

WORKING DRAFT PAPER T 957

CIVIL AVIATION AUTHORITY

BRITISH CIVIL AIRWORTHINESS REQUIREMENTS

SECTION T
LIGHT GYROPLANES

PAPER NO.T 957

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AMENDMENTS TO BCAR SECTION T ISSUE 3

1 INTRODUCTION

1.1 This paper makes proposals to:

- a) Introduce advisory material where it is considered to be necessary.
- b) Introduce a number of changes arising from an increased understanding of the flight characteristics of gyroplanes gained during CAA Flight Department investigations into the stability of gyroplanes and an investigation into rotor teeter behaviour carried out by Glasgow University.
- c) Address some areas of inconsistency within the current requirements and improve the applicability to current gyroplane designs.
- d) Address some areas of inconsistency between BCAR Section S and BCAR Section T and to adopt changes made to BCAR Section S that are considered to be equally applicable to BCAR Section T.

1.2 These proposals have been developed by the BCAR Section T Working Group, which is made up of representatives from the Light Aircraft Association (LAA), the UK BCAR A1 approved gyroplane manufacturers and the CAA.

2 DISCUSSION

2.1 Foreword

The change to paragraph 1.2 is editorial only. Regulation (EC) 1592/2002 has been superseded by Regulation (EC) 216/2008.

Under Paragraph 2 Recognition, reference to recognition of light gyroplanes from European Economic Area (EEA) States has been extended to cover other States, which ensure an equivalent level of safety, as is current practice. This is consistent with BCAR Section S.

2.2 Abbreviations and Definitions

Test experience has shown that minimum control speeds require careful investigation, and also that power-on and power-off characteristics can be quite different. Changes to this paragraph define the minimum control speeds.

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Changes made to this paragraph include replacing VFR with VMC as is standard UK terminology and replacing the current definitions of 'fire proof' and 'fire resistant' with the more comprehensive definitions in BCAR Section S.

2.3 T 2 Applicability

The change to this paragraph is to replace VFR with VMC. Standard UK terminology is to use VMC.

Forced induction engines, either supercharged, or turbo-supercharged, are widely utilised in the light aircraft sector and the existing limitation of normally aspirated engines for light gyroplanes is considered overly restrictive. Although BCAR Section T does not specifically exclude tractor types, it is considered that the code is equally valid for such configurations.

2.4 T 23 Load distribution limits

Previous changes to BCAR Section T neglected to align the placarded maximum pilot weight with that in BCAR Section S of not less than 86 kg because it was felt at that time that BCAR Section T had adequate scope for a MTOW increase, the upper limit being 600 kg. Certification experience since that time has highlighted that because some gyroplanes are already limited to 450 kg elsewhere in Europe, the application of 90 kg for occupant weight is proving unnecessarily restrictive. It is therefore proposed that this is reduced to 86 kg to align with BCAR Section S 23 & 25.

2.5 T 25 Weight limits

See Item 2.4 above.

2.6 T 71 Glide

The term 'glide' is more appropriate for fixed wing aircraft so the title has been changed to 'rate of descent' as this is more appropriate for gyroplanes.

2.7 T 73 Minimum speed for level flight

Currently, minimum speed is considered only as a performance parameter, without considering controllability at low speed. This paragraph has been amended to link the concept of minimum control speed (introduced by the new paragraph T 149) with V_{MIN} .

2.8 T 79 Height-speed envelope

The current wording of the title is incorrect and should refer to Height-speed envelope. Currently the Height-speed envelope is only required above V_{MIN} . At some combinations of height and speed below V_{MIN} , a safe landing is not assured and therefore speeds below V_{MIN} should also be investigated.

2.9 T 143 Controllability and Manoeuvrability

The concept of minimum control speeds has been introduced into the requirement, see paragraph 2.8 (T 149), and the requirement now addresses controllability following engine failure at $V_{MC(power-on)}$.

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Reversal of turns is included for consistency with BCAR Section S.

2.10 **T 149 Minimum control speed**

CAA Flight Test experience has shown that control characteristics can become limited at low airspeeds for some gyroplane configurations, being strongly affected by the state of power application. A requirement to determine minimum control speeds, power-on and power-off, has been introduced.

2.11 **T 321 b) Flight Loads**

As aircraft may be approved for operation with occupant weights in excess of those specified in T 25, compliance with the flight loads requirements should be shown for the operational range specified within the Flight Manual. This requirement change was introduced for microlight aircraft under BCAR S Paper 930 and is considered to be equally applicable to gyroplanes.

The requirement b) has been revised to include a critical altitude at which the gyroplane may operate. As rotor RPM increases with altitude, it is considered that this could be critical to rotor design.

2.12 **T 474 c) Landing case strength**

The definition of Pzmax has been moved to T 479 b) to be consistent with the changes introduced to BCAR Section S under Paper S 930.

2.13 **T 479b) Level landing conditions**

Changes to T 479 b) introduced under BCAR Paper T 925 have been included under Part 2 AMC T 479 a) 2) Sub-paragraph b) in error. These changes have been moved to Part 1 T 479 b). The definition of Pz has been changed to be consistent with the definition used in BCAR Section S introduced under Paper S 930.

2.14 **T 483 One wheel landing conditions**

Following the change to T 479 b), see item 2.13 above, the reference to AMC T 479 b) has been corrected to T 479 b).

2.15 **T 485 Side load condition**

A reference to the new AMC material has been added.

2.16 **T 655 Control-surface installations (other than rotor blades)**

Additional requirements have been added to cover the case where a gyroplane is fitted with an adjustable stabiliser. The wording of BCAR S 655 b) has been used as this is considered to be appropriate.

2.17 **T 677 b) Trim system**

This change is introduced for consistency with BCAR Section S. T 677 c) has been deleted as this is superseded by the changes to T 677 b).

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2.18 **T 679 Control system locks**

A new requirement is introduced to address the design and construction of control system locks and for consistency with BCAR Section S.

2.19 **T 773 Cockpit view**

A reference to the new AMC material has been added.

2.20 **T 779 Motion and effect of controls**

Currently, Section T has no requirement addressing the motion and effect of cockpit controls. CAA Flight Test experience has identified the potential for confusion, particularly concerning the operation of trim controls. It is considered that the relevant requirement in BCAR S is equally applicable to gyroplanes.

2.21 **T 780 Colour markings of cockpit controls**

This requirement has been moved from T 1555 b) for consistency with BCAR Section S.

2.22 **T 785 a) Seats and safety harnesses**

The current wording would allow the seats to be designed to a weight lower than the placarded value (to 86kg). The wording has been changed to clarify that the placarded occupant weight must be used.

2.23 **T 903 Compatibility**

This change is introduced for consistency with BCAR Section S.

2.24 **T 925 Propeller clearance**

This requirement has been revised to state that there must be adequate clearance available. Values for minimum clearance are now given as Interpretative Material because the actual clearance required is dependent on the propeller/undercarriage configuration. This change has been introduced for microlight aircraft under BCAR S Paper 930 and is considered to be equally applicable to gyroplanes.

2.25 **T 963 a) Fuel tanks**

This change is introduced for consistency with BCAR Section S.

2.26 **T 967 Fuel tank installation**

This change is introduced for consistency with BCAR Section S.

2.27 **T 971 a) Fuel tank sump**

The current requirement does not require non-permanently installed tanks to have a drainable sump. However it is considered that the engine should be protected from debris or water in the fuel system irrespective of whether the gyroplane includes temporary (including those removed for filling) or permanently installed tanks,

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bearing in mind the alternative provisions included in the requirement for a separate sediment bowl or chamber. Therefore the requirement in paragraph a) has been changed to include all tanks.

