Safety Regulation Group

Civil Aviation Authority

CAP 750

British Civil Airworthiness Requirements

Section VLH - Very Light Helicopters

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BCAR Section VLH

Section VLH - Very Light Helicopters

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Enquiries regarding the content of this publication should be addressed to:
Strategy and Standards Department, Safety Regulation Group, Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR.

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Revision History

Initial Issue **November 2004**

BCAR Section VLH is the basis for the issue of Permits to Fly for new types of very light helicopters, application for approval of which is received after the above date. The basis for the issue of Certificates of Airworthiness for small rotorcraft will continue to be JAR-27.

Issue 1 of BCAR Section VLH presents the technical intent of BCAR Paper VLH 888, and was made effective upon acceptance of the advice of the Airworthiness Requirements Board.

Foreword

1 General

1.1 British Civil Airworthiness Requirements (hereinafter referred to as the 'Requirements') of which Section VLH is a constituent part, are published by the Civil Aviation Authority (hereinafter referred to as the 'CAA'). They comprise minimum requirements and constitute the basis for the issue of Certificates, Permits and Approvals in accordance with the Air Navigation Order.

1.2 This BCAR Section VLH for Light Helicopters has been based on BCAR Section T, which is applicable to light gyroplanes, suitably amended to cover helicopters, and is intended to reflect a similar level of airworthiness. Where appropriate, rotorcraft requirements have been included which align with FAR/CS-27. In addition, some material has been taken from CS-VLA.

1.3 Helicopters which have been shown to comply with BCAR Section VLH will only be eligible for a Permit to Fly.

2 Recognition

Recognition will be accorded to very light helicopters designed, manufactured and tested in accordance with technical standards or regulations of other signatory states to the European Economic Area (EEA) agreement, 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 EEA states, including in particular those conforming with EN 45000, 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 Interpretation

3.1 These requirements, with or without explanatory material, should not be regarded as constituting a textbook of current aeronautical knowledge; interpretation of the requirements against a background of such knowledge is essential.

3.2 Where necessary, the mandatory requirements have been supplemented by Acceptable Means of Compliance and Interpretative Material (AMC), which give acceptable interpretation of requirements, state recommended practices or give supplementary information.

3.3 Mandatory clauses are invariably denoted by the use of 'shall' or 'must'; 'should' or 'may' are used in the text to indicate permissive or recommended clauses.

3.4 It is implicit in requirements expressed qualitatively (e.g. 'readily visible', 'adequately tested') that the CAA will adjudicate in cases where doubt exists.

4 Presentation

4.1 Arrangement of Requirements

This Section VLH is divided into 2 Parts and a section on abbreviations and definitions. It is so arranged that requirements of general applicability are presented at the beginning of the relevant Sub-section.

4.2 Editorial

As far as possible, BCAR Section VLH paragraphs carry the same number as the equivalent paragraph in FAR/JAR-27

4.3 S.I. units

S.I. units have been used in these requirements.

NOTE: Strict observance of the S.I. system is not compatible with current aeronautical practice, in which performance data are scheduled. Consequently, some variations from S.I. units will be found in Sub-section B.

5 Issue and Amendment

5.1 The printed version of the BCAR Section VLH, which is identified by an Issue No. and date will be deemed to be amended by each BCAR Amendment, appropriate to the Section, which is issued subsequent to the date of issue of the printed version.

5.2 A suitable announcement will be made in the aeronautical press whenever BCAR Amendments are consolidated into the printed version of the Section.

5.3 Material differences from the previous issue are indicated with bold square brackets.

6 Effective Date

New requirements and amendments promulgated in BCAR Amendments are effective from the date printed on them. Thus for any application made on or after the date of issue of a printed version of the Section, the effective requirements will be made up of those in the printed version of the Section together with those in any appropriate BCAR Amendments incorporated at the time the application is made.

7 Application and Enquiries

Applications for permission to reproduce any part of the requirements and any enquiries regarding their technical content should be addressed to the Civil Aviation Authority, Safety Regulation Group, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR.

Abbreviations and Definitions

Critical Part	Those parts of the helicopter the failure of which would endanger the helicopter.
Fire-proof	Capable of withstanding for a period of at least 15 minutes the application of heat by the standard flame.
Fire-resistant	Capable of withstanding for a period of at least 5 minutes the application of heat by the standard flame.
Primary Structure	Those parts of the structure the failure of which would endanger the helicopter.
Standard Flame	A flame with the characteristics which are similar to those described in BS3G.100 part 2 Section 3-13.
EAS	Equivalent air speed. True airspeed x $\left(\frac{\rho}{\rho\sigma}\right)^{½}$ where ρ is the air density and $\rho\sigma$ is the air density in standard sea level conditions.
IAS	Indicated air speed. The readings of the pitot-static airspeed indicator as installed in the rotorcraft, corrected only for instrument error.
V_D	The Maximum Design Speed, EAS.
V_{DF}	The Maximum Demonstrated Flight Speed, EAS. This must not exceed V_D.
V_{NE}	The Never Exceed Speed, IAS. This must not exceed 0·9 V_{DF}.
V_Y	Best Rate of Climb Speed, IAS.
V_H	Maximum speed in level flight with the engine at maximum continuous power, IAS.
VMC	Visual Meteorological Conditions.

Part 1 Requirements

Sub-Section A General

VLH 1 Applicability

a) BCAR-VLH prescribes airworthiness standards for the issue of a Permit to Fly for an amateur constructed helicopter which:

1) is designed to carry not more than two occupants;

2) has a maximum weight not exceeding 750 kg;

3) is restricted to day/VMC operations in non-icing conditions;

4) is of orthodox design incorporating:

i) a single main rotor;

ii) a skid, ski or fixed float landing gear;

iii) a single engine spark or compression ignition; and

iv) a simple fuel system.

5) The design is to exclude:

i) hydraulic systems;

ii) boosted flight controls;

iii) combustion heaters;

iv) external loads; and

v) emergency flotation gear.

(See AMC VLH 1 a).)

b) Where these requirements are inappropriate to particular design and construction features, it will be necessary to reconsider the validity of the requirements for each particular case and the Civil Aviation Authority (CAA) must be consulted as to the applicable requirements.

c) **Permitted Operations**

These requirements apply to light helicopters designed for non-aerobatic operation. (See AMC VLH 1 c).)

VLH 5 Substantiation

Where it can be shown that a particular feature is similar in all significant respects to one which is part of a previously accepted design, and can be considered as a separate entity in terms of its function, the CAA will take this into account when assessing the acceptability of the feature, and it may then not be necessary to test or otherwise substantiate to the level set out in the appropriate requirement.

Sub-Section B Flight

General

VLH 21 Proof of compliance

(See AMC VLH 21)

a) Unless a combination of weight and centre-of-gravity (c.g.) is specified, each requirement of this Sub-Section must be met by test upon a helicopter of the type for which a Permit to Fly is requested, at the most adverse combinations of weight and c.g. within the range of loading conditions within which the helicopter will be operated. Calculation may be used in lieu of tests providing the calculations are based on, and equal in accuracy to, the results of testing.

b) If agreed by the CAA, compliance may be shown by demonstration of an adequate satisfactory safe history of operation by a number of examples of the type. The number to be agreed with the CAA. (See AMC VLH 21 b).)

c) Compliance must be established for all configurations at which the helicopter will be operated, except as otherwise stated.

d) Consideration must be given to significant variations of performance and in-flight characteristics caused by rain and the accumulation of insects.

NOTE: Flight tests may also be required to show compliance with requirements of other Sub-Sections of BCAR Section VLH.

VLH 23 Load distribution limits

a) The ranges of weight and centre-of-gravity within which the helicopter is to be safely operated must be selected by the applicant.

b) The centre-of-gravity 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 90 kg per person.

VLH 25 Weight limits

a) **Maximum Weight.** The maximum weight selected by the applicant must not be less than the empty weight of the helicopter together with:

1) Each seat occupied, full quantity of oil, and at least enough fuel for one hour of operation at rated maximum continuous power; or

2) One pilot, full quantity of oil, and fuel to full tank capacity; whichever is the greater. An occupant weight of 90 kg shall be assumed for the purpose of this paragraph.

b) **Minimum Weight.** The minimum weight selected by the applicant must not be greater than the sum of:

1) The empty weight of the helicopter;

2) The weight of the pilot (assumed as 55 kg); and

3) The fuel necessary for one half hour of operation at maximum continuous power.

VLH 27 Centre-of-gravity limits

a) The forward and aft limits for centre-of-gravity position must be established for each weight within the range selected in accordance with VLH 25.

b) If the design of the rotorcraft permits significant lateral assymetry of loading, the lateral limits for centre-of-gravity position must be established.

VLH 29 Empty weight and corresponding centre-of-gravity

a) The empty weight and corresponding centre-of-gravity must be determined by weighing the helicopter:

1) with:

i) fixed ballast;

ii) required minimum equipment; and

iii) unusable fuel, maximum oil and, where appropriate, engine coolant.

2) excluding:

i) weight of occupant(s); and

ii) other readily removable items of load.

b) The condition of the helicopter at the time of determining empty weight must be one that is well defined and easily repeated.

VLH 31 Removable ballast

Removable ballast may be used in showing compliance with the flight requirements of this Sub-Section.

