3.1 Engine Failure

In case of an engine failure the following action is recommended:

Engine failure during take-off run

- Maintain directional control using sensitive but appropriate pedal input
- With the rotor/stick remaining aft, let gyroplane decelerate. Wheel brakes may be used to assist
- At walking speed level-off rotor disc, use wheel brakes and bring rotor to a stop

Engine failure after lift-off and below 150 ft AGL

- The climb-out should be performed according to the Height-Velocity-Diagram in CHAPTER 5
- When engine failure occurs, immediately lower nose to enter glide attitude
- Continue straight ahead – a 180° turn back to the airfield may be a bad option
- Maintain airspeed until ground is approached, then perform flare
- If a low level engine failure, with low groundspeed, then an aggressive and immediate flare may be required

Engine failure at or above 150 ft AGL

- Consider wind speed and direction
- Select a suitable landing site
- If time allows, a restart may be attempted, see “Air restart procedure” below
- Perform a landing into wind and/or upslope if possible
- Prior to touch-down switch OFF Main Switch

Engine failure at night

- Consider wind speed and direction
- Both landing lights should be turned on by 400ft and on below 400ft.
- Select a suitable landing site – the landing lights make the ground visible in full dark from around 200ft
- If time allows, a restart may be attempted, see “Air restart procedure” below
- Perform a landing into wind and/or upslope if possible
- Make a faster descent at 60KIAS (~70mph), to allow more time in the flare to make a safe landing.
- Prior to touch-down switch OFF Main Switch

WARNING

Always plan your route to remain within safe gliding distance to areas where a safe forced landing can be performed in case of an engine failure. A landing in high trees or open waters may end fatally.

NOTE

The best engine-off glide ratio is about 1:3 at 55KIAS (60mph, 100km/h). Depending on a possible headwind the glide may be extended by slightly increasing airspeed. It is heavily recommended to train your forced landing capabilities regularly, preferably with a qualified flight instructor.

3.2 Air Restart Procedure

- Airspeed 50-60KIAS (90 – 100 km/h, 50-60mph)
  (whilst restart is possible at all permitted airspeeds and altitudes, this airspeed is optimum)
- Check fuel pump(s) ON
- Check both magnetos ON
- Propeller in FINE pitch (if an in-flight adjustable propeller)
- Throttle slightly open
- With the left hand, turn the Main Switch/Starter key completely to OFF, then START
- If possible, allow engine and oil to warm-up before full power is applied

NOTE

The starter interlock function prevents inadvertent starter engagement. Before attempting an engine start, the interlock must be reset by turning the Main Switch/Starter key to OFF.

3.3 Landing into Trees or High Vegetation

- Assume the surface of the treetops or vegetation as level
- Plan touch-down and flare with minimum rate of descent
- As soon as the wheels contact the vegetation bring the rotor disc to level attitude to avoid partial blade tip contact with vegetation
- Shut down engine by switching magnetos OFF and master switch OFF

3.4 **Degradation of Engine Power**

A gradual decay in engine RPM, accompanied by a rough running engine or even vibration may be an indicator for carburettor icing. In this case, continue with a high power setting and change altitude into air which is less susceptible to carburettor icing.

If the situation cannot be corrected be prepared for further loss of power and ultimately engine failure.

NOTE

ROTAX 912: To reduce the risk of carburettor icing the engine is fitted with a hot water heated jacket around the carburettor inlets. Note that the system can work properly only when the engine is at operating temperature.

Turbo engines (ROTAX 914) are generally less susceptible to carburettor icing.

3.5 Evacuating the Aircraft

In normal circumstances occupants should never leave the aircraft while the propeller or the rotors are turning. If abandoning the aircraft in an emergency the pilot should turn off the engine magneto switches and turn the master switch to “OFF” if this can be done without endangering the occupants.

If abandoning the aircraft with either the propeller and/or the rotors turning the occupants should follow a path in line with the nose of the aircraft, to minimise the risk of being struck by either the rotor or the propeller.

