TRANSITION TO MOTORGLIDERS (Interim Guidance 2018)

Refs:

1. **Definitions CS 22 EASA https://www.easa.europa.eu/certification-specifications/cs-22-sailplanes-and-powered-sailplanes**

2. **FAA Advisory Circular AC 61-94, Power Transition Course for Self-launching or Powered Sailplanes https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/22888**

3. **SAC Instructor Manual**

4. **Advanced Soaring Made Easy by Bernard Eckey, Edition 4, Appendix D**

5. **https://en.wikipedia.org/wiki/Motor_glider**

6. **FAI -** The **International Gliding Commission** (**IGC**)[1] is the international governing body for the sport of gliding. It is governed by meetings of delegates from national gliding associations.

7. **CARs**

DEFINITIONS

Motor Glider: The FAI Gliding Commission Sporting Code definition is: a fixed-wing aerodyne equipped with a means of propulsion, capable of sustained soaring flight without thrust from the means of propulsion. In the US, a powered glider may be certificated for up to two occupants, up to 850 kg maximum weight, and with a maximum ratio of weight to wing span squared of 3 kg/m. These gliders are defined in the international glider design specifications CS -22 at Ref 1. Thrust can be from combustion engines 2 & 4 stroke, electric motors, or very small jet engines. Glider Pilots require additional basic understanding of the power plants and aircraft systems including emergency procedures under power. Basic soaring skills/knowledge and glider cross country skills (bronze badge) are sufficient for sustainer and self-launch MG.

Sustainer Motor Glider: Sustainer motor gliders must be launched like an unpowered glider as the engine power is not strong enough to self-launch, but once launched by aerotow or ground launch method, can climb slowly to extend a flight once the engine is deployed and started. This design is used primarily to avoid out landing and extend glides to reach an airfield or return to the point of launch. Sufficient fuel for extended cross country flights is not carried in the designs.

Self -Launch Motor Gliders: Self-launching retractable propeller motor gliders have sufficient thrust and initial climb rate to take off without assistance, or they may be launched as a conventional glider by aerotow or ground launch methods. The engines also have a starter motor and a large battery to allow the engine to be started on the ground, and an alternator to recharge the battery. These engines also can be used as sustainers to avoid out landings. These designs do not carry sufficient fuel for extended cross country flight under power.

Touring Motor Glider: These gliders are motor gliders typically with a maximum of two seats, capable of self-launch and cannot be launched by aerotow or glider ground launch methods. They carry sufficient fuel for extended cross country flight for the primary purpose of being able to travel to more distant gliding sites/locations. Generally these designs have lower soaring performance due to engine weight or propeller drag, but more modern designs have excellent soaring performance comparable to un-powered high performance gliders in excess of 50:1 glide ratios. These gliders may be used to transit more complicated airspace/airports, remote locations, and require some additional piloting skills similar to conventional airplanes. This can be achieved by the glider pilot holding additional licences (RPP/PPP/CPL) or receiving additional TMG flight training for method of launch endorsement.

INTRODUCTION

Pilots progressing to sustainer engine (turbo), self-launching, or other touring motor gliders should obtain a thorough dual checkout in a similar glider before attempting solo flight. Pilots have had difficulty with these glider types, and the procedures in this appendix should normally be performed in a two-seat motor glider, but if none is available they should be performed solo. These guidelines are for pilots transitioning to a sustainer engine, self-launching or touring motor glider.
Many of the older models have complicated starting procedures and can distract the pilot from the task of safely flying the ’plane. In addition, most of these sailplanes have poor soaring performance when the engine is deployed but not operating. A series of flights and exercises have been devised therefore, to assist pilots to safely convert into their motorized sailplane. The pilot must become familiar with handling the aircraft under these emergency conditions before attempting a flight solo with the engine on. The initial airfield selected for this training should have a fairly long runway (4000 to 5000 feet) and have many off-field landing options close by. Learning on too short a runway will be difficult. It is hoped these guidelines will help pilots convert safely into engine takeoffs and emergency landings when first flying a motorized glider.

GENERAL GUIDELINES

- Before using the engine for the first time, the pilot should become thoroughly competent at flying the glider without using the motor if possible. This will require a number of soaring flights, launching usually by aero tow or ground launch, during which the characteristics of the glider can be explored and mastered.

- Takeoff performance in a self-launching glider can be greatly affected by weight, slope of the runway, length/wetness of the grass, hard runway surface, wheel brake, density altitude, bugs on wings, etc. Before takeoff under the glider's own power, a physical landmark for a lift-off decision point must be selected to allow a safe abort. If not airborne by this point the takeoff must be aborted. Calculations for estimating runway length are found in the Aircraft Flight Manual and the pilot should be familiar with calculating take off performances.

