DH 82A
Tiger Moth

Type Conversion Syllabus

Compiled by Martin Burdan

Pilot Notes For The Tiger Moth

Introduction

Some time ago I remember admiring the work of a New Zealand restorer of rare automobiles belonging to the pre-1920's era. Such was his expertise that collecters from all over the world would ship their unique collections of dilapidated parts to his workshop entrusting him to work wonders and return the rebuilt vehicle, faithful to its original specification in the most minute detail.

What made his work remarkable was that in some cases not only were many of the parts missing, but because of the rarity of the machine none of the original workshop manuals was available. This meant it wasn't unusual to have only a faded snapshot from which to transform a motley assortment of bits into the gleaming finished product; quite some challenge given the need to understand the whims of an obscure and remote manufacturer whose particular specialist practices had long since been forgotten.

Looking at the impressive speedometer that he had built from scratch for an Italian machine without reference to any plan or even photo, I asked, 'How do you guarantee the owner that this speedo is accurate to what was originally in this car?' His answer was short and deceptively simple. He replied, 'I have to think like an Italian designer would have done then'.

His comment has stuck with me and I can't help thinking that it is the crux to safe flying in our beloved Tiger Moths, belonging as they do to an era of aviation long since gone. In order to operate them sucessfully I believe we must "think" like a pilot of the 1930's and understand, not just the basic technical and operational peculiarities of the aircraft, but the whole aviation environment within which it existed.

Each era of avaition has its own environment or "culture" within which a pilot is trained to develop at least a grasp and appreciation of the correct manner of doing things. Aircraft of a particular time all had similar handling characteristics and demanded attention in particular ways. It was precisely this similarity that enabled the ATA pilots of WWII to ferry, as part of a daily routine, aircraft varying from Tiger Moths, to high performance fighters, to four-engine bombers. And the latter single-handed. Both literally and figuratively in the case of the one-armed ferry pilot. No checkout from someone with more experience was necessarily forthcoming. Typically the pilot would simply sit in the aircraft studying the pilots notes before flying it for the first time. The experience of similar types meant this was quite a safe practise. Much like a pilot today could, if perhaps a little untidily at least reasonably safely, hop from a C152 to Cheeroke 140 to Tomahawk.

Operating machinery within a clearly defined and accepted environment meant that a Model T Ford owner, for example, had an infused understanding of the need to retard the spark and set the throttle correctly before hand cranking to start. He knew how to hold the handle correctly to avoid having his thumb broken in the event of a backfire. Furthermore, as the vehicle got older the need to jack up the back wheel as a precaution against the vagaries of the gearbox was fully understood. If the system of bands in the gearbox was out of adjustment and the oil cold, the drive train effectively became complete and if a rear wheel wasn't jacked up or the car somehow immobilised, the likelihood of being mown down as your vehicle roared into life can easily be imagined. And we have only covered aspects of starting this once ubiquitous machine. There remains plenty else to catch out today's average Toyota driver keen on going for a spin in a Model T.

Another potential problem with flying older aircraft today is that pilots will at some stage be placed in situations like the New Zealander suddenly transfered to living in a remote African village. He may have read about what to expect in the new country, be able to speak a little of the language and be happy and willing to "do as when in Rome". He copes sufficiently on the surface. However when he drops his guard or the unexpected comes along, he may well resort, by instinct, to actions learned during his upbringing back home. And this action or response may or may not be culturally appropriate.

The 1987 crash of the World's one and only flying Bristol Blenheim, barely two months after a lengthy rebuild, is an unhappy example of instinct overtaking judgement appropriate to the era. The 15,000 hour pilot committed the beginners mistake of opening the throttles too quickly on a go-around. Radial engines, moreso than their modern inline counterparts, will rich cut in such circumstances, merely backfiring until the throttle is closed and reopened slowly. Despite the accompanying engineer urging him to do just that, the pilot steadfastly held them open, believing the engines would pick up. They did not and the aircraft was wrecked, fortunately without loss of life.

During the First World War todays concept of a runway did not exist. Squadrons operated out of square-shaped fields for the simple reason that the aeroplanes had to be taken off and landed into wind. "Crosswinds", as we know them, were non-existent as aircraft of the time had virtually no crosswind capability. Pilots had an inherent understanding of the need of the aircraft to function into wind.

The manner of operating a rotary engine was an art in itself, being entirely different to that of an inline or radial engine. There is, for example, no throttle on a rotary for controlling rpm. The engine runs constantly at full throttle and rpm are controlled to a limited extent by altering the mixture, or by operating a magneto cutout ("blip switch") on the control column.

Such considerations, while quite foreign today, were once merely accepted as part of the pilot's lot. The pilot was conditioned to the framework which applied to the aeroplane. And this framework extended beyond the congenial mix of pilot and aeroplane to the greater aviation community, including engineers, other pilots and the wider general public.

Meaning, for example, if a pilot arrived on a cross-country and landed in a strong wind, any aviation-minded person on the ground would immediately know what to do in terms of offering assistance. An engineer stationed at Ashburton during the war spoke to me of routinely seeing the Canturbury nor-wester spring up while gaggles of Tigers were still flying. The ground staff would, without prompting, down tools and form a line, into wind, in order to catch each landing Tiger and shepherd it to the safety of the hangars. Nothing unusual. A part of daily life. Not so down at the average Aero Club today, whose membership would probably not identify with hearding Cessna 152's as they taxi in.

Landing in interesting winds at Wellington airport in a Proctor, I was urged by the controller to keep my speed up after touchdown to reach the nearest taxiway and clear the runway more quickly. Fifty years ago the few controllers existing would have understood that the landing of a twitchy taildragger finishes only when the aircraft stops, and prolonging the process is about as pleasurable as having teeth extracted.

The Tiger Moth was a product of its era and demands, like the Sopwith Camel or Wright Flyer, both of different eras again, to be approached on the terms and language of that time. The Tiger speaks the language of an open-cockpit, flapless, brakeless, high drag tailskid biplane, with none of the comforts of audible stall warning or self-starter. Unfortunately today we continue to see examples of pilots speaking the wrong language, and the Tiger signalling, the hard way, its displeasure at this lack of communication.

Spin recovery, sideslipping and prop swinging, while all basic to flying a Tiger, are a dialect seen as unnecessary in the modern instructional syllabus. Spin recovery, in the days when all training was done on Tigers, had to be competently demonstrated by the pupil before going solo. Today, few instructors will be current spinning aeroplanes that will only recover if the proper technique is applied. Sideslipping is a technique vital to the Tiger pilots repertoire, but remains largely untaught today. I heard one flight testing officer speak of sideslipping, in relation to the Tiger, as "dangerous". If this attitude is anything to go by, then little wonder gaps are being seen and felt these days.

There is thus a need, not only to retrieve techniques of an earlier era, but to retrain and re-educate the modern pilot born and bred of today's era.

One of the key links towards regaining and retaining aviations "institutional memory" for aircraft like the Tiger, is the instructor. Instructors must pass on not only the correct facts, figures and information. More important, they must convey to the student a real depth of understanding and enthusiasm for the prefered operating environment of a 1930's aircraft, and how that merges with the often quite different aviation envirnonment of today.

The aim of these notes is to attempt to fill some of the gaps, created by the shifting aviation environment over more than half a century, in the standard and readily available Tiger Moth Pilot Notes. This advice will hopefully assist aspiring Tiger pilots in establishing and maintaining a mutually enjoyable relationship. While experience will of course be the best guide in the end, perhaps some of these pointers will help avoid along the way the more expensive encounters that no one really needs.

