	105	57
Approach speed	V_{APP}	90	49
Manoeuvre speed (two people)	V_{D}	90	49
Manoeuvre speed (one person)	V_{D1}	90	49
Minimum speed	V_{min}	60	32

NOTE:

The actual speed distinctly differs from the speed indicated during a steep climb, descent and in autorotation due to a change of the angle of attack.

5.3 Take-off

Lift-off speed is about 66 km/h (36 kt).

Standard take-off run is about 200 m (656 ft).

Take-off distance to a height of 15 m (50 ft), after acceleration up to V_Y = 100 km/h (54 kt) ,is about 299 m (981 ft).

5.4 Climb

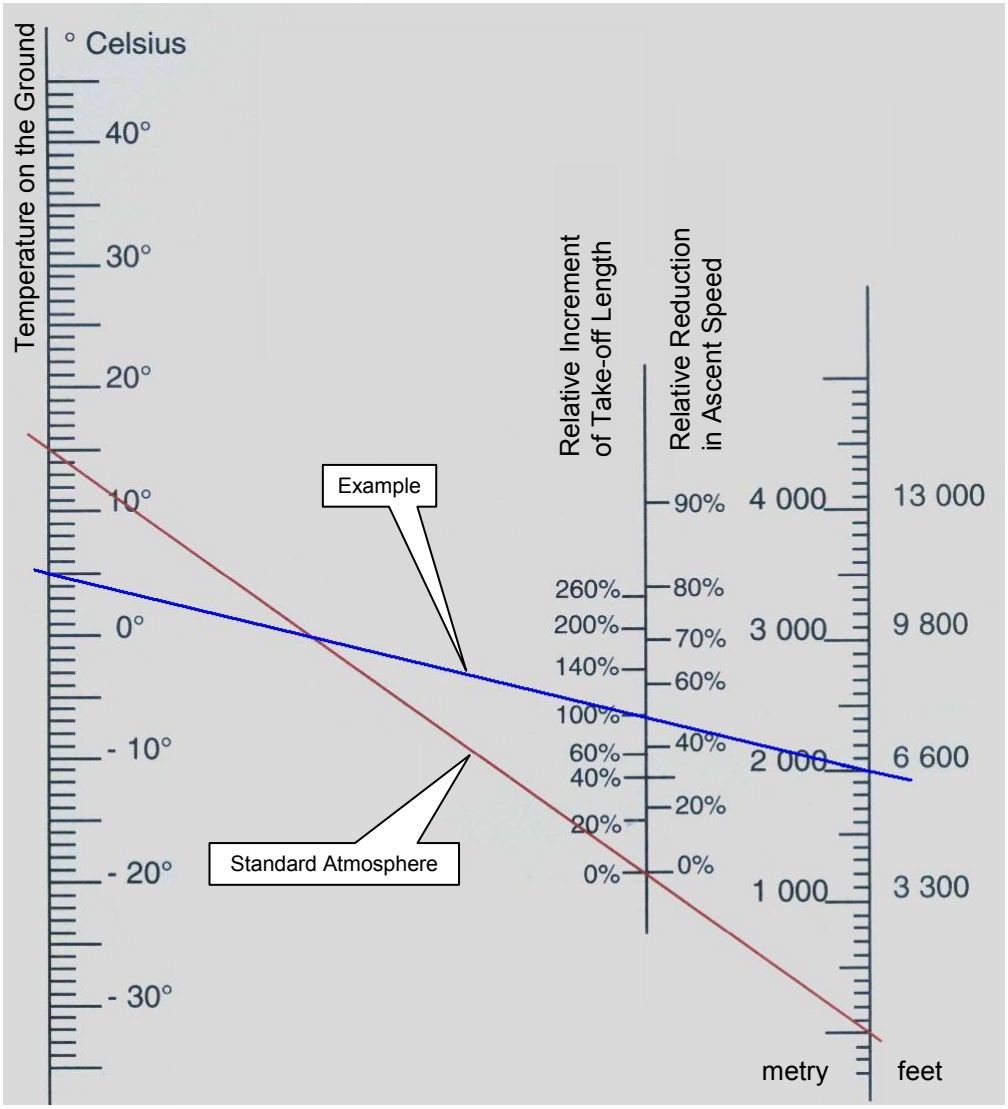
The maximum rate of climb at ground level, with a speed of V_Y = 105 km/h (57 kt), is about 3 m/s (600 ft/min), and with a one-person crew it can reach 6 m/s (1170 ft/min).

