1 APPENDIX R62.21
TOURING MOTOR GLIDERS
THEORETICAL KNOWLEDGE COURSE

1. Aim of training course

The aim of the course is to train a candidate to the level of proficiency required for the issue of a type rating touring motor gliders, and to provide the training necessary to act as pilot-in-command of any touring motor glider for which he or she holds a valid type rating, engaged in non-revenue flights under visual flight rules.

2. Theoretical knowledge course

2.1 The theoretical knowledge course must cover the subjects as detailed in the syllabus:

(1) Principles of Flight
(2) Air Law
(3) Aviation Meteorology
(4) Aircraft Engines, Airframes and Instruments
(5) General Navigation
(6) Human Performance Limitations and Passenger care
(7) Principles of gliding.

2.2 Restricted Radio Telephony Operator's Certificate as prescribed in AIC 30.9

3. Theoretical knowledge course syllabus

3.1 Principles of Flight –

3.1.1 General

(1) PHYSICS AND MECHANICS

(a) Speed, velocity, force
(b) Wing Lift theory
(c) Understanding of Polar Curve & Lift / Drag (L/D) theory

Note: The student must have a good understanding of the speed-squared law as applicable to Lift with specific reference to gusts and lulls, and their effect on your flight path.

(2) AEROFOILS, LIFT AND DRAG

(a) Drag – understanding the effect of various forms of drag
(b) Airfoil shapes
(c) Lift and drag – Angle of attack and airspeed
(d) Distribution of lift, Centre of pressure
(e) Drag – Induced, parasite – Form, skin, interference
(d) Lift/drag ratio & Glide angle
(e) Aspect Ratio and its contribution to drag

(3) EQUILIBRIUM
- (a) The four forces: Lift, weight, thrust and drag
- (b) Centre of gravity (C of G) position & the neutral point.
- (c) The balance of the four forces: Straight and level
  - Climbing
  - Descending

(4) STABILITY
- (a) Positive, neutral, negative
- (b) Lateral and directional stability
- (c) Longitudinal stability and the Cof G & Neutral point
- (e) wash out

(5) loose formation/group flying

(6) AERODYNAMIC LAYOUT
- (a) Effects
- (b) Limitations

(7) TURNING FLIGHT
- (a) The forces in the turn
- (b) Compensation for loss of lift & airspeed & attitude control in the turn

(8) THE STALL
- (a) Airflow separation
- (b) Angle of Attack @the Stall – Relationship to airspeed
- (c) Wing loading
- (d) Increased stall speed with bank angle increase
- (e) High-speed stall as it differs from normal stall.

(9) AIRCRAFT PERFORMANCE
- (a) Power curves
  - Effect of temperature, altitude, density, moisture etc.
  - Range and endurance
- (b) Climbing performance
  - Rate of climb, optimum climb rate & power settings.
  - Optimum climb, angle of climb, configuration & aircraft limitations.
- (c) Take-off and landing performance
  - Take-off run available –surface type, slope & obstacles
  - Take-off distance available - surface type, slope & obstacles
  - Landing distance available
- (d) Take-off and initial climb - performance
  - Effect of –
  - wind, wind gradient and wind shear
  - weight, configuration
  - pressure,altitude,temperature,and,density(altitude)
  - ground surface type and slope (gradient)
- (e) Approach and landing – performance

Effect of –
wind, wind gradient and wind shear
weight ,configuration
turbulence and gusts
ground effect
Downwind landings.

3.1.2 Principles of flight - Conventional control specific

(1) FLYING CONTROLS

(a) The three axes: Vertical (yaw), Lateral (roll), Longitudinal (pitch)
(b) Operation and function of elevators, ailerons and rudder
(c) Principles and purpose of mass and aerodynamic balance
(d) Operation and purpose of trimming controls
(e) Operation and function of flaps and their types including flaperons.
(f) Operation and function of spoilers or airbrakes
(g) Aileron drag and differential movement.

(2) WEIGHT AND BALANCE

(a) Limitations on aircraft weight
(b) Limitations in relation to aircraft balance
(c) Weight and centre of gravity calculations
(a) A.U.W.
(b)C of G range
(c) Placarded weight range

(3) THE SPIN
(a) Causes of a spin & control positions that cause a spin & flap configuration.
(b) Incipient,cross control & developed spin conditions
(c) Effect of the C of G on spinning characteristics
(d) Effect of aerodynamic configuration & geometric layout on spinning.
(e) Spin recovery from all situations /configurations & control effects.
(f) Wash-out
(g) Type specifications & considerations.
(b) Autorotation

(4) PERFORMANCE
(a) Use of flaps
- Take off and initial climb performance

- Approach and landing performance – effect of use of flaps & Airbrakes/spoilers

(b) Cross control

- Slipping –under rudder or over banking
- Skidding – over ruddering & under banking

(c) Adverse yaw and the need for rudder

(5) STABILITY

(a) Relationship of C of G to control in pitch

(b) Effects of dihedral & pendulum effects.

