CIVIL AVIATION
SAFETY AUTHORITY
AUSTRALIA

Advisory Circular

BWS 18 Oct 99

AC 91.15(0) OCTOBER 1999

GUIDELINES FOR AEROBATICS

CONTENTS

1. REFERENCES

- CASR Part 91.320 – Aerobatic Flight
- FAR 91.303 (1998)
- FAA AC 91-48; 91.61
- FAA AIM Section 8-1-7
- BASI Air Safety Research Report 872-1017 (1988)

2. PURPOSE

This Advisory Circular (AC) provides information to enhance the safety of aerobatic flight.

3. STATUS OF THIS AC

This is the first AC to be issued on this subject.

Advisory Circulars (ACs) are advisory only. ACs provide recommendations and guidance to illustrate a method, or several methods, not necessarily being the only method by which legislative requirements may be met. They also provide a means of illustrating the meaning of certain requirements by offering interpretive and explanatory guidance. ACs should always be read in conjunction with the referenced regulations.

4. GENERAL

4.1 Definitions. In this AC the following definitions apply:

"**Aerobatic flight**" means manoeuvres intentionally performed by the pilot that involve:

(a) bank angles in excess of 60 degrees; or

(b) pitch angles in excess of 45 degrees, or otherwise abnormal to the aircraft type; or

(c) abrupt changes of direction, angles of bank, angles of pitch, or speed.

"**Acrobatic category**" means an aircraft certified for aerobatic manoeuvres in accordance with relevant design rules. Manoeuvre limitations are shown in the aircraft's flight manual.

"**Utility category**" means an aircraft certified for *limited* aerobatic manoeuvres in accordance with relevant design rules. Permitted manoeuvres and limitations are shown in the aircraft's flight manual.

4.2 Aerobatic flying is demanding of both aircraft and pilot. The aircraft must be highly manoeuvrable, yet tolerant of G loadings. The pilot must have skill and stamina. He or she must be mindful of the limitations of the aircraft, of normal human limitations, and of their personal tolerances. The most important of human limitations are the biomedical factors and the pilot's response to acceleration loadings (G loadings). The physiological effects of positive G loading range from reduced vision to loss of consciousness. The aerobatic pilot needs to understand these effects to fly safely and make the most of the activity.

4.3 Pilots planning to engage in aerobatics should be aware of the physical stress of accelerative forces during aerobatic manoeuvres. Many prospective aerobatic pilots enthusiastically undertake initial aerobatic training but find their first experiences with higher G forces include airsickness, disorientation and discomfort. These effects are normal and natural, and usually disappear with exposure and experience. To minimise or avoid adverse effects and the inherent hazards, the aerobatic instructor and the trainee must have a basic understanding of the physiological effects of G force and the process of adaptation.

4.4 Forces experienced during a rapid pull-up manoeuvre (positive G loading) cause blood and body organs to be displaced toward the lower part of the body, away from the head, leaving the heart unable to supply oxygenated blood to the brain. Since the brain requires continuous blood circulation for an adequate oxygen supply, a pilot can tolerate higher G-forces for only a short time before losing vision and mental functions. When the blood circulation to the brain decreases as a result of G forces, a pilot will experience decreased visual acuity ("tunnel vision", "grey-out", "black-out"), then decreased mental acuity, and finally unconsciousness. Even a brief loss of mental performance during a manoeuvre can lead to improper control movements which could cause structural failure of the aircraft, or collision with another object or terrain.

4.5 Forces experienced during a rapid push-over manoeuvre (negative G loading) cause the blood and body organs to be displaced toward the head. Depending on the forces involved and individual tolerance, a pilot may experience discomfort, headache, "red-out," disorientation, and even unconsciousness.

4.6 A serious danger is that a rapid onset of high G loadings (as during 'snap' manoeuvres) can overstress the aircraft before pilot incapacitation reduces control inputs. Regardless of the aircraft's capacity to endure the G loadings, snap manoeuvres also put the pilot at risk of losing consciousness without any precursor warning.

4.7 In steep turns, the centrifugal forces tend to push the pilot into the seat, thereby resulting in blood and body organ displacement toward the lower part of the body, as in the case of rapid pull-up manoeuvres, with the same physiological effects and symptoms.

4.8 Tolerance to G forces is dependent on human physiology and the individual pilot. Humans progressively adapt to imposed strains and stress, and with practice, manoeuvres will have less physiological effects. Relevant factors include the pilot's anatomy, cardiovascular architecture, nervous system, the quality of the pilot's blood, general physical state, recency of exposure and experience. A pilot new to aerobatics should have a check up with an Aviation Medical Examiner prior to aerobatic training. All aerobatic pilots should be aware that lack of recent practise, illness, and poor physical condition can reduce tolerance to accelerative forces and increase the possibility of a dangerous loss of consciousness.

5. Gs AND THEIR PHYSIOLOGICAL EFFECTS.

5.1 G may be thought of as a force or thrust against a body induced by gravity or a dynamic force. On the ground, gravity causes a static body to have a weight equal to one unit of gravitational force, or one G, measured in terms of the thrust of the body against the ground. When an elevator, car, or aeroplane accelerates, slows down, or changes direction, occupants experience the effects of their body's resistance to the applied force. The phenomena of being forced against whatever restrains the person from continuing in a straight line may be referred to as experiencing a G-force. For example, consider a pull-up from a dive as illustrated in Figure 1. The amount of G experienced by the pilot at a given airspeed depends on the magnitude of his or her control inputs and the resultant change in direction of flight. If the pilot "pulled" +4 Gs while mounted on a set of scales, he or she would register four times their usual weight.

5.2 The G-forces depicted in Figure 1 are designated with a positive (+) number because their direction is from head to foot. However, imagine a pushover at the start of a dive (see Figure 2). The aircraft changes direction in such a way that the pilot tends to be thrown upward and outward. There may be a sensation of weightlessness, and if the pilot were on scales, he or she would register less than their usual weight. In Figure 2 the notation used would be negative (-) because the direction of acceleration is toward the pilot's head.

5.3 One notational system for describing Gs is based on reference to the direction of accelerations to the axes of the pilot as he sits in the cockpit (see Figure 3). Fore and aft accelerations (Gx), and lateral accelerations (Gy) are usually relatively low values and apart from the possibility of disorientation and occasional discomfort have little practical affect on an aerobatic pilot's body or mental processes.

Note: In this AC, the expression "G" is to be taken as +Gz

FIGURE 1. Gs acting on pilot in pull up from dive

FIGURE 2. Gs acting on pilot in pushover

FIGURE 3. Notational system for Gs acting on pilot

5.4. The main effects of G accelerations are upon the movement of blood about the body. The +G effects encountered in the pullout of a dive (Figure 1) will impel blood toward the lower portions of the body, thus reducing the supply of blood from the heart to the eyes and brain, which require a continuous supply of freshly oxygenated blood for normal operation. Diminished blood flow to the head can lead to disturbances of vision, uncoordinated muscular activity, and unconsciousness.

