Chapter five
Issue of aerobatic ratings

The following categories of aerobatic ratings are applicable: -

(a) Piston engined aircraft
(b) Jet/Turbine aircraft
(c) Gliders (As yet no criteria for the issue of aerobatic ratings has been prepared)
(d) Other aircraft such as microlights

5.1 Piston engined aircraft

For the purpose of general aviation training, incipient and positive spins up to two turns are not to be considered to be aerobatics manoeuvres in terms of these regulations. Ratings are issued per aircraft type, an approved aerobatic instructor will need to approve each type separately

The procedure for the issue of Aerobatic ratings falls into two categories: -

1st – Ab initio Candidates
2nd – Candidates with proven aerobatic experience

5.1.1 Ab initio Candidates

5.1.1.1 Candidates will undertake as course of instruction as set out in the SAC "Guide and syllabus of instruction" document held by the Aero Club of South Africa and forming part of this document.

5.1.1.2 Persons allowed to give such instruction fall into two categories: -

(a) Professional Instructors as defined by the SACAA who themselves hold at least a Classic or Sportsman aerobatic rating themselves.
(b) SAC Approved Instructors, being those SAC members who have held or who would have been eligible to hold an Advanced or Unlimited rating and who are currently the holder of at least a Classic or Sportsman rating themselves.

5.1.1.3 It is a requirement that dual aerobatic instruction be given by persons outlined above in 5.1.1.2 it not acceptable that candidates are given instruction via radio, instruction for basic manoeuvres has to be with the instructor in the aircraft.

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5.1.1.4 SAC Approved Instructors must hold a conversion applicable to the type of aircraft to be flown, candidates for the rating must also hold a rating for the aircraft type.

5.1.1.5 On the successful completion of the aerobatic instruction to the satisfaction of the aerobatic instructor, the required documentation will be submitted to the Aero Club of South Africa, the issue of a GRADUATE AEROBATIC RATING will then be undertaken on compliance with Aero Club procedures with regards to membership and fees.

5.1.1.6 The holder of a Graduate Aerobatic Rating is then allowed to practise aerobatics and enter an SAC contest at Graduate level and then progress as per the guidelines set out on the progressive issue of aerobatic ratings at a higher level. (Appendix B. Aerobatic Competition and Aerobatic Rating Status document.)

5.1.1.7 Alternately the holder of a Graduate Aerobatic Rating may in exceptional circumstances be allowed to classify for a Classic or Sportsman Rating by demonstrating the required ability before an SAC approved Board of Judges.

5.1.2 Pilots with proven aerobatic experience

5.1.2.1 Pilots must motivate their application to be classified to a Board of SAC approved Judges, on the successful approval of their motivation the candidates will then demonstrate their ability to an average of 70% for the current SAC approved known sequence at the level agreed by the Board of Judges. This should be preferably carried out at an SAC contest or in exceptional circumstances before a board of Judges.

5.1.2.2 On successfully demonstrating their ability the approved documentation will be forwarded to the Aero Club of South Africa for the issuing of the appropriate rating.

5.1.3 Validity of an Aerobatic Rating

5.1.3.1 Graduate – the rating will be valid for a period of two years, in which time the holder must appear either at an SAC contest or before a Board of Judges to classify for a Sportsman or Classic rating or the continuation of the Graduate Rating itself. Failure to comply with this requirement makes the Graduate Rating null and void and the holder will be required to undertake a further course of instruction for the issue of a further Graduate rating.

5.1.3.2 Classic, Sportsman, Advanced & Unlimited – the rating is valid for a period of two years from the date of issue, but should the holder not enter for a period of twelve months from date if issue an SAC approved contest or in exceptional circumstances appear before a Board of Judges, the rating will be downgraded one class, e.g. a holder of an Advanced rating would now be downgraded to Intermediate.

5.2 Jet/Turbine Aircraft

The Sport Aerobatic Club of South Africa has adopted in it's entirety a document prepared my Mr Glen Warden, this document is set out commencing on the next page: -

JET AND TURBINE AEROBATIC RATINGS

1. INTRODUCTION

Any pilot who wishes to incorporate solo aerobatics in his/her display or part of his/her display at air shows including any member of a formation team who as part of the display breaks away and displays aerobatics on his/her own, will require an aerobatic rating. With the inclusion of ex-military type aircraft on the civilian register, the CAA has instructed the Aero Club of South Africa to ensure that operators of such types have appropriate ratings. In the interest of safety of both the individual and the general public it has been deemed essential to incorporate an aerobatic rating for jet and turbine powered aircraft.

Until recently, the issue of an aerobatic rating was restricted to primarily piston powered aircraft. However, with the introduction of a number of ex-military jet and turbine powered aircraft into the civilian sector, it has become necessary to also encompass the issuing of aerobatic ratings for the operation of such aircraft. The SAC acknowledges that these aircraft types will generally not participate in competition flying, however, in an effort to ensure that a safe operation is maintained, pilots of jet and turbine aircraft will from 1st November 2005 be required to be the holder of an aerobatic rating for jet or turbine powered aircraft before they will be permitted to publicly display their aircraft.

Pilots who, owing to personal or operational restrictions, are not in a position to validate their jet/turbine rating before 1st November 2005 will be able to validate at a suitable future date. Pilots requiring a jet/turbine aerobatic rating will be able to liaise with a panel of AeCSA approved Designated Aerobatic Examiners (DAE) near to their location. A list of approved DAE's is attached as an appendix to this document.

2. LEGISLATION

Government Gazette 25194 R999 11/07/03 gave force to what is referred to as an "aerobatic rating". The Civil Aviation Authority (CAA) of South Africa have transferred the task of the issuing of aerobatic ratings to the Aero Club of SA, who in turn, have delegated this responsibility to the Sport Aerobatic Club (SAC), categorised as an "approved organisation" in terms of SA-CATS-FCL 61.38.1. Furthermore, in terms of CAR Part 149, the CAA has designated the responsibility for regulating certain areas of aerobatic flying to the Sport Aerobatic Club (SAC), a section of the Aero Club of South Africa. Therefore, the SAC is empowered to examine pilots wishing to gain an Aerobatic Rating whilst the AeCSA formally issues the rating and keeps a record of who currently has such a rating.

The SAC has developed and adopted from the international body governing aerobatics (CIVA), a clearly defined, tried and tested set of criteria, syllabi and rules and regulations governing aerobatic flight. This accumulated body of knowledge is summarised in a comprehensive document (CAA ARO 002), which has SACAA approval. The Manual of Procedures has been amended to also incorporate activities governing jet and turbine powered aircraft. Guidelines from certain military operations have been incorporated to formulate an attainable and safe performance. In terms of CATS 61.38.3, pilots are to conduct a “skills test” prior to the issue of an aerobatic rating. A “skills test” report in terms of Document CAA/ARO 0002 *et al* will be submitted on application.

