Aerobatics

Basic Manoeuvres and Spinning

in the DHC 1 Chipmunk

Third Edition - August 2017

Derived from various material by

Waypoints Aviation Ltd

Waypoints AVIATION

Aerobatics

Basic Manoeuvres and Spinning

in the DHC 1 Chipmunk

Third Edition – August 2017

Mark Woodhouse
19 Valhalla Drive
Richmond, Nelson 7020
New Zealand
03 5440968
021 620267
waypoints@clear.net.nz
www.waypoints.co.nz

CONTENTS

Page

Aerobatics

Waypoints AVIATION

Page

The Basic Aerobatic Manoeuvres

Page

Spinning

Waypoints AVIATION

Waypoints AVIATION

Introduction

This publication is intended to be a learning tool for pilots completing an Aerobatic Rating in the DHC 1 Chipmunk.

Nothing in this manual is new or original. I have 'borrowed' the material and inspiration from far and wide. Its quality has been very significantly improved by the knowledge, experience and considered input of Ross Crawford, Carlton Campbell and the late Peter Beaumont, for which I am very grateful.

Any residual errors, omissions and poorly explained bits are mine alone.

Should you or anyone you know wish to offer constructive comment on the content of these notes they would be highly valued. Please contact Mark Woodhouse at waypoints@clear.co.nz.

Should you or anyone you know wish to obtain an electronic copy of these notes, they are freely available by contacting Mark Woodhouse at waypoints@clear.co.nz.

Disclaimer

These notes were derived and compiled from a wide range of sources, and while the quality and accuracy of these sources appears to be reliable, there is every possibility that errors exist in this document.

Consequently, Waypoints Aviation Ltd does not guarantee that this publication is without flaw of any kind, and make no warranties, express or implied, with respect to any of the material contained herein.

Waypoints Aviation Ltd also disclaims all liability and responsibility to any person or entity with respect to errors and omissions, or loss or damage caused or alleged to be caused directly or indirectly by the use of information contained within this publication.

Waypoints AVIATION

Waypoints AVIATION

Aerobatics

Introduction

This manual introduces you to basic aerobatics in a light aircraft. The aircraft referred to throughout this manual is the DHC 1 Chipmunk.

Firstly I will cover the general considerations related to flying an aircraft in aerobatic manoeuvres. Then I will introduce you to manoeuvring the aircraft between manoeuvres by covering the wingover. The wingover is a very good manoeuvre to get you flying the aircraft in other than 'normal' profiles. The wingover is also a very good manoeuvre for positioning the aircraft prior to entering other manoeuvres and for linking manoeuvres together.

I will then cover the following basic/intermediate aerobatic manoeuvres:

1. The loop;
2. The aileron roll;
3. The stall turn;
4. The barrel roll;
5. The slow roll;
6. The roll off the top (or Immelmann turn), and,
7. The half reverse Cuban.

Finally I will cover the wingdrop stall as an introduction to the section on spinning.

Aerobatics are a valuable adjunct to any pilot's flying training. Although their operational value is limited, aerobatics will improve your confidence, judgement and coordination in handling aircraft at extremes of attitude and airspeed.

For aerobatics to be smooth and coordinated, you must fully understand the effects of the primary flying controls. No doubt, at this stage, you think you do, but go back through your notes on the earliest flying exercises and see how much you have forgotten! The secondary effects of controls and the effects of airspeed on control response become particularly important during aerobatics.

Your flying instructor, will teach you the basics of aerobatics - but practice is a major factor. Once you have successfully completed a solo aerobatics check, look for as many opportunities as you can to carry out practice. This **must** be under the direct supervision of your flying instructor and only attempt exercises you are approved to practice. You should practise rolling manoeuvres in both directions, so that you get used to the slight differences which exist, rather than developing a preference and practising rolls in one direction only.

Waypoints AVIATION

Your Aerobatics Training Programme

Simply put, with aerobatics training as with most flying training, one size does not fit all. The order in which you will be introduced to and learn aerobatics exercises and the time spent on each will depend largely on your previous experience and the rate at which you develop understanding, skill and confidence.

I have been influenced by a number of instructors over the years and tend toward the belief that students of aerobatic flight should start slowly and build in intensity with succeeding lessons. By beginning with gentle manoeuvres such as wingovers (chandelles) and lazy eights you will experience attitudes which may be unfamiliar to you. You will begin the process of maintaining an awareness of the where the horizon is at all times and of knowing where to look for cues to the progress of a manoeuvre.

The slow approach to building up aerobatics competence and confidence allows you to develop a positive appreciation, i.e. this is the manoeuvre and how to fly it, rather than being rushed into extreme manoeuvres and being scared just a little bit.

The slow approach has a number of separate and important advantages:

- It allows for you to build trust and confidence in both the aircraft and your instructor;
- It allows for you to build tolerance to aerobatic ‘g’ loads;
- It shows up any tendency for you to feel airsick or uncomfortable, and allows you to influence the pace of training;
- By spending the early time on gentle manoeuvres, it gives your instructor a chance to assess your handling ability and potential; and,
- It allows you to perfect the basic manoeuvres before moving on to increasingly difficult and complex manoeuvres.

Waypoints AVIATION

Related Considerations

Civil Aviation Rules and Associated Advisory Circular Information

Note: These extracts are current as at the date of production of this edition of the manual, however things change, so it is important for you to ensure they are still current when you refer to them.

CAR Part 61 Subpart L – Aerobatic Flight Rating

Current date: 10 November 2011

61.551 Eligibility requirements

(a) To be eligible for an aerobatic flight rating a pilot must:

(1) have satisfactorily completed an aerobatics ground course conducted under the authority of:

(i) an aviation training organisation certificate issued in accordance with Part 141 if the certificate authorises the holder to conduct the course; or

(ii) an aviation recreation organisation certificate issued in accordance with Part 149 if the certificate authorises the holder to conduct the course; and

(2) have satisfactorily completed an aerobatics flight training course conducted under the authority of:

(i) an aviation training organisation certificate issued in accordance with Part 141 if the certificate authorises the holder to conduct the course; or

(ii) an aviation recreation organisation certificate issued in accordance with Part 149 if the certificate authorises the holder to conduct the course; and

(3) have demonstrated competency in aerobatics and spinning to:

(i) an appropriately qualified flight instructor who operates under the authority of an aviation training organisation certificate issued in accordance with Part 141 if the certificate authorises the holder to conduct the assessment; or

(ii) a person who operates under the authority of an aviation recreation organisation certificate issued in accordance with Part 149 if the certificate authorises the holder to conduct the assessment.

(b) A holder of the following is deemed to have met the eligibility requirements of paragraphs (a)(1) and (a)(2):

(1) a current aerobatic rating issued by an ICAO Contracting State:

(2) a New Zealand Defence Force pilot qualification.

(c) A pilot who has passed a New Zealand Defence Force aerobatic assessment within the previous 2 years is deemed to have met all the eligibility requirements of paragraph (a).

61.553 Issue

(a) When a pilot has met the eligibility requirements of rule 61.551, the flight instructor or authorised person who conducted the competency demonstration required by rule 61.551(a)(3) may issue the aerobatic rating by entering the following statement in the pilot's logbook in accordance with rule 61.29:

This is to certify that [name of pilot] has satisfied the requirements of Civil Aviation Rules Part 61 for the issue of an aerobatic flight rating.

(b) The holder of an aerobatic flight rating issued under paragraph (a) may apply to the Director to have the rating endorsed on the holder's pilot licence.

(c) On receipt of an application under paragraph (b) and payment of the applicable fee, the Director may endorse the pilot licence with the aerobatic flight rating.

61.555 Privileges and limitations

Subject to the privileges and limitations of the pilot licence or certificate held, a current aerobatic flight rating authorises the holder to conduct aerobatic manoeuvres within the following limitations:

(1) at a height not less than 3000 feet above the surface while carrying a passenger:

(2) at a height not less than 1500 feet above the surface while not carrying a passenger:

(3) at a height less than 1500 feet above the surface while not carrying a passenger when authorised by the holder of an aviation recreation organisation certificate issued in accordance with Part 149, if the certificate authorises the holder to organise aviation events.

61.557 Currency requirements

(a) Except as provided in paragraph (b), the holder of an aerobatic flight rating must not exercise the privileges of the rating unless:

(1) within the previous 24 months, the holder has demonstrated competency in accordance with the requirements of rule 61.551(a)(3); and

(2) the flight instructor or authorised person who conducts the competency demonstration certifies the successful completion of the check in the pilot's logbook in accordance with rule 61.29.

(b) A pilot who completes the demonstration required by paragraph (a) within 60 days before the date on which it is required, is deemed to have completed the demonstration on the required date.

Waypoints AVIATION

Rule 61.551 Eligibility requirements

Ground course

Rule 61.551(a)(1) requires an applicant for an aerobatic flight rating to have satisfactorily completed an aerobatics ground course. The content of the ground course generally includes the material detailed in Appendix I of this Advisory Circular.

Flight training course

Rule 61.551(a)(2) requires an applicant for an aerobatic flight rating to have satisfactorily completed an aerobatics flight training course. The content of this course will generally include the material detailed in Appendix II of this Advisory Circular.

Rule 61.553 Issue

Logbook endorsement

Rule 61.553 states the requirements for the issue of an aerobatic flight rating. The flight instructor operating under the authority of the Part 141 certificate, or the authorised person operating under the authority of the Part 149 organisation, must be satisfied that the eligibility requirements of rule 61.551 have been met before issuing the aerobatic flight rating.

All relevant details must have been instructed, completed, and checked, either orally, in writing, or in practice, to the satisfaction of the certifying person. This process should include a thorough understanding by the candidate of the limitations of the conditions and the responsibilities of the approval. The certifying person must be satisfied that the candidate is both competent and safe. The essential element of aerobatics training is safety and that includes the attitude of the pilot.

The entry in the logbook must be made in accordance with rule 61.29(a)(3) including—

(i) the purpose of the flight; and

(ii) the date of the flight; and

(iii) the expiry date of the flight test, flight review, competency demonstration or check; and

(iv) the name, client number, and signature of the person conducting the flight test, flight review, competency demonstration, or check.

Additional reading material on aerobatics:

Aerobatics - Neil Williams

Flight Unlimited - Muller and Carson

Basic Aerobatics - Campbell and Tempest

Basic Aerobatics - Mike Goulian

Fly for Fun - Bill Thomas

All about Aerobatics – Ross Ewing 2005

Aviation Medicine and Other Human Factors for Pilots - Ewing

Aerobatics, Principles and Practise – David Robson 1999

Waypoints AVIATION

Appendix I - Aerobatic Flight Rating Ground Syllabus

Revision Three: 09 May 2007

It is recommended that the ground course is integrated with the flight training.

Legislation:

Civil Aviation Rules: 91.701 and 91.703.

Airframe and aerodynamics:

Weight: fuel, passengers, and parachute (As applicable).

Centre of Gravity.

The accelerometer (G-meter).

Operational envelope: effect of speed and weight, gravitational limitations, anticipated height loss/gain, rolling and pitching under load, overstress, and effect of turbulence.

Angle of Attack and drag.

Dynamic stall.

Airspeed: dive and recovery, escape manoeuvres, limitations, recommended entry speeds, relationship of IAS and control.

High and low speed flight.

Energy management.

Engine and mechanical limitations:

Limits of engine RPM and redline: temperatures and pressures.
Propellers: forces, effect at high and slow speed, fixed pitch and constant speed.
Fuel and oil system: controls and limitations.

Flight controls limitations and effects:

Ailerons and elevator.
Rudder.
Throttle.
Slipstream.
Torque.

Waypoints AVIATION

Human factors:

Physiological limitations: "G" Force - physiological effects (grey-out, black-out, G induced loss of consciousness, red out), how it is sensed, emphasis on early recognition and prevention of its effects, recovery, becoming adjusted through currency.

Causes of nausea: pilot and passenger monitoring techniques.

Visual illusion: at low level, in poor light, over water; depth of vision.

Disorientation and loss of horizon.

Airmanship:

<u>Prior to Flight:</u>

Pilot: I'M SAFE procedure. Physical fitness, currency, free of performance inhibitors (medication, alcohol, sleep deprivation, occupational and social stress), adrenaline and peer pressure effects.

Aircraft: Pockets empty, aircraft free of loose articles or articles that could come loose, mechanical inspection (aerobatics is most intolerant of airworthiness fault).

Parachutes: fitting and use (as applicable).

<u>In Flight:</u>

Environmental and neighbourly considerations.

HASELL checks.

Safety manoeuvres.

Altitude awareness.

Situational awareness.

<u>Emergency procedures:</u>

Engine failure, control failure, fire, loss of control of passenger, escape manoeuvres and recovery from unusual attitudes, height preservation.

