Australian Government
Civil Aviation Safety Authority

DRAFT

Advisory Circular

AC 21-25(3) JUNE 2012

LIMITED CATEGORY AIRCRAFT PERMIT INDEX

CONTENTS

1. REFERENCES

- Parts 21 to 35 of the *Civil Aviation Safety Regulations 1998* (CASR 1998)
- Regulation 262AM of the *Civil Aviation Regulations 1988* (CAR 1988)
- Australian Warbirds Association Limited, Exposition & Self-Administration Manual;

2. PURPOSE

This Advisory Circular (AC) provides information on the process to be used by the Civil Aviation Safety Authority (CASA) or an approved person for assigning a Permit Index number to a limited category aircraft.

3. STATUS OF THIS ADVISORY CIRCULAR

This is the third AC to be issued on this subject and supersedes AC 21-25(2) dated March 2002 and introduces a new set of risk assessment criteria to be used for determining a Permit Index number. Other amendments include:

- the flow chart has been replaced by a list of risk criteria that are used to arrive at a more comprehensive risk profile;
- the table of previously assigned Indexes has been deleted to avoid confusion; and
- provision has been made for some aircraft to obtain a lower permit Index by use of a safety case.

Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations.

This AC has been approved for release by the Executive Manager Standards Development and Future Technology Division.

4. ACRONYMS

AC Advisory Circular

AWAL Australian Warbirds Association Limited

BRS Ballistic Recovery System

CAO Civil Aviation Order

CAR Civil Aviation Regulations (1988)

CAS Calibrated Air Speed

CASA Civil Aviation Safety Authority

CASR Civil Aviation Safety Regulations 1998

Kg Kilogram

Kts Knots

LPG Liquid Propane Gas

Lt Litre

MOW Maximum Operating Weight

MTOW Maximum Take Off Weight

O_2 Oxygen

Vso Stall speed

5. DEFINITIONS

Maximum Operating Weight (MOW) for ex-military aircraft is the maximum take off weight (MTOW) which has been adjusted to take into account the weight of any military specific equipment (e.g. armament) which has been removed for civil use. This will always be a lower weight than the MTOW of the military version.

A ***populous area*** means an area that is substantially used for, or is in use for, residential, commercial, industrial or recreational purposes.

6. BACKGROUND

6.1 Civil aircraft are designed in accordance with prescribed certification standards and criteria that have been developed by civil authorities with the focus being on safety and reliability. An aircraft that complies with the design, performance and reliability standards that are set out by an Authority are then awarded a type certificate which details the approved design features of the aircraft.

6.2 The civil aircraft manufacturing process is subject to rigorous controls, design conformity inspections and documentation requirements during every stage of the process from raw material through to finished aircraft.

6.3 An essential element of the approval and certification process is that a type certificate holder must produce a set of instructions for continuing airworthiness that are maintained and supported throughout the life of the type certificate.

6.4 The combination of design approval, production checks and controls, and continuing airworthiness management provides aircrew and passengers with an assured level of safety throughout the designed life of the aircraft that is generally accepted as at least equal to other forms of public transportation.

6.5 An aircraft that has been produced to meet a military requirement is similarly subject to design standards and manufacturing process controls; however in many cases the standards and specifications place greater emphasis on operational requirements than safety considerations. The military specifications and standards are generally not recognised by civil authorities and the manufacturing processes are not subject to civil authority oversight. As a result ex-military aircraft, are not recognised in the civil environment unless a manufacturer has undertaken a civil type certification process.

6.6 Military aircraft that have not been designed and manufactured in accordance with civil standards are unable to qualify for a civil type certificate or a normal certificate of airworthiness and under normal circumstances this would preclude civil use of these aircraft once their military life has ended. Ex-military aircraft are widely sought by enthusiasts, adventure operators, and specialist operators for use in film making, air show appearances, providing adventure flights or for personal interests. In order to facilitate civil use of ex-military aircraft, CASA has provided for them to be operated under a Limited category certificate of airworthiness subject to a range of safety based operational restrictions.