Martin Burdan

Outline Of DH82A Type Conversion Syllabus

1. **The aviation environment in the 1930's**
   Think 1930's!!
   Safely mixing 1930's aviation culture with 21st century aviation culture.

2. **Systems**
   The technical peculiarities of the Tiger.

3. **Preflight**

4. **Starting and Shutdown**

5. **Ground Handling**
   Manoeuvring by hand.
   Taxiing.
   Effect of wind and torque.

6. **General Handling**
   Stalling.
   Steep and max rate turns.
   Sideslipping.
   Forced landings.
   Low flying.

7. **Spinning**
   Entry and recovery from fully developed spins.
   Recovery from incipient spins from the gliding turn, steep turn and sideslip.

8. **The Circuit**
   Vary heights between 500 and 1000 ft.
   Low circuit.

9. **Takeoff**
   Short field.
   Crosswind.
   EFATO.

10. **Landing**
    3 point.
    2 point.
    Cross wind.
    Short field.
    Glide approach.
    Slipping approaches, including forward slip onto field from 800 ft

11. **Emergencies**
    Restarting engine in flight.
    Fire in the air.
    Ditching.

12. **'I Learned About Flying From That'**
    A study of articles, accidents and incidents applicable to type.

Background History - The Pilots Environment Up To The 1930's

Aircraft

- Predominantly open cockpit biplanes.
- Flapless.
- Brakeless.
- Tailskid or tailwheel.
- No starter, electric's or automatic stall warning device.
- Communication by Gosport tube.
- Similar handling characteristics for all types.

Biplane Configuration

- High drag.
- 'Biplane effect'.
- Ailerons fitted to only one set of wings means slower roll response.
- Large rudder inputs to overcome adverse yaw.
- Poor visibility, particularly: Taxiing, Take off, Landing and in the Climb.
- Prone to wind effects on the ground (need for wingtip assistance in windy conditions).
- Wingtips closer to the ground.

Airfields

- Square grass paddocks.
- No runways.
- Take off and land into wind.
- 'Racetrack' pattern circuits as poor forward visibility necessitates a curved landing approach.
- No radios/control tower (light signals if any control) means lookout is paramount.
- Airfield personnel aware of aircraft needs e.g. wingtip assistance.
- All aircraft flying similar patterns.

Todays Piloting Environment

Human Factors In The Open Cockpit

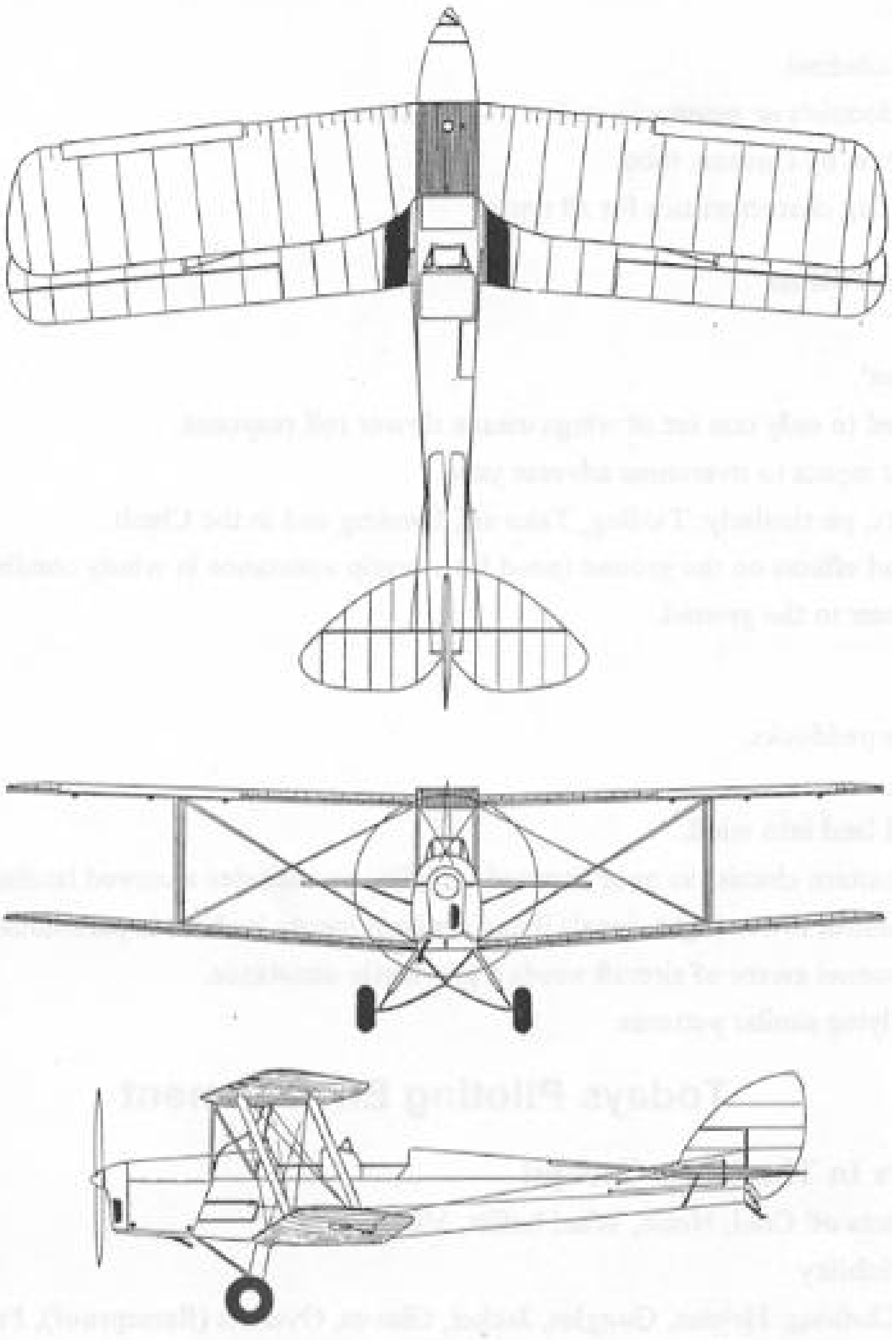
- Physical effects of: Cold, Noise, Wind buffet, Vibration.
- Restricted visibility.
- Restrictive Clothing: Helmet, Goggles, Jacket, Gloves, Overalls (flameproof), Footwear.
- Communication, both visual and aural, more difficult.

Simplicity of *Design* does not equate to simplicity of *Operation*

We need to: *Retrieve* techniques of an earlier era

Retrain the modern pilot

DH 82A Tiger Moth



Tiger Moth Systems - Main Points

Airframe

- Open cockpit biplane:
  - Separate, independent cockpits.
- Construction:
  - Welded steel tubing fuselage.
  - Wooden decking.
  - Wooden spars/ribs.
  - Fabric covering.
  - Wire bracing.
- No flaps.
- No brakes:
  - Tailskid.
- No electric's:
  - Magnetos and Radio excluded.
- No audible stall warning.
- No starter.
- Trims:
  - Spring loading on ***elevator*** (adjustable in flight).
  - Spring loading on ***rudder*** (ground adjustable).