(6) LOAD FACTOR AND MANOEUVRES

(a) Definition of load factor – V_n envelope & max rough air & maneuvering speeds

(b) Effect on stalling speed

(c) In-flight precautions & HASELL checks.

3.2 Air Law

(1) Applicable acts, regulations and other documents
(2) Structure and function of ANR's, CAR's, CAT's, AIP's, Notams, AIC's and AIP supplements.
(3) Classification of aircraft
(4) Aircraft documentation
(5) Aircraft equipment & placarding
(6) Aircraft radio equipment
(7) Aircraft weight schedule /placarding
(8) Documents to be carried on board
(8) Documents and records to be maintained and produced on request
(9) Offences in relating to documents and records
(10) Airworthiness aspects
(11) Pilot licensing requirements
(12) Touring motor Glider pilot - Privileges and limitations
(13 Touring motor Glider pilot – Aircraft ratings
(14) Personal flying logbook
(15) Airspace classification
(16) General flight rules
(17) Visual flight rules
(18) Special flight rules
(19) Flight operations
(20) General provisions
(21) Air traffic services
(22) Flight plans
(23) Air-proximity reporting procedures .
(24) Incident/accident reporting
(25) International operations

(26) Operation of Non-type certified aircraft
(27) Marine living resources act and Proclaimed nature reserves

3.3 Aviation Meteorology

(1) THE ATMOSPHERE
- (a) Composition and structure
- (b) Vertical divisions

(2) PRESSURE, DENSITY AND TEMPERATURE
- (a) Barometric pressure, isobars
- (b) Changes of pressure, density and temperature with altitude
- (c) Solar and terrestrial energy radiation, temperature
- (d) Lapse rate – wet & dry
- (e) Stability and instability
- (f) Effects of radiation, advection subsidence and convergence

(3) HUMIDITY AND PRECIPITATION
- (a) Water vapour in the atmosphere
- (b) Dew point and relative humidity

(4) PRESSURE AND WIND
- (a) High and low pressure areas –their effect on wind direction.
- (b) Wind gradient & shear
- (c) Vertical and horizontal motion
- (d) Effect of wind gradient and windshear on take-off and landing & in general flight
- (e) Relationship between isobars and wind, Buys Ballot's law
- (f) Turbulence, gusts, downbursts/microburst's .
- (g) Local winds, land and sea breezes, berg winds, valley winds, storm outflow

(5) CLOUD TYPES AND THEIR EFFECTS
(a) Cloud types
(b) Convection clouds
(c) Orographic clouds
(d) Stratiform and cumulus clouds (check difference in syllabus)

- (a) Lift
- (b) Caution
- (c) Prediction of development
- (d) Cloud type recognition

(6) VISIBILITY
- (a) Rain, Fog, mist, haze
- (b) Radiation, advection, frontal

(c) Formation and dispersal
(d) Reduction of visibility due to mist, snow, smoke, dust and sand
(e) Hazards of flight due to low visibility, horizontal and vertical

(7) AIRMASSES
(a) Weather associated with pressure systems

(8) FRONTS
(a) Formation of cold and warm fronts
(b) Associated clouds and weather, cold front
(c) Recognizing frontal indicators

(9) ICE ACCRETION
(a) Conditions conducive to ice formation
(b) Effects of hoar frost, rime ice, clear ice
(c) Effects of icing on aircraft performance
(d) Precautions and avoidance of icing conditions
(e) Powerplant icing

(10) THUNDERSTORMS
(a) Formation − air masses, frontal, orographic & cloud types (Mamatus,Cunim) that signify the presence of storms.
(b) Conditions required
(c) Development process
(d) Recognition of favourable conditions for formation
(e) Hazards
(f) Effects of lightning and severe turbulence
(g) Avoidance of flight in the vicinity of thunderstorms

(11) RAIN AND ITS EFFECTS
(a) Wet wings & the effect of water on airflow.
(b) Stall speed & handling characteristics.
(c) Visibility
(d) Internal condensation

