



RECREATIONAL
AVIATION AUSTRALIA

APPENDIX 6

Weightshift Briefings



PRE-FLIGHT INSPECTION: WEIGHTSHIFT (B)

1. AIM

To determine the correct rigging and airworthiness of the trike based on regulatory and operational requirements.

2. APPLICATION

Before first flight of the day, after rigging, and any command flight.

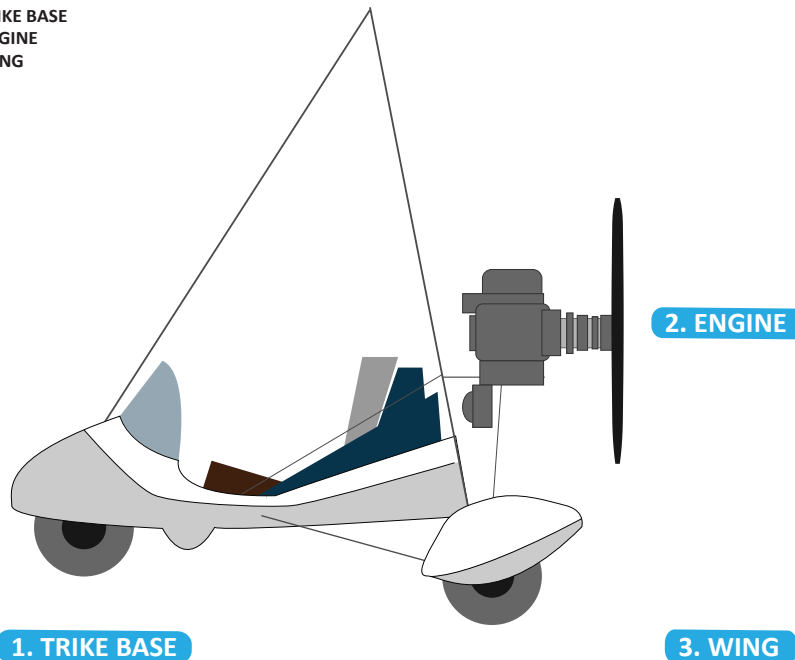
5. AIRMANSHIP AND HUMAN FACTORS

- Assume something is wrong with the trike TEM
- Focus on task without distractions SA
- Seek assistance or confirmation if required ADM
- Perform inspection methodically and consistently TEM
- Familiarise with trike types and known watch items CRM

3. UNDERPINNING THEORY

The trike pre-flight inspection should be broken down into 3 separate individual inspections;

1. TRIKE BASE
2. ENGINE
3. WING



Further References

- Trike Flight & Maintenance Manuals
- RAAus Operations and Technical Manuals
- CAR 1998 Schedule 5
- CAR 42B and CAAP



4. PRE-FLIGHT EXERCISE

- Review POH, Maintenance record and flight authorisation sheets
- Determine administrative compliance to fly via any maintenance record and RAAus requirements
- Ensure the aircraft is secured in suitable place for inspection/refueling
- Determine in what sequence fueling or pre-flight is to take place

General sequence is;

A: Administration:	Appropriate trike documents checked, maintenance record, flight record, registration, known AD's and SB's
C: Cockpit:	Remove locks, confirm switches OFF
E: Engine & Consumables:	Fuel, Oil, coolants hydraulics etc. Fuel checked for quantity, colour, contamination, clarity and odour
A: Airframe:	Metal, composites, and fabric all have different unique requirements for checking
A: Authorisation:	Complete any Administration required

Each inspection element can be assessed using a short acronym of 3 C's:

- **Correct** operation and assembly
- **Condition** - determined as airworthy
- **Change** in condition or integrity from known standard

6. OUTCOMES AND EXPECTATIONS

- Pilot understands relevant maintenance privileges
- Understands and identifies all appropriate systems pertinent to trike
- Pilot can determine and confirm trike serviceability including W&B for flight

EFFECTS OF CONTROLS - WEIGHTSHIFT (B)

1. AIM

To operate the primary and ancillary controls in flight and on the ground and feel and understand the primary, secondary, and further effects they have on the aircraft.

2. APPLICATION

- The fundamental understanding and use of all controls in relation to the weightshift trike.