3. RESTRICTION ON OPERATION

By form of reference, the following Part 91 Regulation (CAR) is brought to the attention of all operators;

CIVIL AVIATION REGULATION

91.02.32 Except when necessary for taking off and landing, or except with prior written approval of the Commissioner, no aircraft

(a) shall be flown over built up areas or over open-air assembly of persons at a height less than 1000 feet above the highest obstacle, within a radius of 2000 feet from the aircraft;

(b) when flown elsewhere than specified in paragraph (a), shall be flown at a height less than 500 feet above the ground or water, unless the flight can be made without hazard or nuisance to persons or property on the ground or water; and

(c) shall circle over or do repeated over-flights over an open air assembly of persons at a height less than 3000 feet above the surface.

4. MINIMUM ENTRY QUALIFICATION FOR A JET/TURBINE TYPE RATING

In order to satisfy the SAC, and before a jet/turbine aerobatic rating is issued, flight crew are to produce proof that they have completed a formal **TYPE** training course following the guidelines as spelled out in CAR Part 94 *et al.* The Civil Aviation Technical Standard CATS-OPS-94 specifies the training syllabus that is to be followed for ex-military aircraft.

CIVIL AVIATION REGULATION
94.01.1 (5)
Notwithstanding the provision of sub-regulation (4), non-type certificated aircraft operated in terms of this Part may be used for the training of its registered owner: Provided the training is provided by an approved ATO and the airworthiness requirements in respect of a non-type certificated aircraft used in training are met.

Although, the initial training has no part on the issuing of an aerobatic rating per sè, the requirement for the issue of an aerobatic rating for jet/turbine aircraft is based on the prior knowledge that the applicant satisfies the minimum requirements for a solid foundation in his/her training on type. The basis of the training is broadly spelled out below;

4.1 Ground Training

Ground training should ideally have been conducted on a formal classroom lecture basis, although with certain less sophisticated types, academic self-study could be considered. On completion of the ground training, the applicant shall successfully complete a

written examination to prove his or her knowledge of all aircraft systems. Reference shall be made to the relevant sections of the approved Flight Manual, Performance Manual and Technical Manuals.

4.2 Normal and Emergency Procedure Training

Normal and Emergency procedures shall ideally be conducted on a simulator, but where impractical, they shall be conducted *in situ* in the form of practice drills and practical tests on and in the aircraft. Blindfold cockpit touch drills are to be conducted to simulate emergency procedures to ensure students have complete familiarity with the positioning of essential switchology and systems.

4.3 Initial Type Training Requirements

The Chief Instructor of the approved ATO will investigate and interview the applicant for a type rating and will prepare a letter of recommendation for the CAA regarding the amount of training required.

CIVIL AVIATION REGULATION
94.02.01 (5)

Once the Commissioner has studied the information submitted in terms of sub-paragraphs (3), (4) and (5), and is satisfied that the training will be done in a responsible and safe manner, minimum requirements regarding the training of the particular individual will be supplied in writing by the Commissioner on Form CA94.02.1.

Extracts from the guidelines established in CATS-OPS-94 section 94.02.01 (3) are included below for reference:

EXPERIENCE LEVEL	QUALIFICATION MILESTONES
*Candidate has **less than**;* ***300** hours total flying time.*	*Minimum of;* ***40** hours instruction on type, of which 5 hours could be on a simulator of that type.* *Minimum of;* ***15** hours with a "check pilot" who should be a qualified instructor on type.* ***Note**: If an instructor is not available, it must be someone who has done the conversion to the instructor's position on type.*
*Candidate has **less than**;* ***300** hours total flying time of which;* ***100** hours are on jet- engine aircraft.*	*Minimum of;* ***30** hours instruction on type, of which 5 hours could be on a simulator of that type.* *Minimum of ;* ***10** hours with a "check pilot".*
*Candidate has **more than**;* ***500** hours total flying time including more than;* ***100** hours as pilot-in-command on a civilian jet aircraft.*	*Minimum of;* ***10** hours instruction on type.* *Minimum of;* ***10** hours with a "check" pilot.*

Candidate has; *a **military jet rating** obtained as a civilian on a similar aircraft type.*	*Minimum of;* ***7** hours instruction on type.* *Minimum of;* ***5** hours with a "check" pilot.*
Candidate has; *held a **military jet licence** issued by an air force.*	*To be determined by CAA.*

4.4 Basic Flight Training Syllabus

It is recommended that a basic minimum number of aspects are covered during the initial aircraft conversion. The basic elements of a proposed flying training syllabus (as applicable) for a type rating are specified below.

- *Aircraft Familiarization*
- *Effect of Controls (including spoilers, boundary layer control, airbrakes, etc.)*
- *Climb and Descent Profiles*
- *Low Speed Handling and Aircraft Behaviour*
- *Stalling (if applicable) at Various Speeds and Configurations*
- *Medium, Steep Turns and Maximum Rate Turns*
- *Accelerated Stalling*
- *Inertial Cross-Coupling*
- *Divergence*
- *Incipient Spinning and Spinning (if permitted)*
- *Precautionary Landings*
- *Forced Landings*
- *Approaches (different speeds and configurations)*
- *Landings (different speeds and configurations)*
- *Navigation (low, medium and high level)*
- *Introduction to instrument flying (if applicable)*
- *Aircraft Emergencies:*
    - *Engine failures/ flame-outs during different stages of flight*
    - *Engine fire/overheat during different stages of flight*
    - *Generator/Alternator Failure*
    - *Hydraulic/Pneumatic Failures*
    - *Flight Control Failures*
    - *Flap/Lift Augmentation Device failures*
    - *Undercarriage Failures*
    - *Smoke in Cockpit*

- *Pressurization Failure*
- *Loss of Canopy in Flight*
- *Ejection Procedure and "Bail-out" Limitations*

5. MINIMUM QUALIFICATION FOR A JET/TURBINE AEROBATIC RATING

Given that jet and turbine powered aircraft have a much larger performance envelope than most piston powered aircraft, it is essential that candidates comply with a minimum number of exercises as spelled out in the table below in order to obtain a jet/turbine aerobatic rating.