Vacating the aircraft in flight (as applicable).

Energy management.

Recognition of when to stop.

Post flight evaluation:

Any activity outside limits of legislation, airframe, engine and pilot.
Medium term post flight effects of aerobatics, disorientation and G force.

Pilot maintenance:

Abilities and restrictions in accordance with Part 43.

Appendix II - Aerobatic Flight Rating Flight Syllabus

Revision Three: 09 May 2007

General

The flight training course should provide an introduction to the basic aerobatic manoeuvres with an emphasis on their safe and accurate execution.

The flight training course should consist of dual instruction, solo practice and consolidation.

The flight training course should cover in practice all the elements of the ground course. Particular attention should be given to engine management, the aerodynamic and loading affects of aerobatic flight on the aircraft, disorientation effects on the pilot, and the elemental need for safety, particularly recovery from unusual attitudes, the management of energy, height above the ground and situational awareness.

The course ought to be flexible enough to cater for aircraft of different performance and capabilities.

Advanced turns (more than 60-degrees of bank angle)
Spinning
Loops
Rolls
Stall turns

Combinations - e.g. Half Cubans, Half Reverse Cubans, and Rolls Off The Top. Emergencies and recovery from unusual attitudes.

It may include:
Snap rolls or other manoeuvres at the discretion of the instructor, and dependent on pilot aptitude and aircraft integrity.

Waypoints AVIATION

Minimum Flight Instructor Requirements:

Revision Three: 09 May 2007

Greater than 3000ft above the surface:

A current Category A Flight Instructor may carry out aerobatic flight instruction training for an Aerobatic Flight Rating provided the flight instructor–

(a) is rated on the aircraft being used for flight instruction, and

(b) is operating under a Part 141 organisation authorised to conduct and issue an Aerobatic Flight Rating.

A current Category B or Category C Flight Instructor may carry out aerobatic flight instruction training for an Aerobatic Flight Rating provided the flight instructor–

(a) is rated on the aircraft being used for flight instruction, and

(b) holds flight instructor aerobatic privilege, and

(c) has a logbook certification by an appropriately authorised Flight Examiner to instruct in spinning and aerobatics, and

(d) is operating under a Part 141 organisation authorised to conduct and issue the Aerobatic Flight Rating, or

A person authorised by and operating under the authority of a Part 149 organisation authorised to conduct and issue an Aerobatic Flight Rating.

At or below 3000ft and greater than 1500ft above the surface:

In addition to the requirements above, the Flight Instructor who is operating under a Part 141 organisation, or the person authorised by the Part 149 organisation, prior to carrying out aerobatic flight instruction at this altitude is to have 50 hours of aerobatic flight instructor experience.

At or below 1500ft above the surface:

In addition to the requirements above, the Flight Instructor who is operating under a Part 141 organisation, or the person authorised by the Part 149 organisation, prior to carrying out aerobatic flight instruction at this altitude is to have 100 hours of aerobatic flight instructor experience.

Persons wishing more information on the aerobatic rating should contact an aerobatic organisation certificated under Rule Part 141 or Rule Part 149.

Waypoints AVIATION

CAR Part 91.701 Aerobatic Flight

Current date: 10 November 2011

(a) Except as provided in paragraph (e), a pilot-in-command must not operate an aircraft in aerobatic flight:

(1) over an area that is within a horizontal distance of 600 metres of a congested area of a city, town, or settlement; or

(2) over an area that is within a horizontal distance of 600 metres of an open air assembly of persons; or

(3) within any controlled airspace except with the authorisation of ATC.

(b) Except as provided in paragraphs (c) and (f), a pilot-in-command must not operate an aircraft in aerobatic flight below a height of 3000 feet above the surface.

(c) A pilot-in-command may operate an aircraft in aerobatic flight below a height of 3000 feet above the surface:

(1) but not less than 1500 feet above the surface if the pilot holds an aerobatic rating issued in accordance with Part 61; and

(2) below a height of 1500 feet above the surface if the pilot:

(i) holds an aerobatic rating issued in accordance with Part 61 ; and

(ii) does not perform aerobatic flight below the height authorised in their aerobatic rating; and

(iii) is participating in an aviation event.

(d) A pilot-in-command must not operate an aircraft in aerobatic flight carrying a passenger unless:

(1) the pilot holds an aerobatic rating issued in accordance with Part 61; and

(2) the flight is conducted at a height not less than 3000 feet above the surface.

(e) A pilot-in-command may operate an aircraft in aerobatic flight over an area that is within a horizontal distance of 600 metres of spectators at an aviation event if the pilot is participating in that aviation event in accordance with rule 91.703.

(f) A pilot of a glider may operate a glider in aerobatic flight below a height of 3000 feet above the surface without holding an aerobatic rating issued in accordance with Part 61 if:

(1) the aerobatic flight is for the purpose of spin training; and

(2) the flight is conducted at a height not less than 1000 feet above the surface.

Waypoints AVIATION

CAR Part 91.703 Aviation Events

Current date: 10 November 2011

(a) No person shall conduct an aviation event, and no person shall operate an aircraft in an aviation event, unless the organiser of the event is the holder of an aviation event authorisation issued by the Director.

(b) Each applicant for an aviation event authorisation shall submit an aviation event plan to the Director at least 90 days prior to the start of the aviation event.

(c) The aviation event plan required by paragraph (b) shall:

(1) contain the following information about the proposed aviation event:

(i) name, position, and address of the organiser; and

(ii) place, date, and time; and

(iii) type of event; and

(iv) details of the structure of the organisation including persons who are responsible for supervising the aviation event; and

(v) details of the flying programme; and

(vi) detailed plan and description of the site with sufficient detail to show compliance with the requirements of paragraph (d); and

(vii) details of control methods to be used for the safety of the spectators; and

(viii) details of emergency services to be provided; and

(2) be acceptable to the Director.

(d) A pilot-in-command of an aircraft participating in an aviation event shall:

(1) for display flights, other than a display of agricultural operations or helicopter operations, operate at a height of at least 100 feet above the surface; and

(2) fly the aircraft aligned with reference to a display line sufficiently distanced from spectators so as not to cause undue risk to persons or property on the surface; and

(3) not carry any passengers; and

(4) not fly over any spectator area; and

(5) not conduct any manoeuvre between the display line and any spectator area; and

(6) with the exception of a helicopter hovering or taxiing, not initiate any manoeuvre in the direction of any spectator area.

(e) Paragraph (a) shall not apply to aviation events at which:

(1) not more than 500 people are in attendance; or

(2) there are no more than three participating aircraft; or

(3) the aircraft are in one formation.

CAR Part 1 Definitions

Current date: 15 December 2012

Aerobatic flight means:

(1) an intentional manoeuvre in which the aircraft is in sustained inverted flight or is rolled from upright to inverted or from inverted to upright position; or

(2) manoeuvres such as rolls, loops, spins, upward vertical flight culminating in a stall turn, hammerhead or whip stall, or a combination of such manoeuvres.

Aviation event means an event to be conducted below the minimum safe heights prescribed under Part 91 that is:

(1) an air show or practice for an air show; or

(2) an air race or practice for an air race; or

(3) an aerobatic competition; or

(4) aerobatic training or practice.

Crew member means a person carried by an aircraft who is:

(1) assigned by the operator:

  (i) as a flight crew member or flight attendant to perform a duty associated with the operation of the flight; or

  (ii) to perform a duty associated with the operation of the aircraft during flight time; or

(2) carried for the sole purpose of:

  (i) undergoing or giving instruction in the control and navigation of the aircraft; or

  (ii) undergoing instruction as a flight engineer or flight attendant; or

(3) authorised by the Director to exercise a function associated with the operation of the aircraft during flight time; or

(4) a flight examiner.

Passenger in relation to an aircraft, means any person carried by the aircraft, other than a crew member.

Waypoints AVIATION

Aerodynamic Considerations

Stalling Speed

As you saw during your earlier stalling exercises, stalling speed is a function of wing loading, which in turn, is a function of acceleration (change of velocity). Acceleration (and therefore wing loading) will be changing throughout a manoeuvre, so that our actual stalling speed is constantly changing. The airspeed indicator is no longer a direct indication of our margin above the stall, therefore we must rely on the 'feel' of the aircraft and on the control column position for stall warning. You need to develop a understanding of the symptoms of an approaching stall.

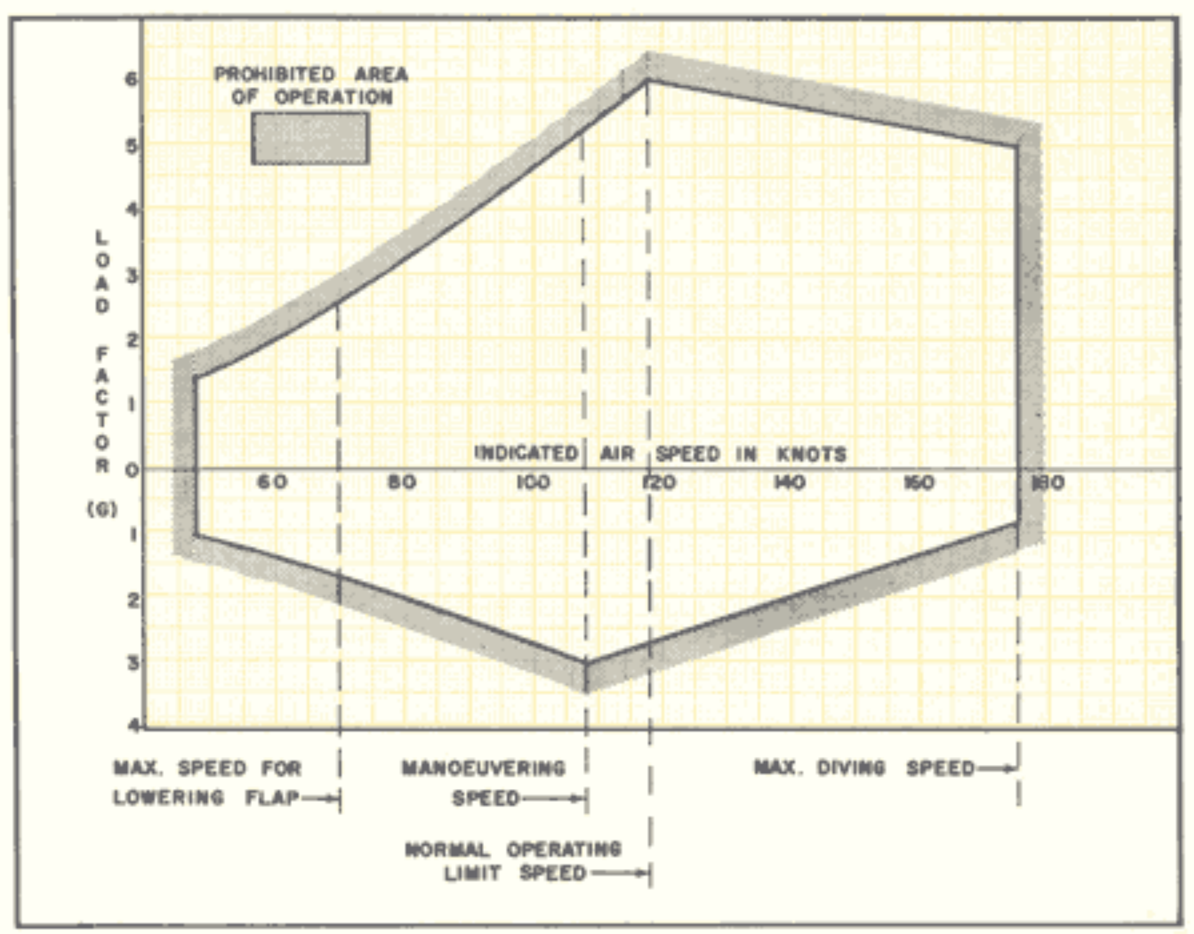


Figure 4-2 Operating Flight Strength Diagram

DHC 1 Chipmunk Manoeuvre Envelope

Effects of Changing Airspeed

During aerobatics, we experience marked changes in airspeed. As the airspeed changes, the response to a control deflection also changes. Thus, if we wish to maintain a constant rate of aircraft movement, we must balance airspeed changes with changing control deflection. Remember also that your 'g' loading and control forces are a function of airspeed.

Airspeed changes also necessitate rudder movements in order to stay in balance and this is an important factor in aerobatics. What this means practically, is that before aerobatics the aircraft should be trimmed for balanced flight at a speed a little above normal cruise, say 100kts. At any time during an aerobatic manoeuvre if the speed differs from 100kts, an amount of rudder input will be required to remain in balance. For example, as speed increases above 100kts, during a dive for instance, increasing right rudder will be required for balance. As we pull up and the speed decreases below our trimmed 100kt condition we apply increasing left rudder. The rudder requirement varying depending on whether the aircraft has a clockwise or anti-clockwise rotating propellor. Changes in power, with the consequent change in slipstream effect, will also require changes in the rudder position to maintain balance.