2.28 **T 995 Fuel valves and controls**

It is considered that for gyroplanes without cowled engine installations, the act of switching off the engine in the event of an engine fire should also turn off the electric fuel pumps (any mechanical pump will stop with the engine). Although the electric fuel pumps may leak some fuel when switched off, it is considered that any engine fire would be evident and the intensity and likelihood of a fire is less in an uncowed installation to one that is cowled. As such any residual fuel leakage would not significantly contribute to any engine fire such that the gyroplane could not maintain safe flight and landing. As a result, for cowled engine installations, a fuel shut off valve will be required.

2.29 **T 1121 Exhaust System - General**

This change is introduced for consistency with BCAR Section S.

2.30 **T 1141 b) Powerplant Controls and Accessories**

There have been accidents with microlight aircraft whose ergonomics required the pilot to be outside an unbraked aircraft for starting. In order to address this problem, a new requirement for all controls for starting (or stopping an engine in an emergency) to be accessible from one position were added. This change is considered to be equally applicable to BCAR Section T.

2.31 **T 1149 c) Propeller speed**

This change is introduced for consistency with BCAR Section S.

2.32 **T 1191 Firewall**

For gyroplanes with cowled engine installations, it is considered that an engine fire may not be evident and the intensity of a fire within the cowling may be such that the gyroplane could not maintain safe flight and landing. As a result, for cowled engine installations, a firewall will be required. (See also changes to T 995 above)

2.33 **T 1305 a) Powerplant instruments**

This change is introduced for consistency with BCAR Section S.

2.34 **T 1307 Miscellaneous equipment**

This change is introduced for consistency with BCAR Section S.

2.35 **T 1323 Airspeed indicating system**

Currently, Section T has no requirement for accuracy of airspeed indication systems, although an airspeed indicator is mandated by T 1303. It is important to know the calibration of the indicating system for performance planning purposes. BCAR S Paper 930 introduces a requirement for the ASI to be calibrated. This requirement is considered to be equally applicable to gyroplanes.

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2.36 **T 1505 c) Operating limitations**

This change is introduced for consistency with BCAR Section S.

2.37 **T 1521 Powerplant and propeller limitations**

This change is introduced for consistency with BCAR Section S.

2.38 **T 1529 Maintenance manual**

The text in AMC T 1529 has been moved to T 1529 for consistency with BCAR Section S.

2.39 **T 1557 d) Miscellaneous markings and placards**

This change is introduced for consistency with BCAR Section S.

2.40 **T 1583 a) Operating limitations**

The airspeed calibration, established under the new requirement T 1323, must be included in the pilot's handbook.

2.41 **T 1585 Operating procedures**

The minimum control speeds established in accordance with T 143 and T 149 must be furnished in the pilot's handbook.

A number of additional procedures have been added for consistency with BCAR Section S and because they are considered to be equally applicable to gyroplanes.

2.42 **T 1935 Blade retention**

Blade retention tests are already being used for microlight aircraft as a means of demonstrating compliance with the requirements of BCAR S. A new requirement has been introduced into BCAR S, under Paper 934, to formalise and standardise the current microlight industry practice. This requirement is considered to be equally applicable to gyroplanes.

2.43 **AMC T 2 a) Applicability**

Regulation (EC) No 216/2008, Annex II, effective 8 April 2008, specifies that single and two-seater gyroplanes with a maximum take off mass not exceeding 560 kg are the responsibility of the National Aviation Authorities. BCAR T has historically permitted certification of gyroplanes up to 600 kg. As Community law takes precedence over National regulations, a note has been added to advise applicants that the CAA may only certificate factory built gyroplanes with weights not exceeding 560 kg using this code.

2.44 **AMC T 2 Applicability**

Additional guidance material has been added to cover other engine types.

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2.45 **AMC T 21 Proof of compliance**

A cross reference to advisory material on extrapolation under AMC T 23 has been added.

2.46 **AMC T 23 Load distribution limits**

A note has been added to clarify that the angle of the thrust line in the diagram has been exaggerated to show that the offset is the perpendicular (normal) distance between the propeller thrust line and the c.g.

The rule requires establishment of a c.g. range including at one extreme a 55 kg pilot. To allow for the difficulty in finding a very light test pilot, AMC material has been added to give guidance on compliance.

2.47 **AMC T 73 Minimum speed for level flight**

Guidance material has been added to clarify the definition of minimum speed, V_{MIN} .

2.48 **AMC T 79 Height speed envelope**

Test experience has shown that a significant H-V envelope can exist for light gyroplanes. AMC material has been added to give guidance on H-V exploration methods.

2.49 **AMC T 143 a) Controllability and Manoeuvrability**

The statement in the AMC that “The gyroplane’s V_{NE} will normally be dictated by the need to have a positive teeter margin up to $V_{NE}+15\%$ ” has been deleted. Concern has been expressed that it is improper to relate an acceptance criteria to an airspeed 15% greater than V_{NE} and, hence, 4% greater than V_{DF} . Furthermore, available technology does not provide for a ready means of measuring rotor teeter angle. An alternative, requiring demonstration of satisfactory flight characteristics at speeds up to $1.11 V_{NE}$ is proposed.

Further guidance material has been added as a flight test techniques guide.

2.50 **AMC T 143 b) Controllability and Manoeuvrability - General**

Gyroplanes can experience unacceptable thrust/attitude coupling. AMC material has been introduced to provide advice on testing.

2.51 **AMC T 149 Minimum control speed**

AMC material has been introduced to provide guidance on testing required to determine minimum control speeds.

2.52 **AMC T 181 Dynamic stability**

Additional guidance material has been included to provide advice on an incremental test technique.

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2.53 **AMC T 321 b) Flight loads general**

This change is introduced for consistency with BCAR Section S.

2.54 **AMC T 397 Limit pilot forces**

This change is introduced for consistency with BCAR Section S. This guidance is intended for circumstances where unconventional primary control systems may be used for disabled pilots. Interpretative material has been added to advise how the load test should be carried out.

2.55 **AMC T 474 Landing case strength**

This paragraph of advisory material is included out of sequence under Part 2 Sub-Section B and should be included under Part 2 Sub-Section C.

2.56 **AMC T 479 a) 2) Level landing conditions**

This paragraph of advisory material, (i.e. the Sub-paragraph a) text), is included out of sequence under Part 2 Sub-Section B and should be included under Part 2 Sub-Section C.

2.57 **AMC T 485 Side load condition**

Interpretative material has been added to BCAR S under Paper 930 to advise the applicant that the effect of yawing acceleration due to side loads during landing should be considered to act on the whole aircraft structure. This interpretative material is considered to be equally applicable to gyroplanes.

2.58 **AMC T 773 c) Cockpit view**

During the CAA Flight Test investigation into the stability of Bensen types, it was apparent that the ability to control the pitch attitude of open cockpit types was compromised by the lack of suitable airframe reference features. Additional guidance material on what could constitute a suitable airframe reference has been added.

2.59 **AMC T 777 a) Cockpit controls**

This change is introduced for consistency with BCAR Section S. As unconventional primary control systems may be used, interpretative material has been added to clarify that the function and sense of these controls must be placarded.

2.60 **AMC T 779 Motion and effect of controls**

In support of the new requirement, AMC material has been added to provide guidance concerning trim control configuration. Twist-grip throttles are also addressed.

2.61 **AMC T 785 a) Seats and safety harnesses**

Current human population data does not match the 86 kg maximum, which may be used by designers. However, mandating (rather than encouraging) the use of

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higher loads would become an inappropriate restriction upon designers, as well as an incompatibility with other codes. It was felt appropriate for designers of microlight aircraft to consider use of heavier crew weights. This change is considered to be equally applicable to gyroplanes.

2.62 **AMC T 925 Propeller clearance**

Values for minimum propeller clearances have been moved from the requirement to AMC, see item 2.11 above. A recommended clearance of 50 mm between the propeller and the airframe has been included to allow for variability in airframe tolerances, engine characteristics, propeller flexibility and differences between test conditions and reality. This change was introduced to BCAR S under Paper 930 and is considered to be equally applicable to gyroplanes.

2.63 **AMC T 1301 a) 3) Equipment function and installation**

This change is introduced for consistency with BCAR Section S.