ENTRY CRITERIA	MINIMUM TRAINING REQUIREMENT
*Candidate has **no** previous aerobatic **experience**.*	***A minimum of 10 hours aerobatic training on the aircraft type.*** *Note: During the conversion to type, aerobatics may form parts of the training*
*Candidate **has an aerobatic rating** issued in terms of Part 61 **and** has **flown more than 6 hours** of aerobatics during the preceding twelve months.*	***Minimum of 6 hours aerobatic training on type**.*
*Candidate has **previous military** aerobatic experience but does not have a civilian aerobatic rating.*	***A minimum of 4 hours aerobatic training on aircraft type**.*
*Candidate has **more than 6 hours aerobatic experience on military jet/turbine aircraft** during the preceding twelve months and has an aerobatic rating.*	***A minimum of 2 hour aerobatic training on type.***

***Important Note**: A comprehensive training file or similar records reflecting the history of training for the candidate shall be kept for presentation to the AeSA, SAC or the CAA if so required.*

5.1 Recurrent Training Requirements

Owing to the relative sophistication of jet/turbine aircraft, it is expected of pilots to retain currency on these aircraft types. In order to ensure currency, pilots are to comply with the minimum proposed training. Extracts from CATS-OPS-94 section 94.01.01 (6) are spelled out below and act as guidelines for the minimum training requirement.

(2) Flying Training

To remain current, the pilot must:

(a) complete at least 12 hours, as pilot-in-command of an ex-military aircraft, over a twelve-months period; or

(b) should this not be the case, or if the pilot has not flown the specific type for a period exceeding three months, the pilot must undergo a check flight with a flight instructor who is current on type; and

(c) undergo at least one check flight on type not later than six months since the previous check flight on type with a flight instructor who is current on type.

5.2 Procedures for Recurrent Training and Validation

5.2.1 Recurrent Training

The pilots are expected to verify that they comply with the currency training requirements. When recurrent training is undertaken the pilot shall make the relevant entry in his flying log book. The flight shall be logged as a dual flight with the name of the instructor as the pilot in command.

5.2.2 Procedures if Pilots Fail to Maintain the Required Standards

An approved jet/turbine Safety Officer or Designated Aerobatic Examiner (DAE) performs the function of a check and balance to ensure that pilots maintain the minimum standard required. Where the Safety Officer/DAE is not satisfied with the standard he/she shall discuss the issue with the pilot and suggest the required remedial actions that need to be taken. Should the pilot not comply with the suggestions/recommendations, then the Safety Officer/DAE should notify the AeCSA who will subsequently notify the Civil Aviation Authority.

5.2.3 Procedures for the Issue of an Initial Jet/Turbine Rating for Pilots already Operating Jet/Turbine Aircraft

The AeCSA is cognisant of the cost of operation of jet/turbine aircraft. Furthermore, and in the absence of a current jet/turbine aerobatic rating, the AeCSA acknowledges that some pilots have already gained experience in jet/turbine aerobatics. In an effort to satisfy a suitable standard, and to introduce a process, pilots wishing to obtain the new jet/turbine aerobatic rating are to validate their capabilities in the form of a “skills test” before a panel of appointed DAE’s from the AeCSA. The format of the skills test is spelled out in the lesson plan for training which is attached to this document. are to contain the basic manoeuvres which are spelled out in the

5.2.4 Procedures for Single Seat Aircraft

Certain variants on the civil aviation register may only be available as single seat aircraft. In such cases, pilots are to demonstrate their currency on the dual seat variant of that type or an aircraft of similar performance. Should such type or similar type not be available for this purpose, the pilot is to request, in writing, a waiver from the AeCSA to demonstrate his currency on that particular type.

6. REQUIREMENTS FOR THE ISSUE OF AN INITIAL JET/TURBINE AEROBATIC RATING

For the issue of an initial Jet/Turbine aerobatic rating, the following criteria shall be complied with;

- The candidate must be a member of the Aero Club.
- The candidate must be a member of the Sports Aerobatic Club (SAC).
- The candidate must be in possession of a valid PPL, CPL or ALTP as issued or validated by the CAA.
- A suitably qualified Designated Aerobatic Examiner (DAE) for Jet/Turbine aircraft must have authorised and signed out the candidate.
- Successful candidates will be issued with a Graduate rating.
- The candidate must lodge this form with Aero Club who will issue him with the appropriate rating card.
- The candidate must pay the Aero Club/SAC the required fee for the aerobatic rating.
- **Important Note**: It is the responsibility of the candidate/applicant to comply with the above criteria

7. RENEWAL OF AEROBATIC RATINGS

Aerobatics are renewable annually. In order to renew the jet/turbine aerobatic rating, the following criteria are to be met.

- The applicant must be a fully paid up member of the Aero Club of SA.
- The applicant must be a fully paid up member of the SAC.
- The applicant must be in possession of a valid PPL, CPL or ALTP as issued or validated by the CAA.
- The applicant must produce proof of his participation in at least six (6) aerobatic displays in that particular/or similar aircraft type over the past twelve (12) months.
- The applicant must produce proof of his/her competency, signed by a DAE, clearly indicating the limitations to which that pilot may operate. (Exception to this clause may only be granted with the express consent of the SAC committee).
- The applicant must pay the Aero Club / SAC the required fee for the renewal of the aerobatic rating.
- **Important Note**: It is the responsibility of the candidate/applicant to comply with the above criteria

8. LAPSE, SUSPENSION OR AMENDMENT TO THE JET/TURBINE AEROBATIC RATING

The issue of an aerobatic rating is subject to certain privileges. However, due consideration is given to the issue thereof. In accordance with the responsibilities transferred from the CAA to the AeCSA, and therefore the SAC as the responsible entity for Aerobatic Ratings, the following aspects are to be adhered to

- The SAC committee reserves the right to revoke any SAC issued aerobatic rating.
- The aerobatic rating as issued by the SAC, is valid for 12 months from date of issue.
- The aerobatic rating as issued by the SAC, automatically lapses should the pilots' flying license as issued by the CAA, expire in this period.
- A pilot who is the holder of a “graduate” class jet/turbine aerobatic rating who has not presented his/her aircraft at all during the year, shall forfeit his privileges as the holder of a jet/turbine aerobatic rating and will need to validate before a panel of a minimum of three (3) judges before a jet/turbine aerobatic rating is re-issued.
- A pilot who is the holder of a jet/turbine aerobatic rating higher than “Graduate” who has not presented his/her aircraft one year, shall automatically revert to the next lower level. (For example: An "Advanced" pilot, for example, who fails to display at the “Advanced" level for one year may now compete at the “Intermediate" level only for the following year.
- **Important Note**: It is the responsibility of the candidate/applicant to comply with the above criteria

9. MANAGEMENT OF THE JET/TURBINE AEROBATIC RATING

In order to retain visibility and ensure a safe operation by holders of a jet/turbine aerobatic rating, the following procedures are to be followed;

9.1 Guidelines to Management

- A record is to be kept of all the pilots’ participation throughout the year.
- A list of pilots, sanctioned by the SAC committee, who may give jet/turbine aerobatic instruction for the SAC will be published from time to time. These instructors may, charge for their services, provided

that they hold the necessary qualifications as issued by the CAA i.e. they are commercial pilots with instructor ratings. Candidates may only log dual time when they have flown with commercial instructors.