The practical ceiling is 4500 m Above Sea Level (14 800 ft).

5.5 Diagram of Recalculating Take-off distance and Rate of Climb Depending on Air Temperature and Pressure

The diagram depicts the values applicable for light aircraft.

Important: The diagram is provided only for general information and shall not be applied without ensuring the appropriate safety margin.



Example:

Conditions at the take-off airfield: temperature 15 ºC, pressure matching an altitude of 2000 m.

Connect with a line the points matching the above values on appropriate scales.

At the point where this line intersects with the middle scale, read the results.

In the stated example, the take-off run distance will increase by 100% and the rate of climb will decrease by 50% in comparison with the values in standard atmosphere conditions.

CAUTION: Bad runway conditions (high grass, sand, mud, snow, etc.) can even make take-off impossible. Always make sure that the runway is in required condition.

5.6 Landing

Approach speed: V_{APP} = 90 km/h (49 kt),.

Landing from above the obstacle 15 m (50 ft): 45÷55 m (150÷180 ft).

Standard landing run: 0÷10 m (0÷33 ft).

5.7 Range and Flight Endurance

Fuel consumption at a cross-country speed of V_C = 130 km/h (70 kt) is 29 dm^3/h.

Hence, at take-off with the full fuel tanks (118 dm^3 of consumable fuel):

- Range is: 520 km.
- Flight Endurance is: 4 h.

Chapter 6 Weights and the Position of the Centre of Gravity

6.1 Introduction

Chapter 6 includes information regarding the gyrocopter empty weight, the usable weight, and also the admissible load variants assuring the position of the centre of gravity of the gyrocopter is in the admissible range.

The way of weighing and specifying the position of the centre of gravity of the gyrocopter is stated in the Aircraft Maintenance Manual (document no. TERCEL-SM-001-EN) in Chapter 6.

6.2 Weights

The maximum take-off weight (MTOW) is 560 kg (1234 lb).

The empty weight(including rotor) is 326 kg (718 lb), whereas the actual empty weight for a specific model is included in the up-to-date weighing report and is stated in subsection 6.4 of this manual.

Restrictions concerning load weights:

Minimum crew weight	60 kg	132 lb
Maximum crew weight	220 kg	485 lb
Maximum one person weight	110 kg	243 lb
Maximum fuel weight (78 dm^3)	93 kg	205 lb

The current take-off weight is equal to the sum of the empty gyrocopter weight and the weights of the crew, luggage and fuel. Under no circumstances, do not exceed the approved maximum take-off weight (MTOW) equal to 600 kg (1322 lb). Proposed load sheet is presented below.

	Weight	Minimum	Maximum
Nominal proper weight		----------	----------
Crew weight			
Fuel weight			
Luggage weight			
Total			

During solo flights, it is recommended to place a ballast on the board (on the seat fastened with seat belts) to ensure the appropriate balancing of the machine. A ballast in the form of a sack of sand or a can of water is recommended. The ballast must be protected against movement. Ballast weight is specified below:

Pilot left seat weight [kg]	Ballast right seat [kg]	Ballast right seat [lb]
50 ÷ 60 kg	12 kg	26 lb
60 ÷ 80 kg	10 kg	22 lb
80 ÷ 100 kg	8 kg	18 lb