2.64 **AMC T 1505 a) Airspeed limitations**

This new guidance is introduced for consistency with BCAR Section S.

2.65 **AMC T 1529 Maintenance manual**

In order to ensure that engines and propellers are correctly installed and maintained, advisory material has been introduced to formalise the current best practice within the industry.

2.66 **AMC T 1585 Operating procedures**

For some gyroplanes, the minimum speeds determined in T 73 and T 149 may be below the normal operating range of the airspeed indicator. Guidance material has been added to address this case.

2.67 **AMC T 1935 Blade retention**

Additional guidance material has been added to clarify which factors are required to be included. Wording similar to AMC S 1935 has been used.

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3 PROPOSALS

Differences from the existing standards of BCAR Section T are denoted by bold underlined text.

3.1 Amend **Foreword General** as follows:

‘1.2 This Code is applicable only to those gyroplanes that are excluded from regulation by the European Aviation Safety Agency under Regulation (EC) No. **[] 216/2008** Article 4 and Annex II.

2 Recognition

Recognition will be accorded to light gyroplanes designed, manufactured and tested in accordance with technical standards or regulations of other [] states [], which ensure an equivalent level of safety. The results of checks and tests carried out by suitably qualified and approved bodies and laboratories of other [] states [] will be taken into consideration where such results provide a level of accuracy, fitness and suitability for purpose equivalent to the results of tests carried out in the United Kingdom and where such bodies and laboratories offer a suitable and satisfactory guarantee of technical and professional competence and understanding.’

3.2 Split **Abbreviations and Definitions** into separate paragraphs and add the following:

Abbreviations

C_N Aerodynamic normal force coefficient.

EAS Equivalent airspeed. True airspeed $\times \left(\frac{p}{p_0}\right)^{1/2}$ where p is the air density and p_0 is the air density in standard sea level conditions.

IAS Indicated airspeed. The readings of the pitot-static airspeed indicator as installed in the rotorcraft, corrected only for instrument error.

ISA International Standard Atmosphere

V_D The Maximum Design Speed, EAS.

V_{DF} The Maximum Demonstrated Flight Speed, EAS. This must not exceed V_D .

V_H Maximum speed in level flight with the engine at maximum continuous power, IAS.

[] VMC Visual Meteorological Conditions

$V_{MC (power-off)}$ The minimum power-off control airspeed (IAS) at which control of the aircraft is assured in all axes following failure of the engine, including transient effects experienced at the point of failure.

$V_{MC (power-on)}$ The minimum power-on control airspeed (IAS) at which control of the aircraft is assured in all axes with the engine producing the power required to maintain the flight condition.

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V_{MIN} Minimum Level Flight Speed, IAS, limited by either power or controllability considerations.

V_{NE} The Never Exceed Speed IAS. []

V_Y Best rate of Climb Speed, IAS.

Definitions

Fireproof

'Fireproof' with respect to materials, components and equipment means the capability to withstand the application of heat by a flame, for a period of 15 minutes without any failure that would create a hazard to the aircraft.

Compliance with the criteria for fireproof materials or components should be shown as follows:

- 1) The flame to which the materials or components are subjected should be $1100^{\circ}\text{C} \pm 80^{\circ}\text{C}$.
- 2) Sheet materials approximately 64 cm^2 should be subjected to the flame from a suitable burner.
- 3) The flame must be large enough to maintain the required test temperature over an area approximately 13 mm^2 .

For example, materials which are considered fireproof without being subjected to fire tests include:

- a) stainless steel sheet 0.4 mm (0.016 in) thick;
- b) mild steel sheet protected against corrosion 0.45 mm (0.018 in) thick; and
- c) titanium sheet 0.45 mm (0.018 in) thick.

Fire-resistant

'Fire-resistant' with respect to materials, components and equipment means the capability to withstand the application of heat by a flame, as defined for 'Fireproof', for a period of 5 minutes without any failure that would create a hazard to the aircraft.

Primary Structure

Primary Structure Those parts of the structure, the failure of which would endanger the gyroplane.'

3.3 Amend **T 2 Applicability** as follows:

'a) This Section T states requirements applicable to gyroplanes having:

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- 1) not more than two occupants;
 - 2) a maximum all-up (take-off) weight not exceeding 600 kg; and
 - 3) restricted to day **VMC**.
- c) These requirements apply to light gyroplanes of orthodox design. Aircraft having the following basic features will be so regarded:
- 1) Single teetering two-bladed rotor of fixed pitch; **(see AMC T 2 c) 1).**
 - 2) Single **reciprocating** engine **which may be** normally-aspirated, **turbo-supercharged or supercharged (see AMC T 2 c) 2).** and propeller; and
 - 3) One nose wheel and/or tail wheel, and non-retractable two-main-wheel undercarriage.
- 4) Pusher or tractor configuration.**

3.4 Amend T 23 Load Distribution Limits as follows:

- 'b) The c.g. range must not be less than that which corresponds to the weight of each occupant, varying between a minimum of 55 kg weight for a pilot alone up to the maximum placarded weight for a pilot and passenger, together with a variation in fuel contents from zero to full fuel. The placarded maximum weight must be not less than **86** kg per person.'

3.5 Amend T 25 Weight limits as follows:

- 'b) Not less than the weight which results from the empty weight of the gyroplane, plus a weight of occupant(s) of **86** kg for a single-seat gyroplane or **172** kg for a two-seat gyroplane, plus the required minimum equipment, plus fuel for at least 60 minutes flight at maximum continuous power.
- c) Not less than the weight, which results with one (**86** kg pilot) occupant, required minimum equipment and maximum fuel. (See AMC T 25 c).'

3.6 Amend the title of T 71 Glide as follows:

'T 71 **Rate of Descent**

3.7 Amend T 73 Minimum speed for level flight as follows:

The minimum **airspeed** for level flight (V_{MIN}) must be determined. **This speed must not be less than the minimum control speed ($V_{MC(power-on)}$) established under T 149 (see AMC T 73)**

3.8 Amend T 79 High-speed envelope as follows:

Height-speed envelope **(see AMC T 79).**

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If there are any combinations of height and forward speed **of V_{MIN} and greater []** from which a safe landing cannot be made following engine failure, a limiting height-speed envelope must be established.

3.9 Amend T 143 Controllability and Manoeuvrability as follows:

'a) The gyroplane must be safely controllable and manoeuvrable with sufficient margin of control movement and **rotor clearance** to correct for atmospheric turbulence and to permit control of the attitude of the gyroplane at all power settings at the critical weight and c.g., at sea level and at the maximum altitude at which the gyroplane will be operated:

- 1) during steady flight at speeds **between $V_{MC(power-on)}$ or $V_{MC(power-off)}$, whichever is lowest,** and V_{DF} ; **(see AMC T 143 a) 1.)**
- 2) during speed changes;
- 3) during changes of engine power, (including sudden loss of engine power); **(see AMC T 143 a) 3) and b.)** and
- 4) during any manoeuvre appropriate to the type, including:
 - i) take-off;
 - ii) climb;
 - iii) turning flight;
 - iv) descent (power-on and power-off) including vertical and spiral descents;
 - v) landing (power-on and power-off);
 - vi) recovery to power-on flight from a bailed approach; and
 - vii) during dynamic manoeuvres including steep turns, straight pull-outs, and roll reversals.

b) It must be possible to maintain any required flight condition and make a smooth transition from one flight condition to another (including turns, slips **and reversal of turns**) with no more than average piloting skill, alertness or strength, and without danger of exceeding the limit manoeuvring load-factor, under any operating condition probable for the type, with the engine running at all possible associated power settings within the allowable range, including the effect of power changes and sudden engine failure.

If $V_{mc(power-on)}$ is less than $V_{mc(power-off)}$, (see T 149), it must be demonstrated that it is possible, without exceptional pilot skill or strength, to recover the aircraft to $V_{mc(power-off)}$ after the engine has been made inoperative at $V_{mc(power-on)}$. (See AMC T 143 a) 3) and b.).