Effect of Altitude

Unless your aircraft is fitted with a supercharger or turbocharger, power available reduces with an increase in density altitude. At a higher density altitude, with less power available, manoeuvres which cause an increase in drag will cause a greater reduction in airspeed than those at lower altitude. At a higher density altitude the aircraft will have to be dived more steeply to gain the required entry speed and the height loss in the manoeuvre will be more than normal.

Waypoints AVIATION

Physiological Considerations

Effect of ‘g’ Forces

During the lessons at various stages throughout your flight training, the full effects of positive and negative ‘g’ should have been discussed. You will have already experienced some manoeuvres with higher than normal ‘g’ forces associated, such as steep turns. During positive ‘g’ manoeuvres (which you will perform most often) blood is forced away from your head, to pool in the torso and legs. This can lead to tunnel vision, grey out and eventually blackout, and in extreme cases unconsciousness. High ‘g’ affects each of us differently and its effects on a person can change from day to day. This may depend on how well rested we are, on whether we have eaten, on our state of general fitness and on many other factors. However, we can control its effects ourselves to some extent by tensing the stomach muscles and by ‘grunting’ during manoeuvres. Your instructor will show you how and when to do this.

The effect of negative ‘g’ is to force blood into the head and, if the value of negative ‘g’ is high enough, it can cause the pilot to ‘red out’. The effect of red out is a decrease in vision, with a red film in front of the eyes.

Orientation

It is important that when performing manoeuvres you remain orientated within a specific geographical location. We do not want you to wander all over the sky and compromise your lookout, wander into controlled airspace or into an area where another aircraft is operating. The wind will tend to drift you away from a selected location. For these reasons it will help to select an obvious, long line feature into wind (e.g. a road) and perform your aerobatic manoeuvres along it, so as to remain orientated within a specific area.

Airsickness

Feeling uncomfortable and even a little air sick during the first few aerobatics lessons is quite normal. If you feel a little uneasy or perhaps airsick, even just a little bit, tell your instructor immediately. And don’t be embarrassed to call an early end to the lesson. The worst thing you can do is to try to tough it out. There is little learning potential and certainly no enjoyment in continuing, so don’t be uncomfortable when you don’t have to be. With experience most people adjust to these new sensations fairly quickly.

You can minimise any feelings of air sickness you may have by getting as much air experience as you can. This will help you to relax, reduce anxiety and build self-confidence. Keeping fit, eating regular well balanced meals, taking alcohol in moderation and generally leading a healthy lifestyle will all help you to avoid air sickness.

That said, you should always carry at least one airsick bag when flying aerobatic manoeuvres. It’s a lot more pleasant than the clean up later.

Waypoints AVIATION

Handling Considerations

Engine Handling

Manoeuvring during aerobatics requires frequent power changes but remember your basic engine handling techniques and avoid 'slamming' the throttle open or closed.

In the DHC 1 Chipmunk the maximum engine RPM while aerobating is 2550. A red line should have been marked on the engine tachometer to indicate this limit. In a dive with full throttle set, 120kts is the prompt to start pulling the nose up and/or reducing power to avoid an engine overspeed. When diving, have the throttle set to AT LEAST 1/3 open.

Sustained inverted flying is prohibited at any time. During manoeuvres involving transient periods of negative G, such as slow rolls, the throttle should be closed before reaching the inverted attitude and the negative G phase confined to a period not exceeding 5 seconds.

Airframe Limitations

Remember that during aerobatics we can gain confidence by regularly flying close to the aircraft's and our limits. However the limits imposed on the aircraft are there for a good reason and the following should be known instinctively.

a. V_{ne} - 155kts IAS — The velocity to never exceed.

b. V_a - 117kts IAS (@ MAUW) — The maximum speed at which application of full or abrupt aerodynamic control will not overstress the aircraft.

Remember that V_a reduces, i.e. becomes more limiting, at weights less than MAUW.

There is normally no problem in keeping inside the V_{ne} speed of 155kts because this speed can only be reached in a steep powered dive. However it is possible to exceed the 'g' limits by pulling too hard on entry to manoeuvres, so be wary of this. The maximum load factors are + 6 and - 3 g. However, most DHC 1 Chipmunks are not fitted with accelerometers, so due caution must be paid to the abruptness and degree of control inputs at airspeed above V_a. If you suspect that you have overstressed the aircraft, stop the manoeuvres and return to the airfield to seek engineering advice immediately.

It is very important, especially if spinning, to ensure that aircraft's weight and balance are confirmed as being within the limitations for the aircraft (in the utility category if specified). In the case of the DHC1 Chipmunk, aerobatic manoeuvres are not permitted when the aircraft's weight exceeds 2,100 lb (953 kgs).

WARNING

Care must be taken in manoeuvres at speeds above 100 kts IAS, as it is possible to exceed the load factor limitation of +6G.

Pre-Manoeuvre Considerations

Preflight

Prior to beginning a session of aerobatic manoeuvres, a thorough external and internal preflight is vital. The external preflight must cover all items normally inspected, giving especially careful attention to structural members and flying control systems. The internal preflight must include checks of control restrictions, seat belts and a thorough search for loose articles in the cockpit.

Tapping along the underside of the length of the fuselage can show up loose items. Empty your pockets of items such as car keys, loose change and pens etc. Vacuuming the aircraft regularly will help reduce the chance of loose items jamming with the controls.

Whilst not a legal requirements, the wearing of a parachute is recommended. However, there is little sense in wearing one if it has not been checked by professionals and if you do not know how to exit the aircraft in flight and deploy the chute. At least one training jump with a parachute or parasail club is worth considering.

Pre-Manoeuvre Checks

It is important to complete a set of safety checks prior to beginning manoeuvres involving significant movement about all three aircraft axis, to make sure you and the aircraft are ready for these manoeuvres. The mnemonic for these pre-manoeuvre checks is HASELL. They should be completed as follows:

H Height:

Begin your manoeuvre or group of manoeuvres at an altitude sufficient to recover to normal controlled flight by a safe height above ground. The safe recovery heights vary depending on the situation and on the type of manoeuvres you are about to fly. I suggest the following are reasonable minima:

a. Stalling - dual 2000 feet AGL
- solo 2500 feet AGL

b. Aerobatics - dual 1500 feet AGL
- solo 3000 feet AGL

c. Spinning - dual 4000 feet AGL
- solo 5000 feet AGL

Also make a point of ensuring adequate clearance from cloud, both laterally and vertically and from controlled airspace, unless you have asked for and been given a clearance from air traffic control.

A Airframe:

Check that the flaps are in the required position for the exercise to be flown, normally fully up. If you are intending to use the flap during the manoeuvres, don't forget the flap limiting speeds.

Trim the aircraft for balanced flight at a speed a little above normal cruise, in the DHC 1 Chipmunk about 100kts.

If your aircraft is fitted with cowl flaps, set these to the recommended setting for the exercise to be flown. If the undercarriage is retractable, ensure that it is securely retracted.

> **WARNING**
>
> In the DHC 1 Chipmunk the wheel brakes **must be completely OFF** during spinning and aerobatics to ensure full rudder travel is available.

S Security:

You must ensure all potential loose articles are secure as these can cause personal injury and/or jam the flying controls during manoeuvres. This includes items such as pens, hairclips and earrings etc. Also, pay particular attention to your own (and your passenger's) harness. Make sure the lap strap, is fully tight and the buckle secure, then tighten the shoulder harnesses. You don't want to become a loose article yourself!

In the DHC 1 Chipmunk, the DI must be caged.

E Engine:

You should already be monitoring your engine's condition and performance instruments at regular intervals during any flight. However this is especially important prior to and during manoeuvre exercises, as you will most likely have completed a full power climb and will be making a number of large power changes during manoeuvres.

In the DHC 1 Chipmunk, set the mixture to full rich and the throttle as required. If fitted select the electric low boost fuel pump on.

L Location:

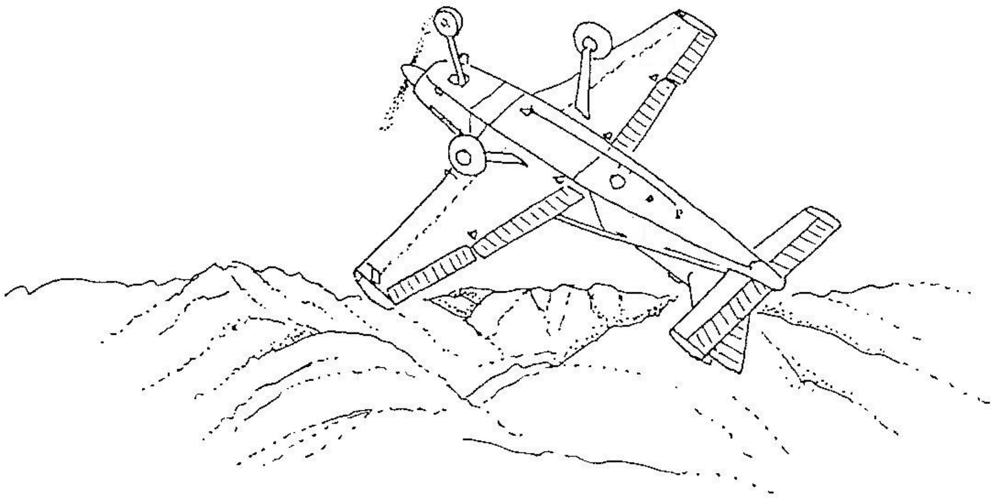
You should select an area for your manoeuvres which is sparsely populated. Avoid heavy air traffic transit areas where aircraft confliction is more likely and do not manoeuvre over cloud or water, as orientation is more difficult to maintain. For aerobatics, select a line feature on the ground which is aligned with the prevailing upper level winds. This will make it easier to remain aligned during manoeuvres. If possible, keep the sun on your beam. By doing this there is less change of being dazzled, to the detriment of your lookout and aircraft control.

L Lookout:

Complete a thorough lookout to make sure that the area above, below and around you is clear of other aircraft and of cloud. A left turn or gentle wingover is usually best, as it gives you the best down and across the horizon. The situation can change rapidly, so keep a good lookout before and during each subsequent manoeuvre.

It is also a very good idea to complete a set of abbreviated pre-manoeuvre checks between manoeuvres or sets of manoeuvres. This helps to ensure the aircraft remains in a safe condition and location to continue the exercises. Use the mnemonic HELL for these intermediate checks, with each letter having the same meaning as above.

The Basic Aerobatic Manoeuvres



Introduction

The sequence of aerobatic manoeuvres taught is arranged so that you begin by learning the easier manoeuvres and progress through to the more challenging ones. Whilst it is your prerogative to control how many training flights you will undertake and when, I have found that mastery of aerobatics, at least to solo standard, will take 5 to 6 hours of training undertaken over a relatively short time. Not to mention ground briefings and the study of references such as this manual.

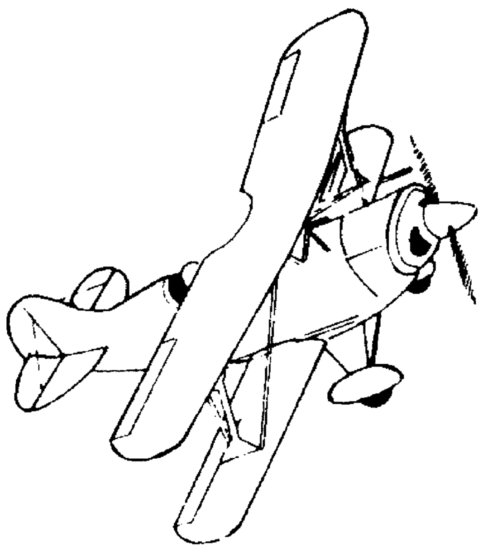
All the basic manoeuvres described below, and many intermediate manoeuvres, are within the capability of the DHC 1 Chipmunk. I will discuss in detail each of the basic manoeuvres, including how to deal with any situation that may arise through mishandling of controls during practice.

Although, in a manual of this type, the control movement for an aerobatic manoeuvre must be tabulated, in flight you must make a smooth transition from one stage to the next. Do not picture the manoeuvre as a series of mechanical actions.

Learn the entry speeds recommended in the Flight Manual. With experience, you may be able to reduce these slightly, but it is not necessary to increase them. Once you have mastered entries from a straight dive, you may find it easier to go from one aerobatic to another via a wing over. This gives you a chance to look out properly, without interrupting the flow of aerobatics.