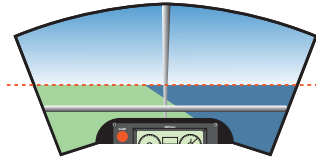
5. AIRMANSHIP AND HUMAN FACTORS

- "I have control / you have control"
- See and avoid
- Clock code, relative height / distance
- Horizon & control bar remains primary reference
- Land features
- Limitations on lookout - SA
- Limitations of memory
- More comfortable with practice/workload
- Demonstration / practice process - CRM
- Self assessment - I.M.S.A.F.E
- Handover process (CRM)
- Correct horizon referencing and scanning SA
- Fly the wing not the base - correct referencing
- Uncoordinated lesson by nature
- Control feel and grip

4. FLIGHT EXERCISE

In the air

- Attitude flying is achieved by referencing the wing to the horizon (fly the wing)
- Attitude - horizon as primary reference, bar position relative to the horizon
- Demonstrate - Handover sequence
- Pendulum and stability demonstrated
- Primary control effects demonstrated and practiced
- Secondary/further control effects, effects of airspeed
- On ground control of wing and steering system - understand and practice
- Power and slipstream effects demonstrated and practiced



On the ground

- Control speed with throttle
- Brakes - control slowing / stop
- Pedals - control steering

Axis	Input	Movement	Primary Effect	Secondary/Further	Use
Lateral	Control Bar	Forward Rearward	Pitch Up Down	Airspeed	Attitude and Airspeed
Longitudinal	Control Bar	Right Left	Roll Left Right	Slip - spiral descent	Direction

Airspeed

- Increased airspeed - increased control feel, faster response rate, less movement needed
- Decreased airspeed - reduced control feel, slower response rate, more movement needed

Power

- Decrease in power → nose pitches down and rolls*
- Increase in power → nose pitches up and rolls*
- Increased power → increased torque effect

*Roll will vary depending on engine rotation

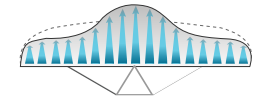
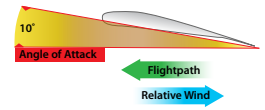
Trim

- To relieve bar pressure (if fitted)

3. UNDERPINNING THEORY

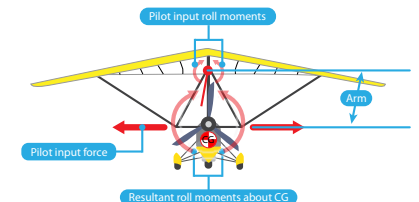
Lift

- As air flows over the wing, increased speed above the wing results in reduced pressure = Lift
- Lift can be altered by changing the shape of the wing, the angle of attack, and the airspeed



The trike flies due to the production of lift created by the wing and is controlled by the movement of control bar to effect weight shift in pitch & roll (2 axis)

- Control Bar movement affects C of G
- Moving forward/aft sets attitude of wing
- Rolling is achieved by moving bar sideways
- Rolling of wing occurs due to changes wing shape



6. OUTCOMES AND EXPECTATIONS

- Student identifies and understands control actions and responses.
- Can identify and reference the horizon correctly.
- Is comfortable in the airborne environment.

STRAIGHT AND LEVEL - TRIKE

1. AIM

- To establish and maintain straight and level flight at a constant airspeed, height and heading when required.
- To regain straight and level flight.
- To maintain straight and level flight at selected airspeeds or power settings.

2. APPLICATION

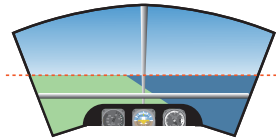
- Smooth throttle movements
- Coordination of controls
- Pitch controls attitude
- Power controls climb / descent

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - Situational Awareness SA - method for scanning, training area boundaries, maintaining visual horizon
- "I have control / you have control"
- Scan - work cycle
- Threat referencing - CLOCKCODE Principle
- Blind Spots