Likely variations from any recommended techniques must not cause unsafe flight conditions.

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- f) The gyroplane shall not exhibit any serious tendency to enter a Pilot-Induced Oscillation (PIO) at all power settings at the critical weight and c.g., at sea level and at the maximum altitude at which the gyroplane will be operated:
- 1) during steady flight at speeds **between $V_{MC(\text{power-on})}$ or $V_{MC(\text{power-off})}$, whichever is lowest, and V_{DF}** ;
 - 2) during speed changes;
 - 3) during changes of engine power, (including sudden loss of engine power); and
 - 4) during any manoeuvre appropriate to the type, including:
 - i) take-off;
 - ii) climb;
 - iii) turning flight;
 - iv) descent (power-on and power-off) including vertical and spiral descents;
 - v) landing (power-on and power-off);
 - vi) recovery to power-on flight from a balked approach; and
 - vii) during dynamic manoeuvres including steep turns, straight pull-outs, and roll reversals.'

3.10 Add T 149 Minimum Control Speed as follows:

'T 149 Minimum Control Speed (See AMC T 149)

The following minimum control speeds must be determined:

a) Minimum power-off control speed, $V_{mc(\text{power-off})}$

b) Minimum power-on control speed, $V_{mc(\text{power-on})}$

3.11 Amend T 321 b) Flight loads as follows:

b) Compliance with the flight load requirements must be shown:

1) at each critical density altitude within the range in which the gyroplane may be expected to operate; and

2) at each practicable combination of weight and disposable load within the operating limitations specified in the Flight Manual.

3.12 Amend T 474 c) Landing case as follows:

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- 'c) In the absence of load factors determined from drop testing, a limit vertical landing gear reaction factor of 3 must be used which may be based on static reactions for all the wheels in contact at touchdown. []'

3.13 Move **AMC T 479 a) 2) Sub-paragraph b)** to **T 479 b)** and modify as follows:

- 'b) **Pz max, used in cases 1, 2 and 3 below, is the greatest value of the landing gear reaction derived from the criterion in paragraph T 474(c).**
The following drag and vertical force (in ground axes) combinations must be considered in the absence of rational analysis:

- 1) Spin up (longitudinal aft):
Vertical = 0.6 Pz max and
drag = 0.5 Pz max;
- 2) Spring back (longitudinal forward):
Vertical = 0.8 Pz max and
drag = -0.5 Pz max (forward); []
- 3) Maximum vertical reaction:
Vertical = Pz max and
drag = ± 0.3 Pz max.

[]'

3.14 Amend **T 483 One wheel landing conditions** as follows:

'For the one-wheel landing condition, the gyroplane is assumed to be in the level attitude and to contact the ground on one side of the main landing gear. In this attitude, the ground reactions must be the same as those obtained on that side under [] T 479 b). The unsymmetrical ground reaction must be reacted by rolling and yawing accelerations.'

3.15 Amend **T 485 Side load condition** as follows:

'T 485 Side load condition (**See AMC T 485**)

- a) For the side load condition, the gyroplane is assumed to be in the attitude specified in T 479 a) with only the main wheels contacting the ground, and with the shock absorbers and tyres in their static positions.
- b) The vertical limit load factor must be 1.33, with the vertical ground reaction divided equally between the main wheels. No lift is assumed.
- c) The limit side inertia factor must be 0.83, with the side ground reaction divided between the main wheels so that:
 - 1) 0.5 W is acting inboard on one side; and
 - 2) 0.33 W is acting outboard on the other side.'

3.16 Renumber **T 655** as **T 655 a)** and add **T 655 b)** as follows:

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a) Movable control surfaces must be installed so that there is no interference between any surfaces or their bracings when one surface is held in any position and the others are operated through their full angular movement. This requirement must be met:

- 1)** under the limit load conditions for all control surfaces through their full angular range; and
- 2)** under limit load on the gyroplane structure other than the control surfaces.

b) If an adjustable stabiliser is used, it must have stops that will limit its range of travel to that allowing safe flight and landing.

3.17 Amend **T 677 b) Trim system** as follows and delete **T 677 c)**:

b) There must be some means to indicate to the pilot the position of the trim device, with respect to the range of adjustment. **[] This means must be visible to the pilot (when strapped in) and must be located and designed to prevent confusion.**

[]

3.18 Add **T 679 Control system locks** as follows:

Control system locks

If there is a device to lock the control system on the ground, there must be a means to:

- a) give unmistakable warning to the pilot when the lock is engaged; and**
- b) prevent the lock from engaging in flight.**

3.19 Amend **T 773 Cockpit view** as follows:

‘Each cockpit must be designed so that:

- a) the pilot’s field of view is sufficiently extensive, clear and undistorted for safe operation. (See AMC T 773 a.);
- b) if a windscreen is provided, rain does not unduly impair his view along the flight path in normal flight and during landing. (See AMC T 773 b.);
- c) the pilot is easily able to establish a pitch attitude by reference to a fixed point of the airframe, when looking forward. **(See AMC T 773 c)**’

3.20 Add **T 779 Motion and effect of cockpit controls** as follows:

T 779 Motion and effect of cockpit controls

Cockpit controls must be designed so that they operate as follows:

Controls	Motion and effect
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Roll	Right (clockwise) for “right wing” down
Pitch	Rearward for nose up
Yaw	Right pedal forward for nose right
Trim	Corresponding to sense of motion and axis of the controls (See AMC T 779.)
Throttle control	Forward, or clockwise, to increase power (See AMC T 779.)
Propeller pitch	Forward to decrease pitch and/or increase rpm
Mixture	Forward, or up, for rich
Switches	Down for off

- 3.21 Add **T 780 Colour markings of cockpit controls** as follows and delete **T1555 b)**:

Colour markings of cockpit controls

Emergency controls must be coloured red.

- 3.22 Amend **T 785 a) Seats and safety harnesses** as follows:

- ‘a) Each seat and its supporting structure must be designed for **the placarded occupant weight of T 1557 d) 1) iii) and must not be lower** than that specified under T25b) and for the maximum load factors corresponding to the specified flight and ground conditions, including the emergency landing condition prescribed in T 561b).’

- 3.23 Amend **T 903 Powerplant Compatibility** as follows:

The applicant must show that each combination of engine, **exhaust system** and propeller in a gyroplane, for which a Permit to Fly is sought, is compatible with the gyroplane, functions in a satisfactory manner and can be operated safely within any limitations established under T 1505 and T 1521.

- 3.24 Amend **T 925 Propeller clearance** as follows:

- a) Amend the first paragraph of **T 925** as follows:

‘[] Propeller [] clearances at maximum weight, with the most adverse c.g., with the propeller in the most adverse pitch position and taking account of likely airframe flexibility, may not be less than the following:’

- b) Amend **T 925 a)** as follows:

‘(a) Ground clearance: There must be **adequate ground clearance between** the propeller and the ground, with the landing gear statically deflected and in the level normal, take-off, landing or taxiing attitude, whichever is most critical (**see AMC T 925 a).**) In addition, there must be positive clearance between the propeller and the ground in the level take-off attitude, with:’

- c) Amend **T 925 b)** as follows:

‘b) Clearance from other parts of the gyroplane: There must be positive clearance between all rotating parts of the propeller and spinner and other parts of the gyroplane under all operating conditions **with due allowance for airframe and propeller flexibility. (See AMC T 925 b).**’

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3.25 Amend T 963 a) Fuel tanks general as follows:

- a) Each fuel tank must be able to withstand without failure, the vibration, inertia, fluid and structural loads to which it may be subjected in normal operation.