Engine

- Inverted, 130 hp (or 145 hp), 4 cylinder air-cooled inline, Dry sump.
- Large mass:
  - At 6.124 litres there is a need for careful warm-up.
- Bronze cylinder heads:
  - Need for ***unleaded*** fuel.
  - Alloy heads leaded or unleaded.
  - Minimum 73 octane.
- Left hand tractor:
  - Power on, ***right*** swing.
  - Power off, ***left*** swing.
- Oil:
  - ***100*** grade (***80*** grade will do for an emergency top up).
  - Detergent ***or*** non detergent? Determine which type for the particular engine. ***Do not mix*** detergent oil into an engine running on 'straight' oil. If necessary 'straight' oil may be added to an engine running on detergent oil.
  - 2.1 gal max.
  - 1/2 min. operating level.
  - Oil filter. Turn 360 degrees once a day.
  - Consumption approx. 1/2-1 litre per hour. (With ring mod. 3-6 hrs/litre).
  - Tank shape means greater ***apparent*** consumption at the top of the dipstick.
  - Leaks are normal and increase during aerobatics.

- Magnetos:
    - Impulse right hand side. (This can stick. Know the procedure for 'unsticking').
    - Manual advance/retard linkage.
- Switches:
    - Two sets.
    - Down and *off.*
    - Up and *on*.
- Carburettor heat:
    - 'Automatic', but understand its operation and pitfalls thoroughly.
- Mixture:
    - Often disconnected or wired back.
    - Works in ***reverse*** sense to modern aircraft.
- Throttle operation:
    - ***Smooth*** opening (3 seconds as a guide). Engine will cut if throttle is rammed open.
    - The last third is more difficult to open as the carb heat cold air butterfly opens.

Fuel

- 19 gal gravity feed.
- 18 gal max. for aerobatics.
- No graduations on fuel sight glass. Consider your watch along with the gague.
- Approximately 15 minutes flying time remaining once the 'pip' disappears.
- Carb 'Tickler' button floods the inlet manifold for priming.

Instruments

- No coloured arcs.
- Airspeed indicator:
    - mph.
- Turn and slip:
    - ***Top*** needle slip/skid. Can be difficult to see if the pilot sits high.
    - ***Bottom*** needle turn indicator.
    - Venturis for gyro suction.
- Oil pressure gauge:
    - Large scale and small operating range.
- Compass:
    - Entirely different mode of operation.
- Inclinometer:
    - Indicates fore/aft angle of the aircraft.
    - *Not* a VSI.
- Tachometer
    - Cable drive and needle may fluctuate.

Pre-flight Inspection - Main Points

Attitude

- *Pre-flight the aircraft as though you are looking for excuses **NOT** to go flying, and then be pleasantly surprised that you can, rather than conducting a cursory 'look over' as a prelude to the foregone conclusion that you **WILL** go flying.*
- Be systematic.
- Carry a rag. You will get your hands dirty!
- **LOOK and SEE, TOUCH and FEEL, LISTEN and HEAR.**
- Maintain a clean aeroplane. This:
  - Looks nice.
  - Increases the life of fabric and woodwork.
  - Allows the pilot to keep a closer eye on things.

Aircraft - Preliminary

- Check oil, (and do a fuel drain) *before* you lift the tail.
- Wind direction:
  - Into wind for start-up.
  - Suitability for taxiing.
- Ground surface:
  - Free of stones.
  - Suitable for a secure foothold for prop swinging.
- Chock aircraft.
- Switches off, throttle closed.
- Trim fully aft.

Engine

- Oil leaks/consumption:
  - Develop a sense of what is 'normal'.
- Oil filter:
  - Turn 360 degrees clockwise or anticlockwise once a day.
- Exhaust manifold:
  - Nuts secure.
  - Pipe free of cracks, particularly around the flanges.
- Cooling baffles:
  - Secure, particularly the clips fastening the two rods.
  - Monitor any cracks.
- Ignition and fuel systems:
  - Magneto grounding wires secure and caps uncracked.
  - Ignition leads secure.
  - Spark plugs firm (check with your fingers).
  - Monitor linkage play and check lock nut security.
  - Carburettor heat butterfly operation.

- Cowls:
  - Monitor any cracks.
  - Security of the 10 nuts which fasten them.
- Check switches off, throttle closed. Swing propeller 4 blades to check for:
  - Compression leaks.
  - 'Hydraulic effect'.
  - Impulse 'clack'.
  - Propeller security.
  - Blade condition, particularly brass leading edge and security of its rivets.
  - ***Treat engine as live always!!***
- Lift engine on propeller boss to check security of the prop and play in engine mount bushes.
- Spinner tight against the propeller hub and splitpin secure.

Airframe

- Condition of all fabric, riblets and leading/trailing edges (particularly near wingwalks).
- Condition of all bushes: Rudder bar, Ailerons, Elevators, Rudder.
- Firmness and security of bracing wires and struts.
- Bracing wires free of corrosion.
- Undercarriage: alignment of bolts and stays.
- Tyres:
  - Condition.
  - Creep.
  - Inflation (12-15 lbs).
- Front cockpit:
  - No loose articles.
  - Seat cushions secure (remove for solo aerobatics) and correct height for passenger.
  - If flying solo remove stick, secure harness and fasten both doors.
  - Throttle friction nut *loose*.
- Beneath the fuselage:
  - Control box inspection panels secure.
  - Pitot connections.
  - Aileron cables - condition, security.
  - Idler arm clearance and security of splitpins.
- Rear cockpit:
  - No loose articles.
  - Stick free and ailerons/elevator operating in correct sense.
  - Compass ring free to rotate and locking device functioning.
  - Seat cushion correct height.
- Luggage locker:
  - Any equipment secure. Locker empty for aerobatics.
  - Rudder and elevator cables.
  - Condition, security.
- Lift the tail at the *end* of the strut, holding firmly on balance point. Check:
  - Tailskid wear.
  - Tailpost and tailplane rear bracket free of cracks.
  - Rudder travel.
  - Condition of fabric beneath elevators.
- The remainder of the pre-flight is a repetition of the above points.

Starting

Pre-start

- Aircraft into wind.
- Consider taxi feasibility regarding proposed taxi path.
- Ground surface free of stones and suitable for a secure foothold.
- Chocks in place.
- Pilot in cockpit.

The Propeller Swinger:

- Calls the start sequence and is in charge until the moment the engine fires.
- Proceeds to the next instruction when the pilot confirms the current instruction by repeating it.
- Always checks the switches are in the correct position (down and ***off***, up and ***on***).
- Treats the prop as live ***always***.
- Listens for impulse 'clack' when swinging.
- ***Thinks*** before acting. Is ***never*** in a hurry.

Cold start sequence

Call

- "Fuel on".
- Prime the carburettor by holding the 'tickler' button down until fuel flows out under the engine.

Call

- "Switches off, throttle closed".
- Pull the prop clockwise 4 blades.

Call

- "Switches off, throttle wide".
- Pull the prop through anticlockwise 8 blades.

Call

- "Throttle closed".
- "Throttle set" (approx. 1/4 inch).
- "Contact" (Never "switches *on*", as this can be confused with "switches *off*").
- The pilot must hold the stick ***hard*** back.
- Swing the prop clockwise. The engine should start!

Hot Start Sequence

- Try the last call sequence. ***Beware pre-ignition.***

Failure To Start

- Ensure impulse is working. A light tap with a coin in the correct spot will fix it.
- If the engine has been cooling down, use the 'cold start' sequence.
- If the engine is hot or has not started from cold, assume overpriming.

Overpriming

- Swing the prop anticlockwise several blades with the switches off and throttle wide.
- Try the last call sequence.
- If this fails, begin again with the 'cold start' sequence.

Warm-up

- 800-1000 rpm.
- Oil pressure 35 lbs within 30 sec.
- 4-8 minutes (or ***more***), depending on outside temperature.
- Check each mag at 900 rpm.