6.7 In addition to ex-military aircraft, CASA has also provided for operations under a limited certificate of civil aircraft of a historic nature which have lost their eligibility for a standard certificate of airworthiness because the manufacturer or type certificate holder has either gone out of business or discontinued supporting a particular type certificate for economic reasons.

6.8 CASA has also provided for operations on a Limited certificate by civil aircraft that meets the requirements for issue of a standard certificate of airworthiness except for those requirements that are inappropriate for the special purposes for which the aircraft is to be used.

7. NEED FOR A RISK ASSESSMENT PROCESS

7.1 In the absence of accepted systems of controls throughout the design, manufacturing and continuing airworthiness, CASA is unable to assume that limited category aircraft will meet accepted safety standards for civil use. However, CASA accepts that operators of historic and ex-military aircraft are willing to accept the risks associated with these types of aircraft in order to be allowed to continue flying them.

7.2 CASA has therefore based the Limited category around a structure in which pilots and occupants are informed of the risks associated with the operations, and accept that risk the same as participants in other "risky" aviation and non-aviation related activities. In framing the Limited category, CASA has built in safeguards to ensure that the risk is confined to the occupants of the aircraft while protecting the general public from risk of harm or property damage.

7.3 The Controls and Risk mitigators are applied in two parts:

7.3.1 The first part of the controls and risk mitigation process is the assessment and certification stage during which CASA or an authorised person will inspect the aircraft and its documentation and issue a Limited category certificate of airworthiness with appropriate conditions applied. This process is discussed in detail in AC 21.5 *Limited Category Aircraft Certification.* The conditions that may be applied by CASA or the authorised person will vary according to the assessed risk profile of each individual aircraft and these conditions will be set out in an Annex to an aircraft's Limited certificate of airworthiness.

7.3.2 In addition to the conditions applied to a specific aircraft during the assessment and certification stage, a range of operating limitations that apply to all Limited category aircraft are set out in Regulations. See Regulations 262AM and 262AN of CAR 1988.

7.4 It is a requirement of the regulations that flight over populous areas by Limited category aircraft is not permitted unless an aircraft has been approved to do so by CASA or an authorised person, or has been assigned a Permit Index number which permits the flights. The Permit Index assessment protocols form the second part of the risk mitigation process.

8. PERMIT INDEX (CATEGORISATION OF RISK)

8.1 Limited category aircraft are not permitted to fly over populous areas unless they have been either assigned a Permit Index number that permits the flights or have been approved to do so by CASA or an authorised person. In either case, a risk assessment must be carried out following the processes set out in this AC.

8.2 The process of risk assessment has been developed to provide a series of benchmarks against which each aircraft may be assessed in relation to a list of potential risk factors. The primary concern of the risk assessment process is the safety of people and property on the ground. At the end of the process, a Permit Index number will be applied to the aircraft which is appropriate to the risk profile that has been determined for a particular aircraft.

8.3 Each Permit Index number is linked to a set of geographical operational restrictions which become more restrictive as the Permit Index number rises from 0 through to 3. The effect of these restrictions is to ensure that safety of the general public is not compromised.

8.4 The risk assessment process considers a variety of risk factors which can be broadly grouped under two main risk headings:

- The level of risk of a particular aircraft being involved in an accident; and
- The potential of the aircraft to cause injury or death to third parties or damage to property in the event of being involved in an accident.

8.5 The potential of an aircraft to crash (level of risk) is dependent upon:

- structural integrity of the airframe;
- reliability of the engine;
- reliability of fuel systems;
- reliability of control systems; and
- physical condition of the aircraft.

8.6 Other causal factors such as weather, terrain and pilot skill levels are common to all types of aircraft and are not singled out for consideration in this AC.

8.7 The severity of the crash and its effect on the surrounding areas is affected by:

- the mass of the aircraft;
- construction of the aircraft (wood, composite, metal);
- the amount fuel on board;
- the type of fuel used;
- other hazardous materials on board; and
- velocity of the aircraft at impact.

8.8 The risk factors that could affect the likelihood of an accident or the severity of the consequences of an accident have been given a weighting based on the perceived level of risk. The weightings range from minus 80 for the highest level of risk to plus 60 for the lowest level of risk.