- Never attempt to deploy the engine and start it in the circuit. It is recommended that when planning to deploy and start the engine, circle over your selected landing field. Climb away while circling over the field until certain the engine is performing well. Typical heights for engine starts are 2000' AGL.

- Do not deploy the engine in flight unless you have picked out a good and reachable field or airport with the engine out and wind milling. Should the engine not start, you will need the field in short order.

- Once the engine is deployed and does not start by 800 feet AGL do not continue to attempt a start or try to store the engine unless this is an automatic (one-button) action. Shift your concentration to completing an abbreviated circuit and landing with the engine extended. The downwind, diagonal and base legs will have to be much closer than normal to the intended landing area.

TRANSITION FLIGHTS

Training and checkouts in a two-seat glider

If a suitable two-seat glider with powerful airbrakes is available the pilot should first practice:

- Circuits with the airbrakes open sufficiently to simulate an open and wind-milling motor glider engine producing a large amount of drag,

- Full airbrake landings, and

- The stall and speed recovery exercises described below.

The first stage is to permit the pilot to become familiar with the motor glider's performance and handling without the engine deployed, using another more familiar glider and launch method. This may take several flights. The preference for training and checkouts is with an instructor in a dual motor glider with similar performance to the solo motor glider. If a qualified motor glider instructor is not available then the pilot should perform a self-checkout in his motor glider after completing the above exercises satisfactorily in the two-seat (non-motor) glider.

Motor glider engine handling practice on the ground

The next stage will be to practice deploying, starting/stopping, and retracting the engine while on the ground. Some engines have very complicated procedures that require a checklist to ensure correct completion. Before moving on to the following stage, these skills must be mastered.

Motor glider handling practice with wind-milling engine

The next series of flights are with the motor glider and will explore the glider's handling with the engine deployed but with a wind-milling propeller. The aim is to simulate a launch failure on takeoff at a safe height, e.g. 3000 feet agl, and to determine the minimum safe height above ground that is needed to complete a turn back to the airfield. Using a familiar launch method, climb to a safe altitude for upper air work. Deploy the engine and complete the following two stages of exercises with a wind milling propeller:

- Perform a few stalls from a climbing attitude (simulating a normal climb with the engine operating). Recover from the stall to a normal gliding attitude and airspeed as required for the wind-milling prop condition, and note the height lost. Note also the time taken to regain speed. Repeat a few times trying to recover with minimum height loss and minimum time to recover to a safe speed. To become fully comfortable with the stall characteristics, repeat this exercise on extra flights.

- The second stage for these practice exercises also involves the wind-milling propeller (except with sustainer engines where an engine failure on climb-out will not be simulated). The exercise should be repeated several times to become fully comfortable with the maneuver. Dive to gain speed to above that for a normal climb (the pilot's handbook recommended climb speed). Transition into the normal climb attitude by pulling up. When the speed reduces to the recommended minimum climb speed, assume that the engine fails suddenly. Note the height and time. From this **simulated climb** recover promptly to an exaggerated nose-down attitude to regain a suitable approach speed as fast as possible. Note the height lost in this maneuver and the time taken to reach a safe maneuvering or approach speed. Only when this speed has been reached perform a 180-degree turn to simulate a return to the takeoff runway. Once on the reciprocal heading with wings level, note the height lost and the total time taken since the assumed engine failure to complete the maneuver. A height loss of 500 to 700 feet and 10 to 15 seconds is not uncommon.

** It is doubly important to recognize that **an engine failure low to the ground will require a landing straight ahead**, and that there is a dangerous height zone within which it is very important to lower the nose as quickly as possible to maintain airspeed. At the same time, if the nose is lowered too much, it may be difficult to avoid a very heavy landing. Pilots should therefore practice recoveries to simulate this situation, noting the minimum height required to regain adequate speed suitable for an immediate

normal held-off landing with the engine wind milling. Repeat the exercise for a 10-knot headwind, noting the time taken to reach the higher approach speed and total height lost. This will allow calculation of the absolute minimum height above ground that would be required to return to the airfield and to complete an engine wind-milling, downwind landing following an engine failure on the climb out. Below this height the pilot *must* land the glider straight ahead.

Motor glider landing practice with wind-milling engine

The next series of exercises are to practice landings with the propeller wind-milling. Be prepared to execute an abbreviated circuit as the rate of descent will be high and the approach path much steeper than normal. Once the pilot is comfortable with landing and judging the circuit with the engine wind-milling, the exercises can move on to the takeoff (if solo training) practice stage.