- Aerobatic instructors as appointed by the SAC who are not commercially rated may not charge for their services but must be rated on the type of aircraft on which they give instruction.
- Instructors in the completion of the "skills test" form completing are urged to do so in as much detail as possible since this form will be kept on record at the Aero Club. The knowledge and skills imparted in these early aerobatic sessions will form the foundation of the candidate's aerobatic career. These evaluation forms are open to inspection by the CAA and the committee.
- The jet/turbine aerobatic rating is a proficiency qualification on only jet/turbine aircraft and is not valid for aerobatic displays, formation aerobatics, and any manoeuvre not specified for by its manufacturer. A separate display authorisation issued by the Aero Club of South Africa (AeCSA) is required for the purpose of display flying.
- These rules, regulations and considerations may be amended from time to time. It is the responsibility of the holder of an aerobatic rating issued by the SAC to keep abreast of any changes or new developments.
- The attached syllabus and appropriate rating form is based on the SAC Manual of Procedure as approved by the CAA, a copy of which may be requested from the SAC Committee.

9.2 Discipline

This rating confers the privilege of aerobatic flight on the holder. By the same token there exist certain responsibilities. Supporting the club and its activities, setting an example to other pilots by being totally professional in one's approach to the sport and flying in general, never practising new figures or manoeuvres at insufficient altitude.

9.3 Levels of Qualification for Jet / Turbine Aerobatic Ratings

All initial jet/turbine ratings will be issued in the category "Graduate" Aerobatic Ratings. However, the SAC recognises and endorses additional ratings, which bear witness to the pilot's ability to fly more and more complicated figures and sequences to a progressively lower limit.

The candidate is examined by a panel of SAC designated examiners, who will, if successful, recommend to the AeCSA that he/she be issued with a "Graduate" Jet/Turbine Aerobatic Rating.

They categories of Jet/Turbine Aerobatic Ratings with their lower manoeuvring limits are listed below:

- Graduate - lower limit 1,000ft
- Intermediate - lower limit 750 ft
- Advanced - lower limit 500 ft
- Unlimited - lower limit 300 ft

Pilots move up through the classes by conducting demonstrations before a panel of at least three (3) SAC approved judges.

9.4 Mentorship Programme

Owing to the potential risk of display flying of high performance jet/turbine aircraft it is recommended that candidates select a mentor (or alternatively "shepherd") for the development of their skills. When a pilot wishes to display his aircraft at a show or an event he is to obtain a Display Authorisation from AeCSA. If the aircraft is a dual seat type then the mentor will also fly together with the candidate on the first few displays to assess and guide the candidate in the execution of a safe and presentable display.

This mentor shall be a pilot who has had previous military jet/turbine experience and who is already a holder of a jet/aerobatic display rating and who has experience on the particular type of aircraft (or an aircraft of similar performance) on which the candidate wishes to obtain a jet/turbine rating. The mentor should possess at least 3,000 hours total time and have previously flown jet/turbine displays. The pilot under supervision will log the flight hours while the supervising pilot will not log the hours if he is not a qualified CAA approved instructor.

The mentor will be required to give a brief verbal assessment and sketch of the candidates' training and general approach to display flying to the Display Authorisation Committee (DAC). This assessment will be given in strictest confidence and will not be in writing. In the event of any dispute between the mentor and his protégé or the mentor and the DAC the dispute will be referred to the ethics committee.

It will be the mentor's responsibility to refer the candidate to psychological evaluation if he has any doubts with respect to the candidates' mental approach to display flying.

9.5 Qualification Check List

Pilots who are holders of a jet/turbine aerobatic rating are to have the following items available;

- Valid Pilots Licence
- Membership of Aero Club of South Africa
- Sports Aerobatic Membership
- Jet/Turbine Aerobatic Rating Card

9.6 Display Authorisation

Before a pilot may display his/her aircraft at a show or an event, he will, in addition to the jet/turbine aerobatic rating be required to obtain a Display Authorisation from Aero Club of South Africa. Any applicant for the issue of a "Warbird" category display authorisation should satisfy the DAE that he/she;

- Is the holder of a Jet/Turbine Aerobatic Rating
- Is fully conversant with the systems and technical limitations that pertain to that particular type of aircraft.
- Is cognisant and conversant in the looping, rolling and pitching capabilities of the aircraft.
- Is fully conversant with the performance limitations in terms of height and speed required to execute the required manoeuvres.
- Is familiar with the procedures for a successful egress (ejection/bail-out) from the aircraft should this become necessary?

9.7 Lower Level Waiver.

The lower level waiver is established and granted by Aero Club of South Africa appointed Display Authorization Examiners who will council, advise, mentor and observe the candidate's attitude and ability as an aerobatic display pilot. Due cognisance will be taken of the level to which the candidate has progressed within the discipline of display aerobatics.

The DAC reserves the right to issue lower level waivers. Only in exceptional cases will authority be granted by the DAC to a lower level than what is reflected in the jet/turbine aerobatic rating.

10. RECOMMENDED SYLLABUS FOR JET/TURBINE AEROBATIC RATINGS

At present, the SAC does not have a school where jet/turbine aerobatics are formally taught. A candidate wishing to learn jet/turbine aerobatics will need to approach an ATO or SAC approved instructor(s) that teach jet/turbine aerobatics. The SAC has a list of professional aerobatic instructors or approved aerobatic instructors who could be approached for aerobatic instruction on these specific types.

It is highly recommended for candidates to adopt a mentor as discussed in Par 9.4 above for the development of his/her skills.

As part of document CAA ARO 002 there is an amended syllabus for jet/turbine aircraft, developed for the SAC, which should be followed. The syllabus below addresses all safety aspects pertaining to aerobatic flight including recovery from unusual attitudes. The initial aerobatic rating course will consist of a minimum of eight (8) sessions each covering a specific manoeuvre with constant revision of recovery from potentially high risk situations.