6. SYMPTOMS OF G EFFECTS

6.1 Positive G Effects. The +G induced effects may be described as follows:

(a) lighter (3 to 4) G loadings ("grey-out" phase): there is loss of visual acuity caused by diminished flow of blood to the eyes. Although there is no associated physical impairment, this condition should serve as a warning of a significant reduction of blood pressure in the brain;

(b) larger (5 to 6) G loadings ("black-out" phase): vision is completely lost. This condition results when the oxygen supply to the light sensitive retinal cells is severely reduced. Some mental activity and muscle function remains, but there is seriously reduced blood flow to the head and a high risk of loss of consciousness;

Note: In some centrifuge studies, 50 percent of the pilots had loss of consciousness without warning symptoms. Therefore, a pilot should not rely on G-related symptoms as an alert to possible loss of consciousness.

(c) loss of consciousness: when the blood flow through the brain is reduced sufficiently the pilot will lose consciousness. He or she may have jerking, convulsive movements; which have been observed in many subjects of centrifuge studies and in some pilots during actual flight. The pilot will slump in his or her seat and (if not properly restrained) may fall against the controls.

IN CENTRIFUGE STUDIES, MANY PILOTS LOST (AND REGAINED) CONSCIOUSNESS WITHOUT REALISING THEY HAD DONE SO;

(d) how long does G induced loss of consciousness (G-LOC) last? In a series of studies of pilots in centrifuges, the pilots were unconscious for an average of 15 seconds. Following this, there was an additional 5 to 15 second interval of confusion and disorientation. Thus, if there is loss of consciousness due to +G forces, there will be a 20 to 30 second (or longer) period during which the pilot is not in control of his or her aircraft.

6.2 Negative Gz Effects

6.2.1 Negative G is encountered when acceleration is in a foot to head direction, such as might be obtained during inverted flight, or during an outside loop or pushover manoeuvre (see Figure 2). Blood flows to and tends to stagnate in the head. Under mild conditions of (-)G forces, the pilot will feel congestion, as when standing on his or her head. Engorgement of blood vessels causes a reddening or flushing of the facial skin and a feeling of heat. Blood vessels in the eyes will become dilated and nosebleed may occur. Discomfort, possibly acute, is certain. Visual disturbances may occur. Some persons may experience a headache. It was once thought common to have the lower eyelids rise to cover the pilot's pupil during (-)G, causing the pilot to see only a red glow known as "red-out", but this may be comparatively rare.

6.2.2 Little is known about the effects of high (-)G on humans because (-)G accelerations have caused considerable discomfort in those studied. Aerobatic pilots have reported small haemorrhages in the eyes and skin.

6.2.3 The blood vessels in the brain tolerate mild (-)G stresses well, but the increased blood pressure in the chest and neck causes a slowing of the heart in virtually all subjects. In a few individuals, there is such a marked slowing of the heart that there are intervals of several seconds between beats. In some people, the heart may beat irregularly after (-)G exposure. The slowing of the heart and irregularities of beats can add to the stagnation of blood in the brain. Thus, it appears that the greatest threat from (-)G is the loss of consciousness from the slowing of the heart, irregularities of the heartbeats, and stagnation of blood in the head.

FIGURE 4. Physiological changes brought on by positive and negative G accelerations

7. TOLERANCE TO Gs.

7.1 Because of the number of factors involved, it is difficult to predict how much acceleration a certain individual can withstand. Tolerance is related to the rate of onset of acceleration and to the duration of exposure. Individual tolerance depends on factors such as recency of exposure to the accelerations, the height of the person, age, elasticity of the blood vessels, physical training, the responses of the heart and blood vessels, and on health. Because of the many variables involved, the centrifuge data in the following table are useful only as an estimate of the average pilot's tolerance to +G. Little is known of tolerance to (-)G. These data were collected from 1,000 US Naval aviation pilots and aviation personnel and apply to rates of onset of about +1 G per second - a rate that well may be encountered in civil aerobatic manoeuvres.

Table 1. Thresholds in Relation to +G Tolerance

Symptom	Average Threshold	Deviation	Standard Range
"Grey-out"	4.1 G	± 0.7 G	2.2 to 7.1 G
"Blackout"	4.7 G	± 0.8 G	2.7 to 7.8 G
Unconsciousness	5.4 G	± 0.9 G	3.0 to 8.4 G

Note: the threshold figures shown here can usually be improved upon by practiced pilots.

7.2 Note that at an onset rate of 1 G per second, the G values in Table 1 could just as well be expressed in seconds. Thus, a supposedly average pilot accelerating at 1 G per second might expect "grey-out" at 4.1 seconds, "blackout" at 4.7 seconds, and unconsciousness at 5.4 seconds. More sensitive pilots, however, might be unconscious in 3.0 seconds. If the rate of onset were greater, then symptoms and loss of consciousness would occur sooner.

7.3 A major outcome of these centrifuge studies was the demonstration of significant variations among subjects. The act of piloting an aircraft can raise the acceleration tolerance; thus, the results of some centrifuge studies during which the subject was passive may not apply directly to flight. This increased tolerance is not so great, however, that the aerobatic pilot should consider himself or herself immune to G incapacitation.

7.4 Tolerance of (-)G (foot to head) has not been studied intensively. About -1 G produces an unpleasant congestion of blood in the face and head;(-)2 to (-)3 G causes severe congestion of the face, throbbing headache, progressively blurring, greying, or occasionally reddening of vision. After exposure to (-)G, there may be tiny haemorrhages in the skin and eyes and the eyelids may be swollen. Minus 5 G for 5 seconds is probably the upper limit of tolerance; this level has seldom been achieved by volunteer subjects. Unlike military flying in which (-)G does not present much of a problem, aerobatic flying may demand that a pilot spend over half of his or her air time in inverted flight, "pulling" (-) G.

7.5 One important aspect of tolerance to Gs is the effect of rapid changes from +G to (-)G, or vice versa. Because aerobatics induce such rapid changes, tolerance to changes could be highly significant. It is known, for example, that when one is subjected to (-)G, blood pressure receptors in the head and chest respond to the increased pressure and cause a reflex slowing of the heart (Figure 4). A rapid change to +G (for example, when the pilot executes a half-roll during a manoeuvre) would suddenly drop blood pressure in these receptors and there would be a rapid speeding up of the heart to maintain pressure; but because the reflex system requires some time to sense the need, the heart could be delayed in responding to this demand and blood flow to the brain might suddenly decrease. Because of the sudden transition, and possible delay in response of the heart, a vertical 8 with an outside loop on top (-)G and an inside loop on the bottom (+G) may be one of the most threatening of aerobatic manoeuvres (Figure 5). An inability of the cardiovascular system to react to the rapid change from (-)G to +G is the probable basis for many cases of G-LOC.