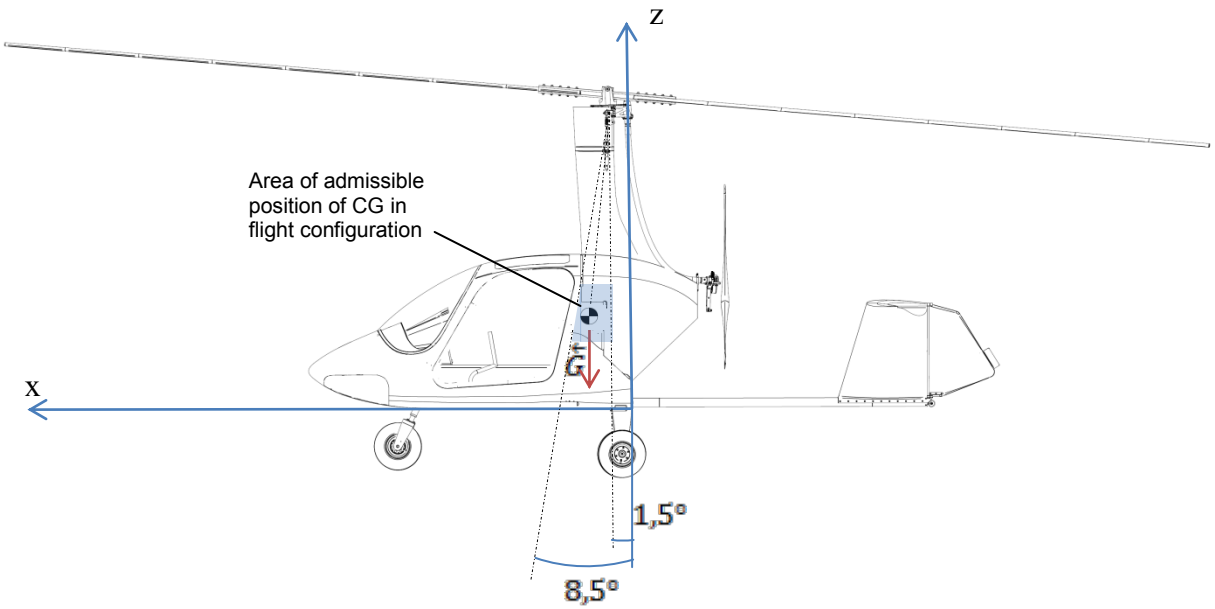
Pilot right seat weight [kg]	Ballast left seat [kg]	Ballast left seat [lb]
50 ÷ 60 kg	15 kg	33 lb
60 ÷ 80 kg	13 kg	29 lb
80 ÷ 100 kg	11 kg	24 lb

CAUTION!

Under no circumstances do not exceed the approved maximum take-off weight (MTOW) equal to 560 kg (1234 lb).

6.3 Position of the Centre of Gravity

The position of the centre of gravity of the gyrocopter (a sideways view) is specified through the value of the angle whose apex is located on the transverse axis for rotor head suspension on the mast, one arm is parallel to the vertical axis of the coordinate system related to the fuselage, and the other arm passes through the centre of gravity of the gyrocopter.



The admissible range of the position of the centre of gravity of the **empty gyrocopter** is:

-0,6° ÷ +0,6°

The actual position of the centre of gravity of the empty gyrocopter for a specific model is included in the up-to-date weighing report and is stated in subsection 6.4 of this manual.

The admissible range of the position of the centre of gravity of the **gyrocopter in flight** is:

+1,5° ÷ +8,5°

NOTE:

Observing the conditions of the admissible load and the proper position of the centre of gravity of the empty gyrocopter ensures maintenance in the above range of the positions of the centre of gravity.

6.4 Entering the Weight and Position of the Centre of Gravity of the Empty Gyrocopter

The table below serves to enter periodic weighing checks of the gyrocopter or weighing checks after making changing in equipment, repairs or lacquering.

Date	Gyrocopter empty weight [kg]	Position of centre of gravity [degrees]	Approved by: Signature

Chapter 7 Description of the Gyrocopter and its Equipment

7.1 Introduction

Chapter 7 includes the description and manner of operating the gyrocopter, its systems and equipment. The details about the optional systems and equipment are included in Chapter 9.

7.2 Airframe

The main structural component of the gyrocopter is the composite fuselage. It is made of glass fibre saturated with vinyl ester resin with a core mat applied as the core of separator structures. Horizontal stabilizer (with symmetric airfoil section) is mounted on vertical tail (consisting of stabilizer and rudder). Tail is attached to two pipes, made of aluminium alloy, guided from the fuselage. A metal mast is affixed to the fuselage structure, on which the control head with the lifting rotor is mounted.

The two-blade rotor with metal structure is manufactured and delivered in a set (blades + a hub) by the AVIATION ARTUR TRENDAK Company. The blades with a 8H12 airfoil section are made from drawn aluminium and are entirely anodized and perfectly balanced.