The wing over and half reverse Cuban, although not strictly considered aerobatic manoeuvres will also be discussed. These are useful manoeuvres to link aerobatic manoeuvres into a sequence whilst maintaining a line feature.

The Wing Over (Chandelle/Lazy Eight)



Techniques

Some of the reasons for the wing over:

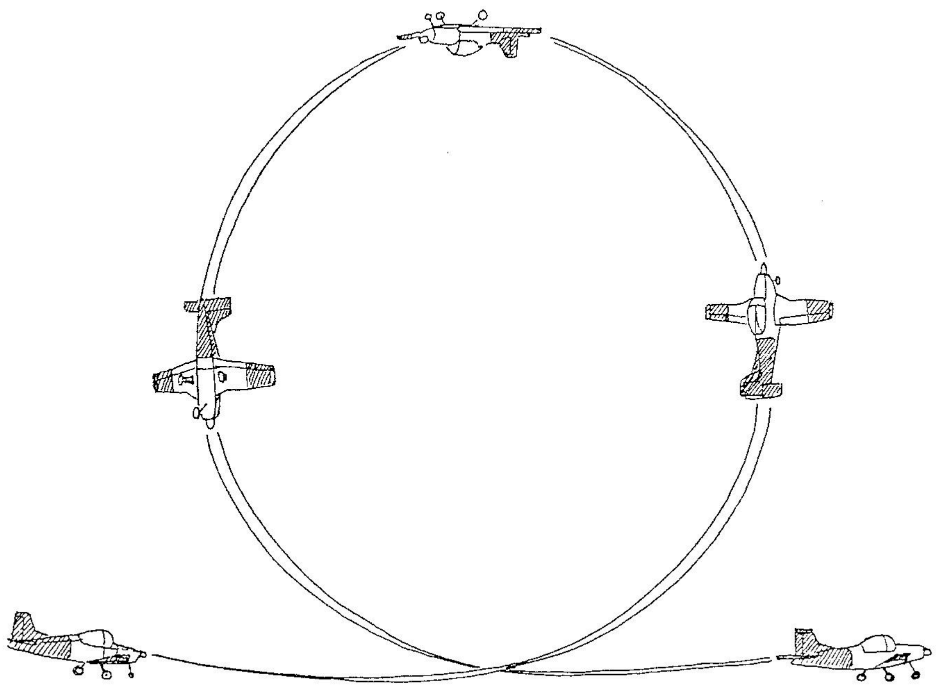
- To convert speed to height;
- To convert height to speed;
- To position the aircraft on a desired heading (or line feature) and attitude;
- For adequate lookout; or,
- Just to have fun!

The wingover itself is a positive ‘g’, balanced pitching and rolling manoeuvre. The degree of pitch is dictated by the airspeed on entry. By use of the wingover we can not only convert excess speed to height at the end of a manoeuvre but we can also use it to link one manoeuvre to another as well as to maintain or return to our line feature.

As for any manoeuvre, a lookout must be carried out before entry. The wingover, by virtue of its various types and uses, is not a ‘by the numbers’ manoeuvre. You can vary it between being all turn or all pitch. Below I will describe a wingover designed to convert excess speed to height while turning through an appropriate heading change, to roll out down a line feature for the next aerobatic manoeuvre.

Firstly fly a nose high attitude to convert excess speed to height. (About the max angle climb attitude used for the short takeoff would do in most cases). At around 60kts roll on bank as required, maintaining back pressure to keep the nose above the horizon initially whilst turning. Coordinate the turn and allow the nose to drop so that the desired dive angle and the required direction are achieved simultaneously. You are now in a position to roll off bank and/or continue in the dive to achieve the speed for the next manoeuvre.

The Loop



Techniques

The normal loop is basically a 360 degree turn executed in the vertical plane. The manoeuvre consists of a climb, inverted flight, dive and recovery to straight and level flight conducted in series. The entire loop should be conducted with a positive ‘g’ level on the aeroplane and at full throttle (within the 2550 RPM limit).

In performing a loop, the aim is to maintain a constant rate of pitch, with a positive ‘g’ load on the aeroplane throughout. Your instructor will demonstrate the rate of pitch required. Before beginning the loop don’t forget you should have the aircraft trimmed for 100kts and carry out a good lookout.

Commence the loop by placing the aircraft in a shallow dive along a line feature to achieve the entry speed of 130kts. Don’t forget that above 100kts right rudder will be required for balance.

Anticipate 130kts and commence a 3½ to 4 ‘g’ pull-up by rearward movement of the control column. Because the airspeed is comparatively high at this stage the pull force is reasonably high but the necessary control movement is small and the aircraft’s pitch response is good.

Fly the aircraft to ensure that the wings are level as the nose pitches up through the horizon and again as the aircraft passes the vertical. As the speed decreases the stick forces also decrease but response to the control deflection is less so, to maintain a constant rate of pitch you must continue to make a progressive rearward movement of the control column. Remember also now speed is decreasing below 100kts so by feel start to increase left rudder to remain in balance.

As you approach the top of the loop, look back for the ‘far’ horizon. Fly the aircraft to ensure that the wings remain level. You will notice the decrease in stick force, so make gentle control movements at this low speed (around 50kts) over the top of the loop. Reduce the back pressure at this stage to avoid stalling.

As the speed starts to increase on the back side of the loop, increasing back pressure will be required on the control column with increased speed during the dive to maintain a constant pitch rate. Now start to look once again for your line feature to enable you to keep straight as you start to pull out.

Smoothly decrease the amount of leftt rudder you have applied over the top of the loop and keep wings level on the pull out. The exit speed will be somewhat lower than the entry speed (approximately 110 to 120kts), with the loop finishing as the nose passes, wings level, through the horizon.

Interesting variations of the basic loop may be performed by (1) including a quarter roll in the recovery dive, and (2) describing a clover-leaf pattern through a series of four consecutive loops with quarter rolls.

Common Loop Errors

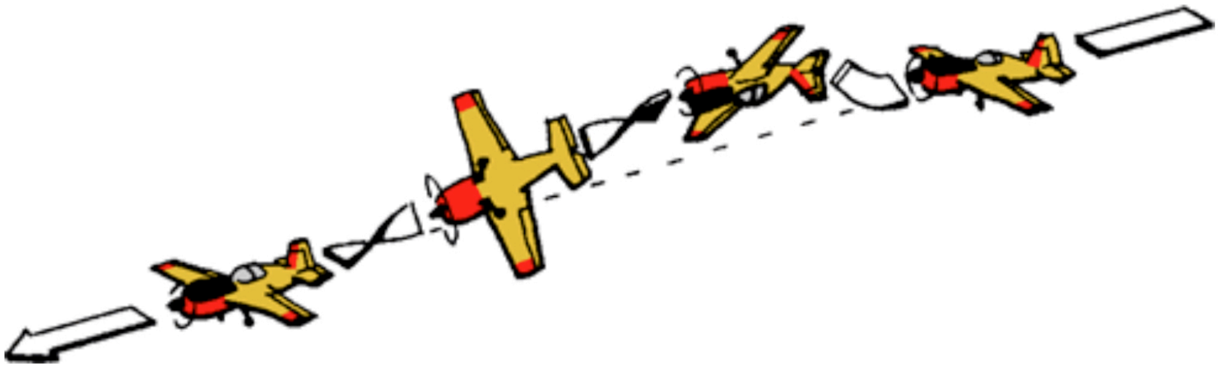
If you attempt to pull too tightly in the loop with too high a rate of pitch, your increased angle of attack may lead you to stall. Recovery is immediate on relaxing the back pressure, but you will probably arrive inverted with little or no airspeed because of the extra drag when stalled. Any attempt to keep the loop going with further rearward movement of the control column will result in another stall. So close the throttle, centralise the controls and complete the Vertical Recovery Technique.

If you attempt to loop at a low rate of pitch, your speed will decrease rapidly as you slowly pass through the vertical. You will probably arrive inverted with little or no airspeed, and will have to take the recovery action outlined above.

A crooked loop is one which does not finish along the line feature used on entry. The reason is usually a failure to maintain the wings level, although the root cause is often the failure to correct yaw and remain the aircraft in balanced throughout the loop. The secondary effect of yaw is roll and, despite the fact that you have kept the control column laterally central, yaw may cause bank errors which become evident as you go over the top of your loop. After you have practised a few loops, you will find that it is quite easy to glance at the ball and then to make any necessary correction somewhere between the vertical and inverted attitudes. Yaw is immediately apparent as you increase speed in the dive, so this presents less problem.

Waypoints AVIATION

The Aileron Roll



Techniques

To carry out an aileron roll, you must roll the aircraft through 360° about the longitudinal axis, at as high a roll rate as the aircraft will allow, and maintain height and direction as you do so.

In reality the aircraft is unable to rotate cleanly around this axis, but rather the nose describes a small circle around your nominated reference feature. The smaller the circle the better.

First, dive the aircraft towards your nominated reference feature, to get 120kts and raise the rose to a slight climbing attitude. Check forward to maintain the nose attitude in pitch and apply full aileron (in this case right aileron) to roll the aircraft through 360° tightly around your nominated reference feature.

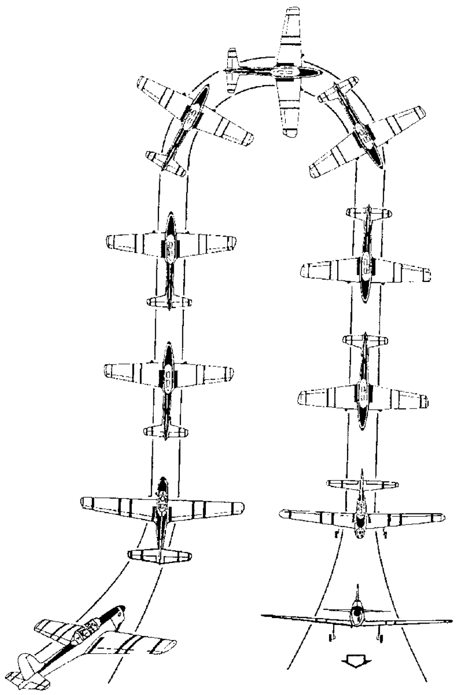
In the last quarter (90º) of the aileron roll, as the aircraft is slowing down, smoothly apply rudder in the direction of roll to assist the ailerons and maintain the roll rate.

As you complete the aileron roll, you will need increasing back pressure to hold the nose up as you return to level flight. The level position is reached in a slightly cross-controlled condition. **Smoothly** centralise the controls to re-establish straight and level flight.

The aileron roll may be summarised as follows:

- Apply lookout procedures and note a reference feature;
- Apply full throttle and dive to achieve 120kts;
- Pull up to a slight climbing attitude;
- Check and roll with full aileron;
- During the final 90° of roll smoothly apply rudder in the direction of roll; then,
- Level the wings and apply a slight back pressure to maintain height, and bring aircraft back to balanced flight.

The Stall Turn



Techniques

The stall turn is a method of changing direction through 180° in the vertical. It was originally used as a combat manoeuvre, although not used as such today. It is nevertheless a good confidence builder and provides useful experience in aircraft handling at very low airspeeds.

In a DHC 1 Chipmunk, often a stall turn to the left is more difficult than a stall turn to the right. The difference being caused by the additional effect of propeller slipstream during a turn to the left (see later). Consequently, we shall describe a stall turn to the right first.

To perform a stall turn to the right, ensure that the airspace is clear, then dive the aircraft as for a loop.

At 120kts, pull up to the vertical climb attitude, ensuring that your wings are level and that the ball is in the centre as you pitch through the horizon. Check the vertical attitude by noting the position of the right wing tip relative to the horizon. The chord line should not be perpendicular, but rather slightly forward so that the wing is at the zero lift angle of attack. To hold the attitude, a slight forward pressure will be necessary. Further, because the airspeed will be decreasing (rapidly), the right rudder introduced during the initial entry must be progressively reduced.

All these inputs must be carried out whilst looking out to the right, because it is necessary to note a reference point on the horizon through which we will cartwheel the aircraft.

Now, prior to losing all of your airspeed, apply right rudder to yaw the nose round to the reference point. Don't be over-anxious, remain focused on your reference point and yaw the nose through it. The aircraft still has flying speed at this stage, so it will be quite manageable in all three planes. Therefore you can use elevator or aileron as necessary to achieve your reference point. In fact, at this stage, because of the further effect of rudder (i.e. roll), hold off with top (opposite) aileron. Thus, all three controls are used to fly the nose from the vertical down to the horizon. The rudder to supply the yaw, the elevator to guide the nose in pitch through your reference point and the aileron to prevent roll.