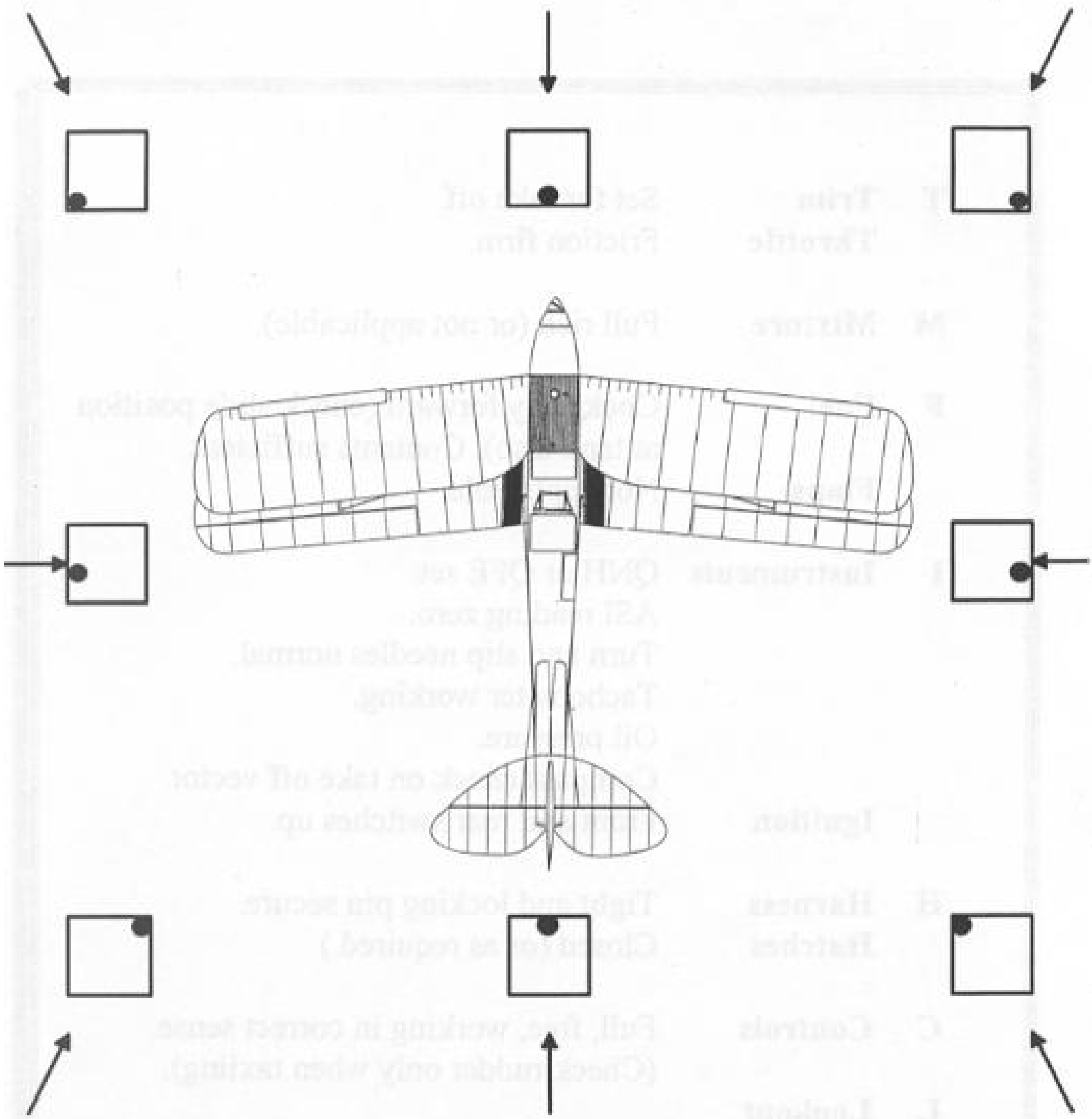
Run-up

- Stick ***hard*** back.
- 1600 rpm check each mag. 100 rpm max drop. Use your ears to determine any rough running.
- Oil pressure 40-45 lbs.
- Full power check only if considered necessary and for ***minimum*** time (max 10 sec).
- 1800 rpm minimum static rpm.
- Check idle 550-600 rpm, recheck oil pressure.
- Wave chocks away.
- Idle 800 rpm minimum for DVA's.

Taxiing

- Anticipate, especially on hard surfaces. Remember, ***no brakes.***
- Taxi slowly. A brisk walking pace is fast enough.
- Weave smoothly. ***Never*** taxi in a straight line. Get your head out of the cockpit.
- Speed control. Application of power will assist turning (especially to the right), but remember it will also increase speed.
- Remember that high power and tight turns can strain the crankshaft.
- Moderate winds and above. Turn in the direction of the weathercock, or use the momentum of the weathercock and turn 270 degrees.
- Wingtip assistance for turning in confined spaces.
- Think ***wind direction*** at all times. Position controls accordingly (see diagram page 10).
- In brisk tailwinds full forward trim will assist positive forward stick.
- Wingtip (and tail) assistance in winds moderate and above.

Stick Position Relative to Wind for Taxiing



Drills of Vital Action

T	**Trim**	Set for take off.
	Throttle	Friction firm.
M	**Mixture**	Full rich (or not applicable).
F	**Fuel**	Cock fully forward (check slide position at tank also). Contents sufficient.
	Flaps	Not applicable.
I	**Instruments**	QNH or QFE set. ASI reading zero. Turn and slip needles normal. Tachometer working. Oil pressure. Compass check on take off vector.
	Ignition	Front and rear switches up.
H	**Harness**	Tight and locking pin secure.
	Hatches	Closed (or as required.)
C	**Controls**	Full, free, working in correct sense. (Check rudder only when taxiing).
L	**Lookout**	

Upper Air Exercises

Pre-Takeoff

- DVA's
- Long periods of 'ticking over' (minimum idle) may cause the plugs to oil. Maintain at least 800 rpm.
- If there is any delay angle off on the runway before lining up to ensure a clear takeoff path ahead.
- Note the 'picture' of the horizon through the cowl. This is the 3-point landing attitude..

Takeoff

- Head out left or right side. (Some prefer head upright and use of peripheral vision).
- Smooth throttle operation (3 seconds to full power).
- Tail up to flying attitude. (Head to normal upright position if you've been looking out one side).
- *Right* swing, *left* rudder. Reasons for swing:
  - Gyroscopic..
  - Asymmetric thrust.
  - Slipstream.
  - Torque.

Climb

- Power back to 2000 rpm at a safe altitude, 66 mph.
- *Lookout* - maintain by climbing in zigzags every ten seconds or so.

Turns

- Effect of torque. Note greater use of rudder.
- Medium, 90, 180 and 360 degrees left and right.
- Steep, 360 degrees left and right.
- Max. rate, 360 degrees, holding the aircraft just above the stall..

Stalling

- HASELL checks.
- Power off, fully developed. Note ASI and aircraft symptoms.
- Power off, recover at onset.
- Power on (1600 rpm), recover at onset.
- Fully developed (1600 rpm).
- Stalling in the turn (1800-1900 rpm), left and right.
- Clearing turn after each stall.

Sideslipping

- Forward slips, left and right.
- Slipping in the turn, left and right.
- Clearing turn after each slip.

Forced Landings Without Power

- Commence at a variety of altitudes.
- Close the throttle.
- Convert speed to height.
- Trim 66 mph.
- Check wind direction.
- Select field. Considerations:
  - Size
  - Shape
  - Slope
  - Surface
  - Obstacles on the surface and on the approach
- Plan the approach.
- Trouble checks - fuel, (mixture), ignition, instruments.
- Check for partial power.
- 'Mayday' (radio equipped).
- Brief passenger.
- Downwind - fuel off, ignition off, harness tight.
- Aim ***high***, planning for initial touchdown point 1/3 of the way into the field.
- When sure of making the field, sideslip to reach desired touchdown point.
- When practicing be sure to warm the engine at least every 1000 ft.