7.3 Flight controls

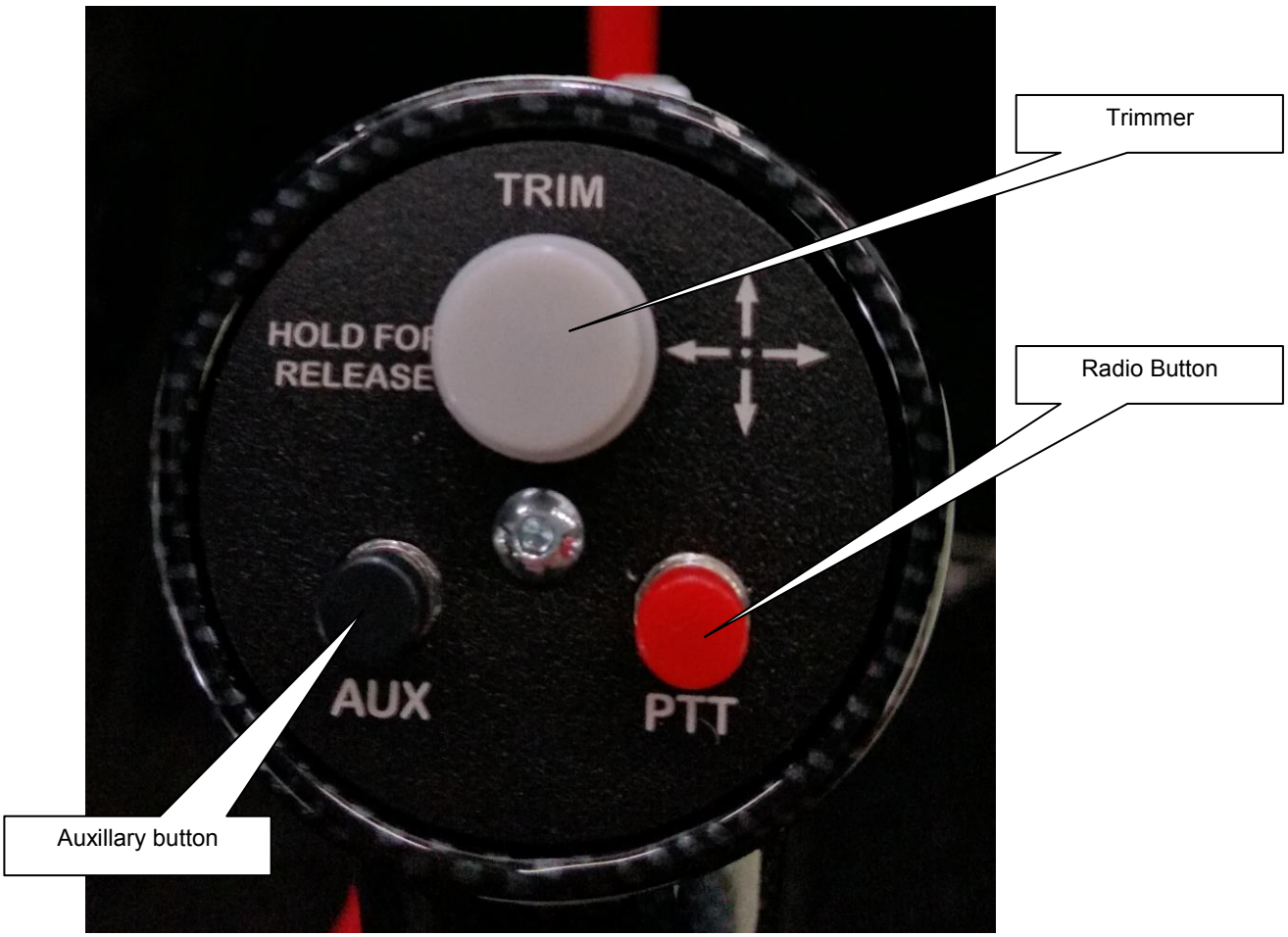
Controlling flight is performed by using the control stick and pedals. Each of crew members have his own flight control set. The movements of the control stick are transmitted by the flexible Bowden cables kinematic system to the rotor head. The movements of the pedals are transmitted to the rudders by the flexible Bowden cables.

When the pilot moves the stick forwards, the rotor head tilt forwards and the gyrocopter pitch down. When moves the stick backwards, the head tilt backwards and causes the nose pitch up. When the pilot moves stick completely forwards (in practice it is impossible in flight), the rotor head disc rests on the fixed frictional component (bent from stainless steel) and brakes the rotor.