VLH 33 Main rotor speed and pitch limits

a) **Main rotor speed limits**. A range of main rotor speeds must be established that:

1) with power-on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate manoeuvre, and is consistent with the kind of governor or synchroniser used; and

2) with power-off, allows each appropriate autorotative manoeuvre to be performed throughout the ranges of airspeed and weight for which certification is requested.

b) **Normal main rotor low pitch limits (power-off)**. It must be shown, with power-off, that:

1) the normal main rotor low pitch limit provides sufficient rotor speed, in any autorotative condition, under the most critical combinations of weight and airspeed; and

2) it is possible to prevent overspeeding of the rotor without exceptional piloting skill.

c) **Main rotor low speed warning**. There must be a main rotor low speed warning which meets the following requirements:

1) The warning must be furnished to the pilot in all flight conditions, including power-on and power-off flight, when the speed of the main rotor approaches a value that can jeopardise safe flight.

2) The warning may be furnished either through the inherent aerodynamic qualities of the helicopter or by a device.

3) The warning must be clear and distinct under all conditions, and must be clearly distinguishable from all other warnings. A visual device that requires the attention of the crew within the cockpit is not acceptable by itself.

4) If a warning device is used, the device must automatically de-activate and reset when the low-speed condition is corrected.

Performance

VLH 45 General

a) Unless otherwise prescribed the performance requirements in this Sub-Section B must be determined:

1) with normal piloting skill under average conditions; and

2) for still air in the standard atmosphere.

b) The performance must correspond to the engine power available under the particular ambient atmospheric conditions and the particular flight condition:

1) at the most critical weight;

2) with the most unfavourable centre-of-gravity for each condition; and

3) using engine power not in excess of the maximum declared for the engine type, and without exceeding powerplant and rotor limitations established under VLH 1521.

VLH 51 Take-off

a) The take-off, with take-off power and rpm:

1) must not require exceptional piloting skill or exceptionally favourable conditions; and

2) must be made in such a manner that a landing can be made and demonstrated safely at any point along the flight path if the engine fails.

b) Sub-paragraph a) of this paragraph must be met at weights up to the maximum for which certification is sought and throughout the range of altitude, from sea-level conditions to the maximum altitude for which certification is sought.

VLH 65 Climb

a) Each helicopter must meet the following requirements:

1) V_Y must be determined:

i) for standard sea-level conditions;

ii) at maximum weight; and

iii) with maximum continuous power.

2) The steady rate of climb must be determined:

i) at V_Y;

ii) corrected for standard sea level conditions within the range from sea-level up to the maximum altitude for which certification is requested;

iii) at the maximum weight; and

iv) with maximum continuous power.

VLH 71 Glide performance

The minimum rate of descent airspeed and the best angle-of-glide airspeed must be determined in autorotation at maximum weight.

VLH 73 Performance at minimum operating speed

The hovering ceiling must be determined over the ranges of weight, altitude, and temperature for which certification is requested, with:

a) take-off power; and

b) the helicopter in ground effect at a height consistent with normal take-off procedures.

VLH 75 Landing

a) The helicopter must be able to be landed with no excessive vertical acceleration, and no tendency to: bounce, nose over, ground loop, porpoise or water loop, and without requiring exceptional piloting skill or exceptionally favourable conditions, with:

1) approach speeds selected by the applicant; and

2) the approach and landing made:

i) with power-on; and

ii) in autorotation with power-off.

VLH 79 Limiting height-speed envelope

If there is any combination of height and forward speed (including hover) under which a safe landing cannot be made following a sudden and complete loss of power, a limiting height-speed envelope must be established (including all pertinent information) for that condition throughout the range of:

a) altitude from standard sea-level conditions to the maximum altitude for which certification is sought; and

b) weight, up to the maximum for which certification is sought.

Flight Characteristics

VLH 141 General

The helicopter must:

a) except as specifically required in the applicable section, meet the flight characteristics requirements of this Sub-Section:

1) at the altitudes and temperatures expected in operation;

2) under any critical loading condition within the range of weights and centres-of-gravity for which certification is requested;

3) for power-on operations, under any condition of speed, power, and rotor rpm for which certification is requested; and

4) for power-off operations, under any condition of speed and rotor rpm for which certification is requested.

b) be able to maintain any required flight condition and make a smooth transition from one flight condition to another without exceptional piloting skill, alertness or strength, and without danger of exceeding the limit manoeuvering 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. Likely variations from any recommended techniques must not cause unsafe flight conditions.

VLH 143 Controllability and manoeuvrability

a) The helicopter must be safely controllable and manoeuvrable:

1) during steady flight; and

2) during any manoeuvre appropriate to the type, including:

i) take-off;

ii) climb;

iii) level flight;

iv) turning flight;

v) autorotation;

vi) landing (power-on and power-off); and

vii) recovery to power-on flight from a balked autorotative approach.

NOTE: See also VLH 141 b).

b) The margin of cyclic control must allow satisfactory roll and pitch control at V_{NE} with:

1) critical weight;

2) critical centre-of-gravity;

3) critical rotor rpm; and

4) power-on and power-off.

c) A wind velocity of not less than 17 knots must be established in which the helicopter can be operated without loss of control on or near the ground in any manoeuvre appropriate to the type (such as crosswind take-offs, sideward flight, and rearward flight), with:

1) critical weight;

2) critical centre-of-gravity;

3) critical rotor rpm; and

4) altitude, from standard sea-level conditions to the maximum altitude for which certification is sought.

d) The helicopter, after complete engine failure, must be controllable over the range of speeds and altitudes for which certification is requested, when such power failure occurs with maximum continuous power and critical weight. No corrective action time delay for any condition following power failure may be less than:

1) For the cruise condition, one second, or normal pilot reaction time (whichever is greater); and

2) For any other condition, normal pilot reaction time.

e) For helicopters for which a V_{NE} (power-off) is established under VLH 1505 c), compliance must be demonstrated with the following requirements with critical rotor rpm:

1) The helicopter must be safely slowed to V_{NE} (power-off), without exceptional pilot skill, after the engine is made inoperative at power-on V_{NE};

2) At a speed of 1·1 V_{NE} (power-off), the margin of cyclic control must allow satisfactory roll and pitch control with power-off.

VLH 151 Flight controls

a) Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.

b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.

VLH 161 Trim control

The trim control (if fitted):

a) must trim any steady control forces to a level that will allow the maintenance of any steady flight condition without the need for exceptional piloting skill, alertness or strength; and

b) may not introduce any undesirable discontinuities in control force gradients.

Stability

VLH 171 Stability: general

The helicopter must be able to be flown, without undue pilot fatigue or strain, in any normal manoeuvre for a period of time as long as that expected in normal operation. At least three take-offs and landings must be made during this demonstration.

VLH 173 Static longitudinal stability

a) The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

b) With the throttle and collective pitch held constant during the manoeuvres specified in VLH 175 a) to c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.

c) During manoeuvre specified in VLH 175 d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10% of the total control travel.

VLH 175 Demonstration of static longitudinal stability

a) **Climb**. Static longitudinal stability must be shown in the climb condition at speeds from 0·85 V_Y to 1·2 V_Y, with:

1) critical weight;

2) critical centre-of-gravity;

3) maximum continuous power; and

4) the helicopter trimmed at V_Y.

b) **Cruise**. Static longitudinal stability must be shown in the cruise condition at speeds from 0·7 V_H or 0·7 V_{NE}, whichever is less, to 1·1 V_H or 1·1 V_{NE}, whichever is less, with:

1) critical weight;

2) critical centre-of-gravity;

3) power for level flight at 0·9 V_H or 0·9 V_{NE}, whichever is less; and

4) the rotorcraft trimmed at 0·9 V_H or 0·9 V_{NE}, whichever is less.

c) **Autorotation**. Static longitudinal stability must be shown in autorotation at airspeeds from 0·5 times the speed for minimum rate of descent to V_{NE}, or to 1·1 V_{NE} (power-off) if V_{NE} (power-off) is established in VLH 1505 c), and with:

1) critical weight;

2) critical centre-of-gravity;

3) power-off; and

4) the helicopter trimmed at appropriate speeds found necessary by the CAA to demonstrate stability throughout the prescribed speed range.

d) **Hovering**. The longitudinal cyclic control must operate with the sense and direction of motion prescribed in VLH 173 between the maximum approved rearward speed and a forward speed of 17 knots with:

1) critical weight;

2) critical centre-of-gravity;

3) power required to maintain an approximate constant height in ground effect; and

4) the helicopter trimmed for hovering.

VLH 177 Static directional stability

Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in VLH 175 a) and b). This must be shown by steadily increasing directional control deflection for sideslip angles up to ±10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.

Ground and Water Handling Characteristics

VLH 231 General

The helicopter must have satisfactory ground and water handling characteristics, including freedom from uncontrolled tendencies in any condition expected in operation.

VLH 238 Wave and wind conditions

(See AMC VLH 238)

If certification for water operations is requested then the maximum wind and wave conditions for operations from a water surface must be established. It is the intention of this paragraph that the operation is from sheltered water courses exhibiting minimal surface motion.

VLH 239 Spray characteristics

If certification for water operation is requested, no spray characteristics during taxying, take-off, or landing may obscure the vision of the pilot or damage the rotors, or other parts of the helicopter.