(12) FLIGHT OVER MOUNTAINOUS AREAS
(a) Hazards
(b) Influence of terrain on atmospheric processes
(c) Mountain waves, windshear, turbulence, vertical movement, rotor effects

(13) CLIMATOLOGY
(a) General world circulation
(b) South African summer patterns
(c) South African winter patterns

(d) The South Westerly Buster
(e) The Cape Doctor
(e) The Black South Easter
(f) The Karroo Katabat

(14) ALTIMETRY
(a) Operational aspects of pressure settings
(b) Pressure altitude, density altitude
(c) Height, altitude, flight level

(15) THE METEOROLOGICAL ORGANISATION
(a)Forecasting service

(16) WEATHER ANALYSIS AND FORECASTING
(a) Weather charts, symbols, signs
(b) Significant weather charts
(c) Prognostic charts for general aviation
(d) Interpretation of weather information / models

(17) WEATHER INFORMATION FOR FLIGHT PLANNING
(a) Reports and forecasts for departure, *en route*, destination and alternate(s)
(b) Interpretation of coded information METAR, TAFA
(c) Availability of ground reports for surface wind, windshear, visibility

(18) METEOROLOGICAL BROADCASTS FOR AVIATION
ATIS, SIGMET
(19) MICRO-METEOROLOGY
(a) Rotors / Turbulence
(b) Venturies
(c) Katabatic and Anabatic winds
(d) Dust devils
(e) The immediate environment.
1. Wind indicators
2. Cloud forms
3. Topography & surface effects
4. Lift triggers and sources and types of lift (thermal activity)

3.4 Aircraft Engines, Airframes and Instruments
(1) AIRCRAFT AIRFRAME
(a) Structure & material types
(b) Materials & maintenance thereof
(c) Wear and tear considerations
• Repairs

- Surface integrity, Gelcoat cracks, tears etc.
- Tie down and weather damage
- UV
- Turbulence
- Hard Landings & other overload situations

- Flutter damage.
- Control surface damage and integrity
- Wing beat frequency for testing of structural integrity

(2) POWERPLANT AND SYSTEMS

(a) Engines – general

- principles of 2 and 4 stroke engines
- Engine casing & cylinder head/s
- Induction system
- Exhaust system
- Cooling system
- Ignition system
- Auxiliary installations and linkages
- Engine management system and sensors
  - Maintenance
  - Maintenance schedules
    - Spark plug leads
    - Air-filter cleaning
    - Cooling system
    - Alternator drive belt (v belt) tension
    - Engine /gearbox oil
    - Carb rubber coupling condition
    - Adjusting full throttle and idle and balance
    - Exhaust system integrity including coupling springs
  - Lubrication

(b) Ignition systems

(c) Carburetion and Fuel system

- Fuel pumps –mechanical & electric stand by emergency pump & pressure Measurement
- Principles of float type carburetor
- Fuel-bypass (choke)
- Recognition of faulty mixture & effects thereof
- Methods to maintaining correct mixture ratio
  - Carburetor jetting and needle & seat inspection..
  - Balancing carburetors
  - Sliding piston main jet carburetors & principles of operation
- Carburetor icing
- Emergency use of Fuel-bypass (choke)
- Fuel lines and routing

(d) Fuel

- Refueling process & principles

- Types
- Suitability
- Hazards of avgas
- Contamination & moisture
- Fuel strainers and drains
- Fire hazards
    - Containers
    - Transportation
    - De-canting

(e) Electrical system
- General – circuit diagram
- Batteries & charging systems
- Circuit breakers and fuses
- Recognizing malfunctions

(3) Propeller
(a) Nomenclature
(b) Forces on blades
(c) Designs – fixed & variable pitch
(d) Effect of blade pitch changes – either ground adjustable or in -flight
(e) Maintenance and care
(f) Variable pitch and full feathering propellers
(g) Blade tracking /run-out & balance effects

(4) INSTRUMENTS
(a) Airspeed indicator
(b) Altimeter
(c) VSI
(d) Magnetic compass
- Precautions when carrying magnetic objects
- Errors

(e) Engine instruments
(f) Temperature and pressure gauges
(g) Digital instruments
(h) RPM
(i) Variometer visual and audio with / without total energy probes.