When the pilot moves the stick to the left, the head tilt to the left and bank the gyrocopter left. Analogously when pilot moves the stick to the right, the head tilt to the right and bank the gyrocopter right.

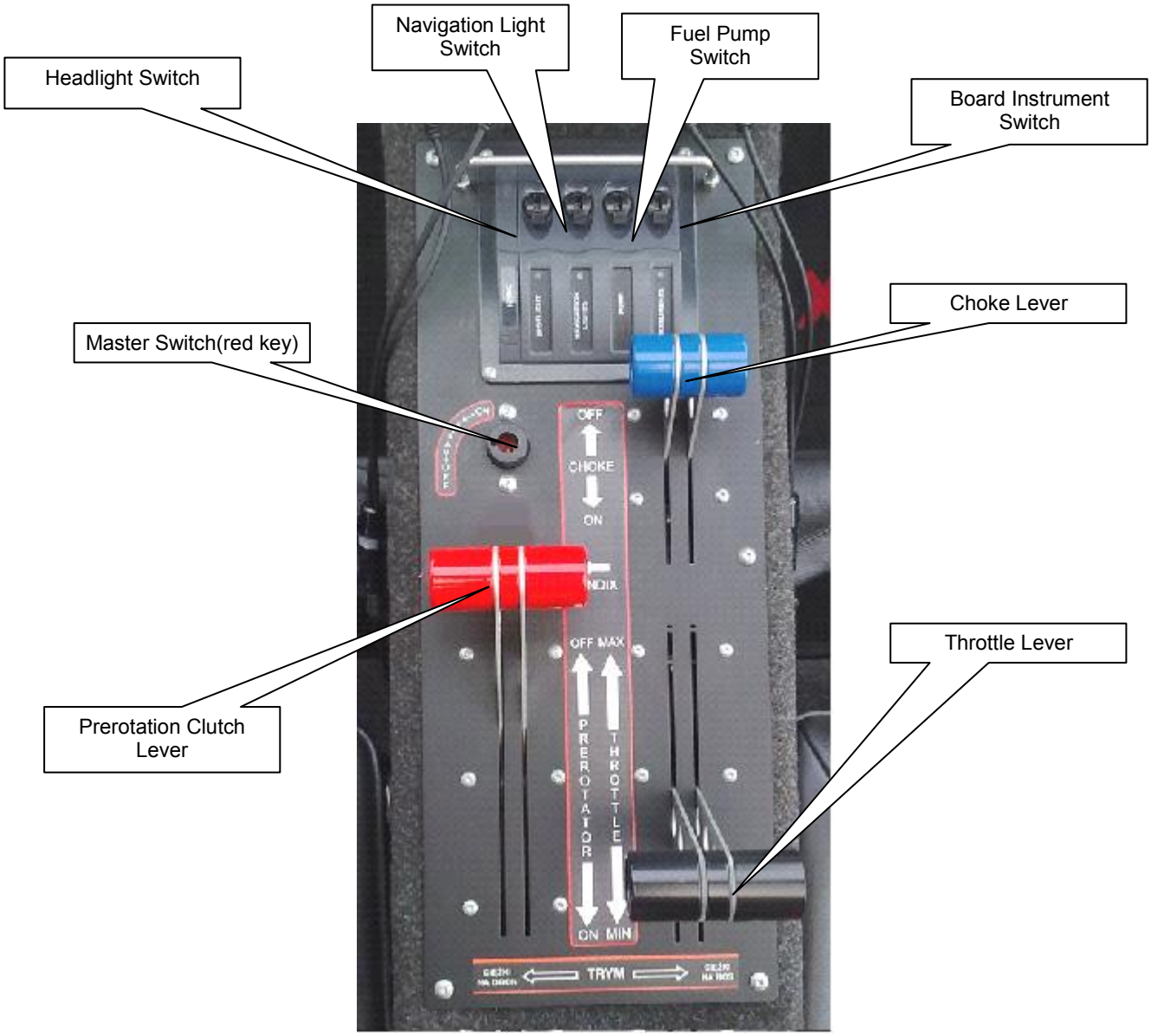
When the pilot pushes the left pedal, both rudders deflects left. Pushing the right pedal causes rudders to deflect right. Deflecting the rudder right pushes the tail left and causes the nose to yaw to the right.