4. FLIGHT EXERCISE

- Horizon
- Demonstrate stability
- Power setting
- Attitude for level



Establishing Straight and Level

Power set for straight and level

Attitude control bar set nose attitude

control bar wing level relative to horizon

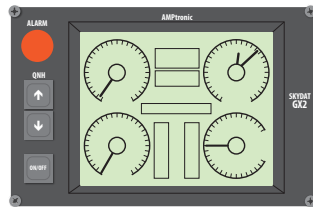
Trim to relieve pressure - hands off (if fitted)

Maintaining Straight and Level

Lookout ahead

Attitude reference position

Instruments - to confirm - not set
- Altimeter and RPM checked every time
- Other instruments and gauges, less frequently



Regaining Straight and Level

- Attitude to set airspeed / power setting correct
- Attitude confirmed
- Wing level
- Reset power
- P A T

Straight and Level at Different Airspeeds

- Any changes in power will result in pitch change
- Inverse relationship between Power / Attitude
- Compensate for secondary effects

Power + Attitude = Performance

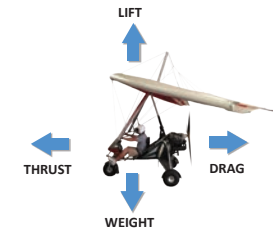
Performance	Mid	Low	High
Power	Cruise	Reduced	Higher
Airspeed	50-60 knots	40 knots	70 knots
Attitude	Normal	Higher	Lower

3. UNDERPINNING THEORY

- The horizon is the line where the land or sea meets the sky
- All flying references the trike's control bar with the horizon

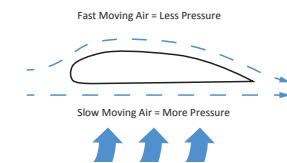
The Four Forces

- Lift, Weight, Thrust, Drag
- Equilibrium when Lift = Weight and Thrust = Drag
- Forces don't act through the same point → moment arms → couple
- Changes in Thrust → pitch changes



Lift

- Air over the top accelerates compared to air passing under the wing
- $L = C_L \frac{1}{2} \rho V^2 S$
- $L = \text{Angle of attack} \times \text{Airspeed}$
- Angle of attack is altered through pitching control bar



Performance

Power + Attitude = Performance

$$\text{PWR} + \frac{\text{IAS}}{\text{A of A}} = P$$



6. OUTCOMES AND EXPECTATIONS

- Student understands use of primary controls to maintain S&L flight
- Student configures trike correctly for any required performance
- Student recognises and corrects deviation with appropriate scan & work cycle
- Competencies +/- 150 ft, +/- 5kts, +/- 10 degrees
- Effective use of CLOCKCODE and See & Avoid

CLIMBING AND DESCENDING - WEIGHTSHIFT (B)

1. AIM

To climb or descend the trike to a pre-determined height, at a rate and airspeed appropriate for the nominated phase of flight.

2. APPLICATION

- For use in all phases of flight to change the altitude of the trike
- Appropriate climb/descent angles for phase of flight
- VFR - conditions considered
- Minimum and maximum heights

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout and situational awareness
SA - monitor for changes in level
- Blind spots managed during climb or descent
- Horizon remains primary reference
- Pre-plan required performance
- Understanding vestibular system and pressure equalisation
- Monitoring and management of temps & pressures
- Smooth throttle moments

3. UNDERPINNING THEORY

Changing power settings is the primary method for creating required force to climb or descend the trike.

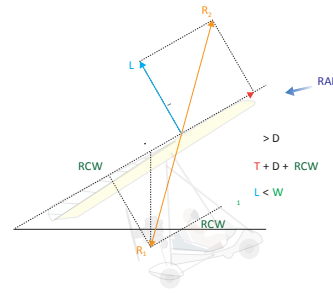
Power: Primary control for trike height change

Control Bar: Set attitude and airspeed

Manage secondary roll due to increased torque effect

Climbing

- Trike is in equilibrium when climbing
- Lift is not increased
- **T must be greater than D**
- Rate of climb (climb performance) depends on excess power available



Climb Performance

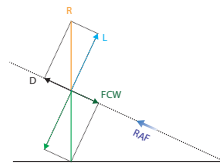
Power More power, better climb performance
Altitude Air density limits performance
Weight ↑ weight - ↓ rate of climb
Wind Affects climb angle and distance covered (relative to ground)