Occupants should be briefed before flight on emergency evacuation procedures, including:

- Actions to be taken in the event of a forced landing
- Operation of the seat harness
- Disconnection of any intercom leads or other connections to the aircraft
- How to safely exit and move away from the aircraft

3.6 Engine Fire

In case of fire the following action is recommended:

Fire on ground

- Both magnetos OFF and master switch OFF to shut-down engine and fuel pumps
- Evacuate aircraft
- Extinguish fire and have damage inspected

Fire in flight

- Immediately initiate an emergency landing
- Initiate emergency call, if time and situation permits
- As soon as a power-off landing can be assured, shut down engine by switching magnetos OFF and master switch OFF
- Continue procedure as described in “Engine Failure” and “Fire on ground”

3.7 Off-field Landing

A precautionary landing at a non-prepared site may be performed at pilot’s discretion in order to avoid unexpected weather, in case of severe illness of the pilot or a passenger, or if technical defects are suspected, for example sudden and severe rotor vibrations.

- Select a suitable landing site from safe altitude, considering slope, wind speed and direction
- Fly a reconnaissance pattern to check for obstacles, especially power lines, wires, and cables in the approach and go-around path
- Overfly the landing site to check for obstructions such as fences, ditches, rocks, height of vegetation, and select most suitable touch-down zone
- Perform a normal approach and touch-down into wind with minimal ground speed

3.8 Flight Control Malfunction

In case of a flight control failure the gyroplane can be controlled with the remaining primary and secondary controls, including power and trim. An immediate reduction of power, respectively speed, may be necessary to avoid pitch oscillations (phugoid) or other effects affecting dynamic or static stability. Navigate to a suitable landing site with wide and shallow turns and approach into wind.

3.8.1 Engine Power Control / Throttle

Throttle jammed open or max

Navigate to a suitable landing site with the power set. If over safe terrain, magneto switches may be used to control power. When within gliding distance to the selected landing site, shut-down engine to perform a power-off landing as per Emergency Procedure “Engine failure”.

NOTE

In case of a control cable breakage the carburettor will be automatically set to full throttle position.

Throttle jammed closed

Land according to chapter Emergency Procedure “Engine failure”. Residual power may be used to extend the glide.

3.8.2 Rudder Malfunction

In case of a stuck or loose rudder, continue flight to a suitable, preferably wide landing site that allows a landing into the wind. If necessary reduce power to avoid excessive side slip. Align gyroplane prior to touch-down, using engine torque or lateral control input to the side where the nose is pointed.

3.8.3 Rotor Head Control

In case of a rotor head control malfunction, control gyroplane using trim and remaining controls. Perform power changes carefully and memorize possible effects on attitude. In some conditions it may be appropriate to reduce power/speed in order to avoid phugoid effects or a possible negative yaw-roll coupling. Approach landing site with wide and shallow turns.

3.8.4 Trim Runaway

Failure of a trim selector switch or pneumatic valve may result in trim runaway (where the trim system runs to one extreme and pushes the control stick accordingly). Although the average pilot is able to resist the out-of-trim stick force and continue to fly the aircraft it may be possible to reduce the stick load by intervention:

Aft Trim Runaway

High forward stick load required to prevent aircraft nose rising (this will be coincident with a high air-pressure reading) – briefly turn the Flight/Brake selector to “Brake” to deplete system air pressure. If the air compressor is heard to start and the pressure rises again then pull the fuse marked “Comp” to stop the compressor. Repeat the brief selection of “Brake” to deplete system air pressure as required.

Forward Trim Runaway

High aft stick load required to prevent aircraft diving (this will be coincident with low or zero air pressure) – check “Comp” fuse. If situation cannot be corrected, land as soon as practicable.

Roll/Lateral Trim Runaway

High roll-left or roll-right stick load required to maintain balanced flight (coincident with high air-pressure reading). Pull the “Comp” fuse to prevent further increase in air pressure and attempt to re-trim. If unsuccessful then continue to expedited landing. Do not select “Brake” in an attempt to reduce air pressure as this will disturb the pitch trim (in which the out-of-trim forces are significantly higher).