VLH 241 Ground resonance

The helicopter may have no dangerous tendency to oscillate on the ground with the rotor turning.

Miscellaneous Flight Requirements

VLH 251 Vibration

Each part of the helicopter must be free from excessive vibration under each appropriate speed and power condition.

Sub-Section C Strength Requirements

General

VLH 301 Loads

(See AMC VLH 301)

a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

b) Unless otherwise provided, the air and ground loads must be placed in equilibrium with inertia loads, considering each major item of mass in the helicopter. These loads must be distributed so as to represent actual conditions or a conservative approximation to them.

c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

VLH 303 Factor of safety

Unless otherwise provided, a factor of safety of 1·5 must be used.

VLH 305 Strength and deformation

a) The structure and control systems must be able to support limit loads without permanent deformation. At any load up to limit loads, the deformation must not interfere with safe operation.

b) The structure must be able to support ultimate loads without failure for at least three seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

VLH 307 Proof of structure

a) Compliance with the strength and deformation requirements of VLH 305 must be shown for each critical load condition. Theoretical structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made. (See AMC VLH 307 a).)

b) Proof of compliance with the strength requirements of this Sub-Section must include:

1) dynamic and endurance tests of rotors, rotor drives, and rotor controls;

2) limit load tests of the control system, including control surfaces;

3) operation tests of the control system; and

4) landing gear drop tests.

NOTE: Evidence of safe/satisfactory service history of operation may, if acceptable to the CAA, be permitted as showing compliance with the intent of certain paragraphs of this BCAR VLH.

VLH 309 Design limitations

The following values and limitations must be established to show compliance with the structural requirements of this Sub-Section:

a) The design maximum weight.

b) The main rotor rpm ranges power-on and power-off.

c) The maximum forward speeds for each main rotor rpm within the ranges determined in sub-paragraph b) of this paragraph.

d) The maximum rearward and sideward flight speeds.

e) The centre-of-gravity limits corresponding to the limitations determined in sub-paragraphs b), c), and d) of this paragraph.

f) The rotational speed ratios between the engine and each connected rotating component.

g) The positive and negative limit manoeuvring load factors.

Flight Loads

VLH 321 General

a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the flight path of the helicopter) to the weight of the helicopter. A positive flight load factor is one in which the aerodynamic force acts upward, with respect to the helicopter.

b) Compliance with the flight load requirements of this Sub-Section must be shown:

1) at each weight from the design minimum weight to the design maximum weight; and

2) with any practical distribution of disposable load within the operating limitations in the Pilot's Handbook.

VLH 337 Limit manoeuvring load factor

(See AMC VLH 337)

The helicopter must be designed for a limit manoeuvring load factor ranging from a positive limit of 3·5 to a negative limit of -1·0.

VLH 339 Resultant limit manoeuvring loads

The loads resulting from the application of limit manoeuvring load factors are assumed to act at the centre of each rotor hub, and to act in directions, so as to represent each critical manoeuvring condition.

VLH 341 Gust loads

The helicopter must be designed to withstand, at each critical airspeed including hovering, the loads resulting from a vertical gust of 9·1 metres per second (30ft/s).

VLH 351 Yawing conditions

a) Each helicopter must be designed for the loads resulting from the manoeuvres specified in sub-paragraphs b) and c) of this paragraph with:

1) unbalanced aerodynamic moments about the centre-of-gravity which the helicopter reacts to in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces; and

2) maximum main rotor speed.

b) To produce the load required in sub-paragraph a) of this paragraph, in unaccelerated flight with zero yaw, at forward speeds from zero up to 0·6 V_{NE}:

1) displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the pilot force specified in VLH 397 a);

2) attain a resulting sideslip angle or 90°, whichever is less; and

3) return the directional control suddenly to neutral.

c) To produce the load required in sub-paragraph a) of this paragraph, in unaccelerated flight with zero yaw, at forward speeds from 0·6 V_{NE} up to V_{NE} or V_H, whichever is less:

1) displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the pilot force specified in VLH 397.

2) with the cockpit directional control deflected as specified in sub-paragraph 1) of this paragraph it is assumed the rotorcraft yaws to the overswing side-slip angle. In lieu of a rational analysis, an overswing angle equal to 1·5 times the static sideslip angle of sub-paragraph 3) of this paragraph may be assumed.

3) with the cockpit directional control deflected as specified in sub-paragraph 1) of this paragraph it is assumed the rotorcraft returns to a static sideslip angle. With the rotorcraft stabilised at this sideslip angle the directional control is suddenly returned to neutral.

4) in the absence of a rational calculation supporting lower values, the following static sideslip angle must be assumed:

i) at the lesser speed of V_{NE} or V_H a static sideslip angle of 15°;

ii) at 0·6 V_{NE} a static sideslip angle of 90°; and

iii) at speeds between V_{NE} and V_H, which ever is less, and 0·6 V_{NE} the static sideslip angle must be assumed to vary directly with speed.

VLH 361 Engine torque

a) The engine mount and its supporting structure must be designed for the effects of:

1) the limit torque corresponding to take-off power and rotor speed, acting simultaneously with 75% of the limit loads of VLH 337; and

2) the limit torque corresponding to the maximum continuous power and rotor speed, acting simultaneously with the limit loads of VLH 337.

b) The limit torque to be accounted for in VLH 361 a) and VLH 547 d) is obtained by multiplying the mean torque by the appropriate factor from the following table:

Table 1

Engine	Two stroke			Four stroke				
Cylinder	1	2	3 or more	1	2	3	4	5 or more
Factor	6	3	2	8	4	3	2	1.33

VLH 363 Side load on engine mount

a) The engine mount and its supporting structure must be designed for a limit load factor in a lateral direction, for the side load on the engine mount, of not less than one third of the limit load factor of VLH 337.

b) The side load prescribed in a) may be assumed to be independent of other flight conditions.

Control Surfaces and System Loads

VLH 391 General

Each auxiliary rotor, each stabilising surface, and each system operating any flight control must meet the requirements of VLH 395, 397, 399, 411 and 427.

VLH 395 Control system

Each primary flight control system, including its supporting structure, must be designed to withstand loads resulting from the limit pilot forces prescribed in VLH 397.

VLH 397 Limit pilot forces

For primary flight controls the limit pilot forces are as follows:

a) for foot controls, 580N (130 lbf);

b) for stick controls:

1) 450N (100 lbf) fore-and-aft, and vertically; and

2) 300N (67 lbf) laterally; and

c) for twist controls, 356.R Ncm (radius in cm) (80.R lbf in (radius in inches)). (Where R = twist grip radius.)

VLH 399 Dual control systems

Dual control systems must be designed to withstand the loads that result when each pilot applies 0·75 times the load specified in VLH 397, with

a) the pilots acting together in the same direction; and

b) the pilots acting in opposition.

VLH 405 Secondary control systems

(See AMC VLH 405)

Secondary control systems such as those for brakes, trim controls etc., must be designed to withstand the maximum forces that a pilot is likely to apply to those controls.

VLH 411 Ground clearance: tail rotor guard

a) It must be impossible for the tail rotor to contact the landing surface during a normal landing.

b) If a tail rotor guard is required to show compliance with sub-paragraph a) of this paragraph:

1) suitable design loads must be established for the guard; and

2) the guard and its supporting structure must be designed to withstand those loads.

Ground Loads

VLH 427 Unsymmetrical loads

a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and rotor wake effects in combination with the prescribed flight conditions.

b) To meet the design criteria of sub-paragraph a) of this paragraph, in the absence of more rational data, both of the following must be met:

1) 100% of the maximum loading from the symmetrical flight conditions acts on the surface on one side of the plane of symmetry and no loading acts on the other side.

2) 50% of the maximum loading from the symmetrical flight conditions acts on the surface on each side of the plane of symmetry but in opposite directions.

c) For empennage arrangements where the horizontal tail surfaces are supported by the vertical tail surfaces, the vertical tail surfaces and supporting structure must be designed for the combined vertical horizontal surface loads resulting from each prescribed flight condition, considered separately. The flight conditions must be selected so the maximum design loads are obtained on each surface. In the absence of more rational data, the unsymmetrical horizontal tail surface loading distributions described in this paragraph must be assumed.

VLH 471 General

a) The limit ground loads specified in this Sub-Section are considered to be external loads that act upon a helicopter structure. In each specified landing condition, the external reactions must be placed in equilibrium by the linear and angular inertia forces in a rational or conservative manner.

b) The critical centres-of-gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

VLH 473 Ground loading conditions and assumptions

a) For specified landing conditions, the maximum weight must be used. The rotor lift may be assumed to act through the centre-of-gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight.

b) Unless otherwise prescribed, for each specified landing condition, the helicopter must be designed for a limit load factor of not less than the limit inertia load factor substantiated in VLH 725.

VLH 475 Shock absorbers

Unless otherwise prescribed, for each specified landing condition, the shock absorbers, if installed, must be assumed to be in their most critical position.

VLH 501 Ground loading conditions

a) The helicopter must be designed for the loading conditions specified in this paragraph. In showing compliance with this paragraph, the following apply:

1) The design maximum weight, centre-of-gravity, and load factor must be determined as in VLH 471 to 475.