7.6 Some people can withstand more accelerative force than others, but everyone has a limit which varies in accordance with their general well-being. Military research, training and equipment aims only to increase the average G tolerance of pilots. Seasoned aerobatic pilots may represent a select.. group because persons with less physiological resistance probably drop out of aerobatics before reaching the highest levels of performance.

7.7 A wise aerobatic pilot will realise the potential hazards of Gs and will seek to find the level of acceleration he or she can safely endure, and change the level in accordance with their health, fitness, and recency.

8. Gs IN AEROBATICS.

8.1 The ordinary accelerometer in an aerobatic aircraft "pegs out" at a maximum and a minimum value and gives no indication of the duration of the Gs, so that the accelerometer record has little significance as a record of physiological stress. The US National Aeronautics and Space Administration (NASA) data show that a range of +8 G to (-)6 G can occur during aerobatic competition.

8.2 In one study both Gs and time were recorded during four competitive sequences or displays. The study showed that the pilot experienced negative Gs about half of the total time spent in the performance.

8.2.1 Approximately 10 percent of the time he was pulling +2 G or more with highs to +5.4 G, and about 10 percent of the time he pulled (-)3 G or more with lows to (-)5.2 G. In an outside 360 degree turn the pilot experienced (-)2 G or more for 32 seconds.

8.2.2 The horizontal rolling 360 degree turn produced rapid and repeated G oscillations. In 28 seconds the pilot experienced 6 major G excursions: (-)3.4, +2.3, (-)3.5, +2.0, (-)4.0, and +2.3. The first transition from negative to positive Gs was 5.7 Gs in 2 seconds, or approximately 2.9 Gs/second.

8.2.3 The outside/inside vertical 8 (see **FIGURE 5**) was probably the most physiologically demanding - the pilot experienced a maximum of (-)5.2 Gs in the upper outside loop and 5 seconds later pulled +5.0 Gs in the lower inside loop. This amounted to 10.2 Gs in 5 seconds, or over 2 Gs per second for 5 seconds. Even G tolerant pilots may have changes in vision or possibly loss of consciousness in this manoeuvre

8.2.4 During several manoeuvres the rate of onset equalled or exceeded 1 G per second, and in some manoeuvres, the rate of onset and duration of the Gs were at levels that have been found to cause unconsciousness in some subjects in centrifuge studies.

FIGURE 5. Negative and positive Gs recorded second by second during the outside (upper loop) / inside (lower loop) vertical 8 manoeuvre. The major physiological consequences are indicated at their respective positions in the manoeuvre. The rapid change from negative to positive is particularly stressful.

9. AVOIDING G INCAPACITATION.

9.1 Any type of flying involves some degree of risk. The prudent pilot is familiar with the risks involved and acquires the knowledge and skills necessary for reducing these risks to a minimum. The pilot is also aware of his or her own limitations and can make accurate judgments of his or her ability to withstand the stresses of flight. As noted here, the susceptibility to acceleration is an especially important limitation of the aerobatic pilot, and recognising and understanding this limitation is important to safe aerobatic flying. Any pilot who loses consciousness loses control, and at lower levels there is clearly no margin for loss of control of an aircraft. Shown below are some suggestions for minimising the hazards of acceleration in aerobatic flight.

9.1.1 If you experience dimming or greying of vision during flight, realise that this represents diminished blood flow through the eyes and that you may be close to your tolerance limit. Ease off on the controls to reduce the G load and/or change the manoeuvre regime.

9.1.2 If you experience incapacitation or have any lingering symptoms as a result of aerobatics, consult a knowledgeable D.A.M.E .... before you resume flying. Some people may be unusually susceptible to G loading. If you are one of these, you need to know about it.

9.1.3 Frequent exposure to G stress may "tune" the human system, making it less sensitive to higher G loads. If you have not flown aerobatics for some time, begin with the simpler, less stressful manoeuvres when you take it up again.

9.1.4 Typical physical conditioning does not generally optimise tolerance to G loads - endurance running may actually reduce G tolerance. On the other hand, resistance and strength training which increases muscle mass and strength generally improves tolerance to accelerative forces, so an exercise program which concentrates on muscle-building activities would appear to be the choice for a person performing championship level aerobatics. However it's done, a well tuned cardiovascular system will recover more rapidly from stress, so keep in shape.

9.1.5 Be especially mindful of your current physical condition. Do you really "feel" like aerobatics today? If you don't feel well, wait until you do.

9.1.6 Be careful of what, and how, you eat. A low blood sugar level can make you very sensitive to G loading. It can also make you feel unwell, and will much reduce your physical and mental performance. Adequate exercise and an appropriate diet will maintain your blood sugar at normal levels. Remember that after a high carbohydrate meal (e.g., pancakes and syrup, or candy bars), the blood sugar will fall in about an hour, sometimes quicker, so avoid such meals. Eat well balanced, light meals before flying. A large meal could cause pooling of the blood in the digestive tract and decrease G tolerance by reducing the amount of blood available to the general circulation.

9.1.7 While it is not of great concern in Australia, if you are operating overseas be aware that if you are accustomed to flying in a coastal region and then undertake the same aerobatics in a region of higher altitudes you will have a lowered tolerance to Gs. The oxygen content of the blood is lowered by exposure to the higher altitude, and the oxygen supply to the brain might be reduced to critical levels during +G loading (remember, too, that your aircraft will be operating at a higher TAS for a given IAS, and will have a reduced power output).

9.1.8 Remember that anything that reduces blood volume or cardiovascular response may reduce G tolerance. Dehydration, excessive sweating, severe sunburn, low blood pressure, prolonged standing or sitting, hypoxia, infection (even minor illnesses), and many medications all lower G tolerance. Alcohol and hangovers will reduce your ability to perform safe and satisfying aerobatic manoeuvres.

9.1.9 Become acquainted with some of the techniques used by military pilots to reduce the effects of acceleration. For example, some of the effects of +G can be counteracted by pulling the head down between the shoulders, tensing abdominal, chest and leg muscles, closing the glottis by vocalising the word 'hook', and then exhaling slowly during the period of stress. Try to breath as you need to, don't hold your breath. Any muscle contractions that tighten the muscles of the trunk and legs will reduce the space available in the arteries for blood to pool in the lower parts of the body, thus increasing the blood pressure to the brain and hence tolerance to +G. There is no method to counter the effects of (-)G.