Motor glider takeoffs

Practice the takeoff and be prepared for trim changes created by the propeller thrust. Engine speed control will be important and the climb angle with the more powerful engines may be impressive! For older self-launching gliders note that the takeoff run may be somewhat longer and the climb-out angle lower than for other launch methods, and this will depend of course on the engine power and propeller thrust plus effects of hard surface or grass, density altitude, etc. Therefore obstacle clearance on a short runway could be difficult. Takeoffs must be practiced first on a long runway before attempting shorter field takeoffs and landings. Be prepared for launch interruptions on takeoff and have your **O**ptions predetermined as part of the pre-launch CISTRSC-O, and the glider and the pilot's personal pre-takeoff checklists.
Lastly, partial loss of engine power or thrust must be treated as an engine failure, and a safe speed recovered before turns are attempted. If the glider is below the absolute minimum height above ground required to return to the airfield, the glider must never be maneuvered into a 180 degree turn, but a field ahead should be used for an emergency landing with the wind-milling prop.

Many MG have limited power for obstacle clearance and it is critical to know you aircraft performance capabilities and calculate take off and obstacle clearance from graphs and tables in the Aircraft Flight Manual provide by the manufacturer.

Lastly, if an engine is not performing well on take-off always assume that it will fail at any time an plan accordingly for an emergency landing.

Touring Motor Gliders (TMG)

More of these gliders are being manufactured as they are gaining popularity. The TMG is increasing in availability and some can have ranges in excess of 1000 nm and can be utilized closer to sport plane capabilities.

Power pilots typically require less time on type to fly a TMG under power than glider pilots. These flights are mostly touch and go, except for approximately one hour cross-country flying. Pilots flying TMGs cross-country will potentially have to deal with more complicated issues related to airspace, radio procedures, controlled airports, and ATC procedures. This will require more elaborate flight planning and navigation skills.

TMG pilots should receive additional ground school training emphasizing the points above. Potential TMG pilots could attend a powered flight ground school to fill in the voids in the glider training. Pilots also holding a PPL or Recreational Permit would not need the additional ground school or cross country training. A bronze badge is the minimum requirement for glider cross-country flight. In addition, for glider pilots to fly TMG without power flying cross country training experience:

- Checkout on type include sufficient number of dual flights to demonstrate normal and emergency handling of aircraft under power and as a glider; and
- a dual cross-country practice in a TMG under powered flight in excess of 50 km and include flight planning, navigation, diversion skills and airport landing.

"401.24 *The holder of a pilot licence - glider may, under day VFR, act as*

(a) pilot-in-command of a glider in which no passenger is carried on board;

(b) pilot-in-command of a glider in which passengers are carried on board where

(i) the glider is launched by a method of launch endorsed by the holder of a flight instructor rating - glider in the holder's personal log pursuant to subsection 401.18(1) or (2), and

(ii) the method of launch has been used by the holder for not less than three previous solo flights; and …"

421.18 ***Examiner's Endorsement of Personal Log - Gliders and Balloons***

(1) Gliders

The endorsement of personal log shall include the method of launch and the date and the name, signature and licence number of the examiner.

Flying a MG is authorized without a launch specific endorsement unless one wants to carry passengers. MG/TMG pilots are reminded that where the use of the glider motor as a method of launch according to CAR 401.18 requires:

"(2) *Where the holder of a pilot licence - glider demonstrates, in accordance with the personnel licensing standards, additional methods of launch to an instructor who holds a flight instructor rating - glider, the instructor shall so endorse the holder's personal log, recording therein the additional methods of launch used."*

This would indicate a glider instructor may endorse the launch method used on MG/TMG CAR 421.24 for glider license standards requires:

"(5) Skill

(b) An applicant shall submit a letter from the holder of a Flight Instructor Rating - Glider, qualified on the method of launch for the glider used for the test, attesting to the applicant's satisfactory completion of the skill requirement."

Additional skill and knowledge requirement for MG Pilots as follows:

Motor Glider Knowledge Requirements:

Aero engine operations & propeller aerodynamics (all MG)
Flight planning for filing flight plans (TMG)
ATC communications at controlled airports including clearances (TMG)
VFR supplement for controlled airport information(TMG)
Calculating aircraft performances for Take Off (all MG)
Airmanship for Taxi techniques (all MG)
Starting/run up (all MG)

All MG Air Work:

Powered T/O and Landing
Slow flight powered
Stalls powered
Spiral powered
Where applicable; Engine emergency procedures, engine failure, Engine Fire or smoke in cockpit, carbon monoxide, carb icing, electrical fire
Refueling safety
Electric Motor operations and battery maintenance and care.
Electrical fire in primary power source
Jet Turbine emergency procedures

TMG Specific:

Pilot cross country navigation by dead reckoning powered flight and altitude holding, and diversions
Precautionary landings, including soft field techniques, overshoot technique, and short field techniques.