3.26 Amend T 967 Fuel tank installation as follows:

- a) Each fuel tank must be supported so that the loads resulting from the weight of the fuel are not concentrated. In addition:
 - 1) There must be pads, if necessary, to prevent chafing between each tank and its supports; and
 - 2) Materials employed for supporting the tank or padding the supporting members must be non-absorbent or treated to prevent the absorption of fuel.
- b) Each compartment containing a fuel tank must be ventilated and drained to prevent accumulation of flammable fluids and vapours. Each compartment adjacent to a tank must be treated in a similar manner.
- c) No fuel tank may be located where an engine fire could impinge on it. (See AMC T 967 c.)
- d) It must be demonstrated that the presence of the tank will in no way interfere with the operation of any part of the gyroplane, or the normal movement of the occupants.**
- e)** Structural damage which may result from a heavy landing in excess of the ultimate capability of the landing gear, but within the emergency landing conditions of T 561, must not result in rupture of the fuel tank or fuel lines.

3.27 Amend T 971 a) Fuel tank sump as follows:

‘Each fuel tank, [] must have a drainable sump which is effective in all normal ground and flight attitudes and with a capacity of 0.10% of the tank capacity, or 120 ml, whichever is the greater. Alternatively:’

3.28 Amend T 995 Fuel Valves and Controls as follows:

- a) **For gyroplanes with cowled engine installations,** there must be a **positive quick acting valve** to shut off fuel to the engine **compartment**.
- b) The portion of the line between the **shut off valve** and the **engine compartment** must be as short as possible.
- c) **The shut off means must be guarded against inadvertent operation and be within easy reach of crew members.**

3.29 Amend T 1121 Exhaust system General as follows:

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- a) The exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in the cockpit.
 - b) Each exhaust system part with a surface hot enough to ignite flammable fluids or vapours must be located or shielded so that leakage from any system carrying flammable fluids or vapours will not result in a fire caused by impingement of the fluids or vapours on any part of the exhaust system, including shields for the exhaust system.**
 - c) Each exhaust system component must be separated by fireproof shields from adjacent flammable parts of the gyroplane.
 - d) No exhaust gases may discharge dangerously near any oil- or fuel-system drain.
 - e) Each exhaust system component must be ventilated to prevent points of excessively high temperature.
- 3.30 Amend T 1141 **Powerplant controls and accessories** as follows:
- a) The portion of each powerplant control located in an engine compartment that is required to be operated in the event of fire must be at least fire-resistant.
 - b) All controls for starting the engine (and stopping the engine in both normal and emergency conditions) must be easily accessible from one position so as to minimise the risk of an aircraft 'running away'.**
- 3.31 Amend T 1149 **Propeller speed** as follows:
- a) Propeller speed must be limited to, and propeller pitch must be fixed at, values that ensure safe operation under normal operating conditions.
 - b) During take-off and climb at the recommended best-rate-of-climb speed, the propeller must limit the engine rotational speed at full throttle to a value not greater than the maximum allowable rotational speed.
 - c) During a descent at VNE with throttle closed or the engine inoperative, the propeller must not permit a rotational speed to be achieved that is greater than 110% of the maximum allowable rotational speed of the engine or propeller, whichever is the lower.**
- 3.32 Add T 1191 **Firewalls** as follows:
- a) Cowled engine installations must be isolated from the rest of the gyroplane by a firewall or shroud.**
 - b) The firewall or shroud must be constructed so that no hazardous quantity of liquid, gas or flame can pass from the engine compartment to other parts of the gyroplane.**
 - c) Each opening in the firewall or shroud must be sealed with close fitting, fire resistant grommets, bushings, or firewall fittings.**

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- d) **The firewall and shroud must be fire resistant and protected against corrosion.**

3.33 Amend T 1305 a) Powerplant instruments as follows:

- a) Such pressure, temperature and rpm indications as **the engine manufacturer may require or** as are necessary to operate the engine within its limitations;

3.34 Amend T 1307 Miscellaneous equipment as follows:

- a)** A safety harness must be available to each occupant, capable of restraining the wearer against the forces resulting from the accelerations prescribed for emergency landing conditions in T 561.

- b) It must not be possible for an unsecured safety harness to contact the propeller or rotor or any other rotating parts.**

3.35 Add T 1323 Airspeed Indicating System as follows:

T 1323 Airspeed Indicating System

- a) **The airspeed indicating system must be calibrated.**
- b) **Calibration must be made in flight.**
- c) **The airspeed indicating system must be suitable for speeds between 0.8 V_Y and at least 1.05 V_{NE} .**

3.36 Amend T 1505 Airspeed limitations as follows:

- a) All flight speeds must be stated in terms of indicated airspeed (IAS).
- b) The never-exceed speed, V_{NE} , must not exceed 0.9 times the maximum speed demonstrated in flight tests (V_{DF}).
- c) The maximum speed demonstrated in flight V_{DF} must not exceed the Design Maximum Speed, V_D .**

3.37 Amend T 1521 Powerplant and propeller limitations as follows:

The powerplant and propeller limitations must be established **so that they do not exceed the corresponding limits specified by the engine and propeller manufacturers, except that where the gyroplane manufacturer has satisfactorily demonstrated that higher limitations can be used safely with the gyroplane, these may be stated.**

3.38 Amend T 1529 Maintenance Manual as follows:

A maintenance manual containing the information **that the applicant considers essential for proper maintenance must be provided. The applicant must consider at least the following in developing the essential information:**

- a) Description of systems;**

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- b) Lubrication instructions setting forth the frequency and the lubricants and fluids which are to be used in the various systems;**
- c) Pressures and electrical loads applicable to the various systems;**
- d) Tolerances and adjustments necessary for proper functioning, including control surface travels and limits of rotor pitch angles relative to the hub;**
- e) Method of determining c.g. position e.g. hang check;**
- f) Methods of rotor tracking and maximum permissible values of play at hinge pins and control circuit backlash;**
- g) Identification of primary and secondary structures;**
- h) Frequency and extent of inspections necessary for proper maintenance;**
- i) Special repair methods applicable to the gyroplane;**
- j) Special inspection techniques and maintenance 'cautions';**
- k) List of special tools;**
- l) Rigging data necessary for proper operation;**
- m) Statement of service life limitations (replacement or overhaul) of parts, components and accessories subject to such limitations;**
- n) The materials necessary for small repairs;**
- o) Care and cleaning recommendations;**
- p) Instructions for rigging and de-rigging;**
- q) Information on supporting points and measures to be taken to prevent damage during ground transportation; and**
- r) List of placards and markings and their locations.**

3.39 Amend T 1557 Miscellaneous markings and placards as follows:

- a) Baggage compartment. Each baggage compartment must have a placard stating the loading limitations.
- b) Fuel- and oil-filler openings. The following apply:
 - 1) Fuel-filler openings must be marked at or near the filler cover with the minimum fuel grade and if applicable the fuel/oil ratio;

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- 2) Oil-filler openings must be marked at or near the filler cover:
 - i) with the grade; and
 - ii) if the oil is detergent or non-detergent.
- c) Fuel tanks. The usable fuel capacity of each tank must be marked either at the selector or on the gauge (when provided), or on the tank if this is translucent and visible to the pilot in flight.
- d) In-flight engine starting. A placard must be provided stating any limitations to be observed during in-flight engine starting.**
- e) Loading.**
 - 1) Placards. The following data must be placarded in each gyroplane so as to be plainly visible to the pilot:
 - i) Empty weight (actual);
 - ii) Maximum weight;
 - iii) Maximum and minimum cockpit load, including that permitted in each seat;
 - iv) Cockpit load conditions for two seater flown solo; and
 - v) Fuel load limitations for the range of allowable cockpit loads.
 - 2) Removable ballast. If removable ballast is used, the place for carrying ballast must have a placard stating instructions for the proper placement and securing of the removable ballast under each loading condition for which removable ballast is necessary.
- f) Aerobatic manoeuvres.** A placard prohibiting aerobatic manoeuvres must be plainly visible to the pilot.