Low Flying

- Purpose
  - To note effect of wind - slip/skid.
  - To ensure correctly balanced turns.
  - To carry out safe 'bad weather reversal' technique.
- 250 to 300 ft
- 1800-1900 rpm, 75 mph approx.
- Loosen throttle friction nut for ease of power changes in the turn.
- Control airspeed with throttle.
- Carb icing:
  - do ***not*** fly for prolonged periods at low power (below 1700 rpm).

Sideslipping

Aim

- To lose height without gaining airspeed.
- Typically used on approach.

The Forward Slip

- Power off
- Aileron in desired direction of the slip (this will normally be into wind on final approach), with enough opposite rudder to maintain intended forward direction.
- Fly an *attitude* and monitor airspeed (66-70 mph)
    - Airspeed too high and aerodynamic loads will be high.
    - Airspeed too low and aircraft may flick and spin.
- Increase aileron/rudder to increase the rate of descent and vice versa.

The Slipping Turn

- As for a forward slip, but increase bank and/or hold off rudder.

Recovery

- Level wings with ailerons and reduce rudder accordingly. Check airspeed.

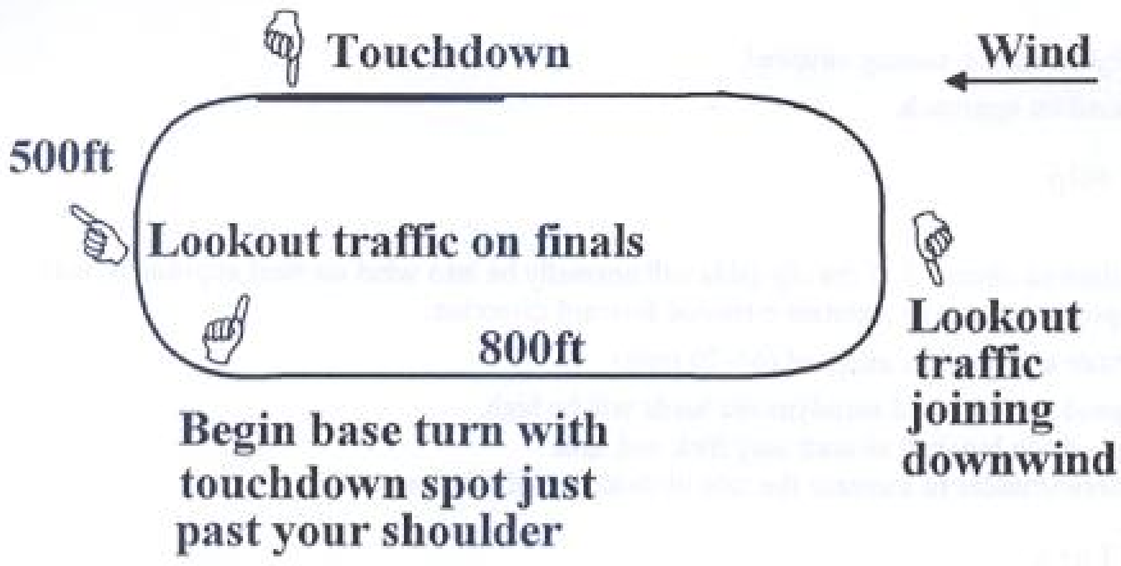
Considerations

- ASI may be inaccurate in the slip.
- Nose does not point along the path of descent.

Human Factors

- Warm engine if slipping from a considerable height and after each exercise.
- Clearing turn after each exercise.
- Low comfort factor with wind on the side of your face and the aircraft out of balance.
- Lookout, particularly on the 'blind' side.
- Don't slip too close to the ground with the risk of striking the lower wing. With this in mind recover from the slip above 100 ft.
- Remember the effect of *inertia* when sideslipping close to the ground.

The Circuit



General

- Smaller and differently shaped circuit to what modern aircraft use.
- Need for constant ***Lookout!!!***

Lining Up

- Lookout for traffic in the circuit.
- Angle off on the runway if any delays to ensure clear takeoff path ahead.
- Decision point for abandoned take off.
- Note the 'picture' of the horizon through the cowl. This is the 3-point landing attitude.
- Align the compass to check its reading against the takeoff vector.
- Check the windsock immediately before rolling.

Takeoff

- Head upright or out left or right side. Become ***ambidextrous!***
- Throttle smoothly to full power. Count 'one hundred, two hundred, three hundred'.
- Stick (following throttle) well forward.
- Tail up to flying attitude. Be prepared to check stick back to hold this attitude.
- Right swing, *left* rudder.
- Lookout either side if necessary once the tail is up.
- Lift off and let the speed build up to 66 mph before assuming the climb attitude.

Climbout

- Power back to 2000 rpm at a safe height, 66 mph.

Crosswind

- Lookout, particularly for traffic joining downwind.

Downwind

- 700 to 800 ft.
- Wing tip tracking down landing path.
- DVA's: Fuel, (Mixture), Instruments, Harness, (Radio).

Base

- Begin turn onto base when touchdown point just passes your shoulder.
- Power as required (1400 rpm), 75 mph.
- Maintain upper side of glide slope.
- Assess rate of descent and adjust power accordingly.
- Lookout, particularly for traffic on finals.
- Wheeler or three pointer? Assess conditions and **decide prior** to touchdown.
- Balanced turn onto finals important in the 'low and slow' situation.

Finals

- Approach 66 mph (or faster if conditions warrant).
- 60 mph over the fence (55 mph short landing).

The Landing

Wheeler Landings

- A ***'must'*** for higher winds (15+ kts), gusts, crosswinds.
- Greater visibility and control.
- Fly on with some power, no slower than 60 mph.
- 70+ mph to maintain aileron control in gusty conditions. Consider runway length.
- ***Lightly*** check stick forward as the wheels touch. Close throttle.
- ***Follow*** the tail down with the stick as it settles. ***Leading*** the tail may cause 'ballooning'.
- Tail down, stick ***hard*** back.
- Be ready on the rudder to hold straight.
- Relax only when the aircraft has ***stopped***.

Three Point Landings

- Vulnerable to wind in this attitude with large wing area and poor aileron response.
- Wheel it on if any doubt.
- High nose attitude.
- Head out one side, but be prepared to change sides.

Crosswind Landings

- Max. crosswind component 10 mph.
- Angle into wind if possible.
- Crab until short finals, then into wind wing down, hold straight with rudder, flying on touching one wheel first.
- Maintain power as necessary until both wheels are on.
- Watch for weathercocking when one or both wheels touch.

Shutdown

- 800 rpm check magnetos for both live and dead cut.
- Idle approximately 30 seconds to cool engine evenly.
- Increase power to approximately 700 rpm to get some inertia into the propeller.
- Switch off both magnetos.
- Smoothly open throttle to fully wide position before the propeller stops turning. This draws cold air into the cylinders to cool any carbon hotspots and prevents running on or back firing.
- Close throttle.
- Front magneto switches off.
- Fuel off.
- Trim hard back.

Picketing

Light Winds

- Nose into wind.
- Chocks behind the wheels.
- Trim hard back.
- Control lock in place.

Moderate Winds (15 to 20 kts) And Above

- Select a sheltered spot if possible.
- Tail into wind.
- Chocks in front of the wheels.
- Trim hard forward.

Spinning

Aim

- To identify the incipient and fully developed spin.
- To recover with minimum loss of height.