This syllabus should cover the basic aerobatic and recovery manoeuvres viz:

- *performance investigation for high performance aircraft*
- *loss of control*
- *auto-rotative manoeuvres*
- *low speed manoeuvring*
- *rolling*
- *looping*
- *turn reversals*
- *inverted flight.*

The course also covers aerobatic notation, sequence construction, energy management and display flying. The overall objective of the initial jet/turbine aerobatic rating course is to prepare the candidate to fly a solo, linked sequence of basic manoeuvres.

The issue of a jet/turbine aerobatic rating would depend upon the level of sophistication of the type of aircraft to be displayed.

10.1 Training Syllabus

This document cannot be deemed to be entirely prescriptive should certain of the recommended training exercises fall outside of the aircraft's flight envelope. Discretion will be used to determine a satisfactory training regime.

The recommended expanded syllabus for jet/turbine is attached as an appendix to this document.

Operators are urged to submit alternative training programmes to SAC for their specific aircraft types should the recommended manoeuvres fall outside of the operating envelope of the specific aircraft for which a jet/turbine aerobatic rating is sought.

10.2 Prescribed Reading Matter

The following reference material and recommended reading is deemed to form part of the training syllabus for jet/turbine aerobatic ratings;

- "*Flight Unlimited*" by Annette Carson & Eric Mueller
- "*Aerobatics*" by Neil Williams
- "*Better Aerobatics*" by Alan Cassidy
- *"Aerospace Physiological Training Program"* by Secretary of the US Air Force.
  (A good website for the above can be sourced on

  http://afpubs.hq.af.mil)

The following book is deemed to be mandatory reading for aspirant jet/turbine aerobatic rating pilots.

- African Aviation Series book *"Zero Error Margin"* by Des Barker

SPORTS AEROBATIC CLUB OF SOUTH AFRICA

RECOMMENDED FLYING TRAINING SYLLABUS

FOR

JET/TURBINE AEROBATIC RATING

JET/TURBINE AEROBATIC RATING

LESSON 1

PERFORMANCE INVESTIGATION

1. Aim of the Lesson

The primary aim of the first lesson is to explore the performance characteristics of the particular aircraft at the extremes of the flight envelope. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. In its purest form, it is the means by which pilots, accurately and comprehensively, explore the flight characteristics of the specific aircraft. This is to establish the ultimate operating parameters which can subsequently be utilised for display purposes.

2.2 Research. It provides for the recording of experimental, research and evaluation data to cater for the needs and requirements when planning manoeuvres, focussing on energy management for that particular type of aircraft.

2.3Theory. Candidates to mathematically calculate stall speed as a function of bank angle.

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 2,000 ft AGL.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances

4.2 Steep Turns

- Conduct steep turns at varying speeds
- Note rates of turn
- Candidate pilots to calculate radius of turn
- Candidate pilots to observe stall speed as a function of bank angle

4.3 Maximum Rate Turns

- Conduct maximum rate turns at varying speeds
- Note buffet boundaries
- Candidates pilots to demonstrate stall speed for manoeuvring

4.4 Turn Reversals

- Perform a steep turn through 180° with a turn reversal through 180° without height loss. Note loss of energy and changing radius
- Perform steep turns through 180° with a reversal into a max. rate turn through 180° without height loss. Note speed decay and reduction in radius of turn on completion.

4.5 Pitch-up Manoeuvres

- Pitch to the vertical at varying speeds (use max. thrust)
- Note vertical penetration versus entry speed
- Note minimum speed to sustain level flight after pull-ups
- Calculate individual and average RoC.
- Determine whether it is quicker to use a zoom climb or maximum sustained rate of climb.
- Determine what the possible uses of the zoom climb are.

4.6 Pull-Down Manoeuvres

- Pitch from various attitudes (half-roll pull-through)
- Govern speed and height for the recovery!!!
- Pitch to 30° and pull through
- Pitch to 45° and pull through
- Pitch to 60° and pull through
- Pitch to 75° and pull through
- Note entry speeds, height penetration, recovery height and speed
- Note handling and directional deficiencies at the half roll
- Emphasize the danger of this type of manoeuvre at low level.

4.7 Practiced Forced Landing

- Instructor to initiate a simulated PFLWOP from any position during exercise
- Emphasize attitude, speed and height relationships
- Candid dates to execute a safe, successful simulated PFLWOP
- Instructor to emphasize position in relation to safe areas throughout

5. Emergencies

Determine who is the commander of the aircraft!
Discuss actions in the event of an emergency
Discuss crew responsibilities and duties
Discuss flame out/compressor stall during hard manoeuvring
Ejection/Bail-out actions

6. Safety

Ensure operations in a safe area
Ensure all safety checks completed
Discuss lookout and clock-code reporting throughout
Discuss loss of control and actions in the event of LoC

7. Airmanship

7.1 Jet and Turbine powered aircraft use high volumes of fuel. Ensure that the sortie "flows" from one exercise to the next with the minimum loss of energy, fuel and time. Plan the exercise to face in the correct direction.

7.2 Remember that inaccurate flying and rough handling will have a detrimental effect on the results obtained.

7.3 Remember that performance data reflecting the manufacturer's specifications is available in either the flight manual (aerodynamic), or relevant technical publication (structural), for all stages of a particular flight.

7.4 It is important to understand that aircraft performance investigation is not restricted to any one particular aspect of flying. The aircraft is subject to structural and aerodynamic limitations from the moment it starts up, until it has been shut down at the end of the sortie.

7.5 In conclusion, remember that exercises involving performance investigation require the highest levels of professionalism and airmanship. Plenty of pre-flight study and a mature approach to the task in hand will ensure that you achieve both accurate and worthwhile results.

8. Questions?

JET/TURBINE AEROBATIC RATING

LESSON 2

LOW SPEED HANDLING

1. Aim of the Lesson

The primary aim of the second lesson is to explore the performance characteristics of the particular aircraft at the extremes of the flight envelope when operating at the stall boundary. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. It is the means by which pilots can explore the flight characteristics of the specific aircraft under controlled conditions. This is to establish the ultimate operating parameters of an aircraft operating at high alpha and high load factor, conditions that can be experienced inadvertently in a display.

2.2 Research. It provides for the recording of experimental, research and evaluation data to cater for the needs and requirements when planning manoeuvres, focussing on energy management for that particular type of aircraft.