3.40 Amend T 1583 a) **Operating limitations** as follows:

a) Airspeed Limitations. The following limitations must be furnished:

- 1) The airspeed limit V_{NE} together with information on the significance of this limit; [] **and**
- 2) **Airspeed indicator system calibration.**

3.41 Amend T 1585 **Operating Procedures** as follows:

'Operating **data and** procedures

a) [] Information concerning normal and emergency procedures and other pertinent information necessary for safe operation must be furnished.

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- b)** The procedure(s) and speeds for making a take-off in accordance with T 51 and the subsequent climb;
- c)** The procedure and speed for making a normal approach and landing, and where different, the procedure and speed for making an approach and landing with the engine inoperative, in accordance with T 75;
- d)** **A statement must be made of the maximum crosswind components in which take-off and landing have been demonstrated and whether control was found to be limiting.**
- e)** The procedure(s) for abandoning a take-off due to engine failure or other cause;
- f)** The best rate of climb speed, which must not be less than that selected to show compliance with T 65;
- g)** The airspeed associated with the minimum rate of descent determined in accordance with T 71;
- h)** The minimum speed for level flight V_{MIN} established in accordance with T 73 **(See AMC T 1585 e) & g).);**
- i)** The procedure and speed for making a normal approach and landing, and where different, the procedure and speed for making an approach and landing with the engine inoperative, in accordance with T 75;
- j)** **The minimum control airspeeds V_{MC} (power-off) and V_{MC} (power-on) established in accordance with T 143 and T 149 (See AMC T 1585 g) and i).);**
- k)** **If special procedures are necessary to start the engine in flight, these must be furnished.**
- l)** Use of any carburettor heat control, (if fitted); and
- m)** Procedures for the amendment of the empty weight and composition of the useful load limitations in the pilot handbook and placards, including maximum fuel load to be carried, following periodic weighing of the gyroplane.
- n)** **Information must be provided on safe procedures for the assembly, rigging and disassembly likely to be undertaken by the pilot before and after flight, such that inadvertent damage to the gyroplane can be avoided.**
- o)** **Information must be provided on safe procedures for securing and ground handling of the aircraft.'**

3.42 Add T 1935 Blade Retention as follows:

'T 1935 Blade Retention

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Blade retention devices for propellers with detachable blades must be capable of withstanding a limit load equal to twice the centrifugal force occurring at the maximum rotational speed (other than transient overspeed) for which approval is sought, or the maximum governed rotational speed, as appropriate (see AMC T 1935).'

3.43 Add AMC T 2 a) (Interpretative Material) as follows:

'a) This code is applicable to amateur built gyroplanes with a maximum all-up (take-off) weight not exceeding 600 kg and to factory built gyroplanes with a maximum all-up (take-off) weight not exceeding 560 kg in accordance with EU Regulation (EC) 216/2008 Annex II.'

3.44 Amend AMC T 2 c) (Interpretative Material) as follows:

a) Renumber 'AMC T 2 c) (Interpretative Material)' as 'AMC T 2 c) 1) (Interpretative Material)'

b) Add AMC T 2 c) 2) (Interpretative Material) as follows:

'Other engine types such as Wankel rotary will be addressed by means of a special condition.'

3.45 Add AMC T 21 5) (Interpretative Material) as follows:

'5) Refer to AMC T 23 for permitted extrapolation of test results for light weight in lieu of actual testing.'

3.46 Amend AMC T 23 (Interpretative Material) as follows:

a) Include the following Note under the diagram:

'Note - The angle of the propeller thrust line is exaggerated to show that the offset is the perpendicular (normal) distance from the propeller thrust line to the c.g.'

b) Add AMC T 23 c):

'c) The minimum pilot weight of 55 kg referred to in T 23 has a practical implication for flight testing, it may not be possible to find a test pilot of this low weight. Some allowance can be made for extrapolation of results from an assessing pilot heavier than 55 Kg. If trends of handling qualities with decreasing weight show that no unacceptable characteristics will exist then a minimum pilot weight of 55 kg can be accepted. If there is any doubt as to the acceptability of handling qualities, and compliance with all relevant paragraphs of Section T, then it will be necessary to have a placarded minimum pilot weight. This minimum pilot weight requirement could be met by use of suitably secured ballast for light pilots. For gyroplanes with two seats it may be permissible for one or both of the occupants to be less than the solo flight minimum pilot weight provided the CG is within the acceptable range and the placard is clearly worded to permit this.'

3.47 Add AMC T 73 (Interpretative Material) as follows:

‘AMC T 73 (Interpretative Material)

V_{MIN} is primarily intended as a performance parameter i.e. the minimum airspeed at which level flight can be maintained. For a typical pusher configuration gyroplane, this will normally be achieved at maximum power, as propeller slipstream effects will maintain controllability in yaw over the vertical tail surface(s).

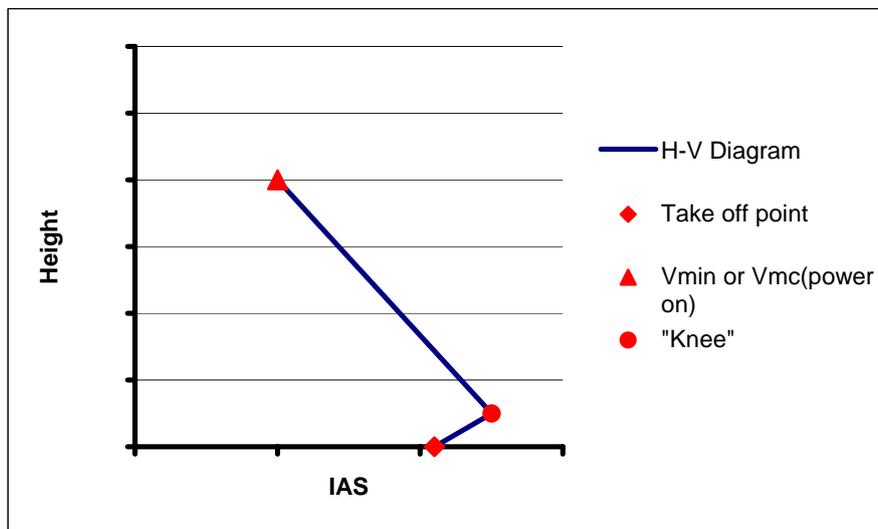
It is possible, however, that other configurations, e.g. tractor, may reach a controllability limit at less than maximum power, as propeller slipstream effects will be much less and yaw controllability will be primarily dependent on airspeed.

V_{MIN} can, therefore, be defined by either power availability or low speed controllability. (see also AMC T 149)’

3.48 Add AMC T 79 (Interpretative Material) as follows:

‘AMC T 79 (Interpretative Material)

The Height-speed envelope is normally referred to as the Height-Velocity (H-V) diagram. A typical H-V diagram for a gyroplane would normally cover critical weight, approximately sea level, ISA conditions and may appear thus, the area to the left of the line defining the envelope of airspeed and height above the ground from which a safe landing following an engine failure is not assured:



The diagram above consists of 2 distinct portions, a) the take off portion and b) the level flight (cruise) portion. The “knee” separates the take off portion from the cruise portion and represents the highest point of the take off procedure. Up to this point, normal pilot intervention time of approximately 0.5 sec should be applied between failing the engine and initiation of recovery action. In the cruise portion above the knee and at airspeeds greater than V_{MIN} , an intervention time of 1 sec can be used.

Experience has shown that it is not normally necessary to conduct actual engine shut downs as the residual thrust of an idling engine has little effect on the final outcome of the tests.

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It is recommended that investigation of upper portions of the H-V curve be conducted, as far as possible, at a safe altitude, with a power recovery. Only when there is confidence in the validity of the curve should limited testing be carried out to a landing. Clearly, the testing of the take off portion can only be conducted to a landing.