The gyrocopter is equipped with an electrical trim system. This device reduces the effort required to adjust or maintain a desired flight attitude. Electrical trimming is implemented by means of electrical actuators installed in control system. By clicking appropriate trimmer, actuator will move and change the neutral position of Control Stick. In order to release trimmers pilot has to push the Trim Button and hold it longer than one second. This changes position of actuators towards 0 position. This will reduce all forces generated by trimmers on control stick. Trimmer actuator position is represented in cockpit by proper indicators. The figure below presents control stick grip.



On the rudder there is a relieving flap, which aims at facilitating flight straight ahead without the necessity for the pilot to use the pedals. It is installed by the manufacturer after the phase of test flights. If needed, flap position can be corrected, by gently bending it in or out (see Aircraft Maintenance Manual).

7.4 Central Console



7.5 Instrument Panel

An instrument panel is presented below. Different panel configuration and set of flight and navigation instruments is possible. The details concerning other variants are stated in Chapter 9 “Supplements”.

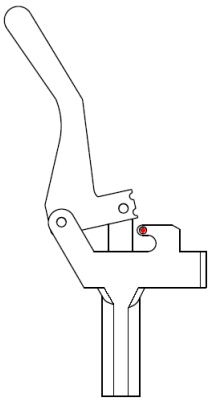
The presented below configuration of instruments consist of airspeed indicator (Light Aircraft 7FMS223), altimeter (Light Aircraft BG-19), vertical speed indicator (Light Aircraft BC6), Manifold pressure and RPM indicator (MGL Avionics MAP-2T), universal engine monitor and rotor RPM indicator (MGL Avionics E-1), fuel level indicator , trim position indicator.

7.6 Main gear, Wheel Brakes

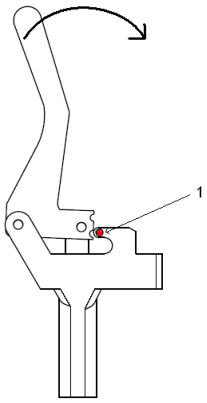
The gyrocopter is equipped with fixed tricycle landing gear. The main landing gear leg is elastic, made of composite. The forward leg, dampened only with the pneumatic wheel unit, is controlled only by using the rudder pedals.

Normal operating range of tyre pressure is 2 - 4 bar.

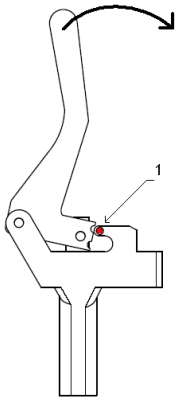
The main landing gear wheels are equipped with hydraulic disc brakes. The brakes are activated with the lever on the control stick and act simultaneously on both wheels.



Released Lever
Inactive Brakes



Medium Force
Active Brakes; Position Recommended during Parking



Large Force
Active Brakes; Position Recommended during Prerotation

To lock the brake lever in position, pull it to demanded position and press the red button (marked no 1). In order to release the brake, pull the lever harder to enable the automatic release of the lock.

CAUTION!

Do not use the brake during a long-lasting stopover.
It can cause damage to the braking system.

When taxiing or performing the landing run, brake without locking the lever.

Information on the sort of brake fluid and its replacement/replenishment are included in the Aircraft Maintenance Manual.

7.7 Seats and the Safety Belts

Two ergonomic bucket seats, made of composite, can be moved in front-aft direction in limited range. Adjusting the position can be performed during flight and consists of releasing seat lock by pushing lever beneath the seat.

Each seat is equipped with adjustable four-point belts.

7.8 Glazing, Doors

The glazing is made of Plexiglas with a thickness of 3 mm and comprise of panoramic front pane, two roof panes, two panes in the bow part of the floor as well as the side doors almost entirely glazed on the left and right sides.

The doors open in the forward direction. In the closed position, they are blocked with a lock accessible both from the outside and inside. In the door windows, air vents are fitted.