9.1.10 Any pilot will lose consciousness if his or her physiological limitations are exceeded, and physical fitness, though important for other reasons, does not greatly affect individual tolerances. In particular, rapid transitions from sustained negative to positive Gs are likely to lead to sudden loss of consciousness and the obvious hazards that follow from such an event. The most rugged performance is likely to be at the pilot's minimum permitted height above ground level, and return to consciousness may be accompanied by a period of incapacitation or confusion of 15 seconds or more. Whatever your past aerobatic qualifications, if you haven't done aerobatics for a while, check yourself out on a dual ride at medium height.

9.1.11 Loss of consciousness usually results in the relaxation of the G force. This can be fatal if it occurs, say, in recovery from a dive toward the ground, and probably explains many of those puzzling cases where an experienced pilot simply fails to complete recovery from a downward manoeuvre. Assuming the aircraft hasn't crashed, after the relaxation of G the pilot may be 'out' for some 15 seconds, and then begin to recover. For a further 30 seconds the pilot may be extremely confused, disoriented and anxious, and may even adopt a 'give-up' attitude. Not least, the pilot may later be totally unaware of the episode, and proceed with a false idea of their G tolerance.

LOSS OF CONSCIOUSNESS DURING AEROBATIC MANOEUVRES CONSTITUTES ONE OF THE MOST SERIOUS HAZARDS ASSOCIATED WITH THE ACTIVITY.

FIGURE 6 shows the limits related to G-LOC. Particularly note that rapid-onset high G forces will lead to G-LOC without warning symptoms, whereas moderate or gradual onset manoeuvres usually provide physiological warnings of pending G-LOC.

10 THE AIRCRAFT

10.1 CASR Part 23 prescribes airworthiness standards for normal, utility, and aerobatic aircraft. CASR part 23 in turn calls up by reference FAR Part 23. FAR Part 23.3 states "The acrobatic category is limited to aeroplanes that have a seating configuration, excluding pilot seats, of nine or less, a maximum certificated take off weight of 12,500 pounds (5700kg) or less, and intended for use without restrictions, other than those shown to be necessary as a result of required flight tests". If aerobatics are planned, be sure your aircraft is certificated in the "acrobatic" category, or otherwise determine its "g" limits and ensure that all manoeuvres are conducted well inside those limits. In addition, there may be restrictions on the types of manoeuvres that can be flown. Aircraft operating limitations must be observed (see POH, flight manual or other manufacturer's guidance).

10.2 FAR Part 23.25.2(1) states that the weight limit with each seat occupied assumes a weight of 86Kg for utility and acrobatic category aeroplanes, except that seats other than pilot seats may be placarded for a lesser weight. *Be aware that many aircraft may not meet this standard, including new aircraft based on old US designs*

10.3 The difference between "**acrobatic**" category aircraft and "**normal**" or "**utility**" is basically the limit load factors, or "G loadings" the structure can withstand. An aircraft may be approved for increased loadings at lighter weights.

10.4 Aerobatic aircraft must be robust. For example, the following is a comparison between normal, utility and acrobatic category aircraft:

AIRCRAFT CATEGORY

	Normal	Utility	Acrobatic
Positive	+3.8 Gs	+4.4 Gs	+6.0 Gs
Negative	*(-)1.52 Gs	*(-)1.76 Gs	**(-)3.0 Gs

* 0.4 times of the positive limit.
**0.5 times of the positive limit.

10.5 It is obvious from the table above that aircraft certificated in the "acrobatic" category are designed to be significantly stronger than "utility" or "normal" category aeroplanes. Some idea of the requirements can be gained from the observation that a level 60 degree angle of bank turn calls for 2 G, while a basic loop generally requires about 4 G.

10.6 Many aircraft that still fly were designed to standards that existed before and immediately after World War II, and some popular aircraft used in casual aerobatics were designed to various military and other standards that could be determined only from the manufacturer's data, if it is available. Owners and pilots must also take into account the effects of time, such as corrosion, material quality, build quality, metal fatigue, and other factors which would have a deleterious effect on the aircraft's structural integrity. Put simply, it is important to be aware that many aircraft do not necessarily equal the newer certification requirements of Part 23, and the pilot must be cautious as to what manoeuvres they can safely perform.

10.7 . Restrictions are often recommended or mandated where uncertainty exists. Experience has shown the need for caution, and limitations aim to minimise the chance of technical failure. There are various systems for advising pilots and operators about certification status, the effects of time, and how best to deal with the uncertainties of origin or previous maintenance. Owners and pilots of old and ex-military aircraft should consult airworthiness engineers and authorities and respect their advice. They provide objective analysis and advice to offset the hazards that might arise out of an excess of natural enthusiasm for an attractive machine.

MATERIAL STRESS IS CUMULATIVE AND A MANOEUVRE THAT WAS SAFE SOME YEARS AGO COULD BE FATAL TODAY

10.8 "Operating limitations," are determined at the time of manufacture and are in accordance with pertinent CASRs. In aerobatic aircraft, the primary manoeuvres that can be performed safely are usually listed either in the approved aircraft flight manual or on placards located in the cockpit. Apart from G, other limitations such as indicated airspeeds, RPM, temperature, and other maximums must be observed. All limitations must be known to the point where observing them is automatic.

10.9 Manoeuvring speed (Va) is particularly important, and prospective aerobatic pilots must know its meaning and implications. Manoeuvring speed (usually expressed as "Va", or "Vman") is the speed at which the pilot can apply full deflection of pitch, roll and yaw controls without exceeding any of the relevant limitations. At Va the aircraft will stall at the maximum permissible G, and above Va application of full pitch control will overstress the aircraft. The pilot knows only the pitch limitation, so there is no room for experimentation. The limit will be shown in the aeroplane's flight manual.

10.10 Any discussion of aerobatic aircraft would not be complete without mentioning amateur-built aircraft. Many of these aircraft are used for sport aerobatics, competition, and air display work. It is difficult, however, for a person not knowledgeable of aircraft structures to determine whether or not the amateur-built aircraft is suitable for aerobatics. This may be determined by the builder at the time of certification.

CASA DOES NOT SPECIFY STRUCTURAL STANDARDS FOR AMATEUR-BUILT AIRCRAFT.

Be cautious about any unofficial claim that the aircraft is "fully aerobatic." it may never have been designed for that purpose. Aerobatics in amateur built aircraft should only be conducted in aeroplanes with service records in that type of operation or which have been designed and built for that purpose.

10.11 Restraints are vitally important in the aerobatic aeroplanes and have much more stress placed on them than in non-aerobatic aircraft. If possible, and subject to airworthiness approval, consider installing dual seatbelts and crotch strap on separate attachment points, especially if significant negative G is intended.