Climb Configurations

Performance	Power	Attitude
Best RoC	Full	_____ kts
Best AoC	Full	_____ kts
Cruise	> Cruise	_____ kts
Recommended		_____ kts

Descending

- Trike is in equilibrium when descending
- Airspeed maintained by Control Bar/attitude
- FCW balances D



Descent Performance

Power Controls rate of descent
L/D ratio Efficiency of wing, steepness of glide
Weight ↑ weight ↑ FCW - ↑ glide speed
Wind Affects descent angle and range (relative to ground)

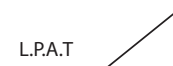
Descent Configurations

Performance	Power	Attitude
Glide	Idle	_____ kts
Powered		_____ kts
Cruise		_____ kts

4. FLIGHT EXERCISE

Climbing

Entry



Lookout Above / Around

Power Full power (control pitch and torque)

Attitude Climb attitude, wings level

Trim Set (if fitted)

Airspeed Controlled with attitude

Maintaining

Lookout

Attitude

Instruments

Change - check - hold - trim

Exit

Attitude Select and hold S+L attitude, adjust as speed increases

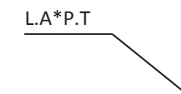
Power Wait for trike to accelerate, then set cruise power

Trim To hold S+L attitude



Descending

Entry



*Protect airspeed in low performance trikes in descent

Lookout Below / Around

Power Descent power (control pitch and torque)

Attitude Set glide attitude

Trim Set (if fitted)

Airspeed = _____ RoD = _____

Airspeed controlled with attitude

Maintaining

Lookout

Attitude

Instruments

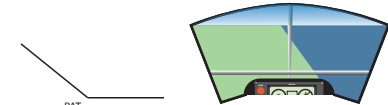
Change - check - hold - trim

Exit

Power Increase power to cruise

Attitude Manage pitch for S+L attitude

Trim To hold S+L attitude



6. OUTCOMES AND EXPECTATIONS

- Correct sequence of actions and control through a range of climb and descent scenarios and configurations
- Recognition of errors and appropriate corrections applied
- Required standards: Heading +/- 10 degrees, Nominated height +/- 100 ft, Airspeed +/- kt

TURNING - WEIGHTSHIFT (B)

1. AIM

To roll the trike to a predetermined Angle of Bank (AOB), whilst maintaining the required performance and balance for level, climbing or descending flight to any predetermined heading.

2. APPLICATION

For use in all phase of flight to change the trikes heading.

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - Situational Awareness SA
- Appropriate bank angles for phase of flight
- Blind spots in turn
- Horizon remains primary reference
- Understanding vestibular system and balance
- Dangers of pilot induced oscillations

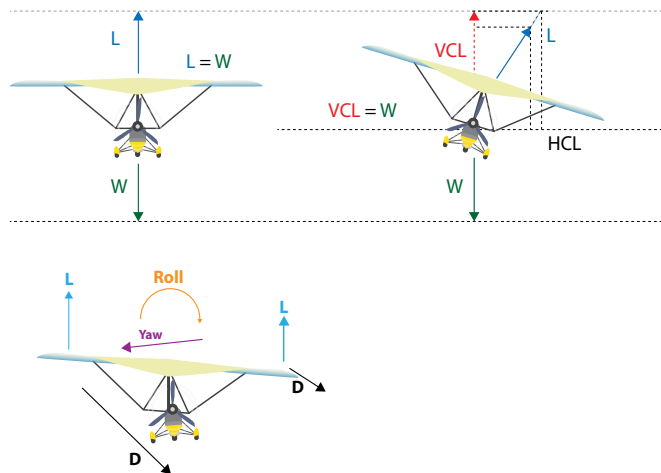
3. UNDERPINNING THEORY

Banking (Rolling) the trike is the primary method for creating a force towards the turning direction.