3.8.5 Pitch Oscillation Recovery

There are generally two types of pitch oscillation: that caused by pilot over control (‘PIO, Pilot Induced Oscillation’) and that caused by aerodynamic oscillation.

PIO is not generally found on two seat gyroplanes due their inherent stability. It is initiated by the pilot over-controlling the stick. If a situation develops where a divergent aircraft pitching oscillation is occurring in sympathy with fore-aft control stick inputs, firstly stop the control input – do NOT try to control PIO with the stick.

For both situations, smoothly closing the throttle whilst maintaining a level flight attitude will return the aircraft to a stable, slow speed condition very quickly, from which the pilot can recover to normal flight.

Recovery from PIO or aerodynamic oscillation can result in height loss.

3.8.6 Vibration

A gyroplane is subject to a number of out of balance forces which will generate different levels of vibration depending on the engine and rotor rpms, and on loading conditions. Rotors are normally balanced two seated, so a reduction in occupant loading will naturally change the rotor response.

Engine and Propeller Vibration

Vibration in this area will change with engine rpm, and can therefore be affected and isolated by the pilot. The propeller is normally balanced to less than 0.1ips, meaning low vibration. Vibration will increase as the propeller gets dirty, and will also increase if damaged. A sudden change in flight will indicate a fault has developed, either through an impact (loose luggage, bird strike etc. passing through the propeller) or by some mechanical failure. In the event the pilot should make a precautionary landing for evaluation. Propeller damage may also be evident from a change in noise level.

Upon landing, carefully check the propeller for damage, loose bolts or evidence of mechanical failure within the prop or engine. Especially check the engine to engine bearer connections, and the engine bearer to airframe connections.

Rotor Vibration

Rotors will vibrate in flight due to tracking errors (side to side stick shake), rotor CG misalignment with the axis of the bearing in the flat plane (oscillatory stick shake), and also in the vertical plane (two per rev shake). The amount of shake will not suddenly change in flight or between flights unless there has been mechanical failure, external influence or rotor strike.

Vibration will increase (and performance decrease dramatically) with dirt build up on the rotor blades, so before any analysis make sure they are clean.

If there is a change in vibration in flight make a precautionary landing and investigate. If on rotor startup, stop and investigate:

Check items:

- Rotor impact with tail of aircraft.
- Hanger damage e.g. twist or distortion of trailing edge.
- Blade bent from ground handling.
- If after a recent re-assembly of the rotor, that the blades and hubs are serial-number matched, and that the shim washers are correctly matched to the hub bar and rotor tower.

A reduction in vibration may be caused by increased flexibility between the rotor head and the occupant. This may be control system looseness, so check all system joints for tightness, and also for cracks at the base of the mast. Check security of all fastenings between the rotor and the pilot. Check also for any cracks or other damage to the primary structure; body, tail, keel tube, rotor head, rotor, mast.

3.8.7 Other Equipment Failure

Good judgement must be used in monitoring instruments, and timely action taken should a reading be in doubt. If in doubt, make a precautionary landing and resolve the issue rather than continuing a flight. Actions recommended:

Airspeed Indicator / ASI

In level flight fly with an engine rpm of 4,200 lightly laden to 5,000 heavily laden which will give approx 45-60 KIAS (80-110 km/h, 50-70 mph), propeller in cruise power setting. When descending (nose down) throttle back to approx 3,000 to 3,500 rpm to prevent overspeed. Continue to your

designated landing site, maintaining speed for a flare on landing in the final descent. Leave plenty of space to land in should the flare be prolonged. Experience will aid judgement of the best engine rpm to maintain to match the desired flight speed and payload.

Altimeter / ALT

In a gyroplane it is reasonably easy to judge height. If in controlled airspace ensure the controlling authority is informed to prevent traffic conflict. Otherwise continue to a safe landing using navigational skills to avoid potential collisions.

NOTE

The configuration menu on the devices can be accessed to change between different units of measure.

If a device turns off when uncommanded, this could signify a software reset has been signalled internally. Attempt to manually restart the unit by depressing the power button. If the device does not restart assume the instrument has failed.