8.9 When all the factors have been considered against a particular aircraft, a risk points score will be used to allocate a permit index number to that aircraft.

9. AIRCRAFT WEIGHTED INDEX- POINTS SCORE

9.1 An aircraft is assessed by scoring it against each of the risk factors listed in Table 1 and where applicable, the weighting index number will be added to or subtracted from the aircraft total score. The final score will determine the Permit Index number for the aircraft as detailed in Table 2. The scores are as follows:

9.2 Aircraft or engine civil certification

9.2.1 If the aircraft type or its engine has received civil certification in its unmodified form, then the aircraft will attract a high positive score. This reflects the higher confidence levels that can be assumed when an aircraft or engine is manufactured in accordance with standards, procedures and controls that are known to the regulating authority.

TABLE 1: CERTIFICATION STATUS

Aircraft with direct civil equivalent	60 points
Aircraft engine only with similar civil equivalent	30 points
Aircraft with no civil equivalent	0 points

Note: *An engine that is basically a civil engine which has been strengthened in some areas for military use will be treated the same as the original civilian engine model provided that there is acceptable data to show that the changes to the engine have not had a negative effect on the engine's reliability.*

9.3 Aircraft Maximum Take-off Weight or Maximum Operating Weight

9.3.1 The aircraft mass will be a significant factor in the event of a crash. For a given speed, the lighter the aircraft, the lower the level of damage likely to result from impact with objects on the ground.

9.3.2 Four categories are applicable:

TABLE 2: TAKE-OFF WEIGHT

Up to - 2000 kgs	10 points
2001 - 4000 kgs	6 points
4001 - 5700 kgs	4 points
5701 - 10,000 kgs	0 points
Greater than 10,000 kgs	-30 points

9.4 Multi-Engine aircraft

9.4.1 Multi-engine aircraft that meet the minimum performance requirements set out in Civil Aviation Order (CAO) 20.7.1B (MTOW above 5700 Kg) or CAO 20.7.4 (MTOW less than 5700Kg) will be scored positively to reflect the margins of safety that apply during approach and departure stages of flight.

TABLE 3: MULTI-ENGINE AIRCRAFT

Aircraft above 5700 kg that can comply with CAO 20.7.1B	30 points
Aircraft 5700 kg and below that comply with CAO 20.7.4	20 points
Aircraft 5700 kg and below that do not comply with CAO 20.7.4	0 points
Aircraft above 5700 kg that do not comply with CAO 20.7.1B	-20 points

9.5 Aircraft Stall Speed

9.5.1 Stall speed is used as an indicator of the kinetic energy that will need to be dissipated in the event of a crash. At any given weight, the faster an aircraft is travelling at impact, the higher the associated risk to life and property.

9.5.2 When assessing a helicopter, the autorotation speed is to be substituted for stall speed.

TABLE 4: STALL SPEED

Vso	<61 Kts CAS	30 points
Vso	62 – 80 Kts CAS	20 points
Vso	81 – 100 Kts CAS	10 points
Vso	100 – 120 Kts CAS	0 points
Vso	> 120 Kts CAS	-20 points

9.6 Aircraft Glide Capability

9.6.1 The glide capability of an aircraft will determine the aircrafts ability in the event of an engine failure, to glide clear of a populous area from a given height. Helicopters in autorotation are treated as “not known” and rated 0 because of their high descent rate and steep angle of descent during autorotation.

TABLE 5: GLIDE CAPABILITY

High	greater than 14:1	10 points
Medium	6:1 to 14:1	6 points
Low	less than 6:1	4 points
Not known and helicopters		0 points

9.7 Aircraft Fatigue History and Documentation

9.7.1 The operational history of the aircraft can be a critical element in the risk assessment process. In particular an aircraft with high total flight times, high cycle times or one that has been regularly flown in high G manoeuvres may be approaching or even beyond its design fatigue life.

9.7.2 In order to assess the risk of fatigue failure, the delegate or appointed person will require access to the complete operational history of the aircraft. If the history is not known and the aircraft MTOW is greater than 2000Kg, then fatigue becomes a significant risk concern.