The aircraft is now at the highest point of the stall turn and, to ensure that it drops through cleanly, the throttle may be smoothly closed. The nose will then continue to fall through the horizon down to a vertical dive. As the aircraft swings/yaws to the vertical dive attitude, anticipate, and apply opposite rudder (left in this case) to prevent the nose over swinging the vertical and then centralise the rudders for the pull out. Forward elevator will be required to hold the nose in the vertical on the way down.

Although the airspeed is low, the ailerons are still effective. This enables the aircraft to be controlled in roll. Redirect your attention straight ahead towards the ground and locate your line feature.

It only remains now to recover from the dive. Although the throttle may be closed, the airspeed will still increase rapidly, allowing the nose to be raised almost immediately. Feel the aircraft through the pitch change as in a loop, except that you do not open the throttle until the nose is above the horizon and positive oil pressure is indicated.

As stated earlier, in a DHC 1 Chipmunk a stall turn to the left is more difficult than one to the right because of the effect of propeller slipstream. You will remember that the propeller imparts a circular motion to the air that is pushed back over the fuselage. The air then impinges on the fin at an angle, in a DHC 1 Chipmunk causing the aircraft to yaw to the right. This effect is at a maximum and very powerful when the aircraft is flying with full power at low speed. These are the very conditions experienced during the stall turn and are the reasons why the stall turn to the left is more difficult.

The entry to the stall turn left is the same as for a stall turn to the right. The pull-up and check in the vertical are also the same, except that this time you must check on the position of the left wing tip relative to the horizon. Immediately the aircraft is checked going up vertically, begin to feed in left rudder.

Now it is particularly important that you focus on the external reference point at this stage because the rate of movement of the nose is critical. At first, the aircraft will respond quite nicely to the rudder and will yaw as required.

However, as the speed decreases, the slipstream effect becomes stronger and tries to yaw the aircraft to the right and, if the engine is left at full power, the slipstream effect becomes stronger and stronger until it completely overcomes the left rudder applied.

By carefully watching the nose movement to the left, you should notice it being slowed down by the slipstream effect. As soon as you see this, continue feeding in rudder, and slowly reduce the throttle. This reduces the slipstream yawing effect but keeps the rudder effective. Once the rudder is fully applied, keep it so until you have yawed to the horizon.

The throttle movement is very slow. If you can imagine the throttle lever being connected to the nose, it 'pulls' the nose around to the horizon and reaches the closed position a little earlier than on a stall turn to the right.

One important point that should be remembered is that the nose, once it has begun to yaw, should not be permitted to stop, because momentum plays a part in overcoming the slipstream effect. Therefore, it is important that the nose movement is observed closely and, once full rudder is applied, any slowing down must be counteracted by increasing the rate of throttle closure.

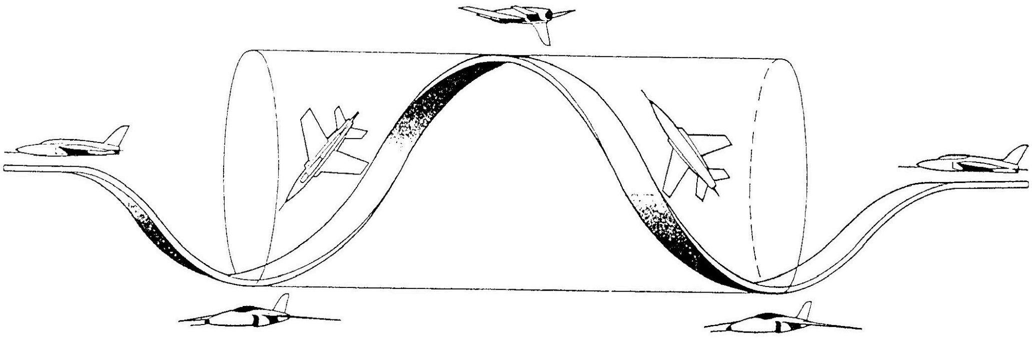
When the nose has been brought down to the horizon, the actions required to complete the manoeuvre are the same as for a stall turn to the right.

The actions necessary to perform a stall turn are summarised as follows:

- Apply full throttle (within the 2550 RPM limit);
- Dive to gain 120kts, in balance;
- Look up, and then pull up;
- Check wings level and in balance;
- Check when in the vertical position, using right or left wing tip as appropriate;
- Feed in rudder progressively and yaw the nose;
- Maintain the aircraft vertical in pitch and prevent roll;
- As the nose movement begins to slow down, slowly close the throttle to keep the nose moving (left). Fly the nose down to the position on the horizon vacated by the wing tip;
- Allow the nose to drop through to the vertical;
- Check with opposite rudder to prevent oscillations; then,
- Recover from ensuing dive, applying power only when nose is above horizon with positive oil pressure indicated.

Waypoints AVIATION

The Barrel Roll



Techniques

The barrel roll is a coordinated manoeuvre in which the aeroplane is rolled and pitched through 360 degrees around the longitudinal and lateral axis of the aeroplane while maintaining a constant radius around a point on the horizon. Particular emphasis is made on actually "flying" the aeroplane around the reference points.

Of all the basic aerobatic manoeuvres, the barrel roll is probably the most graceful and gentle to perform. However, since it requires constantly changing pressures on all the controls throughout the manoeuvre, it is probably the most difficult to perform accurately.

Before barrel rolling the aircraft, scan the airspace that you are going to use for the roll and make sure that it is completely clear, then keep a good lookout during the manoeuvre. During your scan, select a point on the horizon, (e.g. a cloud or a ground feature) and imagine a circle around it, noting any feature that will help you to remain orientated around the roll.

The barrel roll is entered by diving the aeroplane to 120kts while simultaneously turning to an entry heading approximately 45 degrees off of a selected reference point. During the entry, a 3 'g' pull-up is initiated and as the nose passes through the horizon a coordinated turn begun. After 45 degrees of turn, the aeroplane should be positioned in a 90 degree bank and the nose at its highest point. The roll is continued at a constant rate to the inverted position with the wings level with the horizon. A constant roll rate is continued until reaching the original entry heading in straight and level flight. A varying elevator back pressure is required to maintain positive 'g' throughout the manoeuvre. The recovery is completed when the nose is above the horizon and the airspeed is at or below 100kts.

If you are coordinated throughout the roll, the aircraft will remain balanced. You might, after a few practices, find time to check the ball when inverted. But generally, if you apply the normal principle of rudder with aileron according to the amount of aileron being used, you will not be far out and the aircraft will be quite balanced.

Waypoints AVIATION

Summary of Barrel Roll

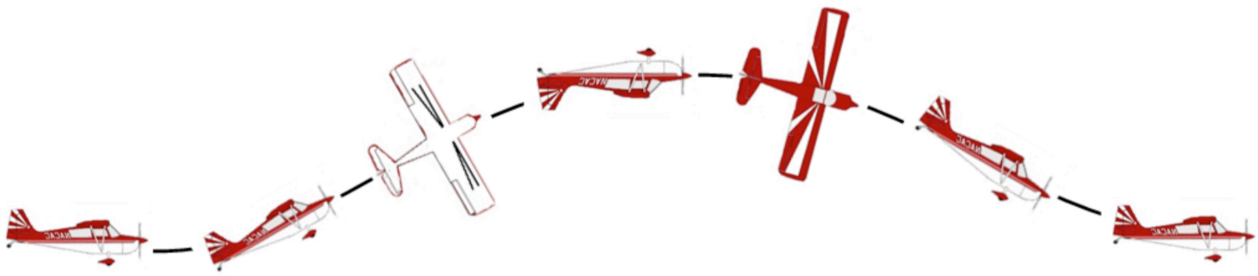
The main point discussed in the previous paragraphs are summarised below:

- Apply full throttle (within the 2550 RPM limit);
- Look out in the direction in which you intend to roll;
- Prescribe an imaginary circle around a reference point;
- Dive the aircraft to gain 100kts;
- Bank away from the desired direction of the barrel roll. I.e. for a barrel roll to the right, apply 45º angle of bank to the left. At 120kts proceed as follows:
    - Pull up with elevator and start the roll with a small aileron deflection;
    - Wings level as you pull up through the horizon;
    - Coordinate pitch and roll to fly around your imaginary circle;
    - Wings level just above the horizon, inverted; and
    - Continue the coordinated pitch and roll to complete the barrel roll.

Common Barrel Roll Errors

Most pilots have difficulty maintaining the axis of the barrel roll level (horizontal). This is most often due to insufficient pitch up on entry. Remember that there is 360° of pitch as well as 360° of roll in a barrel roll. A good indication of whether your axis is horizontal, is to note a feature on the wing tip, as you pull through the horizon. The aircraft should appear to be over this point when inverted.

The Slow Roll



Techniques

To carry out a slow roll, you must slowly roll the aircraft through 360° and maintain height and direction as you do so.

First, dive the aircraft to get 120kts and raise the rose to a slight climbing attitude, about 10-15º nose up should do it. Check forward to maintain the nose attitude in pitch and roll the aircraft (in this case with right aileron) at a rate shown to you by your instructor.

As the first quarter roll is completed and the wings are perpendicular to the horizon, the nose should be kept up with top (left, in the case of the DHC 1 Chipmunk) rudder. At the 90° point almost full top (left) rudder is required to keep the nose above the horizon. To achieve this, start to progressively feed in left (top rudder) from the 45° angle of bank point to the 90° point.

Continue to roll the aircraft with aileron but, as soon as the wing passes through the perpendicular, the rudder pressure is steadily reduced. Forward elevator pressure is then applied to achieve the inverted flight attitude. This involves quite a strong and progressive ‘push’.

As the wings rotate through the inverted attitude, the rudder should be centralised and quite a heavy forward pressure applied to the control column to hold the nose above the horizon.

As soon as the wings are past the inverted level position, the forward pressure on the control column can be reduced slowly because, once again, we are approaching the situation where the aircraft is on its side and the nose can start to again be held up by top rudder (right, in the case of the DHC 1 Chipmunk). However, because the speed is lower, more rudder will be necessary than on the previous occasion.

Because of the need for rudder, this time in the direction of roll, there will be a progressive increase in the tendency to roll caused by the further effect of rudder. In fact, if allowed to develop, the rate of roll will increase rapidly. This tendency must be anticipated and kept under control by application of opposite aileron as required.

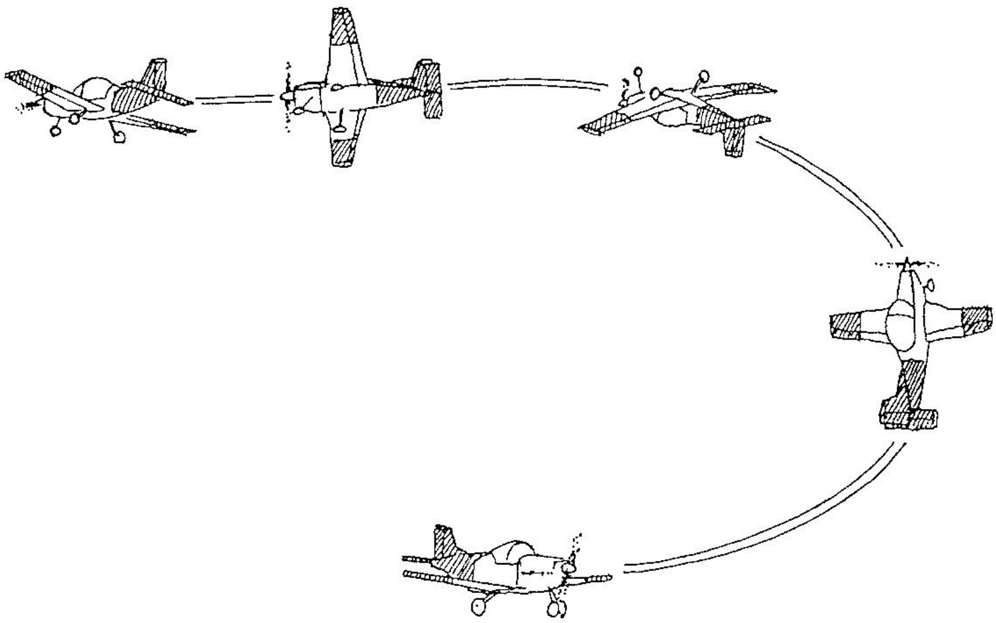
Thus, you will pass through the perpendicular stage with a lot of top rudder (right, in the case of the DHC 1 Chipmunk) and a small amount of right aileron to keep the rate of roll constant.

Complete the roll, using increasing back pressure to hold the nose up as you return to level flight. The level position is reached in quite a cross-controlled condition. **Smoothly** centralise the control to reestablish straight and level flight.