Testing should be conducted as close as possible to the maximum permitted gross weight and in low wind speeds - <3kt. Applicants should be alert to the possibility of a tail wind component occurring when testing in light and variable wind conditions as this could result in a significant increase of the height required to carry out a safe landing.

a) Take off portion. A selection of airspeed/height points between the takeoff point and the knee should be investigated. The knee will usually be around the best rate of climb speed (V_y) and the height at which this is achieved after take off. Having determined this point, testing should be initiated by stabilising the aircraft at the height of the knee, but at a higher airspeed, above the runway, and closing the throttle to idle. Initial test points should be undertaken using a gentle throttle closure and immediate corrective action. The rate of throttle closure and pilot delay can then be progressively increased until a rapid throttle closure and the appropriate intervention time are achieved. A series of tests should then be conducted at progressively decreasing airspeeds until the actual knee point has been established by reaching a limiting case e.g. maximum rate of descent on landing, pilot workload or controllability. This procedure can then be repeated at one or more intermediate points between the take off point and the knee.

Having satisfactorily investigated the lower portion from steady state entry conditions, a sample of points on the line should be investigated dynamically during take off. Again, caution should be exercised, as the behaviour of the aircraft will be different in the dynamic case. Testing at a lighter weight, with no delay is recommended initially. The end point should be considered to be maximum gross weight, maximum take off power and 0.5 sec pilot delay.

b) Cruise portion. It will be necessary to demonstrate a number of points between the knee and V_{MIN} . Initial testing should be performed at a safe altitude, with the height loss to recover to a simulated flare and landing being estimated for each selected airspeed. These points can then be investigated in a progressive manner as above, the aircraft being stabilised at the required height, but at a higher than desired airspeed. Airspeed can then be progressively reduced to the desired H-V point, and pilot delay increased to 1 sec.

c) Airspeeds less than V_{MIN} . In the case that $V_{MC (power-on)}$ is less than $V_{min,1}$ limited flight testing should be carried out to determine the approximate height loss in recovery from the following conditions:

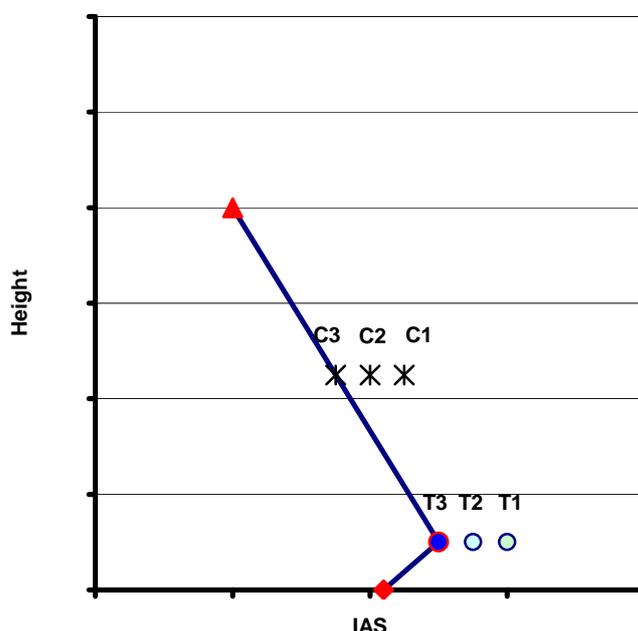
i) $V_{MC(power-on)}$ in a stabilised rate of descent at the appropriate power setting, closing the throttle to simulate power failure and

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initiating a recovery after a 0.5 second delay. The height loss from the point of throttle closure should be determined.

- ii) $V_{MC(\text{power-off})}$ in a stabilised rate of descent at idle power. The engine is assumed not to respond for the recovery and the height loss measured from the point where the engine would normally have responded.

The testing should be carried out in free air only, landings from this condition are not required. The height loss to recover to a simulated flare and landing being estimated for each condition. The handbook should state the height loss for these descent conditions but also state that it is an estimate and not an absolute value.



The incremental approach for test points to a landing is illustrated in the diagram above:

For the cruise portion the speed is reduced (C1, C2, C3).

For the take off portion the speed is reduced (T1, T2, T3)'

3.49 Amend **AMC T 143 a) (Interpretative Material)** as follows:

- a) Renumber '**AMC T 143 a) (Interpretative Material)**' as '**AMC T 143 a) 1) (Interpretative Material)**' and amend as follows:

'[] It will be necessary to show that there is a margin beyond the gyroplane's specified limitations within which the gyroplane is safely controllable and manoeuvrable.

The size of the margin will depend on the handling characteristics of the gyroplane, and must be agreed with the CAA, but in general, it will be expected that satisfactory flight characteristics have been demonstrated at speeds up to

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1.11V_{NE}. This demonstration must include satisfactory control margin and rotor clearance. (see also T 661)

[]'

- b) Add AMC T 143 a) 3) (Interpretative Material) as follows:

'AMC T 143 a) 3) (Interpretative Material)

Having established $V_{mc(power-off)}$ and either V_{MIN} or $V_{mc(power-on)}$ under T 73 and T 149, if $V_{mc(power-off)}$ is greater than either V_{MIN} or $V_{mc(power-on)}$ it must be shown that, it is possible to recover the gyroplane in the event of an engine failure at the lowest power-on minimum airspeed. This should be done by carrying out simulated engine failures at incrementally reducing airspeeds down to the lowest power-on airspeed. The aircraft should be established at the chosen incremental speed which should initially be at $V_{mc(power-off)}$, and the throttle carefully closed to idle whilst simultaneously increasing airspeed. The rate of throttle closure can then be incrementally increased until an engine failure has been simulated. Having successfully demonstrated a simulated engine failure with immediate recovery, the tests should be continued with increasing pilot intervention time. The objective is ultimately to simulate an engine failure with a realistic intervention time of around 0.5 sec. Having achieved a successful test point, further tests can be carried out at incrementally lower airspeeds with the aircraft being accelerated to $V_{mc(power-off)}$ following engine failure until the limiting power-on minimum airspeed is demonstrated. Following determination of this speed, confirmation flight testing should be conducted in an incremental manner (first test points at higher speed) with real engine shutdowns over a suitable landing site.

If at any time, the ability to recover the aircraft to a safe idle glide is in doubt, this is indicative that the power-on minimum airspeed is too low. The investigation must be continued to establish a minimum power-on airspeed that allows safe recovery following engine failure and this should be declared as the limiting flight condition, $V_{mc(power-on)}$.

- 3.50 Add AMC T 143 b) (Interpretative Material) as follows:

'AMC T 143 b) (Interpretative Material)

It must be assured that no unacceptable coupling to attitude is experienced with rapid applications of throttle (e.g. go around) or rapid power loss (e.g. engine failure). This may be particularly apparent with gyroplanes which have an exaggerated thrust line/vertical CG offset. For example, slow speed flight in a gyroplane with a high thrust line will result in a nose down pitch couple from thrust which must be opposed by aft control displacement. At the point of engine failure, the nose down couple is lost and the nose up pitch attitude can increase very rapidly before the pilot intervenes. Although the pitch axis is most noticeably affected, engine torque effects can couple to roll and yaw and must also be considered.'

- 3.51 Add AMC T 149 (Interpretative Material) as follows:

'AMC T 149 (Interpretative Material)

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It is recommended that $V_{mc(power-off)}$ be established before exploration of V_{MIN} and $V_{mc(power-on)}$ is commenced in order that, in the event of an actual engine failure during the power-on exploration, the recovery action is well understood.

a) $V_{mc(power-off)}$ is the lowest airspeed, IAS, at which control of the aircraft is assured with the engine shut down. Investigation should be conducted in a cautious and progressive manner by establishing the aircraft in level flight at or around minimum power airspeed at a safe altitude and closing the throttle to idle. Airspeed should then be decreased incrementally until a control, typically in the yaw axis, becomes ineffective or limited. Power should then be applied and airspeed increased to recover as required. Following determination of this speed, confirmation flight testing should be conducted in an incremental manner (first test points at higher speed) with real engine shutdowns over a suitable landing site. An intervention time of approximately 0.5 sec should be applied between failing the engine and initiation of recovery action.

b) $V_{mc(power-on)}$ is the lowest airspeed, IAS, at which the gyroplane is still fully controllable in all axes with power applied. Most contemporary light gyroplanes are of a compact pusher configuration and the vertical surfaces are subject to considerable propeller slipstream effects at low speed, high power, and control may be possible even at zero airspeed (with a corresponding rate of descent). Some autogyro configurations, e.g. tractor types, may have limited propeller slipstream effect on the fin/rudder. In this case directional stability and control may be primarily dependent on airspeed with control limits being reached in level flight at an airspeed with less than full power.