2) Structural yielding of elastic spring members under limit loads is acceptable.

3) Design ultimate loads for elastic spring members need not exceed those obtained in a drop test of the gear with:

i) a drop height of 1·5 times that specified in VLH 725; and

ii) an assumed rotor lift of not more than 1·5 times that used in the limit drop tests prescribed in VLH 725.

4) Compliance with sub-paragraphs b) to e) of this paragraph must be shown with:

i) the skid gear in its most critically deflected position for the landing condition being considered; and

ii) the ground reactions rationally distributed along the bottom of the skid tube.

b) **Vertical reactions in the level landing attitude**. In the level attitude, and with the helicopter contacting the ground along the bottom of both skids, the vertical reactions must be applied as prescribed in sub-paragraph a) of this paragraph.

c) **Drag reactions in the level landing attitude**. In the level attitude, and with the helicopter contacting the ground along the bottom of both skids, the following apply:

1) The vertical reactions must be combined with horizontal drag reactions of 50% of the vertical reaction applied at the ground.

2) The resultant ground loads must equal the vertical load specified in sub-paragraph b) of this paragraph.

d) **Sideloads in the level landing attitude**. In the level attitude, and with the helicopter contacting the ground along the bottom of both skids, the following apply:

1) The vertical ground reaction must be:

i) equal to the vertical loads obtained in the condition specified in sub-paragraph b) of this paragraph; and

ii) divided equally among the skids.

2) The vertical ground reactions must be combined with a horizontal sideload of 25% of their value.

3) The total sideload must be applied equally between the skids and along the length of the skids.

4) The unbalanced moments are assumed to be resisted by angular inertia.

5) The skid gear must be investigated for:

i) inward acting sideloads; and

ii) outward acting sideloads.

e) **One-skid landing loads in the level attitude**. In the level attitude, and with the helicopter contacting the ground along the bottom of one skid only, the following apply:

1) The vertical load on the ground contact side must be the same as that obtained on that side in the condition specified in sub-paragraph b) of this paragraph.

2) The unbalanced moments are assumed to be resisted by angular inertia.

f) **Special conditions**. In addition to the conditions specified in sub-paragraphs b) and c) of this paragraph, the helicopter must be designed for the following ground reactions:

1) A ground reaction load acting up and aft at an angle of 45° to the longitudinal axis of the helicopter. This load must be:

i) equal to 1·33 times the maximum weight;

ii) distributed symmetrically among the skids;

iii) concentrated at the forward end of the straight part of the skid tube; and

iv) applied only to the forward end of the skid tube and its attachment to the helicopter.

2) With the helicopter in the level landing attitude, a vertical ground reaction load equal to one-half of the vertical load determined in sub-paragraph b) of this paragraph. This load must be:

i) applied only to the skid tube and its attachment to the helicopter; and

ii) distributed equally over 33·3% of the length between the skid tube attachments and centrally located midway between the skid tube attachments.

VLH 505 Ski landing conditions

If certification for ski operation is requested, the helicopter, with skis, must be designed to withstand the following loading conditions (where P is the maximum static weight on each ski with the helicopter at design maximum weight, and n is the limit load factor determined in VLH 473 b)).

a) Up-load conditions in which:

1) a vertical load of Pn and a horizontal load of Pn/4 are simultaneously applied at the pedestal bearings; and

2) a vertical load of 1·33 P is applied at the pedestal bearings.

b) A side-load condition in which a side load of 0·35 Pn is applied at the pedestal bearings in a horizontal plane perpendicular to the centreline of the helicopter.

c) A torque-load condition in which a torque-load of 1·33P (in lbf ft) is applied to the ski about the vertical axis through the centreline of the pedestal bearings.

Water Loads

VLH 521 Float landing conditions

If certification for float operation is requested, the helicopter, with floats, must be designed to withstand the following loading conditions (where the limit load factor is assumed to be equal to that determined for skid landing gear):

a) Up-load conditions in which:

1) a load is applied so that, with the helicopter in the static level attitude, the resultant water reaction passes vertically through the centre-of-gravity; and

2) the vertical load prescribed in sub-paragraph a) 1) of this paragraph is applied simultaneously with an aft component of 0·25 times the vertical component.

b) A side-load condition in which:

1) a vertical load of 0·75 times the total vertical load specified in sub-paragraph a) 1) of this paragraph is divided equally among the floats; and

2) for each float, the load share determined in sub-paragraph b) 1) of this paragraph, combined with a total side load of 0·25 times the total vertical load specified in sub-paragraph b) 1) of this paragraph, is applied to the float only.

Main Component Requirements

VLH 547 Main rotor structure

a) Each main rotor assembly (including rotor hubs and blades) must be designed as prescribed in this paragraph.

b) The main rotor structure must be designed to withstand the following loads prescribed in VLH 337 to 341:

1) Critical flight loads.

2) Limit loads occurring under normal conditions of autorotation. For this condition, the rotor rpm must be selected to include the effects of altitude.

c) The main rotor structure must be designed to withstand loads simulating:

1) for the rotor blades, hubs, and flapping hinges, the impact force of each blade against its stop during ground operation (see AMC VLH 547 c) 1)); and

2) any other critical condition expected in normal operation.

d) The main rotor structure must be designed to withstand the limit torque at any rotational speed, including zero. In addition:

1) the limit torque need not be greater than the torque defined by a torque limiting device (where provided), and may not be less than the greater of:

   i) the maximum torque likely to be transmitted to the rotor structure in either direction; and

   ii) the limit engine torque specified in VLH 361.

2) the limit torque must be distributed to the rotor blades in a rational manner.

Emergency Landing Conditions

VLH 561 General

a) The helicopter, although it may be damaged in emergency landing conditions, must be designed as prescribed in this paragraph to protect each occupant under those conditions.

b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a crash landing when proper use is made of belts and harnesses provided for in the design, in the following conditions:

Each occupant experiences ultimate inertial forces corresponding to the following load factors:

Table 2

Direction	Load Factor
Upward	-4.0
Forward	-9.0
Sideward	-3.0
Downward	-4.5

These forces are independent of each other and are relative to the surrounding structure.

c) The supporting structure must be designed to restrain, under loads up to those specified in sub-paragraph b) of this paragraph, each item of mass that could injure an occupant if it came loose in a minor crash landing.

d) For a helicopter with the engine located behind an occupants seat, the engine mounting structure must be able to restrain the engine, transmission and any other items supported by the engine mounting structure, when they experience an ultimate inertial force in the forward direction corresponding to a load factor of 15. (See AMC VLH 561 d).)

e) Fuel tanks, fuel lines, oil tanks and oil lines must be capable of retaining their contents under the inertial forces of b) without rupture.

VLH 563 Structural ditching provisions

(See AMC VLH 563)

If certification with fixed flotation gear is requested, then the structural strength for ditching must meet the requirements of this paragraph and VLH 801 d).

a) **Forward speed landing conditions**. The helicopter must initially contact the most critical wave for reasonably probable water conditions at forward velocities from zero up to 30 knots in likely pitch, roll and yaw attitudes. The helicopter limit vertical descent velocity may not be less than 1·52m (5 feet) per second relative to the mean water surface. Rotor lift may be used to act through the centre-of-gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight. A maximum forward velocity of less than 30 knots may be used in design if it can be demonstrated that the forward velocity selected would not be exceeded in a normal engine-out touchdown.

b) **Auxiliary float conditions**. In addition to the landing loads in sub-paragraph a) of this paragraph, each auxiliary float, or its support and attaching structure in the airframe or fuselage, must be designed for the load developed by a fully immersed float unless it can be shown that full immersion is unlikely. If full immersion is unlikely, the highest likely float buoyancy load must be applied. The highest likely buoyancy load must include consideration of a partially immersed float creating restoring moments to compensate the upsetting moments caused by sidewind, unsymmetrical helicopter loading, water wave action, helicopter inertia and probable structural damage and leakage considered under VLH 801 d). Maximum roll and pitch angles determined from compliance with VLH 801 d) may be used, if significant, to determine the extent of immersion of each float.

Fatigue Evaluation

VLH 571 Fatigue strength

(See AMC VLH 571)

a) The detail design of the blades and hub and other parts of the primary structure and control systems of the helicopter shall be such that, as far as reasonably practicable, features that cause high stresses are avoided, unless it can be shown that parts of a similar design, specification and use operating at similar stress levels have accumulated considerable satisfactory service experience.

b) With the exception of the rotor hub spindle, bolts or threaded parts shall not be used in the construction of the rotor hub or blades in any application where they are subject to an alternating tensile stress, unless it can be shown that parts of a similar design, specification and use operating at similar stress levels have had considerable satisfactory service experience.

c) Fatigue testing of the rotor hub spindle, together with its associated nuts, washers and bearing surfaces, shall have an ultimate reserve factor in excess of 10.

d) Materials known to have poor crack propagation properties shall not be used in any part of the primary structure.

e) All parts of the primary structure shall be easily accessible for inspection.

f) Flexible paints or coatings shall not be used on the external surfaces of the primary structure.

Other Loads

VLH 597 Loads from single masses

The attachment means for all single masses, which are part of the equipment of the helicopter, including ballast, must be designed to withstand loads corresponding to the maximum design load factors to be expected from the established flight and ground loads, including the emergency landing conditions of VLH 561.