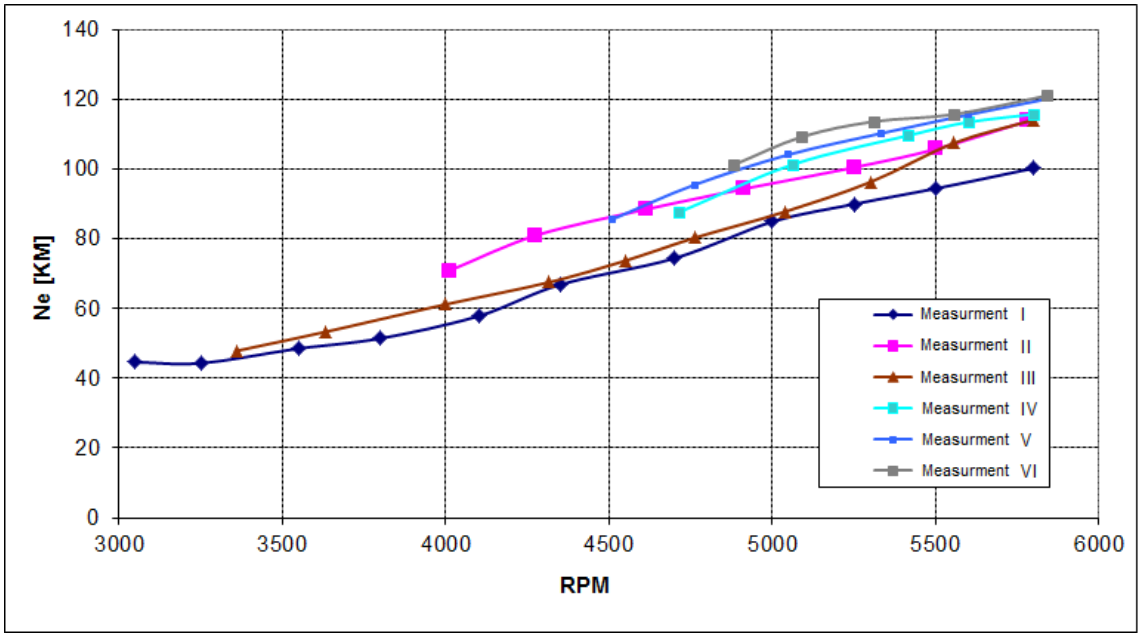
7.9 Power plant

7.9.1 Engine

TERCEL is driven with the **AAT&S CA 912 ULT** engine. It is the Rotax 912 UL engine, modified by the AVIATION ARTUR TRENDAK Company by adding an Iveco turbocompressor.

The details concerning the parameters of the engine and its usage are included in the instruction manual of the **CA 912 ULT** engine.

CA 912 ULT engine characteristic



7.9.2 Propeller

The Three-blade DUC FC-R Inconel propeller with a diameter of 1727 mm. For more information see propeller manual.

7.10 Engine Oil

Traditional oils for aviation piston engines are not appropriate for Rotax engines! Due to the heavy load on the transmission, motorcycle oils with additions for gearboxes are recommended. Oils for heavy motorcycles 4-stroke engines meet all the requirements. Usually they are full-synthetic oils. It is essential to use only oils with the API classification: "SJ", "SG" or "SL".

Recommended oils are included in the Rotax engine manual.

Recommended oil: Castrol 10W50 4T Racing.

Do not apply oils from diesel engines!

A diagram of the oil system and information on oil replacement/replenishment are included in the Aircraft Maintenance Manual.

The oil temperature optimal range for engine work is: 90 ºC ÷ 110 ºC.

If the oil temperature is not correct, it is possible to change the position of the oil cooler (see the Aircraft Maintenance Manual).

NOTE:

Do not use re-refined oil.

7.11 Fuel System

A diagram of the fuel system is included in the Aircraft Maintenance Manual.

Two connected composite fuel tanks are located close to the centre of gravity of the empty gyrocopter, so the quantity of fuel in the tanks does not significantly affect the behaviour of the machine in flight.

The capacity of the tanks is 120 dm^3. The tanks are located behind the seats. Fuel level is easy to evaluate by scales attached to translucent walls. Additional fuel level gauge is located on the instrument board.

It is essential to apply **lead-free** car petrol with the octane minimum number of 95, **recommended 98**.

NOTE:

Do not use AVGAS fuel.

Fuel consumption at a cross-country speed of V_C = 130 km/h (70 kt) is about 29 dm^3/h.

7.12 Electrical System

The diagram of the electrical system of the gyrocopter is presented in Chapter 2 of the Aircraft Maintenance Manual.