9.7.3 If an aircraft's operational history is well documented and shows that the aircraft has not exceeded its approved published fatigue life limit then the fatigue related risk is not considered to be significant.

9.7.4 If an aircraft has a well-documented history but has exceeded its published fatigue life, it will be treated as a high risk aircraft and rated accordingly.

9.7.5 Many small observation or basic training aircraft do not have a calculated fatigue life, and by their nature (simplicity of design, low mass and low speeds) are not regarded as a fatigue risk with normal standards or maintenance. They will not be assessed against this risk indicator.

TABLE 6: OPERATIONAL HISTORY

No verifiable operational history	-80 points
Fatigue life exceeded	-80 points

9.8 Aircraft Maintenance History and Documentation

9.8.1 In order to determine the on-going mechanical and structural reliability of an aircraft, it is helpful to be able to review the aircrafts operational and maintenance history. This data is frequently unavailable when aircraft are salvaged many years after having crashed, or being scrapped.

9.8.2 In most cases, these aircraft will undergo extensive restoration work and will be "like new" upon completion. These aircraft may be scored between 5 and 10, depending on the depth of restoration work. When assessing restored aircraft consideration should be given to the age of electrical wiring, hydraulic lines, fuel systems etc. which could adversely affect the aircraft reliability but may not necessarily be visible during a cursory inspection.

9.8.3 A small observation or basic training aircraft that has little or no historical records, but has had a recently overhauled engine and propeller installed, will be allocated a partial point score provided that the engine and propeller overhauls have been properly documented.

9.8.4 Aircraft, particularly helicopters, which have time lifed components will rate a maximum negative score if any of the lifed components are time expired.

Note: *Life limited items other than engine, propeller or helicopter dynamic components, may be assessed by a Maintenance Review Board (MRB) convened by CASA or an approved organisation for criticality and scored accordingly.*

9.8.5 Examples of such items would include: electrical components, undercarriage components, radio equipment etc. which may have had a life limitation imposed for military reasons that do not necessarily apply in the civil application.

TABLE 7: MAINTENANCE HISTORY

Full history and Documentation including worksheets	10 points
Full history and Documentation including worksheets	5-10 points
Partial Docs and worksheets	0-5 points
No proper records or data	-80 points
Time life limited components expired	-80 points

9.9 Aircraft Repair and Modifications

9.9.1 Repairs and modifications that have been carried out in accordance with approved engineering data such as manufacturer's approved design or Subpart 21M approval will be scored as zero to reflect that the alterations have not adversely affected the aircraft risk profile.

9.9.2 Minor repairs and modifications which have some engineering justification but have not been approved by the aircraft manufacturer or a competent authority will be negatively scored.

9.9.3 Aircraft which have had major repairs and modifications that have no engineering justification will be negatively scored to the maximum value to reflect the relative risk levels.

TABLE 8: MODIFICATION STATUS

All repairs and modifications in accordance with approved data	0 points
Minor repairs and modifications supported by engineering justification	-5 points
Major repairs and mods not approved or accompanied by engineering justification	-80 points

Note: ***Engineering*** *justification must be provided by a holder of an appropriate qualification, ie. aircraft structures engineer, power plant engineer, hydraulic engineer.*

9.10 Engine Type

9.10.1 Engines are scored by their type according to known reliability levels. Turbocharged and turbo-compound piston engines are considered to be the least reliable engine types in service, while turbo prop and turbo shaft engines have demonstrated a long history of reliable operation and are scored accordingly. Turbofan engines are considered to be the most reliable of the turbojet family of engines and are scored higher than the pure jets. This is partially a reflection of the development effort that has been put into turbofan technology which provides high thrust outputs with considerably lower fuel consumption than the older pure jet types.

TABLE 9: ENGINE TYPE

Turbocharged piston engines	-5 points
Turbo compound (piston) engines	-5 points
Non-turbocharged piston engines	0 points
Turbo-prop , turbo-shaft	10 points
Turbo fan	5 points
Turbojet	2 points

9.11 Aircraft Design Philosophy

9.11.1 Design philosophy 1. An aircraft with a civil equivalent or a basic trainer, transport or observation aircraft.

9.11.2 Aircraft that fall into this category will be similar in all aspects to a civil aircraft and will not require special piloting skills, maintenance techniques or specialist support equipment.