Sub-Section D Design and Construction

VLH 601 General

a) The helicopter may have no design features or details that experience has shown to be hazardous or unreliable.

b) The suitability of each questionable design detail and part must be established by tests.

VLH 602 Critical parts

(See AMC VLH 602)

Critical parts must be subject to a critical parts plan.

VLH 603 Materials

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must:

a) be established by experience or tests; and

b) meet specifications that ensure their having the strength and other properties assumed in the design data. (See AMC VLH 603 b).)

VLH 605 Fabrication methods

The methods of fabrication used must produce consistently sound structures which must be reliable with respect to maintaining the original strength under reasonable service conditions. If a fabrication process (such as gluing, spot welding, heat treating, or processing of non-metallic materials) requires close control to reach this objective, the process must be performed under a defined process specification. Unconventional methods of fabrication must be substantiated by adequate tests.

VLH 607 Locking of connections

An acceptable means of locking must be provided on all connecting elements in the primary structure and in control and other mechanical systems which are essential to safe operation of the helicopter. In particular self-locking nuts must not be used on any bolt subject to rotation in operation, unless a non-friction locking device is used in addition to the self-locking device.

VLH 609 Protection of structure

Each part of the structure must:

a) be suitably protected against deterioration or loss of strength in service due to any cause, including:

   1) weathering;

   2) corrosion;

   3) abrasion; and

b) have adequate provisions for ventilation and drainage.

VLH 611 Inspection

Means must be provided to allow inspection (including inspection of principal static and rotating structural elements and control systems), close examination, repair and replacement of each part requiring periodic inspection, maintenance, adjustments for proper alignment and function, lubrication or servicing.

VLH 612 Provisions for rigging and de-rigging

The design must be such that where any rigging and de-rigging may be expected to be carried out on a routine basis, the probability of damage or incorrect assembly is minimised. It must be possible to inspect the helicopter easily for correct assembly.

VLH 613 Material strength properties and design values

a) The design values must be chosen so that the probability of any structure being under strength because of material variations is extremely remote. (See AMC VLH 613 a).)

b) The strength, detail design, and fabrication of the structure must minimise the probability of disastrous fatigue failure, particularly at points of stress concentration.

c) Where the temperature attained in an essential component or structure in normal operating conditions has a significant effect on strength, that effect must be taken into account. (See AMC VLH 613 c).)

VLH 619 Special factors

a) The factor of safety prescribed in VLH 303 must be multiplied by appropriate combinations of the special factors prescribed in VLH 619 b), VLH 621 to VLH 626, and VLH 693. (See AMC VLH 619 a).)

b) For each part of the structure not covered by VLH 621 to VLH 625 but whose strength is:

1) uncertain;

2) likely to deteriorate in service before normal replacement; or

3) subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods;

the special factor must be chosen so that failure of the part due to inadequate strength is improbable.

VLH 621 Casting factors

For castings, the strength of which is substantiated by at least one static test and which are inspected by visual methods, a casting factor of 2·0 must be applied. This factor may be reduced to 1·25 providing the reduction is substantiated by tests on not less than three sample castings and if these and all production castings are subjected to an accepted visual and radiographic inspection or an approved equivalent non-destructive inspection method.

VLH 623 Bearing factors

The factor of safety for bearing loads at bolted or pinned joints must be multiplied by a special factor of 2·0 to provide for:

a) relative motion in operation; and

b) joints with clearance (free fit) subject to pounding and/or vibration.

VLH 625 Fitting factors

For each fitting (a part or terminal used to join one structural member to another), the following apply:

a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1·15 must be applied to each part of:

   1) the fitting;

   2) the means of attachment; and

   3) the bearing on the joined members.

b) No fitting factor need be used for joint designs based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood).

c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

d) Local attachments in the load path between the safety belt or harness and the main helicopter structure must be shown by analysis, test, or both, to have at least the strength necessary for 1·33 times the loads corresponding to the emergency alighting inertia loads of VLH 561.

VLH 626 Cable factor

(See AMC VLH 626)

An ultimate factor of safety of 2·0 on nominal cable strength must be applied to cables used for structural applications and for all primary control systems.

VLH 629 Flutter prevention and structural stiffness

Each major part of the helicopter must be free from flutter and resonance under each appropriate speed and power condition, and this must be demonstrated by flight tests at speeds up to V_{DF}.

Control Surfaces and Rotors

VLH 653 Drainage

a) For each rotor blade:

   1) there must be a means for venting the internal pressure of the blade;

   2) drainage holes must be provided for the blade; and

   3) the blade must be designed to prevent water from becoming trapped in it.

b) Sub-paragraphs a) 1) and 2) of this paragraph do not apply to sealed blades capable of withstanding the maximum pressure differentials expected in service.

VLH 659 Mass balance

a) The rotors and blades must be mass balanced as necessary to:

1) prevent excessive vibration; and

2) prevent flutter at any speed up to the maximum forward speed.

b) The structural integrity of the mass balance installation must be substantiated.

VLH 661 Rotor-blade clearance

(See AMC VLH 661)

There must be enough clearance between the rotor blades and other parts of the structure to prevent the blades from striking any part of the structure, or passing through any area likely to cause injury to occupants during any operating condition.

VLH 663 Ground resonance prevention means

a) The reliability of the means for preventing ground resonance must be shown either by analysis and tests, or reliable service experience, or by showing through analysis or tests that malfunction or failure of a single means will not cause ground resonance.

b) The probable range of variations, during service, of the damping action of the ground resonance prevention means, must be established and must be investigated during the test required by VLH 241.

VLH 665 Rotor-hub bearings

All rotor-hub bearings must have their suitability established by experience or tests.

Control Systems

VLH 671 General

a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimise the probability of any incorrect assembly that could result in the malfunction of the system.

VLH 673 Primary flight control

a) Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the helicopter.

b) The design of the primary flight controls must be such as to minimise the likelihood of failure of any connecting or transmitting element in the control system that could result in loss of control of any axis.

VLH 675 Stops

a) Each control system must have stops that positively limit the range of motion of the pilot's controls.

b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely effect the control characteristics of the helicopter because of a change in the range of travel of the control.

c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

d) For each main rotor blade, stops that are appropriate to the blade design must be provided to limit travel of the blade about its hinge points and there must be means to keep the blade from hitting the droop stops during any operation other than starting and stopping the rotor.

VLH 679 Control system locks

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

a) give unmistakable warning to the pilot when the lock is engaged; and

b) prevent the lock from engaging in flight.

VLH 681 Limit load static tests

a) Compliance with the limit load requirements must be shown by tests in which:

1) the direction of the test loads produces the most severe loading in the control system; and

2) each fitting, pulley, and bracket used in attaching the system to the main structure is included.

b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

VLH 683 Operation tests

It must be shown by functional tests that the system designed to the loads specified in VLH 397 is free from:

a) jamming;

b) excessive friction; and

c) excessive deformation;

when operating the controls from the cockpit.

VLH 685 Control system details

a) Each detail of each control system must be designed and installed to prevent jamming, chafing and interference from baggage, passengers, loose objects, or the freezing of moisture.

b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system. (See AMC VLH 685 b).)

c) There must be means to prevent the slapping of cables, tubes, or rods against other parts.

VLH 687 Spring devices

The reliability of any spring device used in the control system must be established by tests simulating service conditions unless failure of the spring will not cause flutter or unsafe flight characteristics.

VLH 689 Cable systems

a) Each cable, cable fitting, turnbuckle, splice, and pulley used must meet stated specifications. In addition:

   1) no cable smaller than 2mm diameter may be used in primary control systems;

   2) each cable system must be designed so that there will be no hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations; and

   3) there must be means for visual inspection at each fairlead, pulley, terminal and turnbuckle.

b) Each kind and size of pulley must correspond to the cable with which it is used. Each pulley must have closely fitted guards to prevent the cables from being misplaced or fouled, even when slack. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange. (See AMC VLH 689 b).)

c) Fairleads must be installed so that they do not cause a change in cable direction of more than 3°, except where tests or experience indicate that a higher value would be satisfactory. The radius of curvature of fairleads must not be smaller than the radius of a pulley for the same cable.

d) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.

VLH 691 Autorotation control mechanism

Each main rotor blade pitch control mechanism must allow rapid entry into autorotation after power failure.

VLH 693 Joints

Control system joints (in push-pull systems) that are subject to angular motion, except those in ball- and roller-bearing systems, must have a special factor of safety of not less than 3·33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2·0 for joints in cable-control systems. For ball- or roller-bearings, the approved ratings must not be exceeded.

Landing Gear

VLH 725 Limit drop test
(See AMC VLH 725)

A limit drop test must be conducted.

a) The drop height must be:

1) 330 mm (13 inches) from the lowest point of the landing gear to the ground; or

2) any lesser height, not less than 203 mm (8 inches), resulting in a drop contact velocity equal to the greatest probable sinking speed likely to occur at ground contact in normal power-off landings.

b) If considered, the rotor lift specified in VLH 473 a) must be introduced into the drop test by appropriate energy absorbing devices or by the use of an effective mass.

c) Each landing gear unit must be tested in the attitude simulating the landing condition that is most critical from the standpoint of the energy absorbed by it.

VLH 737 Skis

The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements.