$V_{mc(power-on)}$ should be investigated concurrent with the investigation of V_{MIN} in T 73. The gyroplane should be stabilised in level flight at approximately minimum power airspeed. Airspeed should then be progressively reduced and power increased to maintain level flight. If a controllability limit or other limiting factor (e.g. rotor rpm, handling qualities) is reached before maximum power has been required, the testing should be terminated and this airspeed defined as $V_{mc(power-on)}$, and would therefore be coincident with V_{MIN} . If maximum power is achieved with controllability still being maintained, this airspeed should be defined as $V_{mc(power-on)}$. The gyroplane will be in a descent in this case.'

3.52 Amend **AMC T 181 (Interpretative Material)** as follows:

‘Longitudinal, lateral or directional oscillations with controls fixed or free and following a single disturbance in smooth air, should at least meet the following criteria:

a) Any oscillation having a period of less than 5 seconds should damp to one half amplitude in not more than one cycle. There should be no tendency for undamped small amplitude oscillations to persist.

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- b) Any oscillation having a period between 5 and 10 seconds should damp to one half amplitude in not more than two cycles. There should be no tendency for undamped small oscillations to persist.
- c) Any oscillation having a period between 10 and 20 seconds should be damped, and in no circumstances should an oscillation having a period greater than 20 seconds achieve more than double amplitude in less than 20 seconds.

For gyroplanes with an in flight adjustable variable trim control, where possible the gyroplane should initially be trimmed at the required flight condition. When testing for longitudinal dynamic stability, the disturbance can then be introduced [] by moving one primary flight control to an out-of-trim position in one axis sufficient to change the attitude of the gyroplane by approximately 5 degrees with the other primary controls held fixed and immediately returning it to its original trim position, at which it is then held fixed. Initially, a small input should be employed, sufficient to generate an attitude rate of no more than approx 3 - 5°/sec. The amplitude of the input can then be incrementally increased to generate an adequate pitch rate in the order of 5 - 10°/sec. Extreme caution must be exercised during this evaluation, particularly when considering the potential for rapidly reducing 'G', either as a direct result of an input, or as an indirect result during the ensuing phugoid response. Consideration should be given to some form of measurement of structural clearances for this testing, for example a 'video camera'.

For those gyroplanes which do not have a variable trim control **or which have a variable trim control with insufficient authority to trim at all conditions**, the method of exciting the oscillation is the same [] **and** the control must be returned to the datum position and held fixed in that position. **As it may not have been possible to establish a trim condition with zero control force, care must be taken to ensure that the control is returned to datum following the disturbance.'**

- 3.53 Add **AMC T 321 b) (Interpretative Material)** as follows:

AMC T 321 b) (Interpretative Material)

Altitude is not normally critical for propeller torque and thrust, which are normally greatest at sea level.

- 3.54 Add **AMC T 397(Interpretative Material)** as follows:

AMC T 397 (Interpretative Material)

For unconventional control systems, the design loads should reflect the most sensible mode of operation for the control, e.g. depending on the sense of operation, a hand-operated rudder should be designed for the loads appropriate for either a pitch or roll control.

- 3.55 Move **AMC T 474** to Part 2 Sub-Section C.

- 3.56 Move **AMC T 479 a) 2) Sub-paragraph a) text** to Part 2 Sub-Section C.

- 3.57 Add **AMC T 485 (Interpretative Material)** as follows:

'AMC T 485 (Interpretative Material)

The effect of yawing acceleration due to side loads during landing should be considered to act on the whole aircraft structure.'

- 3.58 Add AMC T 773 c) (Interpretative Material)

'AMC T 773 c) (Interpretative Material)

Attitude control of light gyroplanes is largely dependent on the pilot being able to fly by reference to external visual cues. Certain gyroplane configurations such as pusher types with an open cockpit, have limited airframe structure ahead of the pilot. In order to meet the intent of this requirement, sufficient airframe structure should be within the pilot's normal field of view close enough to the natural position of the horizon in trimmed level flight to allow attitude control. This may require a dedicated attitude reference e.g. a "T-bar" or reference on the windscreen.

- 3.59 Add AMC T 777 a) (Interpretative Material) as follows:

'For unconventional control systems, the function and sense of the control should be placarded.'

- 3.60 Add AMC T 779 (Interpretative Material) as follows:

'1) Trim

The trim control should be mounted in the most logical plane of operation with the axis parallel to the primary control axis. For example, for pitch trim the wheel would be in the vertical plane such that a forward motion of the top of the wheel trims pitch nose down. Some allowance can be made for displacing the axis to improve access by the pilot or due to over-riding design constraints but it would not generally be acceptable for the axis to be significantly displaced, for example by 90°.

For trim wheels the sense of motion should be as follows:

Pitch: Top of wheel moves forward for trim nose down.

Roll: Top of wheel moves right to trim "right wing" low.

Yaw: Top of wheel (forward part) moves right to yaw nose right.

If only a portion of a wheel is accessible, the direction of the pilot's hand movement must be in the same sense as gyroplane motion.

2) Throttle Control

For twist-grip engine power controls, for left-hand operation the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger.'

- 3.61 Add AMC T 785 a) (Interpretative Material) as follows:

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'Although the occupant weight for design must be not less than 86kg, typical weight of equipped heavier crew should be considered.'

3.62 Amend **AMC T 925 (Interpretative Material)** as follows:

a) Add **AMC T 925 a) (Interpretative Material)** as follows:

'AMC T 925 a) (Interpretative Material)

There should be a ground clearance of at least 180 mm for a gyroplane with a nose-wheel landing gear or 230 mm for a gyroplane with a conventional tractor propeller and a tail-wheel landing gear.'

b) Amend **AMC T 925 b) 2) (Interpretative Material)** as follows:

'2) a minimum longitudinal propeller clearance, to allow for airframe and propeller flexibility, varying linearly between 13 mm at the hub and 50 mm at the blade tip.'

3.63 Amend **AMC T 1301 a) 3) (Interpretative Material)** as follows:

Each item of required equipment should function correctly when subjected to the most adverse likely operating conditions including extremes of temperature, rain and humidity.

When radio equipment is installed it should be shown that the electrical system is such that the operation of this equipment is not adversely affected.

3.64 Add **AMC T 1505 a) (Interpretative Material)** as follows:

'Speeds (EAS) determined from structural limitations should be suitably converted.'

3.65 Amend **AMC T 1529 (Interpretative Material)** as follows:

[] Manuals containing the information essential for servicing and maintaining the engine, propeller and rotor should also be provided unless the information is contained within the gyroplane maintenance manual.

Note that the inspection techniques should include procedures to check that the primary structure, controls, rotor and propeller are free from cracks, corrosion or visible damage.

3.66 Add **AMC T 1585 e) & g) (Interpretative Material)**

V_{MIN} , $V_{MC(power-off)}$ and/or $V_{MC(power-on)}$ may be below the normal operating range of the airspeed indicator on some gyroplanes (typically for a pusher configuration). In this case, compliance with T 1585 e) and g) can be shown by estimating the speed. This estimate could be made by carrying out the test in zero wind and measuring ground speed by GPS.'

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3.67 Add **AMC T 1935 Blade retention (Interpretative Material)**

'The pull load should be twice the maximum centrifugal load multiplied by the ultimate factor. No other material factors of T 613 need apply. However, the other special factors of Subpart D do still apply (e.g. casting factor T 621).'