Definition

- Fully developed stall with the aircraft simultaneously ***pitching, rolling*** and ***yawing*** around a vertical axis.

Theory

- Aircraft stalls.
- Wing drops and the nose yaws towards the increased drag of the lower wingtip.
- Angle of bank increases.
- Nose pitches down.
- Full spin develops after approx. one rotation.

Characteristics

- Steep nose down attitude (Flatter spins a result of rearward centre of gravity).
- Constant rate of descent.
- Low airspeed.
- Autorotation i.e. roll, pitch and yaw perpetuate one another (see diagram page 20).

Air Exercises

Fully Developed Spin From A Straight Glide

- HASELL checks.
- Close the throttle.
- Hold aircraft straight and level, raising the nose as the speed drops.
- As aircraft stalls, apply full rudder in desired direction, stick hard back and ailerons central. ***Hold*** controls in this position.

Recovery

- Close throttle.
- Identify direction of rotation. Confirm on turn indicator.
- Full opposite rudder, ***pause***.
- Stick centrally and positively forward to break the stall.
- As rotation stops, centralise controls and ease out of the dive.
- Open throttle carefully. (Nose above the horizon).
- Clearing turn after each exercise.

Incipient Spin Situations

Note that an incipient spin is not a spin at all. It is the condition immediately preceeding a spin. For example, a wing drop stall, which if not corrected may well develop into a spin. Recovery, in all circumstances, is to **centralise the controls and fly the aircraft only when it has recovered flying.**

Incipient Spin From A Side Slip

- Cross the controls, gradually pull the stick back, and note the nose attitude and airspeed at the point of stall.

Incipient Spin from a Steep Turn

- Generally a result of either excess rudder (top or bottom) or excess elevator.
- Reduce power to 1800-1900 rpm to minimise loads.
- Enter as for a normal turn, except increase the elevator back pressure until the aircraft stalls.
- The aircraft will readily drop a wing, particularly if out of balance. As it does so, centralise the controls.
- Close the throttle when the nose is pointing down to avoid excess speed building up. Closing the throttle with the nose high as in a flick over the top, may result in stopping the propeller.
- When the aircraft is clearly flying again, recover from whatever attitude it has assumed. Open the throttle carefully to avoid overspeeding.
- The wing drop is well demonstrated by applying excess bottom or top rudder.
- For excess bottom rudder, attempt to hold the nose up by pulling back on the stick.

Incipient Spin from a Gliding Turn

- This exercise simulates the classic stall/spin situation turning base to finals.
- Set the aircraft up in the glide.
- Begin the turn, but gradually apply excess rudder and hold off bank.
- As the nose drops, attempt to hold it up with elevator.

Incipient Spin from a Climb

- This exercise simulates an engine failure after takeoff and the rapid development of a stall/spin situation unless appropriate corrective action is taken.
- Set the aircraft in a normal climb.
- Close the throttle for a simulated engine failure.
- Hold the stick in its 'climb position', rather than deliberately lowering the nose.
- Gradually apply aileron and rudder.

Incipient Spin from a Climbing Turn

- The exercise is applicable to climbing in potential 'loss of horizon' situations such as mountainous terrain when it is important to maintain correct attitudes and airspeeds.
- Set the aircraft in a normal climb.
- Gradually raise the nose while commencing a turn.
- Demonstrate with and without excess rudder.

Spinning

RAAF Test Pilot Assessment of the Tiger Moth's Spinning Characteristics

11.1 **Baseline Spin.** The baseline spin was defined as an erect (upright) spin entered from wings level flight at 40 KIAS and 5000 ft Hp, with idle power set. Full pro-spin controls were maintained until the recovery procedure (full opposite rudder, aileron neutral and longitudinal stick neutral) was applied. Gross weights between 1800 lb and 1600 lb were evaluated. The aircraft was trimmed at 58 KIAS prior to each spin.

Sideslip was kept to a minimum as airspeed decreased from 58 kt. Ten baseline spins were flown, eight with the automatic slots locked and two with the slots unlocked (for test purposes only; the slats should be locked for intentional spinning). An eight turn limit per spin was observed, although this was not a requirement of Reference A. Although the baseline spin was entered from level flight, spins could also be entered from turns if required.

11.2 **Spin Entry.** From 58 KIAS the airspeed was reduced to 40 KIAS using elevator alone. Initiating the spin was achieved by smoothly introducing simultaneous full aft stick (with neutral aileron) and applying full rudder in the desired spin direction. Full deflection of each control was achieved within one second. The forces were required to initiate the spin were light to moderate and no difficulty was experienced holding the controls in the required position.

11.3 **Incipient Phase.** The incipient phase of the spin was defined as the period from the application of pro-spin controls to the end of the first turn. After the application of the pro-spin controls, the aircraft pitched up slightly and began rolling and yawing in the direction of applied rudder. The aircraft continued rolling through the inverted position, and the nose fell through the horizon to a position 70-80 degrees low. The aircraft continued rolling to an upright attitude with the nose approximately 60 degrees below the horizon, at the completion of the first turn. Time taken for the incipient phase was 3-4 seconds, with an altitude loss of 50-100 feet. The motion, while rapid, was smooth and no hesitations in roll or yaw were experienced. Throughout the incipient phase the light to moderate control forces allowed easy maintenance of the pro-spin controls.

11.4 **Steady State Spin.** After the completion of the first turn the aircraft was defined as being in a steady state spin. The steady state spin was characterised by a 60 degree nose-low attitude, with no detectable oscillations or hesitations in roll or yaw rates. The time per turn was quick (approximately 2-3 seconds), however the motion was quite smooth and no disorientation was experienced. Altitude loss was between 200 and 300 feet per turn. The forces required to hold the pro-spin controls were light to moderate (with outspin force required to keep the aileron neutral), and no stick or rudder buffeting was observed. During the spin the pilot remained firmly restrained, and determining spin direction from outside references was easy. The engine RPM remained stable throughout the spin and no rough running was noticed. Airspeed during the spin was observed at 48 KIAS and 36 KIAS for left and right spins respectively. No other significant differences were observed between left and right spins. The aircraft remained in the steady state spin while the pro-spin controls were applied and no tendency to transition to a spiral dive was noted. Only small differences between the slots locked and unlocked case were observed, although the slots deployed symmetrically during the spin when unlocked.

11.5 **Recovery.** Recovery from the baseline spin was made from both the incipient and steady-state cases. Incipient recovery (which merely required centralising the controls) was rapid, with yaw and roll ceasing within a half a turn after recovery control application. Full power was then applied and the wings levelled. Height loss from the application of recovery controls to wings level, climbing flight at 58 KIAS was approximately 250 feet. Once the spin had progressed to the steady state phase, recovery was effected by applying full deflection rudder opposite to the direction of spin, and simultaneously moving the control column forward to the elevator neutral position, maintaining neutral aileron. Following the application of recovery controls, the rotation ceased abruptly (within one turn), providing the pilot with a good cue to centralise the rudder. Full power was applied after the rotation had ceased, and the wings levelled. Height loss from the application of recovery controls to wings level, climbing flight at 58 KIAS was 300 feet. The recovery technique was straightforward to fly and only required moderate control forces. Once the rotation had ceased, prompt centralisation of the rudder was required to prevent departure in the opposite direction.

11.6 **Recovery Variations.** To establish the recovery technique providing the minimum altitude loss, four additional recovery variations were examined, at the test conditions described at paragraph 11.1. The baseline spin entry technique was used in each case.