Floats and Hulls

VLH 751 Main float buoyancy

a) For main floats, the buoyancy necessary to support the maximum weight of the helicopter in fresh water must be exceeded by:

1) 50%, for single floats; and

2) 60%, for multiple floats.

b) Each main float must have enough watertight compartments so that, with any single main float compartment flooded, the main floats will provide a margin of positive stability great enough to minimise the probability of capsizing.

VLH 753 Main float design

Each rigid float must be able to withstand the vertical, horizontal, and side loads prescribed in VLH 521. These loads may be distributed along the length of the float.

Personnel and Cargo Accommodations

VLH 771 Pilot compartment

For each pilot compartment:

a) the compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue;

b) if there is provision for a second pilot, the helicopter must be controllable with equal safety from either pilot seat; and

c) the vibration and noise characteristics of cockpit appurtenances must not interfere with safe operation.

VLH 773 Cockpit view

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 VLH 773 a));

b) if a windscreen is provided, rain does not unduly impair the pilot's view along the flight path in normal flight and during landing (see AMC VLH 773 b)); and

c) the pilot is easily able to establish a pitch attitude by reference to a fixed point of the airframe, when looking forward.

VLH 775 Windshields and windows

Windshields and windows, if fitted, must be constructed of a material that will not break into dangerous fragments or become opaque when damaged.

VLH 777 Cockpit controls

a) Each cockpit control must be located to provide convenient operation, and to prevent confusion and inadvertent operation.

b) The controls must be located and arranged so that each pilot, when properly secured by his safety harness, has full and unrestricted movement of each control. (See AMC VLH 777 b).)

c) In helicopters with dual controls, it must be possible to operate all essential controls from each of the two pilots seats.

d) Secondary controls must maintain any desired position without requiring constant attention by the pilot(s), and must not tend to creep under loads or vibration. Controls must have adequate strength to withstand operating loads without failure or excessive deflection.

VLH 779 Motion and effect of cockpit controls

Cockpit controls must be designed so that they operate in accordance with the following movements and actuation:

a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the helicopter.

b) Twist-grip engine power controls must be designed so that, 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. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.

VLH 783 Doors

a) Each closed cabin must have at least one adequate and easily accessible external door.

b) Each external door must be located where persons using it will not be endangered by the rotors, propellers, engine intakes and exhausts when appropriate operating procedures are used. If opening procedures are required, they must be marked inside, on or adjacent to, the door opening device.

VLH 785 Seats and safety harnesses

a) Each seat, harness, and adjacent part of the helicopter at each station designated for occupancy during take-off and landing must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the static inertial load factors specified in VLH 561 b).

b) Each seat and its supporting structure must be designed for an occupant weight in accordance with VLH 25 b) and for the maximum load factors corresponding to the specified flight and ground conditions, including the emergency landing conditions prescribed in VLH 561 b).

c) Seats, including cushions, must not deform under flight loads to such an extent that the pilot is unable to reach the controls safely, or that the wrong controls are operated.

d) The strength of the safety harness must not be less than that following from the ultimate loads for the flight- and ground-load conditions and for the emergency landing conditions according to VLH 561 b), taking into account the geometry of the harness and seat arrangement.

e) Each safety harness must be attached so that the wearer is safely retained in the initial sitting position under flight and emergency landing accelerations.

VLH 787 Baggage compartment

a) Each baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the flight- and ground-load conditions of this Section.

b) Means must be provided to protect occupants from injuries by movement of the contents of baggage compartments under the forward load factor specified in VLH 561 b).

VLH 801 Ditching

(See AMC VLH 801)

a) If certification with ditching provisions is requested, the helicopter must meet the requirements of this paragraph and VLH 807, 1411 and 1415.

b) Each practicable design measure, compatible with the general characteristics of the helicopter, must be taken to minimise the probability that in an emergency landing on water, the behaviour of the helicopter would cause immediate injury to the occupants or would make it impossible for them to escape.

c) The probable behaviour of the helicopter in a water landing must be investigated. (See AMC VLH 801 c).)

d) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behaviour of the helicopter in a water landing, the external doors and windows must be designed to withstand the probable maximum local pressures.

VLH 807 Emergency exit

a) The cockpit must be so designed as to provide occupants with unimpeded and rapid escape in an emergency.

b) Where the cockpit is enclosed, the opening system must be designed for simple and easy operation. It must function rapidly and be designed so that it can be operated by each occupant strapped in his/her seat and also from outside the cockpit. There must be reasonable provision to prevent jamming by fuselage deformation.

VLH 831 Ventilation

a) When there is an enclosed cockpit it must be designed so as to afford suitable ventilation under normal flying conditions to prevent the presence of excessive quantities of fuel fumes and carbon monoxide.

b) Carbon monoxide concentration must not exceed one part per 20,000 parts air.

Fire Protection

VLH 853 Compartment interiors

For the personnel compartment:

a) The materials must be at least flame-resistant.

b) If smoking is to be prohibited, there must be a placard stating so, and if smoking is to be allowed there must be an adequate number of self-contained removable ashtrays.

c) Lines, tanks or equipment containing fuel, oil, or other flammable fluids may not be installed in the personnel compartment unless adequately shielded, isolated, or otherwise protected so that any breakage or failure of such an item would not create a hazard.

VLH 855 Baggage compartments

a) Each baggage compartment must be constructed of, or lined with, materials that are at least:

1) flame-resistant, in the case of compartments that are readily accessible to a crew member in flight; and

2) fire-resistant, in the case of other compartments.

b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that:

1) they cannot be damaged by the movement of baggage in the compartment; and

2) their breakage or failure will not create a fire hazard.

VLH 857 Electrical bonding

a) Electrical continuity must be provided to prevent the existence of potential differences between components of the powerplant including fuel and other tanks, and other significant parts of the helicopter which are electrically conductive.

b) The cross-sectional areas of bonding connectors if made from copper must not be less than 1.3 mm^2.

c) There must be provisions for electrically bonding the helicopter to the ground fuelling equipment.

VLH 859 Heating systems

a) **General**. For each heating system that involves the passage of cabin air over, or close to, the exhaust manifold, there must be means to prevent carbon monoxide from entering any cabin or pilot compartment.

b) **Heat exchangers**. Each heat exchanger must be:

1) of suitable materials;

2) adequately cooled under all conditions; and

3) easily disassembled for inspection.

c) **Heater control**. There must be means to prevent the hazardous accumulation of water or ice on, or, in any heater control component, control system tubing, or safety control.

d) Each ventilating air intake must be located so that no flammable fluids or vapours can enter the heater system;

1) during normal operation; or

2) as a result of the malfunction of any other components.

VLH 861 Fire protection of structure, controls, and other parts

Flight controls, engine mounts, rotor mechanism and other flight structure located in the engine compartment must be constructed of fire-proof material or shielded so that they will withstand the effect of a fire.

VLH 863 Flammable fluid fire protection

In each area where flammable fluids or vapours might escape by leakage from a fluid system, there must be means in the form of adequate segregation, ventilation and drainage, to minimise the probability of ignition of the fluids and vapours and the resultant hazard if ignition should occur.

Miscellaneous

VLH 871 Levelling means

There must be means for determining when the helicopter is in a level position on the ground.

VLH 873 Ballast provisions

If provided, ballast provisions must be designed and constructed to prevent inadvertent shifting of ballast in flight.

Sub-Section E Powerplant

General

VLH 901 Installation

(See AMC VLH 901)

a) The powerplant installation shall be considered to include all components of the helicopter which are necessary for its propulsion with exception of the structure of the main and auxiliary rotors. It shall be considered to include all components which are necessary for the control of the major propulsive unit or which affect their safety of operation between normal inspection or overhaul periods.

b) For the powerplant installation:

1) all components of the powerplant installation shall be constructed, arranged, and installed, in a manner which will assure their continuing safe operation between normal inspections or overhaul periods;

2) accessibility shall be provided to permit such inspection and maintenance as is necessary to assure continued airworthiness; and

3) electrical interconnections shall be provided to prevent the existence of the differences of potential between major components of the powerplant installation and other portions of the helicopter.

VLH 903 Engine

a) Acceptable engines are Type Certificated Engines or engine types that have been accepted by the CAA as being appropriate for use in the class of helicopter to which this Section applies.

NOTE: Operational restrictions may be applied depending on the nature of the engine used.

b) The applicant must show that each selected engine in the helicopter, for which a Permit to Fly is sought, is compatible with the helicopter, functions in a satisfactory manner and can be operated safely within any limitations established under VLH 1505 and VLH 1521. (See AMC VLH 903 b).)

c) If an engine cooling fan is installed, means shall be provided to protect the helicopter from failure debris and to permit a safe landing in the event of a fan blade failure.

VLH 907 Engine vibration

The engine shall be installed so as to preclude harmful vibration of any of the engine parts or of any of the components of the helicopter. It shall also be demonstrated that no portion of the rotor drive system is subjected to excessive vibratory stresses.

VLH 909 Supercharger

a) The supercharger, if fitted, is considered to be an integral part of the engine and must be approved or accepted with that engine (see VLH 903 a)).

b) Control system malfunctions, vibrations and abnormal speeds and temperatures, expected in service may not damage the supercharger compressor or turbine.

c) The supercharger case must be able to contain fragments of a compressor or turbine that fails at the highest speed that is obtainable with normal speed control devices inoperative.