- Weightshift using the control bar is the primary control to initiate roll
- Aerodynamic shift in the wing occurs to create rolling force
- Pitch via the Control Bar is used to balance the turn
- Power overcomes additional turning sink rate in steeper turns
- Yaw stability is managed by sweepback of delta wing design

Performance

- When climbing and turning, angle of bank must be reduced maximum of 20°, use 15°



4. FLIGHT EXERCISE

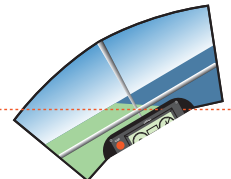
Slip and spiral descent revisited as further effects of roll

- Lookout - ALWAYS before turning
- Use weightshift to roll wing in desired direction
- Centralise weightshift at desired AOB
- Pitch via Control Bar to maintain height and balance turn
- Turn maintenance - AOB & Pitch control, power as required
- Exit from turn same control sequence, pitch, roll, centralise, relax
- Demonstration only

Entry

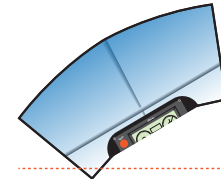
Medium Level Turn

- From S+L
- Lookout
- Roll to 30° AoB
- Pitch as required for level altitude



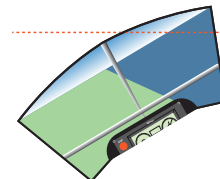
Climbing Turn

- Establish in climb
- Lookout
- Roll to 15° AoB
- Pitch for climbing attitude



Descending Turn

- Establish in glide
- Lookout
- Roll to 30° AoB
- Pitch for descending attitude



In Turn

- Lookout
- Attitude
- Maintain bank angle
- Altitude controlled with bar pressure and power as required

Exit

- Look for reference point
- Anticipate rollout by half the angle of bank
- Roll wing level
- Relax bar pressure
- Reset S+L attitude
- Check PAT

6. OUTCOMES AND EXPECTATIONS

- Correct sequence and control through a range of bank angles up to 60 degrees and in all configurations
- Recognition of errors and appropriate corrections applied
- Required standards: Heading +/- 10 degrees, Height +/- 100 ft, Airspeed +/- 5 kts, Balanced

STALLING - WEIGHTSHIFT (B)

1. AIM

To identify the situations where the trike is likely to stall and recognise pre-stall symptoms. When stalled, adopt the appropriate recovery actions for minimum height loss.

2. APPLICATION

Any phase of flight where critical A of A is exceeded.

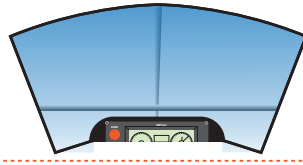
5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - Situational Awareness SA
- Counterintuitive responses and fear TEM
- Mismanagement and distraction SA
- Recognition of loss of primary control functions
- Limitations in identifying sink rate (Vestibular)
- Adherence to personal minimums and airspeed management

4. FLIGHT EXERCISE

Entry

- **HASELL check (Minimum height I.A.W. RAAus Operations Manual)**
- Adopt slow flight to identify symptoms and reduced control
- Recognition of the stall point in various configurations
- Appropriate recovery actions for min height loss and understanding "tuck"
- Demonstration and understanding of developing conditions due to mishandling of wing or lack of recognition
- Practice and recognition of pre-stall scenarios and appropriate actions
- Close throttle
- Keep straight, prevent roll
- Maintain altitude with increasing forward pressure on Control Bar



Symptoms

- Low and decreasing airspeed
- High nose attitude
- Less effective controls - higher Control Bar forces
- High sink rate often undetected
- Control Bar will be fully forward - no further control movement possible

At the stall

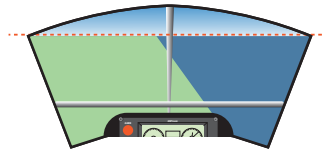
- Trike sinks and wing pitches down

Recovery

- To unstall
- Release Control Bar pressure to reduce angle of attack
- Correct for any roll
- Trike will descend
- Recover to S+L with PAT

To Minimise Height Loss - max of 100 ft

- **Power + Attitude = Performance**
- Unstall, as above, release Control Bar pressure
- Apply full power - maintain heading
- Raise nose to the horizon - reduces sink
- Accelerate then adjust attitude to normal speed
- Regain starting altitude and S+L