11. OPERATIONS

11.1 Preflight. The preflight inspection of aerobatic aeroplanes is generally the same as any other type. However, close attention should be directed to those areas unique to aerobatic aeroplanes or likely to be affected by overstressing or mishandled manoeuvres.

11.1.1 Structure. Check for visual evidence of damage or failure. Check struts and strut connections, elevator and rudder stops, wrinkles in the metal or fabric covering and for looseness in any structural part. An aircraft used extensively for aerobatic training would require particularly close scrutiny.

11.1.2 Cabin door release. In cabin-type aeroplanes cleared for aerobatics, an emergency door release is usually provided. Make sure the release is not corroded or damaged.

11.1.3 Seatbelts & shoulder harness. Make sure the harness is in good condition and undamaged, and carefully check the latching mechanisms. When seated and secured, carefully take the control stick through its full range of movement to ensure that the seat-belt latches for pilot *and passenger* cannot be snagged and released by the control stick or by the pilot's hand, wrist or clothing.

INADVERTENT RELEASE OF A SINGLE LAP-BELT COULD KILL YOU.

11.1.4 Parachute. If a parachute is carried, have a qualified person check you out on preflighting it. Check for proper fit, adjustment, automatic altitude release set and armed (if installed), unobstructed ripcord pins, rigger's seal intact, general condition, and repack currency (currency is 6 months). Unless simultaneous egress is available it may not be practical to carry parachutes with two people on board. *In any case don't carry a parachute unless the aircraft design permits ready egress with parachute attached.*

11.1.5 Loose objects. Be sure everything is properly secured/stowed in flight. A pen or coin can jam the controls.

DON'T CARRY ANYTHING UNLESS IT'S REQUIRED FOR THE FLIGHT.

11.2 Airspace. The airspace utilised for aerobatics should be carefully selected. You should also avoid known student training areas, approach paths, nearby airports (unless specifically authorised), and any other areas known to be congested with itinerant traffic. As a good citizen, don't perform aerobatics over a built-up area, or indeed any inhabited dwelling(s). When performing aerobatics, do not allow your concentration on flying manoeuvres to override your responsibility to remain clear of other traffic. Before performing any aerobatic manoeuvre or group of manoeuvres, clear the area well.

11.3 _Noise. Consider the fact that your aircraft will be operating at high power settings during many aerobatic manoeuvres. Be a "good neighbour" and minimise the noise effect on the surrounding countryside by flying higher and over sparsely populated areas where possible.

11.4 HASELL checks. Prior to commencing aerobatic manoeuvres carry out the following checks:

- **H**eight - sufficient to recover by 1500ft AGL (or the lower limit of the pilot's approval)
- **A**irframe - gear up, flaps up, trims within normal limits
- **S**ecurity - harness secure, hatches closed, no loose objects
- **E**ngine - instruments checked, mixture rich, carb heat checked, fuel adequate, fuel selections made
- **L**ocation - in an appropriate area, not over a built-up area, forced landing options reviewed, major features identified
- **L**ook-out - clearing turns both directions and review between manoeuvres

11.6 Post flight Inspections. If at any time during a flight the aircraft limitations are exceeded, the aircraft should be returned to the airport for an inspection by a qualified mechanic. If something doesn't feel right during the flight, the same advice applies. In the absence of such knowledge the next pilot may fail to notice a defect on the pre flight.

12. SPINNING

12.1 A spin endorsement is a legal prerequisite for aerobatic training for the simple reason that many aerobatic manoeuvres take the aircraft into flight regimes where spins are a possible outcome. Different aircraft can require vastly different heights for recovery from spin situations. An aerobatic pilot must always be ready to make a spin recovery from manoeuvres such as stall turns and tailslides, just in case the manoeuvre miscarries. The pilot who knows well the spinning characteristics of the aircraft is best placed to avoid entering a spin, or at the least, to intuitively know when a spin is a possible outcome of a manoeuvre.

12.2 Not only do the speed and inertia characteristics of the aircraft affect spinning performance, but "The area and disposition of the fin, rudder, and tail plane exert considerable influence on the susceptibility of the aeroplane to spinning." to quote Kermode. Spin training usually concentrates on upright spinning, but the aerobatic pilot must also be prepared for an inverted spin - b*e aware that control movements for recovery differ*.

It is emphasised that this AC does not offer comprehensive advice on the complex subject of spinning, which is best studied before undertaking aerobatic training. Furthermore, the spin characteristics of each aircraft should be assessed and explored for each new aerobatic aeroplane the pilot flys.

13. MINIMUM ALTITUDES.

CASR 91.320 stipulates a minimum height of 1,500 feet above obstructions for completion of recovery from any aerobatic manoeuvre, including spins, unless the pilot is specifically approved to operate to a lower height. The more height for recovery, the more margin for safety. Pilots should take into account the height loss that normally occurs in manoeuvres and then add a safety factor related to their experience, their recency and the nature of the aircraft. Some aeroplanes spin more readily, and some lose more altitude in spin recoveries than others, so manoeuvres such as slow-speed flicks and stall turns may need to be avoided at lower heights. Whatever their log-book qualifications pilots should, on the occasion, select a minimum altitude based on their experience, their currency, and the characteristics of their aircraft.

14. DISORIENTATION AND MOTION SICKNESS

14.1 Spins and aerobatic manoeuvres demand the most of your vision and balance senses. Be aware of the need for a clear horizon, and of the effect of low cloud, sloping landscapes and the difficulty of height perception over water. Given good visual cues, training and experience aerobatic pilots can do some marvellous manoeuvres without coming to grief, but the balance system is not foolproof, and conscious and subconscious elements have to be in tune for it to work. Confusion can be overpowering, and a healthy person standing on the ground can be induced to fall over if the visual cues are convincing enough.

14.2 We usually take our balance system for granted, but if the subconscious system perceives a serious discrepancy between the visual cues and physiological perceptions it may cause disorientation. For instance, the first experience of spinning, or even the first in a while, can be severely disorienting. Even the effects of mild disorientation can cause motion sickness until the system is 'tuned' to the activity.

14.3 Disorientation may occur if the light, cloud cover or terrain is other than normal, and (especially at low level) there may be little time for conscious inputs to correct for errors in perception. Passengers are particularly vulnerable to disorientation (hence the high incidence of passenger motion sickness during aerobatics) because they are not as able as the pilot flying to anticipate the movement of the aircraft. For this reason alone, trainees are usually glad when they get the controls.

15. LIMITATIONS, TRAINING, STANDARDS, EVENTS, CLUBS

15.1 The primary legal limitations imposed on aerobatic flight are stated in CASR 91.320. Aircraft certification standards are expressed in CASR Part 23 and maintenance requirements in CASR Part 43.