Compass

Resort to map, aided by GPS if available, fly at a speed to suit navigational requirements or make a precautionary landing if unable to identify position.

Rotor RPM gauge

This is not essential for safe flight, and rotor rpm cannot normally be affected in flight unless significant “g” or negative “g” is exerted – and then will only provide an indication of the rpm.

Engine RPM

The engine is rpm self-limiting by propeller pitch in flight. If the indication fails, replace on landing. Use audio cues to establish rpm

Oil pressure, oil temp and ECT/coolant temp

Abnormal indication of one gauge can indicate an engine fault or simply a gauge fault. Watching the other gauges will indicate the likely failure mode. For example:

Abnormal indication	Probable failure mode
Gauge suddenly goes to full scale deflection, other gauges reading normally	Gauge faulty
Oil temp suddenly falls to zero, other gauges reading normal	Gauge faulty. Cross refer to oil pressure gauge, if there is pressure there is likely to be temperature
Oil temp rises above maximum, other gauges normal	Very low oil level, blocked radiator or thermostat. Stop engine, make precautionary landing

3.9 Warning Lights

3.9.1 Water (red)

Engine water temperature has exceeded **Error! Reference source not found.** °C. The engine may be damaged and fail shortly.

Reduce power and increase airspeed. If condition cannot be corrected, land as soon as practicable.

3.9.2 Oil P. (red)

Engine oil pressure has dropped below a critical value. The engine may be damaged and fail shortly.

Reduce power immediately and verify situation by cross-checking with oil pressure gauge and other indications. If confirmed, perform a precautionary landing with minimum power while observing engine indications. Be prepared for engine failure. If situations allows, shut-down engine and proceed according to emergency procedure “Engine Failure”.

3.9.3 Boost (red) - only ROTAX 914 UL

Continuous light

The maximum admissible manifold/boost pressure was exceeded.

Reduce power into normal operating range and consider restricted engine performance or boost control malfunction. Record duration and have maintenance action performed.

Blinking

The allowable 5 minutes take-off power time limit has been exceeded.

Reduce power into continuous range. Record duration and have maintenance action performed.

3.9.4 Low Fuel (red)

Less than **Error! Reference source not found.** Litres of fuel remaining.

Perform a normal landing at a suitable landing site and be prepared for engine failure within **Error! Reference source not found.** minutes. Avoid extreme attitudes.

3.9.5 Gen. 1 (orange)

Possible failure of primary generator/alternator.

Turn off nonessential electrical equipment and monitor Low Volt indication.

3.9.6 Gen. 2 (orange) – if installed

Possible failure of secondary (optional) generator/alternator.

Turn off nonessential electrical equipment and monitor Low Volt indication.

3.9.7 Low Volt (orange)

System voltage has dropped below a critical value. Non-essential electrical consumers with a high power consumption will be disconnected automatically.

Reduce electrical load. If condition cannot be corrected, land as soon as practicable.

3.9.8 TCU (orange) - only ROTAX 914 UL

A blinking BOOST CAUTION light indicates a problem with the turbo/boost control, its sensors or the servo. Engine power is degraded and continuous operation may lead to engine damage.

Reduce engine power to remain within engine limits. Be prepared for significantly reduced engine power and engine failure. Land as soon as practicable and have maintenance action performed.

3.9.9 Clutch (orange)

Continuous light

Indicates a slipping clutch during prerotation.

Reduce engine RPM to closer match the rotor speed, and be more gentle when increasing power.

Blinking

Intended take-off run with low rotor RPM – danger of blade flapping

Reduce power immediately, and stop if take-off has started. Re-apply the pre-rotator and increase rotor RPM first. If the correct take-off rotor RPM cannot be reached, abort take-off.

3.9.10 Fuel P. (orange)

Indicates fuel pressure is less than the Rotax minimum required. This is an option fit item.

Lamp will indicate on start up until fuel pressure reaches minimum required.