2.3 Theory. Candidates to mathematically calculate an accelerated stall speed.

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 2,000 ft AGL for stalling and auto-rotative manoeuvres. Recovery for spinning (if certified) should be at a minimum of 3,000 ft AGL.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances

4.2 Stalling

- Conduct a conventional stall in clean configuration
- Note speed for recovery
- Note height for recovery
- Note aircraft behaviour and tendencies

4.3 Stalling in Differing Configurations and Thrust Settings

- Conduct stalling in various configurations/thrust settings
- Note speed for recovery
- Note height for recovery
- Note aircraft behaviour and tendencies

4.4 Accelerated Stalling

- Perform a steep turn through 180° and increase the load factor to induce an accelerated stall
- Perform the above exercise with a turn reversal through 180° and induce to load factor during the turn reversal
- Note loss of energy and increased stall speed
- Note the behaviour of the aircraft in an accelerated stall
- Perform steep turns through 180° with a reversal into a max. rate turn through 180° without height loss. Note speed decay and reduction in radius of turn on completion.

4.5 Auto-Rotative Stalling (Incipient Spinning)

- Commence with a climbing turn with decaying speed.
- Induce cross controls close to the apex with decaying speed and increasing load factor.
- Note the behaviour of the aircraft on departure.
- Note the loss of control effectiveness.
- Institute recovery actions.
- Note loss of height, direction and orientation during recovery.
- Instructor to demonstrate incipient spin entry from high nose attitude, student to recover.
- Instructor to induce similar actions from different attitudes/speeds with student to recover.

4.6 Spinning (if Certified)

- Induce a conventional spin from standard entry conditions.
- Institute normal recovery techniques after 1¼ turns.
- Note the behaviour of the aircraft on departure.
- Institute recovery actions.
- Note loss of height, direction and orientation during recovery.
- If certified, instructor to demonstrate a ¾ turn inverted spin with normal recovery techniques.
- Student to identify symptoms of an inverted spin.
- Discuss spin recovery by using pro-spin techniques for aircraft with a high B/A ratios.
- Instructor to demonstrate spin entry from high nose attitude, student to recover.

4.7 Practiced Forced Landing:

- Instructor to initiate a simulated PFLWOP from any position during exercise
- Emphasize attitude, speed and height relationships
- Candidates to execute a safe, successful simulated PFLWOP
- Instructor to emphasize position in relation to safe areas throughout

5. Emergencies

Determine who is the commander of the aircraft!
Discuss actions in the event of an emergency.
Discuss crew responsibilities and duties
Discuss flame out/compressor stall during manoeuvring

6. Safety

Ensure operations in a safe area
Ensure all safety checks completed
Discuss lookout and clock-code reporting throughout
Discuss loss of control and actions in the event of LoC
Discuss who will have control in the event of LoC

7. Airmanship

7.1 Remember that performance data reflecting the manufacturer's specifications is available in either the flight manual (aerodynamic), or relevant technical publication (structural), for all stages of a particular flight. Review this detail, particularly with respect to loss of control.

7.2 It is important to remember that an aircraft operates to its design limit under normal circumstances. Low speed handling and auto-rotative manoeuvres may subject the aircraft to unpredictable behaviour. Pilots are to well versed in the operation of the aircraft, having undergone a comprehensive conversion to type.

7.3 Jet and Turbine powered aircraft use high volumes of fuel. Ensure that the sortie "flows" from one exercise to the next with the minimum loss of energy, fuel and time. Plan the exercise to face in the correct direction.

7.4 Remember that inaccurate flying and rough handling will have a detrimental effect on the results obtained.

8. Questions?

JET/TURBINE AEROBATIC RATING

LESSON 3

LOOPING MANOEUVRES

1. Aim of the Lesson

The primary aim of the third lesson is to introduce the "loop" manoeuvre and to explore the limitations of looping and investigate the limits of the particular aircraft in the execution of looping manoeuvres. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. The loop forms the basis of most aerobatic displays, either in its entirety or portion thereof. Pilots can explore the flight characteristics of the specific aircraft under governed conditions. This is to establish the ultimate operating parameters of an aircraft performing a loop or portion of a loop.

2.2 Research. It provides for the recording of experimental, research and evaluation data to cater for the execution of a loop with particular emphasis on energy conservation and energy management for that particular type of aircraft.

2.3 Theory. Students are to research and explain to the instructor the reducing radius of turn in a loop and explain why it is important to energy manage the aircraft and how to rectify this problem in order to perform a symmetrical loop. Students are to also research the effect of density altitude on performance. (The instructor will act as a tutor in assisting the research)

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 2,000 ft AGL for looping.

3.3 During the lesson, and with successful execution by the student, the instructor may reduce the height to 1,000 ft AGL as an introduction to looping at a lower altitude.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances
- Ensure aircraft is configured for aerobatics

4.2 Wing-overs

- Practice wing-overs onto a line feature
- Focus on “pegging” the nose attitude and keeping a fixed dive angle.
- Master the art of fixing the dive angle with every entry
- Note entry speeds and height loss to reach looping speed.

4.3 Loop Entry, Execution and Exit

- Conduct a series of academic loops at optimum loop speed
- Note entry versus exit speeds
- Note height gain at the apex
- Note the speed at the apex
- Focus on the radius of the loop
- Note aircraft behaviour and tendencies

4.4 Looping at Differing Speeds

- Instructor to demonstrate loops at lower and higher speeds
- Instructor demonstrates a “buffet” loop.
- Student to note height/speed sacrifice for not having optimum speed. (demonstration of how energy hungry poor loops can be)
- Student to note aircraft behavioural tendencies.
- Decide upon a minimum entry speed for a safe loop performed at a lower speed. (Decide upon a personal “no-go” gate for looping)

4.5 Loss of Control Induced by Poor Execution of an Energy Deficient Loop

- With student flying, instructor to induce high alpha manoeuvre at apex of loop. (student to recover)
- With student flying, instructor to induce auto-rotative manoeuvre inverted at apex of loop. (Student to recover)
- With student flying, instructor to induce cross controls close to the apex with decaying speed and increasing load factor.
- Note the behaviour of the aircraft on departure.
- Note the loss of control effectiveness.
- Student institutes recovery actions.
- Note loss of height, direction and orientation during recovery.

4.6 Loop at Lower Altitude (1,000ft AGL)

- Instructor to demonstrate looping manoeuvres at lower altitude
- Student to practice same as the demonstration.
- Instructor to reinforce the importance of optimised energy management at low level.

4.7 Simulated Relight Procedure

- Instructor to simulate engine failure.
- Student to perform initial actions for engine relight.
- Emphasize attitude, speed and height relationships, seek windmill RPM with height available
- Consider “hot” relight versus “cold” relight
- Consider orientation and safe “bail-out” area.