Rotor Drive System

VLH 917 Design

a) Each rotor drive system must incorporate a unit for each engine to automatically disengage that engine from the main and auxiliary rotors if that engine fails.

b) Each rotor drive system must be arranged so that each rotor necessary for control in autorotation will continue to be driven by the main rotors after disengagement of the engine from the main and auxiliary rotors.

c) The rotor drive system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gear boxes, shafting, universal joints, couplings, clutches, supporting bearings for shafting, any attendant accessory pads or drives and any cooling fans that are a part of, attached to, or mounted on the rotor drive system.

VLH 921 Rotor brake

If there is a means to control the rotation of the rotor drive system independently of the engine, any limitations on the use of that means must be specified, and the control for that means must be guarded to prevent inadvertent operation.

VLH 923 Rotor drive system and control mechanism qualification

a) Each rotor drive system and control mechanism must be shown to be satisfactory for its intended use. This must be shown by service experience, testing or a combination of both.

b) Where compliance is to be shown using service experience, verified evidence of satisfactory operation must be supplied, together with overhaul records for the power train (rotor and transmission) components. Records of all components which have failed to reach their overhaul lives must also be submitted for consideration. (See also VLH 923 c) 2)). (See AMC VLH 923 b).)

c) If a test programme is to be followed:

1) the test must be conducted on the helicopter, and the power must be absorbed by the rotors to be installed, except that other ground test facilities with other appropriate methods of power absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the helicopter;

2) the test must be conducted for not less than 50 hours for new designs. In the case of designs for which service experience exists, but it is in some respects inadequate to fulfil the requirements of sub-paragraph b) of this paragraph, a limited test programme must be implemented to make up for the shortfall in the service experience; and

3) each part tested must be in a serviceable condition at the end of the tests. No intervening disassembly which might affect test results may be conducted. (See AMC VLH 923 c).)

d) The overhaul lives of the rotor drive system components will be agreed with the CAA after submission of the test results and strip inspection detailed at AMC 923 c) paragraphs j) and k).

VLH 927 Additional tests

a) Any additional dynamic, endurance, and operational tests, and vibratory investigations necessary to determine that the rotor drive mechanism is safe, as agreed with the CAA, must be performed. (See AMC VLH 927 a).)

b) It must be shown by tests that the rotor drive system is capable of operating under autorotative conditions for 5 minutes after the loss of pressure in the rotor drive primary oil system.

VLH 928 Flight endurance test

(See AMC VLH 928)

a) It shall be confirmed by flight tests that the proposed powerplant, rotor drive and rotor system operating limitations are compatible with the satisfactory functioning of the system, over the proposed range of operating conditions and flight envelope.

b) The applicant shall conduct a 25 hour flight endurance test on a helicopter of the type for which a Permit to Fly is sought. The helicopter must not exhibit any significant problems or failures during the endurance test. This endurance test must be conducted to a flight schedule, which is representative of operational use and agreed in advance with the CAA.

VLH 931 Shafting critical speed

a) The critical speeds of any shafting must be determined by demonstration, except that analytical methods may be used if reliable methods of analysis are available for the particular design.

b) If any critical speed lies within, or close to, the operating ranges for idling, power-on, and autorotative conditions, the stresses occurring at that speed must be within safe limits. This must be shown by tests.

c) If analytical methods are used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.

VLH 935 Shafting joints

Each universal joint, slip joint, and other shafting joints whose lubrication is necessary for operation must have provision for lubrication.

Fuel System

VLH 951 General

a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine functioning under any normal operating condition.

b) Each fuel system must be arranged so that no fuel pump can draw fuel from more than one tank at a time. Gravity feed systems may not supply fuel to the engine from more than one tank at a time, unless the air spaces are interconnected in a manner to ensure that all interconnected tanks feed equally.

c) The fuel system must be arranged to minimise the occurrence of vapour locks and to prevent introducing air into the system.

VLH 955 Fuel flow

a) **General**. The ability of the fuel system to provide fuel at the rates specified in this paragraph and at a pressure sufficient for proper carburettor or fuel injector operation must be shown in the attitude that is most critical with respect to fuel feed and quantity of unusable fuel. These conditions may be simulated in a suitable mock-up. In addition:

   1) the quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under VLH 959 plus that necessary to show compliance with this paragraph; and

   2) if there is a fuel flowmeter, it must be blocked during the flow test and the fuel must flow through the meter bypass.

b) **Gravity systems**. The fuel flow rate for gravity systems (main and reserve supply) must be 150% of the take-off fuel consumption of the engine.

c) **Pump systems**. The fuel flow rate for each pump system (main and reserve supply) must be 125% of the take-off fuel consumption of the engine at the maximum power established for take-off. This flow rate is required for each primary engine-driven pump and each emergency pump, and must be available when the pump is running as it would during take-off.

NOTE: The fuel consumption quoted by the manufacturer may be for relatively low throttle openings, not the high power case applicable to this requirement.

d) **Multiple fuel tanks**. If the engine can be supplied with fuel from more than one tank, it must be possible, in level flight, to regain full power and fuel pressure to that engine in not more than 10 seconds after switching to any full tank after engine malfunctioning due to fuel depletion becomes apparent while the engine is being supplied from any other tank.

VLH 957 Flow between interconnected tanks

It must be impossible, in a gravity feed system with interconnected tank outlets, for enough fuel to flow between the tanks to cause an overflow of fuel from any tank vent under the conditions in VLH 959, except that full tanks must be used.

VLH 959 Unusable fuel supply

The unusable fuel supply for each tank must be established as not less than that quantity at which the first evidence of malfunctioning occurs under the most adverse fuel feed condition occurring under each intended operation and flight manoeuvre involving that tank. Fuel system component failures need not be considered.

VLH 961 Fuel system hot weather operation

Each fuel system must be free from vapour lock when using fuel at a temperature of 43°C under critical operating conditions, and with the most critical fuel for which certification is requested.

VLH 963 Fuel tanks: general

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

b) Each fuel tank must be provided with a filler cap designed to minimize the probability of incorrect installation or in-flight loss.

c) Where surging of fuel within the tank could cause significant changes in the centre-of-gravity of the helicopter, means must be provided to reduce the surging to within acceptable limits.

VLH 965 Fuel tank test

Each fuel tank must be able to withstand a pressure of 24 kPa (3½ psi) without failure or leakage.

VLH 967 Fuel tank installation

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. No part of the engine nacelle skin that lies immediately behind a major air opening from the engine compartment may act as the wall of an integral tank. (See AMC VLH 967 c).)

d) If a fuel tank is installed in the personnel compartment it must be isolated by fume and fuel-proof enclosures that are drained and vented to the exterior of the helicopter. A bladder type fuel cell, if used, must have a retaining shell at least equivalent to a metal fuel tank in structural integrity.

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 VLH 561, must not result in rupture of the fuel tank, fuel lines, or components.

VLH 969 Fuel tank expansion space

Each fuel tank must have an expansion space of not less than two percent of the tank capacity, unless the tank vent discharges clear of the helicopter (in which case no expansion space is required). It must be impossible to fill the expansion space inadvertently with the helicopter in the normal ground attitude.

VLH 971 Fuel tank sump

a) Each fuel tank, if permanently installed, 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:

   1) a fuel system sediment bowl or chamber that is accessible for drainage and has a capacity of 25 ml. must be fitted; and

   2) each fuel tank outlet must be located so that, in the normal ground attitude, water will drain from all parts of the tank to the sediment bowl or chamber.

b) The drainage system must be readily accessible and easy to drain.

c) Each fuel system drain must have manual or automatic means for positive locking in the closed position.

VLH 973 Fuel tank filler connection

a) Fuel tank filler connections must be located outside the cockpit. Spilled fuel must be prevented from entering the fuel tank compartment or any part of the helicopter other than the tank itself.

b) Each filler cap must provide a fuel-tight seal for the main filler opening. However, there may be small openings in the fuel tank cap for venting purposes or for the purpose of allowing passage of a fuel gauge through the cap.

VLH 975 Fuel tank vents and carburettor vapour vents

a) Each fuel tank must be vented from the top part of the expansion space. In addition:

   1) each vent outlet must be located and constructed in a manner that minimises the possibility of its being obstructed by ice or other foreign matter;

   2) each vent must be constructed to prevent siphoning of fuel during normal operation;

   3) the venting capacity must allow the rapid relief of excessive differences of pressure between the interior and exterior of the tank;

   4) airspaces of tanks with interconnected outlets must be interconnected; and

   5) there may be no undrainable points in any vent line where moisture can accumulate with the helicopter in either the ground or level flight attitudes;

6) no vent may terminate at a point where the discharge of fuel from the vent outlet will constitute a fire hazard or from which fumes may enter personnel compartments; and

7) vents must be arranged to prevent the loss of fuel, except fuel discharged because of thermal expansion, when the helicopter is parked in any direction on a ramp having a 1% slope.

b) The venting system must be designed to minimise spillage of fuel through the vents to an ignition source in the event of a rollover during landing, ground operation, or a survivable impact, unless a rollover is shown to be extremely improbable.

c) Each carburettor with vapour elimination connections and each fuel injection engine employing vapour return provisions must have a separate vent line to lead vapours back to the top of one of the fuel tanks. If there is more than one tank and it is necessary to use these tanks in a definite sequence for any reason, the vapour vent line must lead back to the fuel tank to be used first, unless the relative capacities of the tanks are such that return to another tank is preferable.