The slow roll may be summarised as follows:

- Apply lookout procedures and note a reference feature;
- Apply full throttle (within the 2550 RPM limit);
- Dive to achieve 120kts;
- Pull up to a slight climbing attitude;
- Check forward and roll with aileron;
- By 90° of roll, use top rudder to maintain the nose attitude for level flight, maintaining roll with aileron;
- Past the 90° point, introduce forward elevator to maintain level flight, slowly reducing the rudder already applied. By the inverted flight position, the rudders are neutral and the forward elevator pressure pronounced;
- As you leave level inverted flight, progressively introduce top rudder to maintain height, and reduce the forward elevator pressure. These movements must be so coordinated that level flight and direction are maintained;
- By the 270° point, the elevator pressure is relaxed and top rudder maintains height and tolls the aircraft;
- Control rate of roll by slight opposite aileron; then
- Level wings and bring aircraft back to balanced flight. During the final 90° of roll, because of the decreased airspeed, a slight back pressure will be necessary to maintain height.

The Roll Off The Top (Immelmann Turn)



Techniques

The roll off the top of a loop is another method of changing direction rapidly through 180°.

The Immelmann is a combination half loop followed by a half roll. Positive 'g' should be maintained throughout this manoeuvre.

It was originally used during the 1914-18 war by the German fighter ace, Max Immelmann, and quite naturally became known as the 'Immelmann Turn'. It still retains the name in some circles.

In a DHC 1 Chipmunk, you require 130kts for this manoeuvre. This is a higher entry speed than other manoeuvres and consequently you need a steeper dive to achieve this speed. Don't forget the increase in right rudder above 100kts.

The entry is the same as for the loop, except that the pull-up should be more pronounced. Anticipate 130kts and pull up at only 2 'g' until the nose reaches the horizon then increase the pull to 3.5 to 4.0 'g' for the rest of the entry.

In the vertical, confirm that both wing tips are on the horizon and, as you leave the vertical, drop your head backwards to view the horizon as soon as possible.

Waypoints AVIATION

Once the horizon is in view, prepare to momentarily stop the aircraft looping when the inverted flight attitude is reached. Do this by forward movement of the elevator as the nose pitches towards the horizon.

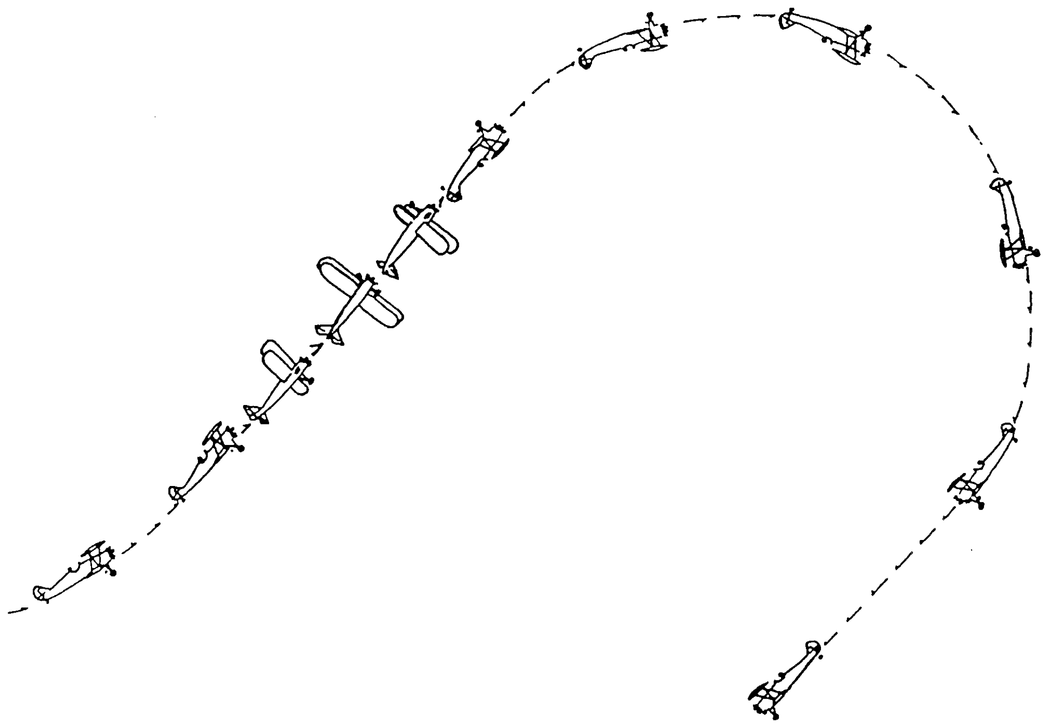
From this inverted flight attitude the aircraft is rolled to the straight and level attitude. Roll either way with aileron, coordinated with rudder and allowing the nose to drop just below the horizon to the level attitude. The nose of the aircraft scribes a "C" shaped pattern through the air during this rolling upright. As it is natural for the nose to want to drop, allow it to do so and resist holding it up by back elevator or you may stall the aircraft.

The roll off the top may be summarised as follows:

- Apply full throttle (within the 2550 RPM limit);
- Dive to achieve 130kts in balanced flight;
- Look up, and then pull up at 2 'g' until the nose reaches the horizon then increase the pull to achieve 3.5 to 4.0 'g';
- Check wings level and ball in the centre as you pitch through the horizon;
- Check wing tips relative to the horizon when passing the vertical;
- Continue to loop round to inverted flight attitude;
- Momentarily check in inverted flight with forward elevator;
- Roll with full aileron, coordinated with rudder;
- Allow the nose to drop to the horizon (i.e. to the level attitude); and
- Regain straight and level flight.

Waypoints AVIATION

The Half Reverse Cuban



Techniques

The Half Reverse Cuban is used to position between two manoeuvres without leaving the line feature. It consists of a climbing attitude on exit from a manoeuvre, followed by a half roll to the inverted attitude and a half loop recovery.

This is a manoeuvre which involves a significant variation in altitude, so a thorough lookout is essential. On exit from the first manoeuvre maintain the max rate of climb attitude (feet on the horizon) at full throttle until the airspeed reduces to 65kts. Initiate the half roll to the inverted attitude and immediately pitch through as you would on exit from a loop. Caution must be exercised to ensure that the airspeed is not allowed to increase too rapidly. This manoeuvre may also be entered from a half snap roll. Your instructor may show you this later in your training.

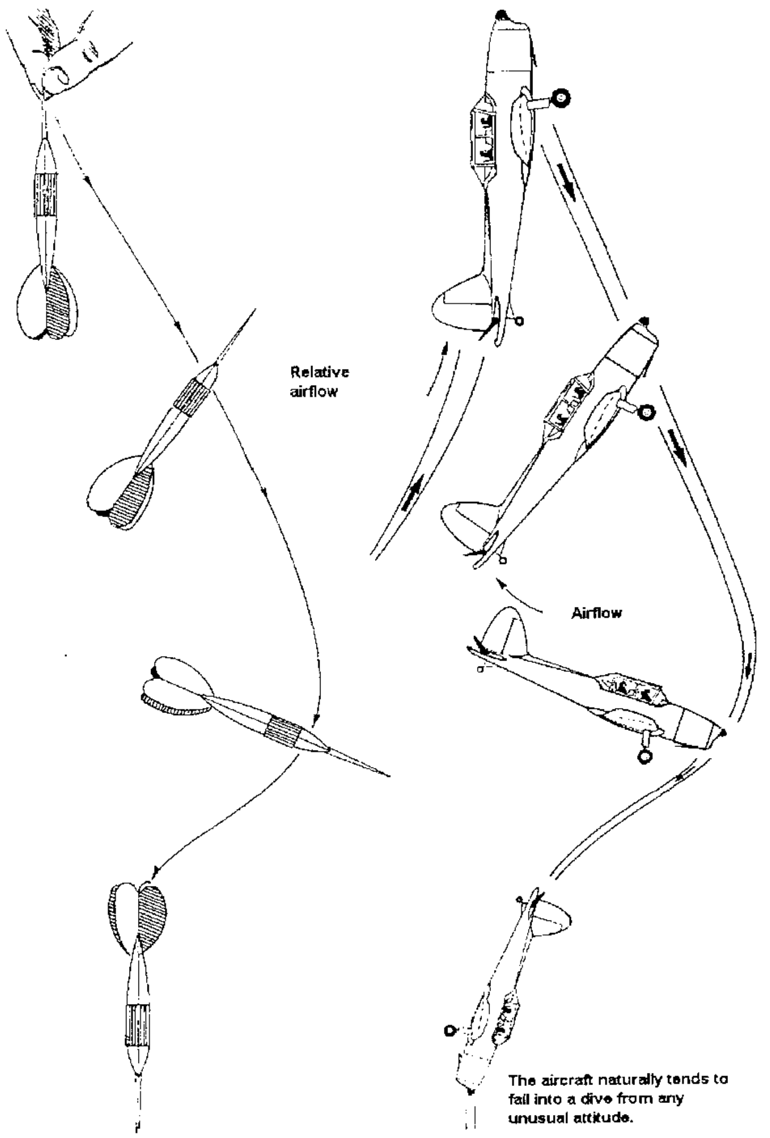
Because this manoeuvre can lose a lot of altitude, up to 500 feet, caution must be exercised on entry to ensure correct technique and sufficient height.

Waypoints AVIATION

Loss of Control in the Vertical

It is possible, especially in your early practice, to inadvertently fly the aircraft into an unintended extremely high nose attitude or an extremely low and inverted nose attitude.

If, because of low airspeed, you lose control in a vertical or rear vertical climb, centralise all of the flying controls, close the throttle and wait for the nose to drop below the horizon.



Keep a **very** firm grip on the controls, including the rudders, to hold them against loads which the reverse airflow may exert on the control surfaces. Power should not be reapplied until the nose is again above the horizon and the oil pressure has been checked. I use the routine “Nose up - Pressure up - Power up”.

You may, on other occasions, find yourself in a very low nose attitude, perhaps inverted or nearing inverted, with high and rising airspeed. Immediately but smoothly, close the throttle, check forward very slightly to unload the wing and roll to the **nearest** horizon, then ease out of the dive. Care should be taken during the pull out to maintain the airspeed and 'g' within limits. Again, wait until the nose is above the horizon and check for positive oil pressure before reapplying power.

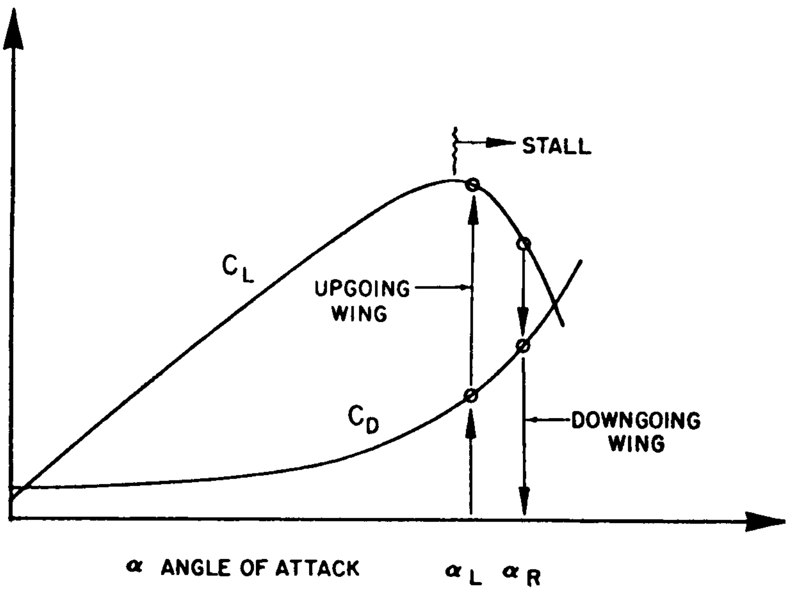
If you are inverted DO NOT be tempted to simply pull through to the horizon. If you do the airspeed and 'g' loading will almost certainly increase to dangerous levels before you get there. You MUST unload the wings with by pushing with elevator and roll upright first, so that the distance to return the nose above the horizon is minimised.

Waypoints AVIATION

Wingdrop Stalls

If your basic training and/or subsequent experience was with aircraft such as the Cessna 152 or Piper Tomahawk, then you will be familiar with the tendency of a wing to drop at the point of stall. However if all or most of your experience is on aircraft with significant washout designed into the wing shape, such as the Piper Warrior, this phenomenon will have little more than academic meaning to you. Then now is a good time to review and experience real wingdrop stalls.

One wing will drop if it stalls before the other and the resulting roll will be maximum if the outer part of the wing stalls before the root. The downgoing wing is subjected to an effective relative airflow from below with a consequent increased angle of attack, taking it further into the stall. The C_L is reduced and C_D increased compared to the upgoing wing, which may now have an angle of attack less than the stall angle. Refer to the diagram below.