5. Emergencies

Determine who is the commander of the aircraft!
Discuss actions in the event of an emergency.

Discuss crew responsibilities and duties
Discuss hydraulic failure and control jam/freeze during manoeuvring

6. Safety

Ensure operations in a safe area
Ensure all safety checks completed
Discuss "G-LoC" induced by high "g" loading and techniques to combat "G-LoC?

7. Airmanship

7.1 Students are to try to finesse their techniques in the handling of the aircraft. They are to try to conserve as much energy as possible throughout the training.

7.2 Plan the exercise well; allow the exercise to flow into a logical sequence. Try not to allow height to be unnecessarily eroded throughout the exercise, thus wasting precious fuel in constant climbs in an attempt to gain altitude.

7.3 DO NOT push the boundaries of safety by attempting lower altitude loops when not prepared. Rather "knock it off" and climb for altitude and start again.

7.4 Remember, "ham-fisted" flying saps energy, try to have a fluid transition from manoeuvre to manoeuvre.

8. Questions?

JET/TURBINE AEROBATIC RATING

LESSON 4

ROLLING MANOEUVRES

1. Aim of the Lesson

The primary aim of the fourth lesson is to introduce the "straight roll" manoeuvre and to explore variations of the manoeuvre, recovery from a bad manoeuvre and dangers associated with rolls at low level. Furthermore, students will experience and investigate the limits of the particular aircraft in the execution of rolling manoeuvres. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. The roll and variants of the "roll" are an integral part of any aerobatic display. Pilots can explore the flight characteristics of the specific aircraft under governed conditions. This is to establish the ultimate operating parameters of an aircraft executing a roll or variation of a roll.

2.2 Research. This lesson allows students to record evaluation data to manage the energy for the execution of a roll applicable to the particular type of aircraft being flown.

2.3 Theory. Students are to research and explain to the instructor the affect of damping in roll, effect of density altitude and gyroscopic interaction in roll. Students are to research the interaction of the "A", "B", and "C" gyros and how the interaction leads to inertial cross-coupling and divergence. (The instructor will act as a tutor in assisting the research)

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 1,000 ft AGL for rolling.

3.3 During the lesson, and with successful execution by the student, the instructor may reduce the height to 500 ft AGL as an introduction to rolling at a lower altitude.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances
- Ensure aircraft is configured for aerobatics

4.2 Straight Roll Entry, Execution and Exit

- Practice rolling along a line feature

- Focus on "fixing" the nose attitude and keeping a fixed point on the horizon.
- Note the nose attitude for entry and exit from a roll at the manufacturers recommended speed.
- Note the roll rate and directional deviation the aircraft may induce.

4.3 Inverted Flight

- The instructor is to demonstrate inverted flight.
- Note the nose attitude
- Note the energy decay
- Instructor demonstrates short inverted turn
- Student to exercise the same as above.
- Student not to loose height on the manoeuvres
- Instructor demonstrates recovery from inverted position.

(Decide upon a personal "no-go" gate for inverted flight)

4.4 Rolling at Differing Speeds

- Instructor to demonstrate rolls at lower and higher speeds
- Student to note rate of roll, nose divergence and control inputs to execute a successful roll at various speeds.
- Student to note aircraft behavioural tendencies.
- Decide upon a minimum entry speed for a safe roll performed at a lower speed. (Decide upon a personal "no-go" gate for rolling)

4.5 Recovery from a Badly Executed Roll

- Instructor to demonstrate a "scooped" roll induced by aerodynamic and inertial cross coupling in pitch and roll.
- Instructor to demonstrate recovery from a badly executed roll from the inverted position.
- Note height and directional control loss.
- Student to recover from all attitudes.
- With student flying, instructor to induce "too much rudder" during rolling. (student to recover)
- With student flying, instructor to induce "too much pitch" during the roll. (student to recover)
- Note loss of height, direction and orientation during recovery.

4.6 Rolling at a Lower Altitude (500ft AGL)

- Instructor to demonstrate rolling manoeuvres at lower altitude.
- Student to practice same as the demonstration.
- Instructor to reinforce the importance of nose attitude and energy management at low level.

4.7 Variations of the Roll

- Instructor to demonstrate "four-point" roll
- Student to practice "four-point" roll
- Instructor to demonstrate multiple roll
- Student to practice multiple roll
- Manoeuvres to be reinforced in subsequent lessons

4.8 "Zoom" Climb following Engine Failure at Low Level.

- Instructor to simulate engine failure during low level rolling exercise.
- Student to perform recovery from inverted without power
- Student to "zoom" with surplus energy to position aircraft into a "safe area"
- Initial actions for "hot" engine relight.
- Consider orientation, PFLWOP or "bail-out" area.

5. Emergencies

Determine who is the commander of the aircraft!
Discuss actions in the event of an emergency.
Discuss crew responsibilities and duties
Discuss fuel starvation (from inverted flight) and immediate actions during the flying demonstration

6. Safety

Ensure operations in a safe area
Ensure all safety checks completed
Discuss loss of directional control to due to inertial cross-coupling.
Discuss recovery techniques for divergence (if applicable)

7. Airmanship

7.1 Students are to try to maintain altitude and direction throughout the horizontal manoeuvring. They are to try to conserve as much energy as possible throughout the training.

7.2 NEVER execute a roll without first considering the nose attitude versus speed relationship. Rather "knock it off" and climb for altitude and start again.

8. Questions?

JET/TURBINE AEROBATIC RATING

LESSON 5

VERTICAL MANOEUVRES

1. Aim of the Lesson

The primary aim of the fifth lesson is to introduce some additional manoeuvres that incorporate pitching (vertical) and rolling manoeuvres as an extension of the principles learned in the previous lessons. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. The manoeuvres planned from the basis of the original loop and rolling manoeuvres encompass:

- Barrel roll,
- Stall turn (if certified),
- Cuban- 8
- Vertical roll (performance permitting)
- Torque Manoeuvres with Propeller- driven Turbine Aircraft

The loop and roll are now combined to form part of an aerobatic display. Pilots can explore the flight characteristics of the specific aircraft under governed conditions. This is to develop a combination of academic manoeuvres to with more complicated exercises using the looping and rolling plane.

2.2 Theory. Students are to research the negative effects of density altitude and the dangers involved with energy degradation throughout a display. (The instructor will act as a tutor in assisting the research)

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 1,000 ft AGL for looping and 500 ft for rolling manoeuvres.