15.2 Some aerobatic clubs have established their own aerobatic training and competency standards within the legal framework.

15.3 Many competitions are carried out in accordance with international sporting standards and performance criteria developed by the Federation Aeronautique International (FAI). Apart from providing an international forum and competition standards, the FAI has a very useful notation system for aerobatic manoeuvres called the Aeresti system, named after its inventor.

15.4 Aerobatics are usually a key element in air displays. Air displays are subject to CASR 91.110 and should be conducted in accordance with the CASA AC 91.16 "Air Displays - Safety and Administrative Arrangements" and any further limitations which may be imposed by an authorising Area Office or the person responsible for safety at the display.

16. ROUND-UP

Minimise the risks:

- check that the aircraft is appropriate, cleared and prepared for the planned manoeuvres
- check that you are physically and mentally ready for spins and aerobatics
- know the limitations of both yourself and the aircraft
- beware the possible consequences of inducing g-LOC
- do the full 'HASELL' check before commencing manoeuvres
- be proficient with recoveries from spins and unusual attitudes
- be aware of the spin characteristics of the aeroplane and avoid manoeuvres likely to lead to a spin below a height sufficient for safe recovery
- start with sufficient height to give plenty of margin for recovery if things go wrong

- never do a flick or ‘snap’ manoeuvre at a speed that could overstress the aircraft or lead to G-LOC
- don’t use full-range control movements near or above manoeuvring speed,
- don’t pull significant G above manoeuvring speed in turbulent conditions (a gust could overstress the aircraft)
- never exceed the G or VNE limits of the aircraft
- don’t exceed maximum engine RPM or manifold pressure
- monitor the health of yourself and the aircraft during the sequence
- maintain a good lookout during the manoeuvres
- constantly monitor your height for recovery margins
- aim to roll upright, level to the nearest horizon, and take time out to recover equilibrium if disorientation occurs
- aim to roll upright, level to the nearest horizon, rather than ‘pull through’ if recovering from a vertical manoeuvre gone wrong
- know which manoeuvres might result in a spin and mentally prepare for an upright or inverted spin recovery during entry to the manoeuvre

Finally, keep reading the experts.

Acknowledgment: This AC has been in part developed from FAA AC 91-61 – with thanks.

APPENDIX 1

APPROVAL TO CONDUCT SPINS AND AEROBATICS

1. INTRODUCTION

1.1 A pilot must not fly as pilot in command during spinning or aerobatic flight until he or she has been certified for spinning and aerobatic manoeuvres in accordance with CASR 91.320.

1.2 This document gives guidance on the training, testing and administration of spinning and normal and low level aerobatics.

2. AEROBATIC TRAINING

2.1 **"Normal" and "low-level" aerobatics.** "Normal" aerobatics may be described as those performed above a height of 1500ft, with "low-level aerobatics" between heights of 330ft (100m) and 1500ft. To conduct aerobatics at any height a pilot must be certified as competent to perform spinning and aerobatic manoeuvres by an approved testing officer (ATO) who holds a personal approval to perform aerobatics.

2.2 **Height**. Heights related to manoeuvres must be in relation to clearance from obstructions within the performance area, plus a safety buffer. The safety buffer will normally be 1000m but should be extended for high performance aeroplanes, or if there are poorly defined obstructions in the area. Height AGL is not sufficient for safety, and maps must not be used to establish minimum heights unless obstructions are clearly and accurately shown. The heights quoted in this document therefore invariably relate to minimum heights above obstructions within 1000m of a point vertically below the aircraft at any part of a manoeuvre or recovery therefrom.

2.3 **Limitations**. Although normal aerobatics may take place down to a height of 1500ft, the regulation permits the testing officer to impose limitations on an inexperienced pilot by making relevant endorsements in the pilot's log-book, among which may be limitations on certain manoeuvres or greater minimum height for all manoeuvres or specific manoeuvres.

2.4 **Training by organisations**. Organisations may only conduct training in aerobatics if they have an operations manual which details instructor standards and training requirements for the aircraft types on which the training is conducted.

2.5 **Instruction**. Flight Instructors certified for aerobatic and spin instruction may conduct dual instruction in spinning and aerobatics down to the minimum height authorised in their personal aerobatic approval, subject to certain recency requirements for low-level aerobatic training.

2.6 **Spinning**. A log-book endorsement for spin entry and recovery must be held before a pilot can be certified as competent to conduct any aerobatic manoeuvre as pilot in command. Spinning is separate endorsement, although they are often done by the same instructors as a prelude to aerobatic training. Regardless of having a formal spin endorsement, if a pilot is not capable of automatically applying standard recovery techniques in developed and incipient spin situations, he or she should not be authorised to perform aerobatic manoeuvres as pilot in command.

2.7 **Primary aerobatic manoeuvres**. The primary aerobatic manoeuvres are:

(a) the barrel roll;

(b) the loop;

(c) the slow roll;

(d) the stall turn; and

(e) the flick roll.

- Complex aerobatic manoeuvres are generally some combination of the primary manoeuvres.

3. SPIN AND AEROBATIC TESTING AND CERTIFICATION

3.1 **Spin certification**. A flight instructor who holds a log-book endorsement for spinning may instruct and certify a pilot for spin entry and recovery manoeuvres. Pilots should normally be certified as safe for recovery from spins which might eventuate from aerobatic manoeuvres conducted from a base height of 1500 ft, except that:

(a) if a pilot is inexperienced or lacks the requisite skill for safe spin recoveries from manoeuvres conducted from a base height of 1500 ft, but is safe at a higher level, the testing officer may accord the candidate an approval for manoeuvres at a higher base height (usually 3000ft); and

(b) if the test is conducted in a high speed aeroplane the testing officer must stipulate a minimum height for any manoeuvres which might result in a spin that is compatible with the aeroplane used in the test; or

(c) if the test is conducted in a high speed aeroplane, but the person undertaking the test is found to be experienced and competent in the manoeuvres (as might be expected for, say, a military pilot) the testing officer aircraft may stipulate a minimum height for manoeuvres in that aeroplane, and another minimum height for unspecified slow-speed aeroplanes.

3.2 **Aerobatic certification**. A flight instructor who holds a log-book endorsement for aerobatic manoeuvres and spinning from a base height of 1500ft may instruct and certify a pilot as safe to conduct aerobatic manoeuvres. Pilots should normally be certified as safe to conduct all the primary aerobatic manoeuvres from a base height of 1500 ft, but must not be cleared for aerobatic manoeuvres below their individual spin recovery certification. If the aeroplane used in the test is not suitable for the performance of all the primary manoeuvres the testing officer must state in the certification that the manoeuvre was not tested and that the candidate is not cleared to conduct the manoeuvre.