This uncommanded roll and subsequent yaw toward the downgoing wing is known as autorotation and if allowed to continue will quickly become the incipient stage of a spin. This is elaborated on later in the section on spinning.

Therefore, if you have a wingdrop at the stall, it must be dealt with immediately and correctly. While the natural tendency is to use aileron to counter roll, you must make a point of **NOT** doing so. The application of down aileron, to lift the dropping wing, will increase its angle of attack further above the stall angle and increase its drag. This only accentuates the autorotation.

Waypoints AVIATION

The correct recovery technique:

- Unstall the wings by moving the control column sufficiently forward to select a lower angle of attack and allow the airspeed to increase. Keep ailerons neutral;
- Apply sufficient rudder to stop the aircraft yawing further;
- Once the wings are unstalled, roll wings level with the ailerons;
- Simultaneously apply full throttle; and,
- Ease out of the dive and complete the after take-off checks.

The application of this technique, despite being tabulated above, must be made in a smooth transition from one stage to the next.

Summary

In this manual I have discussed the basic and some of the intermediate aerobatic manoeuvres. However later on in your aerobatics training and experience I am sure you will be interested in learning other intermediate and some of the more advanced manoeuvres.

How far you continue with aerobatics is up to you. If you choose to continue past your basic aerobatic rating course, then I would encourage you to practice regularly, both to improve your technique and to build your confidence. You would also do well to take an aerobatic instructor up every now and again, to refine your technique and to show you progressively more advanced manoeuvres.

Aerobatics are intended to be good fun and will help to build your confidence. If you feel a little uneasy or perhaps airsick don't worry, with exposure you will adjust to the new feelings. However, make sure you tell your instructor if you are feeling airsick, don't be uncomfortable when you don't have to be.

Before any flight, but especially before aerobatics, consider how you feel. Complete the IMSAFE checklist on yourself. Are you physically and mentally prepared for the flight? Or are you tired, hung over, irritable or distracted? If you are not feeling 100%, then cancel the flight and organise one for another day. If you are under the weather you will neither enjoy the flight nor will you learn efficiently.

Remember to approach the pre-flight seriously and to complete a thorough walk around. You MUST be sure that the aircraft is ready and safe in ALL respects before taking her to the limits. If you are unsure of any aspect, seek the advice of an engineer or of an instructor.

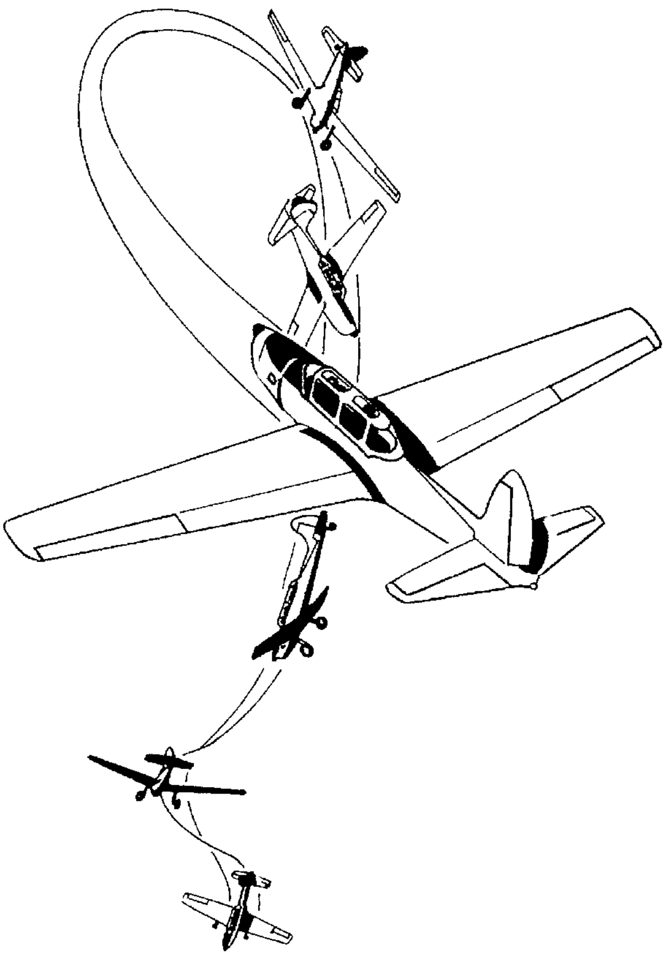
Also remember that you will be flying the aircraft to or near to its limits, so exercise caution and respect for the aircraft, for other airspace users and for yourself. Always practise within the authorisation you have been given, within the aircraft's limitations and within yours.

Finally, if unsure of anything, never be afraid to discuss it with your instructor.

The rest is up to you – enjoy!

Waypoints AVIATION

Spinning



Introduction

The spin is a prolonged stall, combined with a yawing force, that results in a nose-down rapid rotation of the aircraft following a helical path. This condition of flight can develop if the aircraft is not recovered promptly or correctly from a wingdrop stall. Thus, an accidental spin can only stem from the mishandling of controls but the extent of mishandling will vary with different types of aircraft.

A spinning aircraft has departed from normal controlled flight and will suffer a significant height loss. This has led many pilots to view the exercise with reservations, even apprehension, leading to a general air of mystique about spinning. However, the ability to enter a deliberate spin and affect a safe recovery will increase your ability to cope with disorientation and will increase your confidence. This confidence will help you handle aircraft at their limits. As your confidence increases, any apprehension you may have felt will disappear.

Causes of a Spin

As stated above, the spin is a manoeuvre of stalled flight but with associated yaw and roll (autorotation). The aircraft will stabilise into a descent following a helical path about a vertical axis, with a low constant indicated airspeed. In the spin, the aircraft will be simultaneously yawing, rolling and pitching about the vertical spin axis, until recovery is executed.

A spin may be entered from any combination of airspeed, attitude or power. The following situations increase the susceptibility of an aircraft to spin entry:

- Unbalanced flight approaching the stall;
- Incorrect use of aileron to hold wings level at the stall. Caused by an asymmetric fuel load in the wing tanks and subsequent wing drop; or,
- Asymmetric power at point of stall (exploring V_{MCA} in a twin).

Factors Affecting The Spin

Many factors will determine the particular spin characteristics and the rate of recovery including:

- The CofG. The further aft it is, the flatter the spin will be, the greater the rate of descent and the greater the difficulty of recovery.
- The amount of power remaining during and recovering from a spin. More power increases the rate of descent and delays recovery, leading to more height loss.
- Aircraft control rigging. This will determine the amount of available control deflection and associated forces during spin recovery.
- The length of the wings compared with the length of the fuselage. If the fuselage length is short, the anti-yaw moment will be small and recovery relatively slower.
- Size, shape and position of the rudder in relation to the tailplane. This affects the available anti-yaw moment.

Related Considerations

Pre-manoeuvre Checks

Before you commence spinning practice, carry out the pre-manoeuvre checks as detailed above. Avoid spinning where there is a poorly defined horizon, between cloud layers or over water as this may lead to disorientation.

In a spin there is a large height loss. In a DHC 1 Chipmunk, it is recommended that spinning in aircraft fitted with anti-spin strakes (de Havilland Modification H231) be commenced at least 4,000 feet above the ground (agl), and in aircraft without anti-spin strakes be commenced at least 6,000 feet above the ground (agl).

While the DHC 1 Chipmunk is cleared for practice spins of up to eight (8) turns, recovery should be initiated by 3,500 feet agl, in order to be able to regain level flight by 1,500 feet agl, consistent with a height loss of up to 2,000 feet. In aircraft without anti-spin strakes recovery should be initiated after not more than two turns of the spin have been completed.

It is necessary to ensure that the area well below the aircraft is clear prior to entry. This will involve wingover (see above) and/or clearing turns left and right. Advise ATC or the local traffic that you are carrying out spinning, e.g. “XXX control/traffic, ABC spinning in the area of XXX for the next 20 minutes”. Don’t forget to inform control/traffic when you are complete.

Condition of the Aircraft

Everything that follows presupposes that:

- Control surface rigging is maintained within limits;
- Control cable tension is maintained within limits;
- The leading edges of wing and tail surfaces are not significantly damaged or dented;
- The weight and centre of gravity are within limits; and,
- The engine idling rpm is within limits.

NOTE: It is important that no pilot embarks upon an aerobatic or spinning sortie without first checking the loading of their aircraft.

The Flight Manuals and Limitations

The flight manual must be checked, prior to a setting out for a spinning exercise, to ensure that the aeroplane is approved for spinning. Become thoroughly familiar with the manual, noting any spinning limitations, e.g. IAS on entry, number of turns, CofG position or weight.

The following additional limitations will be applied in the DHC 1 Chipmunk:

- Solo trainees will not be authorised to initiate a deliberate spin until checked and specifically approved by their instructor.
- Practice spinning is only permitted with anti-spin strakes fitted.
- The maximum weight for carrying out practice spinning is 2,100 lb.
- Deliberate spin entry must be initiated at less than 60kts; and
- Deliberate inverted spinning is **prohibited**.

WARNING

The wheel brakes **must be completely OFF** during spinning and aerobatics to ensure full rudder travel is available.

Preparing the Chipmunk for Aerobatics

The UK CAA and the Australian CASA do not permit aerobatic and spinning manoeuvres unless the Chipmunk is fitted with anti-spin strakes (De Havilland Modification H231). The New Zealand CAA makes no such limitation.

When aerobatic manoeuvres are permitted such manoeuvres must be performed with the:

- Cockpit canopy SHUT and LOCKED;
- Wheel brakes OFF to ensure full rudder travel;
- Flaps UP;
- Elevator trim NEUTRAL;
- Harness TIGHT and LOCKED (however full forward control column movement must be possible);
- Direction indicator CAGED;
- Mixture RICH;
- Carburettor air AS REQUIRED;
- Oil temperature and pressure WITHIN LIMITS; and,
- Fuel SUFFICIENT.

Brief

Prior to each spin entry, the following points must be pre-briefed:

- Entry altitude and method;
- The direction of spin;
- The number of turns after stabilisation at which recovery will be initiated;
- Who is to initiate the recovery; and,
- If parachutes are worn, the manner in which the aircraft will be vacated if recovery is unsuccessful, including evacuation hand signals to be used in the event of an intercom failure.

These considerations will ensure that both pilots are aware of the precise nature of the exercise and actions required of them in the event of any abnormal development.

Disorientation

Physiological effects may cause disorientation since the rate of rotation is very high. Some effects are:

- Difficulty in reading instruments;
- Loss of visual determination of the direction of rotation;
- Difficulty in levelling the wings during recovery; and
- A temporary reduction in your tolerance to 'g' forces.

The Propeller

While not likely, the propeller in the DHC 1 Chipmunk may stop in a spin due to fuel starvation or reduced/abnormal airflow. Ensure you are familiar with the air start procedures as detailed in the Flight Manual.

Recovery Instructions

During the spin you will lose height quickly. Therefore it is important to avoid the chance of misunderstanding during recovery. When I/your instructor initiates the recovery he/she will tell you to "**Recover now**". Your reply, as you initiate the appropriate recovery technique is "**Recovering now**". When you are initiating the recovery, announce the initiation with the same words - "**Recovering now**".

If you do not announce the recovery in this way, I/your instructor will assume that you have some difficulty and will immediately take control of the aircraft to carry out the recovery action.

Control Loads

During spin recovery the control forces may be higher than you expect considering the low indicated airspeed. Consequently, you should use both hands on the control column, moving it positively to the desired recovery position. In the DHC 1 Chipmunk the ailerons must be kept neutral throughout the recovery.

Demonstration Spin

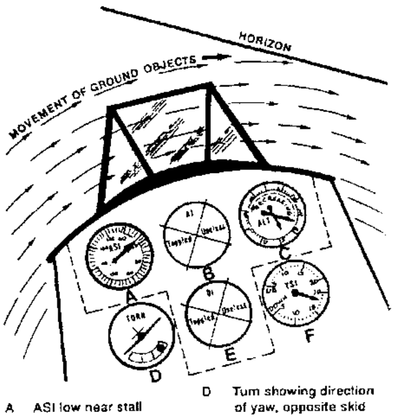
Your instructor will demonstrate a fully developed erect spin and **Standard Chipmunk Spin Recovery**. The DHC 1 Chipmunk is hard to properly establish in a stable spin at almost all centre of gravity positions. The characteristics of one aircraft may differ from another, where one will enter a stable erect spin, another will enter a semi-stalled spiral dive. Some aircraft will enter either. The difference in behaviour depending on variables such as weight and position of the centre of gravity, the intended spin direction, and aileron deflection into or out of the direction of spin.

You should note that having induced the spin, there is no problem in recovering to controlled flight.