3.3 During the lesson, and with successful execution by the student, the instructor may reduce the height to 500 ft AGL as an introduction to rolling and looping at a lower altitude.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances
- Ensure aircraft is configured for aerobatics

4.2 Barrel Roll Entry, Execution and Exit

- Practice pitching and rolling along a line feature
- Focus on "fixing" a position on the horizon and ahead.
- Note the nose attitude for entry and exit from a roll at the manufacturers recommended speed.
- Note the roll rate and directional deviation the aircraft may induce.
- Maintain orientation and directional control throughout
- Ensure entry speed equals exit speed on completion
- (Decide upon a personal "no-go" gate for Barrel Roll)

4.3 Stall Turn (Hammerhead Turn)

- **ONLY** to be performed if aircraft is certified for stall turn manoeuvre.
- Instructor is to demonstrate the "fixing" of the vertical (or near vertical position) for a stall turn.
- Note the nose attitude
- Note the energy decay
- Instructor demonstrates turn at the apex (hammerhead turn)
- Student to exercise the same as above.
- Student to note sacrifice of speed and height on the manoeuvres
- Instructor emphasises badly executed stall turn may induce an inverted flat spin.
- Instructor to emphasise that unlike propeller driven aircraft, in-line thrust jet aircraft have poor control affectivity at the apex of the vertical manoeuvre.

(Decide upon a personal "no-go" gate for height and speed for a stall turn)

4.4 Cuban-8

- Instructor to demonstrate a full Cuban-8 manoeuvre.
- Student to exercise same as above.
- Maintain orientation and directional control throughout
- Ensure entry speed equals exit speed on completion
- Decide upon a minimum entry speed for a Cuban-8 (Decide upon a personal "no-go" gate for the Cuban-8)
- Instructor to demonstrate Reverse ½-Cuban and **EMPHASISE** the inherent danger of poorly executed pitch-up, roll and recovery. Instructor to highlight the height loss, speed build up and high-"G" build up on recovery. (This manoeuvre for low experienced pilots is discouraged)

4.5 Vertical Roll

- Instructor to demonstrate a pitch to the vertical followed by a single roll in the vertical plane. (recovery to a stall turn or push out)
- Instructor to demonstrate recovery from a badly executed vertical roll.
- Note height and rapid speed decay.
- Constantly focus on orientation in relationship to the horizon
- Student to practice the exercise.
- Student to be taught how to recover from the vertical with loss of orientation.

- With student flying, instructor to induce "too much rudder" during rolling. (student to recover)
- With student flying, instructor to induce "too much pitch" during the roll. (student to recover)
- Note loss of height, direction and orientation during recovery.
- (Decide upon a personal "no-go" gate for vertical rolls)

4.6 Torque Manoeuvres (Turbine Powered, Propeller-driven aircraft)

- Instructor to demonstrate torque roll and recovery techniques
- Instructor to demonstrate "tail slide"
- Instructor to demonstrate entry conditions for inverted flat spin.
- Student to practice same as above.
- Instructor to dedicate a separate lesson to these manoeuvres.

5. Emergencies

Determine who is the commander of the aircraft!
Discuss actions in the event of an emergency.
Discuss crew responsibilities and duties
Discuss engine failure/flame-out or compressor stall at the apex of the vertical manoeuvres.

6. Safety

Ensure operations in a safe area
Ensure all safety checks completed
Discuss loss of directional control to due to inertial cross-coupling.
Discuss recovery techniques for divergence (if applicable)

7. Airmanship

7.1 Students are to try to conserve energy and direction and orientation throughout the vertical manoeuvring.

7.2 **NEVER** execute a vertical manoeuvre being energy deficient. Rather "knock it off" and climb for altitude and start again or terminate your display.

7.3 **NEVER** "ad hoc" a manoeuvre if you have insufficient energy, "knock it off" and remove the intended manoeuvre from the sequence. Position for the next manoeuvre when you have sufficient energy! Rather come back another day than never again!

7.4 **BEWARE** of the "challenge gremlin", be mature and disciplined, and use your gained knowledge base to make the right decision. **DO NOT** rise to the bait of "show fever" and become a "show-off" and God forbid, a statistic!

8. Questions?

JET/TURBINE AEROBATIC RATING

LESSON 6

LINKED MANOEUVRES – GRADUATE LEVEL

1. Aim of the Lesson

The primary aim of the sixth lesson is to introduce a series of linked manoeuvres to form a short qualifying sequence based on the previous lessons. The student is to demonstrate successful execution of all exercises.

2. Objectives

2.1 Operating Parameters. The manoeuvres planned from the basis of the original loop and rolling manoeuvres encompass:

- The student will determine an aerobatic sequence of his/her own choice and by keeping the sequence the same, but by employing different flight techniques during the sequence, students will determine which parts of the sequence are energy building, and which are energy depleting.
- The loop and roll are now combined to form part of a linked aerobatic display. Sequences may be linked through fluid entries from one manoeuvre tot eh next or through turn reversals in order to reposition.

2.2 Theory. Students are to prepare the sequence based on elements listed below. They are to formulate a sequence of events within the performance characteristics of the aircraft. Students are to have a clear plan of entry and exit speeds, height requirements and positional information. (The instructor will act as a tutor in preparation of the basic sequence)

3. Domestics

3.1 Route to a safe area where exercise can be conducted unhindered by traffic or ATC.

3.2 Climb to safe altitude for operations with adequate height to be recovered by 1,000 ft AGL for looping and rolling manoeuvres.

3.3 During the lesson, and with successful execution by the student, the instructor may reduce the height to 500 ft AGL as an introduction to rolling and looping at a lower altitude.

4. Conduct of the Exercise

4.1 Safety Checks

- Pre-aerobatic/manoeuvring checks to be completed
- Ensure no fuel asymmetry with no configuration imbalances
- Ensure aircraft is configured for aerobatics

4.2 Basic Sequence

- Sequence to be flown initially at 1, 000 ft AGL then 500 ft AGL
- Loop toward the display centre point along the 45º "off-line"
- Exit the loop in "smear turn left.
- Pitch to the 45º up line, exiting along the 45º "off-line"
- Perform a wing-over back onto the display line
- Perform a straight roll parallel to the display line
- Pull up into a Cuban-8 parallel to the display line
- Recover to the centre-point and perform a steep turn
- Completing the steep turn, position parallel to the display line for inverted flight
- Pull up to the 45º "up-line and perform a straight roll.
- Exit the display area

5. Emergencies

Discuss as required for aircraft type

6. Safety

Apply all procedures as previously briefed.

7. Airmanship

8. Questions?