- as an example, a restriction might arise if the aeroplane is not suitable for flick manoeuvres, or for stall turns
- if the candidate does not wish to perform certain manoeuvres the testing officer must state in the certification that certain manoeuvre(s) were not tested and that the candidate is not cleared to conduct the manoeuvres

3.3 **Form of certification and notification.** On completion of the relevant flight tests the testing officer is to endorse the candidate's log-book and forward notification to CASA as required by the Delegate's Handbook.

4. LOW-LEVEL AEROBATIC TESTING AND CERTIFICATION

4.1 **Low-level aerobatics.** Low-level aerobatic manoeuvres are those carried out below 1500ft. A flight instructor who holds a log-book endorsement for aerobatic manoeuvres and spinning below 1500ft may instruct and certify a pilot as safe to conduct aerobatic manoeuvres down to the level of their personal approval. The form of the test is to be at the testing officer's discretion within the guidelines of this document. The testing officer must assess the competence of the candidate to perform low-level aerobatic manoeuvres, and must show in the approval the primary manoeuvres that were performed satisfactorily and any restrictions that he or she considers to be appropriate.

4.2 **Flight test**. Approval to conduct aerobatics below 1500ft requires the applicant to complete a satisfactory flight test with a CASA flying operations inspector, or an approved test officer (ATO) who holds an approval to conduct low level aerobatic flight tests (see section 5 of this Appendix).

4.3 **Application for low-level aerobatic approval**. Applicants are to arrange completion of sections A to D of the application form shown at Annex A and present it to the testing officer.

- The flight test is to be conducted in accordance with the requirements of Annex A.
- Flight tests conducted below 1000 ft may be either dual or by ground observation at the discretion of the testing officer.

4.4 **Certification and approval.** On completion of a successful low-level aerobatics flight test, the completed application and test report form should be forwarded to the appropriate CASA area office. The area office will issue an approval as follows:

(a) the approval is to be issued in the form shown at Annex B;

(b) the approval is normally to be valid for two years.

(c) the approval may be limited to a specific aircraft type or types.

(d) the approval may be limited to specified manoeuvres.

4.5 **Conditions of Issue.** The conditions of issue of a low level aerobatic approval are detailed at the schedule at Annex B. Additional conditions to those shown at Annex B may be imposed by the testing officer or by CASA.

5. APPROVED TEST OFFICERS

5.1 **Qualification.** A Flight Instructor who is the holder of a low level aerobatic approval may apply to be appointed as a low level aerobatic ATO, provided he or she has logged at least twenty five hours as an aerobatics instructor and is able to present documented procedures for low level aerobatic training and testing.

5.2 **Application.** Applicants for initial appointment as a low level aerobatic ATO are to apply to the appropriate CASA area office in writing, providing the following:

(a) name, type of licence held and aviation reference number;

(b) a copy of their low level aerobatic approval;

(c) details of relevant flying experience;

(d) a copy of their low level aerobatic training and testing procedures;

(d) the type of aircraft proposed for use in the flight test; and

(e) if the candidate operates in conjunction with an organisation, its recommendation that the person be granted low level aerobatic test approval.

5.3 **Testing.** Applicants will be tested by a suitably qualified CASA flying operations inspector, or an ATO with a special approval. The testing officer can only observe for a single-seat test, but is expected to accompany the candidate in a two-seat aircraft to 1000ft and may use his or her discretion about observing below that height. On completion of the test the testing officer must complete an assessment form as shown at Annex C.

5.4 **Renewal.** Applicants for renewal of low-level aerobatic ATO must apply to CASA and may be required to undertake a flight test. The flight test may be waived if the person has recently participated in a major event or has significant recent experience in low-level aerobatics, but will normally be tested at least once every 3 years. The applicant must apply to the appropriate CASA area office with the following details:

(a) name, type of licence held and aviation reference number;

(b) a copy of their low level aerobatic testing approval;

(c) details of relevant recent flying experience;

(d) the organisation with which the applicant operates: and

(e) if the candidate operates in conjunction with an organisation, its recommendation for renewal of the person's low level aerobatic test approval.

5.5 **Certification.** The following applies to a low-level aerobatic approval:

(a) it is to be issued in the form shown at Annex D;

(b) the approval is to be valid for one year;

(c) the minimum height specified is to be dependent on the pilot's performance and experience;

(d) the approval may be limited to a specific aircraft type or types;

(e) the approval may bar the performance of specified manoeuvres.

5.6 **Conditions.** When conducting a flight test an ATO must comply with the conditions of his personal low level aerobatics endorsement.

6. AIR DISPLAY APPROVALS

6.1 A pilot holding a low level aerobatic approval may apply for approval to participate in air displays in accordance with the Schedule to CASR 91.110 and AC 91.16. A person approved to conduct low-level aerobatics at an air display must not participate in an air display except at the invitation of an authorised air display organiser, and in accordance with CASR 91.320 and the related Schedule.

6.2 The holder of a low-level aerobatic approval may be authorised to perform aerobatics before a public gathering without the declaration of a formal air display under CASR 91.110. A condition of any such approval is that the pilot must not perform any aerobatic or abnormal flight manoeuvres within 10km of an official air display, or while any other aircraft is airborne within 5km, except with CASA's approval for the specific occasion.

CIVIL AVIATION
SAFETY AUTHORITY
AUSTRALIA

ANNEX A

TO APPENDIX 1

APPLICATION FOR LOW LEVEL AEROBATICS APPROVAL

SECTION A – PERSONAL DETAILS

Family Name	Given Names		Title	Date of Birth
Residential Address				
Postal Address (If Different)				
Telephone No. Work	Home	Mobile	Fax	Licence Number (ARN)

SECTION B – EXPERIENCE DETAILS

Total hours	Aerobatic hours	Air displays flown	Aerobatic aircraft flown
Other aerobatic experience			
Aerobatic Log Book Endorsement (This should include flight manoeuvres 1 to 10 on the reverse of this form, unless the test aircraft is not capable of performing the manoeuvre)			

SECTION C — DECLARATION OF THE APPLICANT

I certify that the particulars I have provided above are, to the best of my knowledge, true in every respect.