TMG Flight Tolerances:

Headings* +/- 10 degrees Headings
Airspeed +/- 10 kts (tolerance in a gliding approach is +/- 5 kts)
Altitude* +/- 100'

Navigaton* +/- 200 ' x country

(*note that attempting to hold headings or altitudes in a glider will likely result in forced landing in short order. MG sustainer and self-launch, pilots will also seek lift and will need to maneuver with air currents to conserve limited fuel. This skill for holding constant heading and altitude is more applicable to TMG in situations where the aircraft may be flown in controlled airspace or dead reckoning navigation)

MG Training Sylabus

The candidate seeking log book endorsement for a self-launching powered glider shall receive instruction in accordance with the following sections that form this appendix:

(a) Ground Training Syllabus
(b) Flight Training Syllabus

2. Completion of training is to be recorded on the appropriate sheets. Instructors shall initial in the “Brief” column when the item is first briefed, taught or demonstrated. The “Comp” column is initialled and dated when the pupil is considered competent.

3. The sequence of exercises is a guide only. A number of exercises may be covered during any given flight.

4. The attached sheets form the training record for each pilot and shall be retained for a period of 3 years after completion. They must be available for inspection by an officer of TC if required.

(Pilots holding valid Recreational Pilot Permit or higher power licence can have knowledge and skills items checked off the list at the descretion of the MG glider instructor satisfied these requirements are met.)

MG Ground Training Sylabus

Candidate Name: _____

Club: _____

Instructor: _____

	Brief	Comp	Date		Brief	Comp	Date
Power Glider Operations				**Principles of Flight**			
Use of this Training Record				Forces (Lift, Drag, Thrust, Wt)			
Engine & Glider logbooks				S&L under power			
Maintenance schedules				Climbing with power			
Weight and balance				Descending with power			
Ground towing / handling				Turning under power			
Securing / picketing				Stalling			
Rigging and derigging				T/o performance			
Refuelling procedures				Landing performance			
Daily Inspection (DI)				Stability and control			
Use of airspace				Propellers			
Battery charging safety							
Power Glider Systems							
2 stroke engine design / ops				Fuel systems			
4 stroke engine design / ops				Carburettor systems			
Propellers **/ Jet Turbines**				Electrical systems			
Extension / retraction system				Engine instrumentation			
Ignition systems				Emergency equipment			

MG Flight Training Syllabus

Candidate: _____

Club: _____

Instructors: _____

TMG specific checks in red

	Brief	Comp	Date		Brief	Comp	Date
FLIGHT PREPARATION				**CIRCUIT & LANDING**			
- Glider famil				- Normal: engine stowed			
- Documentation				- Pre landing checks (SUFB)			
- Pre Flight DI				- Landing with engine at idle			
- Engine starting / warm-up				- Go around with power			
- Power check				- Landing in crosswind			
GROUND HANDLING				**- Precautionary landing**			
- Use of power				**- soft/short field**			
- Directional control							
- Use of brakes							
CONTROLS				**ADVANCED EXERCISES**			
- Effects of slipstream				- Short take off			
- Engine controls				- Short landing			
- Propeller controls				- Max rate climb			
TAKEOFF WITH POWER				- Max angle climb			
- Pre take off checks				- X/C cruising			
- Launch procedure				**- X/C Nav dead reckoning**			
- Ground roll / lift off				**SITUATIONAL AWARENESS**			
- Normal climb				- Lookout / scanning			
- Engine shutdown / retraction				- Right of way / etiquette			
- Launch in crosswinds				- Use of airspace			
				- Out landing decision making			
POWERED FLIGHT				- Safety around propellers			
- Straight and Level				**- controlled airport use**			
- Turning				**NON-NORMAL SITUATIONS**			
- Cruise				- Low acceleration on t/o			
- Climbing				- Low level launch failure			
- Descending				- Engine failure on approach			
- Effect of configuration				- Fire in flight			
STALLING				- Carburettor icing			
- CALL Checks				- Engine control failures			
- Stall recognition/recovery				- Engine limit exceedance			
- Stall – power on / power off				- No instrument circuit			
- Stall in take off configuration				- CO contamination /poisoning			
- Stall in approach config'ns							
- Incipient spin & recovery				**SOLO OPERATIONS**			
- Full spin & recovery				- Responsibilities as PiC			
- Spiral dive & recovery							

LOGBOOK SIGN-OFF			
- 3 Safe solo flights			
- Multi-choice exam			

POWER PILOTS DIFFERENCES WHEN CONSIDERING CONVERSION TO GLIDING

Use of motor gliders will have an attraction for power pilots not familiar with gliders. Information here is to assist glider instructors with conversion to gliding including MG.