3.5 General Navigation

(1) FORM OF THE EARTH
(a) Axis, poles
(b) Meridians of longitude
(c) Parallels of latitude

(2) DIRECTION
(a) True north
(b) Earth's magnetic field, variation − annual change

(c) Magnetic north
(d) Magnetic influences within the aircraft
(e) Compass deviation
(f) Turning, acceleration errors
(g) Avoiding magnetic interference with the compass

(3) DISTANCE
(a) Nautical mile, statute mile, kilometer

(4) AERONAUTICAL MAPS AND CHARTS (TOPOGRAPHICAL)
(a) Projections and their properties
(b) Scale
(c) ICAO 1:250 000 and 1: 500 000 charts
(d) Main properties
(e) Scale
(f) Depiction of height
(g) Topography
(h) Relief
(i) Cultural features
(j) Aeronautical symbols
(k) Aeronautical information

(5) CHARTS IN PRACTICAL NAVIGATION
(a) Plotting positions
(b) Latitude and longitude
(c) Bearing and distance
(d) Use of navigation protractor
(e) Measurement of tracks and distances
(f) Conversion of units

(6) PRINCIPLES OF NAVIGATION
(a) IAS, RAS (CAS) and TAS
(b) Track, true and magnetic
(c) Wind velocity, heading and ground speed
(d) Triangle of velocities
(e) Calculation of heading and ground speed
(f) Drift, wind correction angle
(g) EET and ETA
(h) Dead reckoning, position, fixes

(7) FLIGHT PLANNING
(a) Selection of charts
(b) Route and aerodrome weather forecasts and reports
(c) Assessing the weather situation
(d) Plotting the route

(e) Considerations of controlled airspace, airspace restrictions, danger areas, etc.
(f) Use of AIP and NOTAMS
(g) ATC liaison procedures in controlled airspace
(h) Fuel considerations
(i) En-*route* safety altitude(s)
(j) Alternate aerodromes
(k) Communications and radio/navaid frequencies
(l) Compilation of flight log
(m)Compilation of ATC flight plan
(n) Selection of check points, time and distance marks

(8) PRACTICAL NAVIGATION
(a) Compass headings, use of deviation card
(b) Organisation of in-flight workload
(c) Departure procedure
(d) Maintenance of heading and altitude
(e) Use of visual observations
(f) Establishing position, checkpoints
(g) Revisions to heading and ETA
(h) Arrival procedures, ATC liaison
(i) Use of minute marker graph.

(9) GLOBAL POSITIONING SYSTEM (GPS)
(a) Limitations
(b) Application
(c) Principles
(d) Presentation and interpretation
(e) Coverage
(f) Errors and accuracy
(g) Factors affecting reliability and accuracy
(h) Legalities

3.6 Human Performance Limitations and Passenger care

3.6.1 Human performance limitations

(1) Introduction
(2) Oxygen
(a) Hypoxia –The dangers & limitations of high altitude flight and the correct use of oxygen equipment.
(b) Hyperventilation

(4) Barotraumas
(5) Common ailments
(6) Decompression
(7) Air sickness
(8) Hearing

(9) Sight
(10) Toxic hazards
(11) Blood pressure
(12) Epilepsy
(13) Alcohol and drugs & medical limitations of prescription medicine
(14) Knowledge and the senses
(15) Disorientation
(16) Avoiding the air proximity
(17) Stress
(18) Management of stress
(19) Emotional factors
(20) Social psychology
    (a) Attitude
    (b) Recognition of authority
    (c) The Ego Factor
    (d) Intermediate syndrome

3.6.2 Passenger Care

(1) Embarking / Disembarking –damage to airframe and canopies
(2) Seatbelt and comfort
(3) Briefing
    (a) Mass limitations of passenger
    (b) Open cockpit flying
    (c) Clothing, long hair and security, control proximity
    (d) Cameras and loose articles
(4) Human performance limitation as applicable to your passenger
(5) Eye-contact and communication
(6) Air law as applicable to passengers
(7) Passenger seat and flying control access
(8) signing of indemnities

3.7 Principles of gliding.

This section is to be completed by a Gliding club.

3.7.1 Thermalling and thermic flight

(1) Introduction to the principles, theory and techniques of thermic flight
(2) Look out, rules and right of way, entering and leaving thermals and cruising flight.
(3) Weather conditions associated with thermic flight

3.7.2 Ridge Soaring and wave flight

(1) Introduction to the principles, theory and techniques ridge and wave flight
(2) Look out, rules and right of way, entering and leaving ridges and wave.
(3) Weather conditions associated with ridge and wave flight
(4) Instrumentation (Flarm) used for ridge soaring flight

3.7.3 Cross Country flight.

(1) Introduction to sustained Cross country flight
(2) Motor re-start considerations and off field landings and recovery.
(3) Flight planning.
(4) Competitions