During this demonstration, your instructor will point out several features. When he/she does this, try to look by moving your eyes, rather than your whole head. In this way, you will reduce any feeling of disorientation. For the same reason, when looking out, look to the horizon through the top of the windscreen or canopy rather than at the rotating ground immediately over the nose of the aircraft.

It is vital however, for the pilot to maintain a thorough cross-reference to the instruments. The main instrument indications are as follows:

- The airspeed will remain at a constant low value. However, the IAS may vary between left and right spins due to position error;
- The turn needle/turn coordinator will show full deflection in the direction of spin (for both erect and inverted spins); and
- The altimeter and VSI will show a high rate of descent.



A ASI low near stall
B AI toppled or caged
C Altimeter decreasing
D Turn showing direction of yaw, opposite skid
E DI toppled or caged
F VSI high rate of descent

Instrument indications in a Spin to the left

Incipient Spin

The incipient spin is that period before the spin has stabilised. This begins with the 'flick' of initial autorotation and is characterised by simultaneous changes of pitch, yaw and roll rates. Disorientation at this stage is quite possible.

If you spin accidentally, recover as soon as possible. This is preferably before the spin has stabilised, i.e. at the incipient stage.

Incipient Recovery Actions

- Centralise all controls (check visually);
- Close the throttle if the nose is below the horizon;
- Allow the flight path to stabilise;
- Level the wings and ease out of the dive; and
- Reapply power when the nose is above the horizon.

If the spin becomes fully developed and the incipient recovery actions are ineffective, carry out the **Standard Chipmunk Spin Recovery**. (See below).

Fully Developed Erect Spin

If autorotation persists and an equilibrium is achieved between the aerodynamic and inertial forces, a stable erect spin is the result. The motions, attitude and angles of the aircraft are somewhat repeatable from turn to turn and the flight path is a helical vertical descent.

In a DHC 1 Chipmunk the spin has the following characteristics:

- Initially the attitude is steep but after about two or three turns the spin usually becomes flatter, with the nose generally 30 to 50 degrees below the horizon, although it will appear less so;
- The airspeed will remain steady at between 30 and 50 kts IAS;
- The rudder force is light; and,
- The stick force is light when aft of neutral. A relatively positive to heavy push force is needed to move the stick fully forward on recovery, and this may be accompanied by some buffeting.

Waypoints AVIATION

Erect Spin Entry Technique

In a DHC 1 Chipmunk, close the throttle and at 50 knots apply full rudder in the intended direction of spin and move the control column (stick) fully back. A more positive spin entry can usually be achieved by applying aileron opposite to the direction of the intended spin. If aileron is so used it must be centralised when a stable spin entry is achieved.

If the control column is not moved fully back until after the spin has been entered, a semi-stalled spiral dive may be encountered. In this case the speed will remain stable at about 80 knots and normal recovery action is immediately effective.

The aircraft may be reluctant to enter a spin, especially to the left and at forward centre of gravity. A spiral dive may develop instead, particularly if the control column is not kept fully back. The spiral dive can be recognised by an increase in the control column forces and a fairly rapid rise in airspeed during the first two turns.

Maintaining the Spin

In a DHC 1 Chipmunk, after a half roll in the direction of spin, the nose drops sharply as rotation continues. Slight pitching may be apparent at this stage. The spin stabilises in two to five turns with the nose gradually rising to about 30-50º below the horizon. The rate of rotation is slightly lower than in the initial stage and the airspeed is low and steady.

The spin is maintained by keeping full rudder and control column fully aft. The inadvertent relaxation of any of these controls could result in the development of a nose down spiral dive. During the first two to three turns, the spin accelerates until the aerodynamic forces are balanced by the centrifugal and gyroscopic inertial forces produced by the mass of the airframe. Beyond this point, the rotation rates tend to be more stable.

For the purpose of training in spins and spin recovery, a three turn spin is normally adequate and should be used. Up to two turns, the spin will progress to a fairly rapid rate of rotation and a steep nose down attitude. Application of the **Standard Chipmunk Spin Recovery** technique will produce a prompt recovery within ¼ to ½ a turn.

If the spin is continued beyond 2-3 turns, some changes in spin characteristics may become evident. Rotation rates may vary and some additional sideslip may be felt. Normal recoveries may take up to a full turn or more.

Waypoints AVIATION

Standard Chipmunk Spin Recovery

Just as the entry to the spin requires firm, positive movement of the controls, so to does the recovery. Spin recovery requires that the balance of aerodynamic, gyroscopic and centrifugal forces be broken by a combination of control inputs which generate aerodynamic forces to oppose the spin. We entered the spin by stalling and applying yaw to the aircraft, therefore we must recover by correcting the yaw and unstalling the wings.

Regardless of how the spin is entered or for how many turns it is sustained, the following recovery technique is to be used:

- Check that the **throttle** is **fully closed**;
- Check the direction of spin on the turn coordinator;
- **Apply and maintain full opposite rudder**;
- **Pause** (The RAF recommend a pause of two seconds);
- Move the **control column progressively and centrally forward** far enough to break the stall;
- Immediately rotation ceases:
  - **Centralise all controls**;
  - **Level the wings**; and
  - **Ease out of the dive**.

Reapply power when the nose is above the horizon and positive oil pressure is indicated.

NOTE

Because of the blanketing effect that the elevators can have over the rudder when they are in full down position, it is vital that full opposite rudder is applied and a pause of two second be maintained before the control column is moved centrally forward.

In the UK, civil registered DHC 1 Chipmunks are required to display the following placard in full view of each pilot.

SPIN RECOVERY

MAY NEED FULL
FORWARD STICK
UNTIL ROTATION STOPS

The relatively flat attitude may cause longer recovery time than for many other aircraft types. Consequently it is important to appreciate that full and decisive control inputs are needed to recover especially nose down elevator.

The two second pause between the application of rudder and starting to move the control column centrally forward is required to allow the rudder to take effect. At high angles of attack, the rudder is largely blanked by the elevator in the down position. By delaying the application of centrally forward control column, the rudder has time to take effect.

A moderate push force is required to move the control centrally forward and care is necessary to ensure that the ailerons are maintained neutral throughout. If recovery action is taken before the spin has become stable, recovery is achieved very quickly. If normal recovery action is taken for recovery from a stable erect spin recovery is achieved within one to two turns, which may involve a height loss of about 1,000 feet to straight and level flight.

Having settled into the spin, do not expect an instantaneous recovery when you move the controls. As your spin recovery actions take effect, the nose-down attitude should steepen and the rate of roll appears to increase. Your first reaction to this may be to think that you have done the wrong thing and made the spin worse. Your second reaction could then be to change the recovery control movements you have made. **But don't do it**; do not be led astray. The steepening of the spin is in fact a sign that your recovery action is taking effect.

After prolonged spinning (six to eight turns), a heavier push force may be necessary to effect the recovery and this may be accompanied by some buffeting. In a stable spin, particularly when the rear seat is occupied, the aircraft may continue rotating for up to three turns after taking recovery action. During this period, the rate of rotation increases and the angle steepens before the spin stops. This is an indication that the correct spin recover actions have been taken. In this case recovery from the spin may involve a total height loss of about 2,000 feet to straight and level flight.

As you pull out of the dive, brace yourself against any 'g' effects. During a spin, your 'g' threshold may be lowered, so that even the small amount of 'g' present in a normal pull-out is noticeable.

Do not be surprised if you have a little difficulty in accurately levelling the wings after the spin has stopped. This is due to slight disorientation following the change from rotating flight to straight flight, and this symptom will tend to disappear as you become accustomed to spinning.

As you will see in later spin exercises, it is quite possible to manoeuvre your aircraft in one direction and through mishandling, spin in another. The tendency may be to think you are spinning in the direction of the original manoeuvre. Also, disorientation may preclude a visual determination of the spin direction. Obviously, we must be certain of the direction of spin in order to use the correct rudder during recovery.

The symbolic aeroplane in the turn coordinator or the needle of the turn and slip indicates the direction of spin. A glance at this instrument will indicate which rudder to apply during recovery. For example, in a spin to the left, the turn coordinator/needle will indicate to the left, leaving a large ‘blank space’ on the right of the instrument. So promptly move your right foot into the ‘blank space’. Obviously the opposite applies to a spin to the right.

Delayed Spin Recovery

If the spin continues after carrying out the **Standard Chipmunk Spin Recovery** technique, confirm:

- That the throttle is closed;
- The direction of spin as indicated on the turn coordinator/needle;
- That the correct control inputs have been made; and
- That the flap has not inadvertently been applied.

If the aircraft is slow to recover from the spin, the application of aileron in the direction of the roll may assist normal recovery action.

When the above actions have been completed the **Emergency Spin Recovery** may be attempted. This is a characteristic of **most** aircraft types.

For the DHC 1 Chipmunk the **Emergency Spin Recovery** technique is to apply full opposite rudder and release the control column. The varying airflow will cause the control column to settle in such a position that the balance of aerodynamic and inertial forces is broken. When the spin has stopped, reapply control and ease out of the dive.

In the DHC 1 Chipmunk failure to recover is highly unlikely. However if experienced, attempt to recover by rocking the aircraft with power applications coordinated with elevator control. Pushing with full power and pulling with throttle closed. Coordinated flap application is considered to be worth trying.

If recovery has not been successful and parachutes are worn, abandon the aircraft by 3000ft AGL.

Inverted Spin and Recovery

Description

An inverted spin could be inadvertently entered following mishandling in inverted flight or some aerobatic manoeuvres such as a mishandled slow roll, stall turn or roll off the top. Deliberate inverted spinning is not authorised.

If a stable inverted spin occurs the symptoms are similar to those seen in the erect spin, with the following exceptions:

- ‘g’ forces are negative (- 1.5 to - 2.0); and
- Yaw direction is opposite to roll.

The airspeed will be low and stable, rate of descent high and the turn coordinator/needle **will** indicate the direction of spin.

Recovery

Recovery is normally rapid since the rudder is not blanketed by the elevator but should be initiated immediately as the design limits of the aircraft may be exceeded. The recovery technique is as for a stable erect spin, except that the control column will need to be moved progressively and centrally rearward instead of forwards.

You are reminded that deliberate inverted spinning in the DHC 1 Chipmunk is prohibited.

Unstable Spin (Semi-Stalled Spiral Dive or Autorotative Spiral)

As the erect spin and the spiral dive can be confused it is essential to understand the difference between them. The spiral dive resembles the spin and is more likely to occur with a forward centre of gravity.

Alternatively, if equilibrium is not achieved between the opposing aerodynamic and inertial forces an unstable (oscillatory) spin may develop. This can occur from incorrect entry technique and is characterised by sporadic increases in IAS, an uneven rate of roll and yaw, pitch oscillations and moderate buffet.

If the wings do not stay fully stalled a semi-stalled spiral dive will develop. The following indicate that a spin entry attempt has led to a semi-stalled spiral dive:

- The attitude is steeply nose down;
- The airspeed will rapidly increase from about 40 kts at the entry to 80-90 kts after about two turns, regardless of the fact that the stick is held fully back and full rudder is applied to maintain the manoeuvre;
- The ‘g’ forces increase and the controls retain the forces of normal manoeuvres but there is some buffeting of the tail;
- There is usually noticeable noise and rattle due to buffeting at increasing airspeed; and,
- Upon releasing the controls the aircraft will recover by itself, or with some opposite rudder, after rotating through a quarter to a half a turn.

Recovery

Recover from an unstable spin using the **Standard Chipmunk Spin Recovery** technique. To recover from a semi-stalled spiral Dive (Autorotative Spiral):

- Close the throttle;
- Release the ‘g’;
- Centralise the controls (by holding the nose on a point);
- Level the wings; and
- Ease out of the dive.

In both cases above, the recovery actions must be initiated before 90kts, to ensure the aircraft limitations are not exceeded.

Common Faults

The most common problems experienced by students with spin recovery are:

- Throttle not checked closed on recovery;
- Controls being centralised by feel and not visually. As a result the controls are not completely central;
- Recovery from the dive without first ensuring that the wings are level;
- Failing to maintain a thorough cross-reference between IAS and the horizon to detect rapidly increasing or excessive airspeed; and/or,
- Opening the throttle too soon and/or too quickly during recovery from the dive (not monitoring the oil pressure).

Conclusion

You should rarely, if ever, find yourself spinning accidentally during your flying career, because an accidental spin only results from mishandling of the controls. However, there is always the risk of an accidental spin, and for that reason, we spin deliberately to accustom ourselves to the sensations of spinning and to practise the recovery techniques until they become automatic.

A thorough knowledge of spinning will not only increase your own self confidence but also ensure that you can safely recognise and recover from an inadvertent spin that may occur whilst you are practising aerobatics solo. The knowledge gained in this manoeuvre will make you a more competent pilot in your future career.

Waypoints AVIATION