9.11.3 Design philosophy 2. An aircraft which has been designed for special missions, resulting in some reduction in the structural soundness, system reliability or fire safety, compared to civil aircraft of a similar class.

9.11.4 Aircraft that fall into this category may have critical systems that require specialist knowledge or skill to operate or maintain the aircraft.

9.11.5 Design philosophy 3. An aircraft which has been designed primarily for special missions having limited consideration for the traditional safety values of civil aircraft in relation to failure analyses, fire protection or severely restricted design life considerations.

TABLE 10: DESIGN PHILOSOPHY

Design philosophy 1	0 points
Design philosophy 2	-10 points
Design philosophy 3	-30 points

9.12 Fuel Types

9.12.1 Avgas is more likely than turbine or diesel fuel to ignite in the event of a crash and burns with a hotter flame. In the event of a serious high impact crash with a high fuel load, the effects will be equally catastrophic and this is reflected in the low points score allocation.

TABLE 11: FUEL TYPE

Turbine/Diesel	3 points
Avgas/Mogas	0 points

9.13 Tankage design

9.13.1 External underwing type fuel tanks are regarded as a higher risk item than internal tanks due to the higher likelihood of rupture in the course of a crash.

9.13.2 Jettisonable tanks present an additional risk of accidental dropping in flight.

TABLE 12: FUEL TANK DESIGN

Internal only	0 points
External - fixed (if usable)	-10 points
Jettisonable tanks	-80 points

Note: *Aircraft that are capable of being fitted with external jettisonable (drop) tanks are prohibited from flying over populous areas while the tanks are installed unless the flight(s) is/are approved by CASA.*

9.14 Fuel Capacity

9.14.1 Fuel capacity will affect the extent and ferocity of any post-crash fire.

TABLE 13: FUEL CAPACITY

Less than 250 Lts	0 points
250 to 500 Lts	-2 points
501 to 1000 Lts	-4 points
> 1000 Lts	-5 points

9.15 On-board explosives or flammables

9.15.1 Explosive devices could detonate during a crash or in a post-crash fire. They also present a significant hazard to emergency response personnel.

TABLE 14: ON-BOARD EXPLOSIVES OR FLAMMABLES

Ejection seat(s)	-2 points
Explosive bolts	-2 points
Flammable gas containers (LPG/Propane)	-2 points
Rocket deployed parachutes/BRS	-2 points
Smoke Generators	-1 points
O_2 cylinders (operational)	-2 points
Detonator cord or other canopy imbedded explosives	-2 points

10. SAFETY CASE

10.1 Any risk assessment document, no matter how comprehensive, will not be able to encompass every possible permutation that might be encountered in practical application. Where the levels of risk are clear cut, no further consideration is necessary and the resulting permit index number may be applied with a high level of confidence.

10.2 Wherever an aircraft is found to be marginally within a risk band, provision has been made for the lower permit index number to be assigned if a satisfactory safety case is provided to the assessor.

10.3 When preparing a safety case, it must contain the following:

- A description of the risk mitigators that will be incorporated to ensure that an acceptable level of public safety is preserved. The proposed measures may include matters such as: operating weight limitations, altitude or flight level limitations, area or route restrictions and pilot qualification/experience requirements.
- Where required, current detailed maps, aerial photographs or satellite images of the populous areas over which the flights are proposed and on which are shown the tracks and altitudes to be used (including proposed emergency landing areas).
- Reliability history of the aircraft type, engine type and propeller type as applicable.

Executive Manager
Standards Division

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APPENDIX A

TABLE 15 - AIRCRAFT SAFETY INDEX ASSESSMENT

To use the table, assess the aircraft against each risk category in Table 1 by finding the associated risk element in column 2 which most closely describes that aspect of the aircraft being assessed. If an aircraft falls between two risk elements in any category, use the lower scoring element.

As each category and element is assessed, add the points score in column 3 to the aircraft score in column 4.