- I apply for approval to conduct aerobatics down to _______________ feet (delete in not applicable)
- I apply for approval to participate in air shows down to _______________ feet (delete in not applicable)

Signature of Applicant	Date

SECTION D — DECLARATION OF THE CHIEF FLYING INSTRUCTOR OR CAPTAIN OF AEROBATIC ORGANISATION

Training Organisation:			
I recommend the applicant for the approval requested at section C.			
Signature of CFI/Captain	Date	Printed Name	ARN

SECTION E: DECLARATION OF THE TESTING OFFICER

Flight Test Number	Date	Location of Test
Comments:		

I certify that I conducted a low level aerobatics approval test as described overleaf. Where a pass has been awarded the applicant demonstrated knowledge and skill commensurate with an approval to perform low level aerobatics to a minimum height of _________ feet AGL

and/or to participate in air shows to a minimum height of ________ feet AGL.			
Signature of Testing Officer	Date	Printed Name	ARN

LOW LEVEL AEROBATIC TEST REPORT

Ground

2	Understood factors in aircraft design affecting positive,	
3	Understood 'g' limit safety factors	
5	Understood principles of recognition and recovery f…	
6	Understood physiological effects of 'g' in fast and slow applications	
7	Understood factors affecting spinning characteristics of aircraft	
8	Understood meaning of 'G LOC' and 'black/grey/red	
9	Understood factors affecting recovery from effects of prolonged 'g'	
10	Understood physical strategies used to delay or reduce onset of 'g' effects	
11	Understood physiological effects of snap manoeuvres	
12	Understood manoeuvre induced disorientation	
13	Understood effects of medication on pilot performance during aerobatics	
14	Understood effect of fatigue on onset of physiological effects of 'g'	
15	Understood air show rules (if applicable)	

Flight Manoeuvres

	spin	
2	loop	
3	slow roll	
4	aileron roll	
5	barrel roll	
6	roll off the top	
7	horizontal and Cuban eights	
8	stall turn	
9	90° inverted turn	
10	tail slide recovery	
11		
12		
13		

Flight

	Manage flight to and from the aerobatics area actions	

	Aerobatic checks	
	Situation awareness maintained	
	Aeroplane operated within engine and airframe	
	VMC maintained	
	Not below minimum height	
	Conducted Aerobatics safely down to minimum height	
	Complied with air show rules (if applicable)	

✓ Satisfactory X *Unsatisfactory* N *Not Tested*

PASS / FAIL	Ground Time	Flight Time	Aircraft Type	**VH -**

ANNEX B

TO APPENDIX 1

INSTRUMENT NUMBER NNNN/YY

CIVIL AVIATION SAFETY REGULATIONS

APPROVAL UNDER REGULATION 91.320

I, *[insert full name of officer]*, a delegate of CASA, under subregulation 91.320 (2) (e) of the Civil Aviation Safety Regulations, permit:

[insert full names of person]

(Aviation Reference Number *[insert number]*)

(a) to engage in aerobatic flight in *[insert aircraft type if applicable]* aircraft at a height no lower than *[insert minimum height]* feet above ground level (AGL), subject to the conditions set out in the Schedule; and

(b) to participate in air displays in *[insert aircraft type if applicable]* aircraft at a height no lower than *[insert minimum height]* feet above ground level (AGL).

[delete subparagraph (b) if not applicable]

CONDITIONS OF APPROVAL UNDER CASR 91.320 (2) (e)

1. The minimum heights and distances from a group of persons shall be those specified for spectators in the Schedule to CASR 91.110.

2. If this approval permits manoeuvres below 500 feet AGL, manoeuvres below that height must only be conducted over a specific location approved by the appropriate CASA area office.

3. Passengers must not be carried during manoeuvres below 1500ft AGL except with CASA's approval, nor during any aerobatic demonstration or display.

4. Aerobatic manoeuvres are not to be conducted within or over:

(a) any location where the manoeuvres are likely to be a hazard to the navigation of other aircraft.

(b) any location known or likely to be noise sensitive; or

(c) over any area that in the event of an aircraft malfunction persons on the ground or water would be endangered.

5. Acrobatics are not to be conducted below:

DOUBLE-CHECK THE LOGIC

(a) 1500ft AGL unless in the preceding 12 months the pilot has performed:

(i) at least three spin recoveries above 1500ft AGL; and

(b) at least three aerobatic sequences at any height;

(b) 1000ft AGL unless the pilot has performed an aerobatic sequence at least four times in the preceding 12 months down to a height of 1500ft AGL or below, with one of these sequences having been in the preceding 30 days; and

(d) 500ft AGL unless the pilot has performed an aerobatic sequence in the preceding 30 days down to a height of 1000 feet AGL or below.

This instrument stops having effect at the end of *[insert date, normally two three?? years after the test]*.

[insert name of officer]

[insert position of officer]

[insert date]

Instrument Number NNNN/YY

ANNEX C
TO APPENDIX 1

Checklist -- Approval of Low Level Aerobatic Authorised testing Officer

Applicant .... **Location** ....

Licence type .... **Organisation** ....

ARN .... **Candidate** ....

Aircraft Type .... **Minimum Height** ....

Assessment of Applicant's Documents

- Low level aerobatic approval Satisfactory ❑
  Unsatisfactory ❑
- Relevant flying experience Satisfactory ❑
  Unsatisfactory ❑
- Testing operations manual Satisfactory ❑
  Unsatisfactory ❑
- recommendation by training organisation Satisfactory ❑
  Unsatisfactory ❑

Assessment of Applicant's Conduct of Theory and Flight Test

- Assessment of candidate's theory knowledge Satisfactory ❑
  Unsatisfactory ❑
- Conduct of briefing Satisfactory ❑
  Unsatisfactory ❑
- Design of test Satisfactory ❑
  Unsatisfactory ❑

- Conduct of test — Satisfactory ❑ Unsatisfactory ❑
- Handling of poor performance — Satisfactory ❑ Unsatisfactory ❑
- Conduct of debriefing — Satisfactory ❑ Unsatisfactory ❑
- Assessment standard — Satisfactory ❑ Unsatisfactory ❑
- Completion of documentation — Satisfactory ❑ Unsatisfactory ❑

Comments ....

....

....

Recommendations ....

....

Signed .... **Date** ....

Inspector ....

ANNEX D
TO APPENDIX 1

INSTRUMENT NUMBER NNNN/YY

LOW LEVEL AEROBATICS
APPROVED TESTING OFFICER APPROVAL

This is to certify that:

[insert full names of person]
(Aviation Reference Number *[insert number]*)

is approved to conduct tests of pilots for low level aerobatics approvals in
[insert aircraft type if applicable] aircraft
at a height not below [insert height] above ground level.

This approval stops having effect if *[insert full names of person]* (Aviation Reference Number *[insert number]*) ceases to be employed by *[insert name of organisation] [and ARN if applicable]* or at the end of *[insert date]*.

[insert name of officer]
[insert position of officer]
For and on behalf of the Civil Aviation Authority

[insert date]

Instrument Number NNNN/YY Page 1 of 1 page

READERS PLEASE NOTE THAT APPENDIX 1 DEALS WITH A LICENSING MATTER AND MAY EVENTUALLY BE TRANSPOSED TO PART 61.