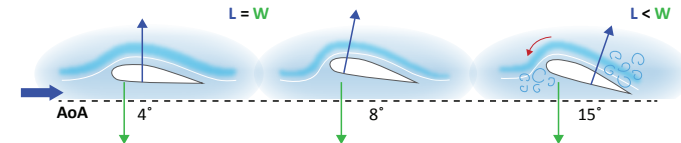


Recovery at Onset

- Normal situation - when not training
- Recover at recognition of pre-stall
- Height loss - 100 ft maximum

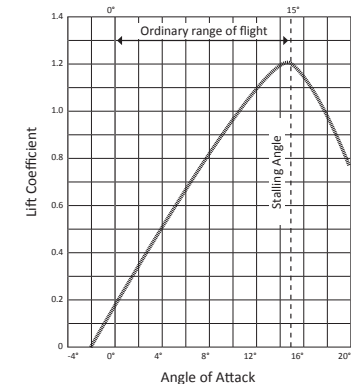
3. UNDERPINNING THEORY

- $L = \text{Angle of Attack} \times \text{Airspeed}$
- Smooth airflow over the wing breaks down and becomes turbulent
- Breaks away from upper surface, aircraft sinks, nose pitches down



At the stall

- When the wing stalls there is a $\downarrow$ in L and large $\uparrow$ in D
- Aircraft sinks, C of P moves rearwards $\rightarrow$ pitch down
- Stall results from exceeding critical Angle of Attack
- Control Bar controls the A of A of wing
- Lift/Drag curve
- Airspeeds are referenced in POH in relation to stalling
- Stall Speed increases in turning flight due to increased "loading"



6. OUTCOMES AND EXPECTATIONS

- Define the stalled condition
- Developed recognition of all pre-stall symptoms in flight
- Pilot can state likely scenarios where stalling may occur
- Apply timely and appropriate corrective actions
- **Required recovery standards:** Height loss <200 ft, Heading maintenance +/- 10 degrees, Airspeed within V_m



CIRCUITS - 3 AXIS AND WEIGHTSHIFT (B)

1. AIM

To combine all practiced phases of flight in a standard format including take off, approach and landing in accordance with recognised circuit procedures.

2. APPLICATION

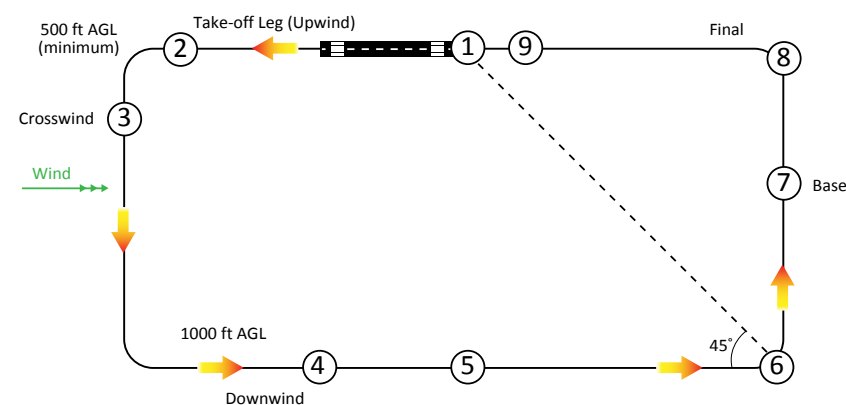
For use when operating at aerodromes for arrival, departure and standard traffic flow around a preselected runway.

3. UNDERPINNING THEORY

- Circuit conventions based on ICAO standards and outlined in CAR 166C
- Use of standard traffic pattern within the manoeuvring area of a landing area
- Circuits should be conducted on the most into wind runway unless conducting cross wind operations
- CAR 166C and CAAP 166-1(X) provide requirements and guidance for operations at non-controlled aerodromes including use of radio for "alerted see and avoid"
- Reference RAAus Syllabus of Flight Training 1.02 Circuits

4. FLIGHT EXERCISE

1. Takeoff	• Reference points and line up checks • Keep straight
2. Climb out	• Separation • T.O.S.S. • After takeoff checks • Turn at 500'ft AGL
3. Crosswind	• Tracking and lookout
4. Downwind	• Positioning • Checks
5. Aircraft configuration	• Possible to reconfigure aircraft depending on performance
6. Base turn	• Lookout • Reference point • Carb heat as required • Positioning • Flap set as required • Turn
7. Base leg	• Track • Attitude controls airspeed • Flap set as required • Power controls descent rate
8. Final	• Anticipate turn 500' ft AGL • Short final alignment • Power to control aim point • Attitude controls airspeed • Reference aiming point • Carb heat as required
9. Landing	• Glide approach OR powered approach (power as required) • Touch down on main wheels • Let nosewheel settle • After landing checks - clear of runway • Look ahead towards end of runway • Progressively increase back pressure to control sink • Keep straight