When all risk categories and elements have been scored and a final total has been tallied, refer to Table 2 for the corresponding Permit Index number

Risk Category	Risk element	Points	Aircraft VH-
Certification Basis	Direct civil equivalent	60	
	Partial equivalent – Engine	30	
	No civil certification	0	
Approved MTOW or Maximum Operating Weight	Up to 2000kgs	10	
	2000 – 4000 Kgs	6	
	4001 – 5700Kgs	4	
	5701 – 10,000 Kgs	0	
	>10,000 Kgs	-30	
Multi-engine aircraft	>5700 meets CAO 20.7.1B	30	
	>5700 Does not meet 20.7.1B	-20	
	5700 & less meets CAO 20.7.4	20	
	5700 & less does not meet CAO 20.7.4	0	
Stall speed (or helicopter autorotation speed)	Vso Less than 61 Kts IAS	30	
	Vso 61 to 80 Kts IAS	20	
	Vso 81 to 100 Kts IAS	10	
	Vso 101 -120 Kts IAS	0	
	Vso greater than 120 Kts IAS	-20	
Glide capability	High (L/D greater than 14:1)	10	
	Medium (L/D 6:1 to 14:1)	6	
	Low (L/D less than 6:1)	4	
	Not known	0	
	Helicopters	0	
Fatigue history	History not known	-80	
	Fatigue life exceeded	-80	
	Not applicable or fatigue life within limits	0	
Maintenance history and documentation	Full history and maintenance records	10	
	Aircraft restored	5-10	

Risk Category	Risk element	Points	Aircraft VH-
	Partial documentation	5	
	No proper records or data	-80	
	Lifed components time expired	-80	
Repairs and modifications	All repairs & mods approved by the aircraft manufacturer or a competent civil authority.	0	
	Repairs & minor mods not approved but with engineering justification	-5	
	Repairs & mods neither approved nor supported by engineering justification	-80	
Engine type & configuration	Turbocharged piston engines	-5	
	Turbo compound piston engines	-5	
	Turbo-shaft or turbo-prop engines	10	
	Non- turbocharged piston engines	0	
	High bypass turbofan engines	10	
	Low bypass turbofan engines	5	
	No bypass turbojet engines	2	
Design philosophy	Design philosophy 1	0	
	Design philosophy 2	-10	
	Design philosophy 3	-30	
Fuel type	Turbine/diesel	3	
	Avgas/Mogas	0	
Fuel tankage.	Internal only	0	
	External-fixed (if usable)	-10	
	External Jettisonable	-80	
Fuel Capacity	Less than 250 litres	0	
	250 to 500 litres	-2	
	501 to 1000 litres	-4	
	More than 1000 litres	-5	
On-board explosives	Ejection seats	-2	
	Explosive bolts	-2	
	Flammable gas containers(LPG/Propane)	-2	
	Rocket deployed parachute/BRS	-2	
	Smoke generator	-1	
	O2 Cylinders (if operational)	-2	
	Detonator cord or other canopy jettison explosive	-2	
Total score			

APPENDIX B

TABLE 16 – PERMIT INDEX ASSIGNMENT

Risk element score	Permit Index	Comments	Operational restrictions
100 ↑ 76	0		No airport or populous area restrictions applicable.
71 to 75	1	May be upgraded to 0 with approved safety case	Operations from an aerodrome in a capital city may only be flown using routes approved by CASA or an authorised person for the purpose. May only fly over a populous area to the least extent necessary to take off from or land at a particular aerodrome other than at a capital city. Flights over populous areas subject to any conditions included in a written approval for the flight(s) issued by CASA or an authorised person.
70 ↑ 41		No upgrading permitted	
36 to 40	2	May be upgraded to 1 with approved safety case	Operations over populous areas by CASA approval only. **This category also applies to any limited category aircraft regardless of permit index number while it is being flown with jettisonable fuel tanks installed.**
35 ↑ 01		No upgrading permitted	
0 to -5	**3**	May be upgraded to 2 with approved safety case	Operations over populous areas prohibited.
-6 ↓ -100		No upgrading permitted	