The main source of aircraft's electrical energy is the direct current generator mounted to the engine. The master switch is located on the central panel and is activated with the removable red key.

The electrical system provides power to all electrical appliances in gyrocopter(the ignition system, magnetos, the electromagnetic prerotation clutch (bendix), cockpit and navigation lights, pumps, sensors, instruments and additional appliances connected to installation. On the side of the instrument board, there is a 12V socket (a typical car socket for a lighter) giving the possibility of connecting additional devices.

Individual circuits are activated with appropriate described switches and protected with safety fuses. When the generator is not working (eg the engine is off, at low rotations or there is a failure), an orange charging indicator light turns on (on the instrument panel) and then the electrical units are powered from the battery.

7.13 Static and Total Pressure System

The total pressure feeder, in the form of a Pitot tube (made from plastic), is located at the nose of the gyrocopter fuselage. It is connected (with a plastic hose) directly to the speedometer. Static pressure to the speedometer, altimeter and vertical speed indicator is taken from the cabin, directly through the instrument connectors.

Chapter 8 Manoeuvring, Temporary Operation and Maintenance

8.1 Introduction

Chapter 8 contains procedures for proper manoeuvring on the ground and the operation of the gyrocopter as recommended by the manufacturer. It also specifies certain requirements concerning maintenance and operation which must be met if the gyrocopter is to retain its performance and reliability. It is sensible to comply with the planned schedule of lubrication and preventive maintenance adapted to encountered climatic and flight conditions.

8.2 Periodic Inspection of the Gyrocopter

Activities done within periodic inspection and the frequency of conducting them are defined in the Aircraft Maintenance Manual of the gyrocopter. Regardless of periodic inspection, the gyrocopter must be subjected to inspections required by the appropriate Aviation Authority to extend the validity of the authorization to perform flights. Required work within periodic inspection of the driving unit and accessories are defined in appropriate instructions and manuals.

The owner/user is responsible for the operation of the gyrocopter, who must guarantee that all the operation will be performed by authorized personnel.

8.3 Repairs and Modifications

Any repairs and modifications of the structure can only be made by authorized personnel and in an agreement with the gyrocopter manufacturer.

NOTE:

Before making any **modifications** to the gyrocopter
contact the appropriate aviation authority to make sure
the planned modification does not undermine the airworthiness.

After making reparations or modifications, weigh the empty gyrocopter and specify its position of the centre of gravity and enter the details in the table in subsection 6.4 of this manual.

8.4 Manoeuvring on the Ground, Road Transport

When transporting or moving the gyrocopter, the control stick should always be immobilized with a strap.

For road transport (on a trailer, in a container), detach the rotor (see subsection 3.1.2) and fix the gyrocopter to the base by the landing gear legs.

Moving the gyrocopter on the ground should be performed with great caution by using a forked drawbar grappled by the front wheel axle or a rope grappled by the front leg.

When parking with the rotor installed, tie the rotor to the fuselage by means of turnbuckles with pockets fitted on the blade tips or by using two straps.

8.5 Cleaning and Conservation

The outside surfaces of the fuselage, rotor and propeller must be washed with water with an addition of mild soap. Hard-to-wash stains of lubricant or oil can be removed by means of a lint free cloth wetted with heavy aliphatic petrol.

For seasoned painted surfaces, you can use any high-grade waxes or an abrasive compound of the automotive type. Soft fabrics or suede must be used for polishing.

The glazing is to be rinsed with clean water or a water solution with an addition of mild soap and next wiped up with clean soft fabric, sponge or suede. Exercise great caution with it to avoid scratches.

NOTE:

To clean the glazing do not apply agents containing alcohol!

The cockpit interior, chairs, rugs and upholstery should be cleaned with a vacuum cleaner. It is recommended to apply commercially available cleaning agents for car upholstery, however, the guidelines located on the wrapping must by strictly observed.

Clean the engine in accordance with the Engine Manual.

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Chapter 9 Supplements

9.1 Introduction

Chapter 9 includes appropriate supplements essential for the safe and efficient operation on the gyrocopter when it is equipped with various additional systems and equipment not applied in the standard variant.

9.2 List of Introduced Supplements

Document no.	Title of an Attached Supplement	Notes

In the “Notes” column, confirm by hand whether there is additional equipment or systems in the gyrocopter model for which this manual is intended.