- Lookout - ALWAYS prior to conducting manoeuvres in vicinity of aerodrome
- Assessment of appropriate runway and taxiing/holding points
- Take-off considerations: performance and emergencies
- Circuits broken down into basic flight manoeuvres
- Demonstration of full standard circuit
- Progressive introduction of all circuit tasks relative to workload
- Aircraft configurations and pre-landing checks
- Descent profile management and the landing phase
- Modification of circuit for conditions/traffic

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout and situational awareness SA
- Appropriate climb/descent profiles for each leg of circuit
- Management of flight sequences while multi-tasking SA, CRM
- Reference attitudes, and runway positioning SA
- Monitoring and management of circuit and aircraft operation TEM
- Right of way and circuit rules

6. OUTCOMES AND EXPECTATIONS

- Correct application of controls and decisions through the range of sequences in the circuit
- Recognition of errors and appropriate corrections applied
- Awareness and appropriate actions for corrections required in circuit
- Reference RAAus Radio Operator Syllabus 2.04 and CAR 166C for radio use
- Required standards: Heading +/- 5 degrees, Nominated Height +/- 50 ft, Airspeed +/- 5 kt, aircraft balanced for all manoeuvres

ENGINE FAILURES: AFTER TAKE-OFF AND IN CIRCUIT (EFATO, EFIC)



1. AIM

To be able to plan and execute an appropriate range of actions based on an engine failure emergency at any point in the circuit area.

2. APPLICATION

Full or partial failures or other circuit emergencies that require immediate actions to ensure safest possible outcomes.

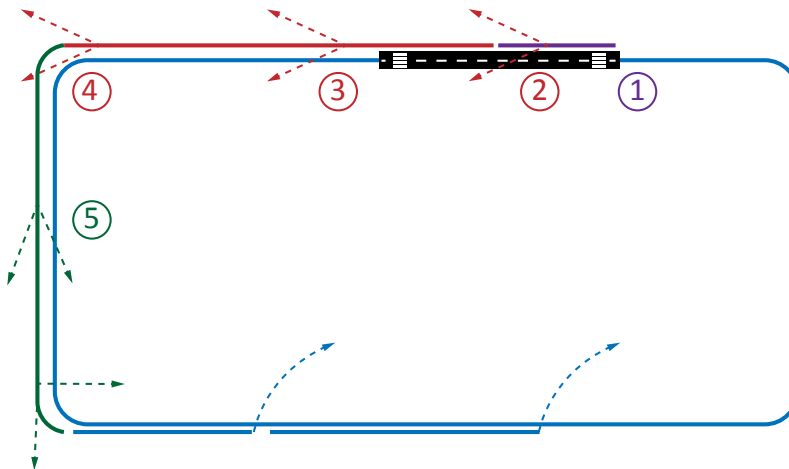
5. AIRMANSHIP AND HUMAN FACTORS

- Pre-planning TEM
- Immediate actions based on suitable options ADM
- Constant assessment of options SA
- Discipline and resist turn back - HF fear & auto responses)

3. UNDERPINNING THEORY

1. **Ground Roll.** Abort take-off at pre-determined "rejection point" power to idle, control direction
2. **On take-off with runway remaining .** Lower nose to best glide attitude. Power to idle, land on remaining runway or within 10 degrees of heading. Emergency braking as required
3. **On upwind climb.** Lower nose to best glide attitude, land straight ahead or best option within 30 degrees of heading only. DO NOT ATTEMPT turn back
4. **On crosswind climb.** Lower nose to best glide attitude, options only within 30 degree of heading or alternate runway if possible. DO NOT ATTEMPT turn back
5. **Approaching circuit height.** Modified circuit or alternate landing options, manage energy to achieve best glide speed, configure aircraft and plan for landing 1/3 into the available landing area. Broadcast emergency only if time allows

NOTES: 1. In all cases maintain safe airspeed 2. Rehearse a pre-take-off safety brief 3. Use appropriate height loss techniques - flap, sideslip, slipping turns to prevent overshoot. 4. Never attempt to "stretch the glide". Reset aiming point if approach misjudged.