11.7 **Controls Central Recovery.** The effect of centralising the rudder and control column (longitudinally and laterally) was examined during one left and one right spin. From a left spin, this technique resulted in a recovery 2.5 turns after the centralisation of the controls, consuming significantly more altitude than the baseline recovery. Similar results were observed during the right spin.

11.8 **Controls Free Recovery.** The effect of abandoning the controls during the spin was examined during one left and one right spin. For each direction of spin, releasing the controls did not effect a recovery after a further four turns, and a standard recovery was then made.

11.9 **Pro-Rudder Recovery.** The effect of maintaining full rudder deflection in the direction of spin, while applying forward control column was assessed during one spin in each direction. In both cases, the aircraft failed to recover and standard recovery action was required.

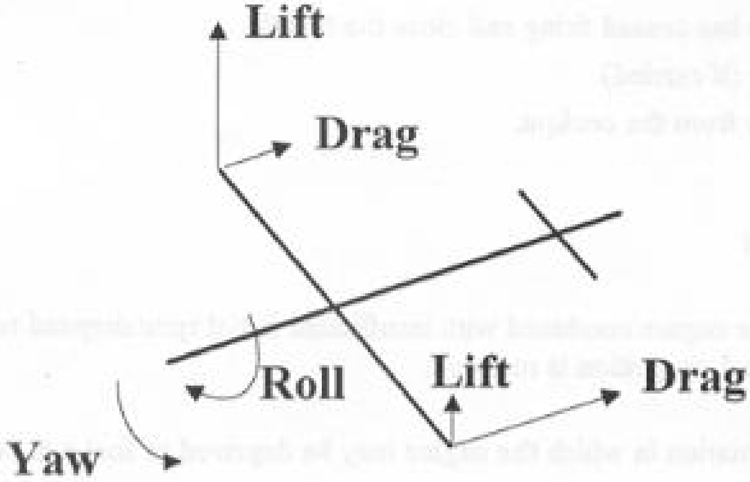
11.10 **Aft Stick Recovery.** The effect of applying full rudder deflection opposite to the direction of spin, while maintaining full aft control column was examined during one spin in each direction. In the case of the left spin, after applying the opposite rudder the spin rotation ceased after less than one turn. For the right spin, the recovery was slightly slower, requiring 2.5 turns.

11.11 **Minimum Altitude Recovery.** In all cases, minimum altitude loss for the spin recovery was achieved by applying full rudder opposite to the direction of spin and moving the control column forward. This is the recommended spin recovery technique.

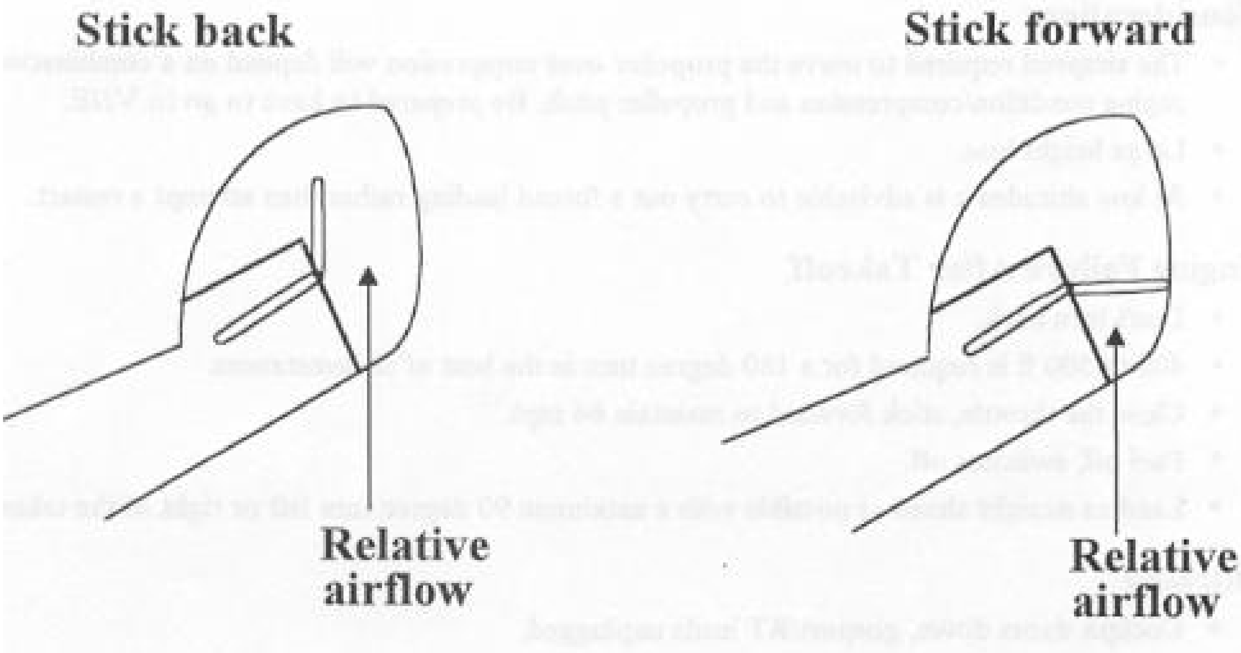
11.12 **Effect of Aileron During the Spin.** The effect of introducing aileron during the spin was evaluated for both the in-spin and out-spin cases during left and right spins. Lateral control column displacement in both directions generally increased the rate of rotation, but did not inhibit recovery if inadvertently applied while moving the stick forward. Lateral control displacement was not required to maintain a stable spin.

FLTLT A.J. Morris January 1993

Principles of Spinning



Blanketing Effect of Elevators



Emergencies

Action In The Event Of A Fire

- Fuel off.
- Open the throttle fully.
- Switches off after the engine has ceased firing and close the throtle.
- Operate the fire extinguisher (if carried).
- Sideslip to keep flames away from the cockpit.
- Land as soon as possible.

Propeller Stopping In Flight

Causes

- Lack of fuel or ignition to the engine combined with insufficient initial rpm/airspeed to keep the propeller rotating until the fuel or ignition is restored.

Likely situations

- Any nose high, low speed situation in which the engine may be deprived of fuel e.g. rolling off the top of a loop.
- Power off stalling.
- Stall turns if poorly executed.
- Initial stages of a spin if the nose is pulled particularly high.

Restarting Engine In Flight

- Switches *on*, throttle closed.
- Dive steeply, but remember the VNE is 160 mph.
- Pull out *gently*.
- Open the throttle carefully. (Nose above the horizon).

Considerations

- The airspeed required to move the propeller over compresion will depend on a combination of engine condition/compression and propeller pitch. Be prepared to have to go to VNE.
- Large height loss.
- At low altitudes it is advisable to carry out a forced landing rather than attempt a restart.

Engine Failure After Takeoff

- Don't turn back.
- 400 to 500 ft is required for a 180 degree turn in the best of circumstances.
- Close the throttle, stick forward to maintain 66 mph.
- Fuel off, switches off.
- Land as straight ahead as possible with a maximum 90 degree turn left or right of the takeoff path.

Ditching

- Cockpit doors down, gosport/RT leads unplugged.
- Land under full control, wings level, as slowly as possible with minimum descent rate in the three point attitude. Aim to touch tail first.
- For smooth or slightly rippled water (about 5 knots) touchdown into wind.

- In winds above 5 knots ditch according to the swell system rather than the wind direction.
- In winds up to 25 knots, ditch parallel to the swell on the crest of a wave, crabbing to offset drift and kicking straight immediately before touchdown.
- In winds 25 to 35 knots, compromise between the swell system and wind direction.
- In winds over 35 knots land into wind regardless of the swell system.
- If landing in the direction of the swell, avoid the face of the swell as the danger of nosing over or diving beneath the surface is greater. If necessary it is preferable to land on the back of a swell.