If lit in flight, check fuel level. Turn on standby fuel pump, if fitted. If the light remains on, and there is sufficient fuel, this could indicate a blocked fuel supply. Be prepared for an engine stoppage and reduce power. Land as soon as practicable and have maintenance action performed.

3.9.11 Pitot (green or orange)

The PITOT lamp is coloured green to indicate at night that the power is turned on to the pitot tube heating. It will indicate orange when the pitot heat system has failed.

3.10 Parameters out of Limits

PARAMETER	EXCURSION	CORRECTIVE ACTION
Engine Oil Temperature	Upper **limit** or **yellow arc**	Reduce power and increase air speed. If condition cannot be corrected, land as soon as practicable.
	Lower **limit**	Allow engine to warm-up on ground.
	Within lower **yellow arc**	Uncritical as long as oil temperature has reached normal operating range at or after take-off.
Coolant Temperature	Upper **limit**	Reduce power and increase air speed. If condition cannot be corrected, land as soon as practicable.
Engine Oil Pressure	Upper **limit** or **yellow arc**	Reduce power. If condition cannot be corrected, have maintenance action performed prior to next flight.
	Lower **limit**	If combined with other indications, such as rising oil temperature or unusual engine behaviour, shut-down engine and perform a power-off landing as per Emergency Procedure “Engine failure”. Otherwise, monitor engine instruments carefully and land as soon as practicable. Have maintenance action performed.

3.11 Rotor System

The entire rotor system including its rotor head with blade attachments and the corresponding components of the flight controls have to be inspected and maintained carefully.

If any undue vibration or unusual behaviour is experienced a precautionary landing should be considered.

3.12 Rotor Icing

A more than normal or constantly increasing power demand may be caused by an iced-up rotor system. This could ultimately result in a condition where altitude cannot be maintained, even at maximum power. An iced-up rotor system can also cause severe vibration. If any of the signs for rotor icing is evident, carry out a precautionary landing.

NOTE

Icing may occur even at temperatures above freezing!

3.13 Landing with a Deflated Tyre

Plan to land directly into the wind with minimum rate of descent at touch-down, if possible on a grass runway. Maintain directional control with adequate pedal input. Consider the use of some propeller thrust to increase rudder effectivity. Lower nose gently with the nose wheel pointing straight.

Alternatively, if landing on asphalt is unavoidable, approach normally, with the intent of a zero-speed touch-down directly into wind.

Only if impossible to recover the aircraft from the landing area it should be manoeuvred under its own power, as this could further damage the tire and wheel rim.

3.14 Alternative Method of Engine Shut-Down

If the engine continues running after the magnetos have been switched off use the following method to shut-down the engine:

Engage full choke, wait a few seconds and open the throttle suddenly.

3.15 Failure of Variable Pitch Propeller (if installed)

Noticeable defect:

In case of a noticeable mechanical defect, indicated by sudden vibration or noise, perform a precautionary landing.

Run-away**:**

Propeller pitch changes without command, usually resulting in unexpected or sudden change in engine RPM and engine manifold pressure.

Run-away to FINE: RPM will increase and propeller pitch will stop in full FINE position. Reduce power if needed, to stay within RPM limits.

Run-away to COARSE: RPM will decrease and MAP will rise until propeller pitch stops in full COARSE position. Reduce power if needed, to stay within MAP limits.

Continue according to emergency procedure ‘FREEZE’.

Freeze**:**

Propeller pitch does not react to pilot input, engine RPM does not change while propeller pitch control is activated. Proceed according to the following table:

Before take off	Do not take-off
During take-off and climb	Try to keep climbing to a safe altitude, return to the airfield and land. If the aircraft does not climb, maintain altitude and to return in a flat curve.
During cruise flight	Depending on the prop position, it should be possible to find a speed and RPM to continue the flight to the next possible landing area. Depending on the prop position your descent will look different and a go around is probably not possible.
During descent	Depending on the prop position (in case of cruise), your descent will look different and a go around will probably not be possible.
During landing	Continue approach as planned. If the prop changes to cruise and the landing looks too long, keep in mind to cut the engine.