4. FLIGHT EXERCISE

- BEFORE LINE UP/TAKE OFF: Pre take off safety brief
- Demonstration and practice EF at various points identified in brief
- Development of "SAFE GLIDE" assessments
- Introduction and practice of height management techniques
- Focus on key tasks

6. OUTCOMES AND EXPECTATIONS

- Student understands likely scenarios and immediate actions required in EF scenarios
- Effective strategies adopted for range of emergencies including safety briefs
- Student demonstrates appropriate disciplines in airspeed management and decision making in a range of engine failure and emergency situations
- Student can determine and execute a suitable landing or appropriate final glide based on any presented EF scenario
- Competencies: Airspeed management +5/-0kts. Nominated landing point (safe stopping distance)

MODIFIED CIRCUITS AND MISSED APPROACHES: 3 AXIS AND WEIGHTSHIFT (B)



1. AIM

For the student to identify scenarios where a modified circuit or missed approach needs to be made and safely conduct the modified procedures with reference to aircraft management, published procedures and airmanship.

2. APPLICATION

For use where alterations or discontinuation of a standard circuit pattern is required for traffic separation or where any doubt exists regarding the safety of continuing any circuit leg or final approach.

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout and situational awareness SA
- Decision making in rejecting take-off and landings ADM
- Management of flight sequences while multi-tasking SA, CRM
- Reference attitudes, and runway for positioning SA
- Monitoring and management of circuit and aircraft operation TEM
- Right of way and circuit rules

3. UNDERPINNING THEORY

Touch and Go • Skill development and practice of landing phase	Low Level Circuit • To expedite landing or where environmental or mechanical hazards exist. 500 ft AGL minimums as per regulations. PPR where required from AD OPR
Stop and Go • Allows full reconfiguration and full take off technique	Wind Gradient • Reducing wind velocity close to ground from mechanical disturbances due to friction with surrounding air
Missed Approach • ("Go Round") Overshoot of aiming point, hazards or unstabilised approach. Energy management, aircraft control (secondary & further effects)	Wind Shear • Sudden change in windspeed and/or direction. Effect on airspeed, controllability, and sink rate near the ground
Varied Circuit Speeds • Application of level flight at various airspeeds within manoeuvring range for separation and aircraft configuration requirements	Wake Turbulence • Disturbed air created by a wings production lift. Wingtip vortices create turbulence. Greatest at high angles of attack and behind taking off or landing aircraft. 600M separation minima's. May require a planned missed approach Reference RAAus Syllabus of Flight Training 1.01/1.02 Elements 8 & 10

2. OUTCOMES AND EXPECTATIONS

- Correct application of controls and decisions through the range of sequences in the circuit
- Recognition of errors and appropriate corrections applied
- Awareness and appropriate actions for corrections required in circuit
- Reference RAAus Operations Manual, CAR 166C and VFRG
- **Required standards:** Heading +/- 5 degrees, Nominated height +/- 50 ft, Airspeed +/- 0 kt, aircraft balanced for all manoeuvres. Decision making to satisfaction of instructor.

4. FLIGHT EXERCISE

Touch and Go landings

- Review of rejection points. Minimum obstacle clearance. Runway alignment, suitable aircraft configurations

Stop and Go landings

- Practice reconfiguration, aircraft control and changing controllability

Missed approaches

- Aircraft configurations and pre-landing checks
- Decision points for aborted approaches
- Maintaining safe climb airspeed and attitude
- Aircraft reconfiguration practice and managing secondary effects
- Repositioning aircraft for effective SA
- Safe re-joining

Circuit arrival, departure, and re-joining

- Departure from all legs of circuit and re-join
- Arrival to join any circuit leg and considerations understood
- Modification of circuit for conditions/traffic
- Alerted See & Avoid with radio as required