Review

Revision

- All exercises as required.

Flight test

- Basic engine and aircraft handling.
- Stalling.
- Spinning.
- Forced landings.
- All types of circuits.
- Engine failure after take off.

Technical examination

- Both written and oral.
- A thorough knowledge of Tiger Moth drills and limitations is required as well as Gipsy Major engine handling and starting techniques.

Operating Data

Engine Data

Type	Gipsy Major Series I, 4 cylinder inverted inline, air cooled.
Bore	4.65 in.
Stroke	5.5 in.
Capacity	6.125 litres.
Compression Ratio	5.25 : 1
Weight	330 lbs (dry).
Rotation	Left Hand Tractor.
B.H.P	120 at 2100 rpm. 130 at 2350 rpm.
Cruising Revs	1900-2050 rpm.
Min. Takeoff rpm	1825 rpm.
Max. Climb rpm	2100 (30 minutes).
Max. Cruise rpm	2100 (30 minutes).
Max. rpm	2400 (5 minutes).
Fuel Consumption	6 to 6.5 gal/hr at 1950 rpm. 7 to 7.25 gal/hr at 2050 rpm. 7.75 to 8 gal/hr at 2100 rpm.
Safe Endurance	2 hr's 30 minutes at 1900-1950 rpm. 2 to 2 hr's 15 minutes at 2000 rpm.
Fuel Type	73 octane min. Unleaded (Bronze heads). Leaded or unleaded (Alloy heads).
Fuel Capacity	19 gallons. 18 gallons max. for aerobatics.
Mixture Control (if fitted)	Not to be used below 5000 ft and must not be used to cause. a drop in rpm.
Oil Capacity	2.1 gallons.
Oil Type	100 grade detergent or non-detergent.
Oil Consumption	1/2 to 1 litre/hr. (Oil ring mod. will give 1 litre in 3-6 hr's).
Oil Pressure	40-45 lbs (Normal). 60 lbs max. (Emergency - not more than 5 minutes). 35 lbs min. 30 lbs min. (Emergency - not more than 5 minutes).

Weights

Empty	1200 lbs approx. (see flight manual).
Fuel	142 lbs.
Oil	20 lbs (included in empty weight).
M.A.U.W.	1770 lbs (aerobatics). 1825 lbs (normal).
Max. Baggage	60 lbs.

Dimensions

Span	29 ft 4".
Length	23 ft 11".
Height	8 ft 9.5".
Track	5 ft 3".
Total Wing Area	239 sq. ft.

Operating Conditions

Warm up	800-1000 rpm for 4-8+ minutes depending on temperature.
Running up	1000 rpm test mags separately.
	1600 rpm mag. check. Max. drop 100 rpm. Use your ears to determine any rough running.
Full Power Check	Only if considered necessary and then max. time 10 seconds. 1800 rpm min. static.
Idle	550-600 rpm.
Takeoff	Full throttle.
Initial Climb	Full Throttle, establish 66 mph, before assuming climb attitude.
Climb	Power back to 2000 rpm at a safe height, 66 mph.
Minimum Climb Speed	60 mph.
Rate of Climb (Sea Level)	800 ft/minute approx.
Service Ceiling	15,800ft (100ft/minute climb)
Cruise	1950-2050 rpm, 80-90 mph.
Maximum Speed	90-110 mph (Depends on rigging, propeller pitch)
Bad Viz. Cruise	1700 rpm min., 75-80 mph.
V.N.E.	160 mph.
Best Gliding Speed	66 mph (Increase to 70-75 mph if penetration is required).
Powered Approach	60-66 mph.
Glide Approach	66 mph.
Gliding Turn	66 mph.
Steep Gliding Turn	75 mph.
Stalling Speed	45 mph.
Max. Crosswind Component	10 mph.

Aerobatics

Note: Speeds will vary depending on load, experience etc.

Loop	110 mph.
Barrel Roll	110 mph.
Stall Turn	110 mph.
Slow Roll	110-120 mph.
Inverted Gliding	85 mph.
Roll off the Top of a Loop	125-135 mph.

DH82A Tiger Moth Type Rating

Technical Knowledge Examination

General

1. Location of Documents________________
2. Location of First Aid Kit________________
3. Location of Axe________________
4. Location of Fire Extinguisher________________
5. Method of operation of Fire Extinguisher________________
6. Method of operation of Control Locks________________
7. Location of Picket Points________________
8. Location of Pitot Tube________________
9. Location of Static Source________________
10. Tyre pressure ________________
11. Explain how to set the compass to fly a heading of 230 degrees ________________

Fuel

1. Fuel type ________________
2. Location of fuel tank(s)________________
3. Location of fuel vent________________
4. Location of fuel drain(s)________________
5. Capacity of fuel tank(s)________________
6. Usable fuel ________________
7. Fuel consumption:

1950 rpm_____	gal/hr	Endurance_____	hrs
2050 rpm_____	gal/hr	Endurance_____	hrs
2100 rpm_____	gal/hr	Endurance_____	hrs

8. Safe endurance at 2000 rpm________________
9. How much flying time remains once the fuel 'pip' is out of sight?________________
10. In what position will the fuel cock be for 'on'?________________

Oil system

1. Location of oil tank________________
2. Capacity and minimum operating level________________
3. Wet or dry sump________________
4. Oil grade and type________________
5. Oil consumption________________
6. Oil pressure:

Minimum_____ Normal_____ Maximum_____ Emergency_____

Engine

1. Type ______________________________

2. Horsepower ______________________________

3. Detail the starting procedure, including all 'calls' ______________________________

____

____

____

____

4.Time and rpm for warm-up ______________________________

5. Run-up rpm ______________________________

6. Maximum rpm drop ______________________________

7. Cruise rpm ______________________________

8. Maximum permissible rpm ______________________________

9. Maximum permissible time at full throttle ______________________________

10. Explain the carburettor heat system with particular reference to its pitfalls ______________________________

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____

____

11. How often should the oil filter be turned? ______________________________

12. Detail the procedure for unsticking the impulse magneto ______________________________

____

13. What 3 things are you checking for when you pull the prop through during the pre-flight?

____

____

14. What 2 circumstances might cause the engine to fire/backfire when being pulled through with the switches off? ______________________________

15. Detail the engine shutdown procedure ______________________________

____

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____

____

Operation and Performance

1. Maximum permissible speed ______________________________

2. Maximum crosswind component ______________________________

3. Climb speed ______________________________

4. Cruise speed ______________________________

5. Approach speed ______________________________

6. Best glide speed ______________________________

7. Stalling speed ______________________________

8. Speed for bad visibility configuration ______________________________

9. Using the performance graphs calculate the take off distance required considering a:

- pressure altitude at sea level
- temperature of 20 degrees C
- 2% uphill slope
- headwind of 10 kts
- weight of 1800 lbs

____

Weight and balance

1. Empty weight ______________________________
2. M.A.U.W. ______________________________
3. M.A.U.W. for aerobatics______________________________
4. Maximum fuel load for aerobatics______________________________
5. Maximum weight for luggage locker______________________________
6. Using the loading envelope graph solve this problem to see if the load is within limits:

Item	Weight (lbs)	Arm (inches)	Moment (lbs/inches)
Empty aircraft			
Pilot and passenger			
Fuel at 7.2 lb/gal			
Oil at 9 lb/gal			
Luggage			
All up weight			

C. of G. position within limits?______________________________

Loading problem checked by______________________________

Technical data checked by______________________________

Licence no. ______________________________

Date ______________________________