1. Power pilots typically under appreciate the amount of rudder to coordinate turns.

2. Tendency to rely on instruments as primary reference verses looking over the nose to horizon to set pitch and bank angles. May focus on airspeed indicator verse holding attitude (chasing airspeed). Unfamiliar with glider ASI of 1 &1/2 revolution unit.

3. Power pilots may have difficulty initially with well banked turns (30-45 degrees) in the circuit as they are generally trained to make shallow banked 20 degrees or rate one turns (15°). Most training gliders are designed to run out of elevator when well banked and are more difficult to stall and will tend to spiral instead.

4. In slow flight near the stall the gliders ailerons tend to remain effective due to wash out, while using rudder can lead to a spin entry if the glider is stalled. Note for power pilots as they have been trained to avoid aileron use in slow flight and use rudder to keep the wings level due to short coupling of controls and short wings on powered airplanes with less wash out. Using rudder in slow flight too aggressively can lead to spin as yaw makes large change in wing tip speeds do to long wings.

5. Power pilots may be surprised by the tendency of longer glider wings tendency to over bank in medium and steep turns and the need to counter the tendency to over roll with aileron and the
need apply into turn rudder to keep yaw string straight, due to drag on faster moving outside wing, effectively cross controlling while adding back stick pressure.

6. Stall recovery, tend to lower nose to horizon only and not to correct recover angle well below horizon; and may not notice mushing stall that can be attained by approaching stall too slowly where there is no clean break just a high decent rate on VSI.

7. Areotow is formation flying and most power pilots find it difficult initially to follow the tug due to gliders slower aileron response and requirement for coordination with rudder. Will not make the earlier small corrections only that must be coordinated with rudder or making use of sideslip technique (cross controlling) for station keeping.

8. Winch launching they will be unfamiliar with nose high attitude and reluctant to let glider climb. In cable breaks power pilots typically have slower recovery technique and not lowering nose well below horizon to recovery attitude and not appreciating how long it takes to accelerate to approach speed (several seconds).

9. Tow plane upset. Glider take off is close to level attitude, attempting to rotate can put glider off ground before it is ready to fly and cause the glider to touch down again when

the nose is lowered to not out climb tow plane; and a tow plane upset condition can be created if the nose is not lowered immediately, Also a C of G hook worsens this condition if glider is rotated and may not be recoverable.

10. Side-slipping, do not appreciate effect of wind gradients with long wingspan and problem of not being able to un-bank the glider. Difficulty of correcting high rate of decent when recovering from slips close to ground.

11. They may find the glider circuit too tight and try to delay the turn to base too late.

12. Head wind gradient effects causing stalls or undershoots and the need to increase minimum approach speeds for winds usually found in POH (or 1.5Vstall + ½ Vwind + Vgust factor).

13. Steeper glider approaches of 8 degrees vs 3 degrees typical of power planes and may fly approach too flat with potential undershoot.

14. Landing flare power pilots typically try to raise nose too soon and above horizon vs leveling off close to the ground. This can lead to bounced landings or wing drop and ground loop.

15. Generally unfamiliar with use of airbrakes and the effect of drag on the glider. Don't let them think of airbrake as a throttle, less they get in an undershoot situation leaving corrections too late.

16. They may be surprised by slipperiness of glider on approach for airspeed control with air brakes closed and how long the glider may float, including pitch sensitivity. They may also not be accustomed to having to still fly the glider once it has landed until it stops moving. They will also likely be unfamiliar with the wheel brake at the end of the airbrake pull or cables/leavers in the glider.

17. Not familiar with glider emergency procedures particularly with safety issues for mast engine mounts on MGs.

18. Generally unfamiliar with use of parachutes and glider egress drills.

19. May find scan technique is inadequate for close flying conditions in thermals or gaggles.

20. General soaring, thermal techniques, wave and ridge soaring techniques and the safety considerations will be new.

21. Will be unfamiliar with glider DI vs Walk around, Critical Assembly Checks, and Positive Control Checks, and glider weight and balance techniques (including water ballast factors).

22. Not familiar with glider stall/spin scenarios and avoidance techniques (wing drop stall recovery vs incipient spin recovery).