VLH 977 Fuel strainer or filter

a) There must be means to protect the engine from the likelihood of stoppage resulting from blockage of the fuel supply and from damage caused by debris in the fuel supply.

b) There must be a strainer at the outlet of each tank. This strainer must have at least 6 meshes per cm (15 meshes per inch), and must be of such proportions that blockage of the fuel supply by objects entering the tank will be extremely unlikely.

c) Each filter and each strainer must be easily accessible for draining and cleaning.

d) Non-metallic filter elements must be shown to be compatible with the type of fuel specified by the manufacturer. (See AMC VLH 977 d).)

Fuel System Components

VLH 991 Fuel pumps

a) **Main pump**. For the main pump, the following applies:

For an engine installation having fuel pumps to supply fuel to the engine, at least one pump must be directly driven by the engine and must meet VLH 955. This pump is a main pump.

b) **Emergency pump**. There must be an emergency pump immediately available to supply fuel to the engine if the main pump (other than a fuel injection pump approved as part of an engine) fails. The power supply for the emergency pump must be independent of the power supply for the main pump.

c) **Warning means**. If both the main pump and emergency pump operate continuously, there must be a means to indicate to the pilot a malfunction of either pump.

d) Operation of any fuel pump may not affect engine operation so as to create a hazard, regardless of the engine power or the functional status of any other fuel pump.

VLH 993 Fuel system lines and fittings

a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions. (See AMC VLH 993 a).)

b) Each fuel line connected to components, between which relative motion could exist, must have provisions for flexibility.

c) Each flexible hose must be shown to be suitable for the particular application.

d) Each fuel line and fitting in any area subject to engine fire conditions must be at least fire-resistant.

e) Leakage from any fuel line or connection must not impinge on hot surfaces or equipment which could cause a fire, nor fall directly onto any occupant.

f) Fuel line runs must be kept apart from electrical cables.

VLH 995 Fuel valves and controls

a) There must be a means to allow the pilot to shut off the fuel to the engine rapidly in flight.

b) The portion of the line between the fuel cock and the carburettor must be as short as possible.

c) No shut-off valve may be on the engine side of any firewall. In addition, there must be means to:

   1) guard against inadvertent operation of each shut-off valve; and

   2) allow the pilot to reopen each valve rapidly after it has been closed.

d) Each fuel cock must have either positive stops or effective detents in the 'ON' and 'OFF' positions.

e) Each check valve must be constructed, or otherwise incorporate provisions, to preclude incorrect assembly or connection of the valve.

f) Fuel tank selector valves must:

   1) require a separate and distinct action to place the selector in the 'OFF' position; and

   2) have the tank selector positions located in such a manner that it is impossible for the selector to pass through the 'OFF' position when changing from one tank to another.

VLH 999 Fuel system drains

A drain must be provided at the lowest point in each fuel system to completely drain the system when the helicopter is in any ground attitude to be expected in service. Each drain must discharge clear of all parts of the helicopter and have means for positive locking in the closed position.

Oil System

VLH 1011 General

a) If an engine is provided with an oil system, it must be capable of supplying the engine with an appropriate quantity of oil at a temperature not exceeding the maximum established as safe for continuous operation.

b) Each oil system must have a usable capacity adequate for the endurance of the helicopter.

c) If an engine depends upon a fuel/oil mixture for lubrication, then a reliable means of providing it with the appropriate mixture must be established. (See AMC VLH 1011 c).)

VLH 1013 Oil tanks

a) Each oil tank must be installed to:

1) meet the requirements of VLH 967 a), b), d) and e); and

2) withstand any vibration, inertia and fluid loads expected in normal operation. Compliance with this requirement may be shown by satisfactory completion of the endurance test of VLH 928.

b) The oil level must be easy to check without having to remove any cowling parts (with the exception of oil-tank access covers) or to use any tools.

c) If the oil tank is installed in the engine compartment, it must be made of fire-proof material.

VLH 1015 Oil tank test

Each oil tank must be able to withstand a pressure of 35 kPa (5 psi) without failure or leakage.

VLH 1017 Oil lines and fittings

a) Oil lines must comply with VLH 993 and must accommodate a flow of oil at a rate and pressure adequate for proper engine functioning, under any normal operating conditions.

b) Each oil line and fitting must be made of fire-resistant material.

c) Breather lines must be arranged so that:

1) condensed water vapour or oil that might freeze and obstruct the line cannot accumulate at any point;

2) the breather discharge will not constitute a fire hazard if foaming occurs, or cause emitted oil to strike the occupant(s) or the pilot's windshields; and

3) the breather does not discharge into the engine air-induction system.

VLH 1019 Oil strainer or filter

Each oil strainer or filter in the powerplant installation must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

VLH 1021 Oil system drains

A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must have means for positive locking in the closed position.

VLH 1023 Oil radiators

Each oil radiator and its supporting structures must be able to withstand the vibration, inertia, and oil pressure loads to which it would be subjected in operation.

VLH 1027 Transmissions and gearboxes: general

a) Pressure lubrication systems for transmissions and gearboxes must comply with the engine oil system requirements of VLH 1013, 1015, 1017, 1021 and 1337 d).

b) Each pressure lubrication system must have an oil strainer or filter through which all of the lubricant flows and must:

   1) be designed to remove from the lubricant any contaminant which may damage transmission and drive system components or impede the flow of lubricant to a hazardous degree;

   2) be equipped with a means to indicate collection of contaminants on the filter or strainer at or before opening of the bypass required by sub-paragraph b) 3) of this paragraph; and

   3) be equipped with a bypass constructed and installed so that:

      i) the lubricant will flow at the normal rate through the rest of the system with the strainer or filter completely blocked; and

      ii) the release of collected contaminants is minimised by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flowpath.

c) For each lubricant tank or sump outlet supplying lubrication to rotor drive systems and rotor drive system components, a screen must be provided to prevent entrance into the lubrication system of any object that might obstruct the flow of lubricant from the outlet to the filter required by sub-paragraph b) of this paragraph. The requirements of sub-paragraph b) do not apply to screens installed at lubricant tank or sump outlets.

d) Splash-type lubrication systems for rotor drive system gearboxes must comply with VLH 1021 and 1337 d).

Cooling

VLH 1041 General

The powerplant cooling provisions must be able to maintain the temperatures of powerplant components and engine fluids within the temperature limits established for such components and fluids under all surface (ground and water) and flight operating conditions.

VLH 1043 Cooling Tests

(See AMC VLH 1043)

a) Cooling tests must be carried out to show compliance with VLH 1041.

b) The test conditions selected must be the most adverse of operational and flight conditions anticipated.

c) The maximum anticipated air temperature is 38°C at sea level. If tests are conducted in conditions less than this the test results must be converted accordingly.

Liquid Cooling

VLH 1061 Installation

a) **General**. A liquid-cooled engine must have an independent cooling system (including coolant tank) installed.

b) The coolant tank must be installed to:

1) meet the requirements of VLH 967 a) and b) and VLH 1013 a) 2); and

2) ensure no air or vapour can be trapped in any part of the system, except the expansion tank, during filling or during operation.

c) Coolant tank

1) Each coolant tank must have an expansion space of at least 10% of the total cooling system capacity and it must be impossible to fill the expansion space inadvertently with the helicopter in the normal ground attitude.

2) Spilled coolant must be prevented from entering any part of the helicopter other than the tank itself and must be discharged clear of the helicopter.

d) **Lines and fittings**. Each coolant system line and fitting must meet the requirements of VLH 993 a), b) and c).

e) **Radiators**. Each coolant radiator must be able to withstand any vibration, inertia, and coolant pressure load to which it may normally be subjected. In addition:

1) each radiator must be supported to allow expansion due to operating temperatures and prevent the transmittal of harmful vibration to the radiator; and

2) if flammable coolant is used, the air intake duct to the coolant radiator must be located so that (in case of fire) flames from the nacelle cannot strike the radiator.

f) **Drains**. There must be an accessible drain that:

1) drains the entire cooling system (including the coolant tank, radiator and the engine) when the helicopter is in the normal ground attitude;

2) discharges clear of the entire helicopter; and

3) has means to positively lock it closed.

VLH 1063 Coolant tank tests

Each coolant tank must be tested under VLH 965, except that the test required by VLH 965 must be replaced with a similar test using the sum of a pressure of 24 kPa (3·5 psi), plus the maximum working pressure of the system.

Induction System

VLH 1091 Air induction

a) The air induction system must supply the air required by the engine under the operating conditions for which certification is requested. (See AMC VLH 1091 a).)

b) Primary air intakes may open within the cowling if that part of the cowling is isolated from the engine accessory section by a fire-resistant diaphragm or if there are means to prevent the emergence of backfire flames.

VLH 1093 Induction system icing protection

(See AMC VLH 1093)

The engine air induction system shall incorporate means for the prevention and elimination of ice accumulations unless it is demonstrated that this can be accomplished by other means.

VLH 1101 Carburettor air preheater design

Each carburettor air preheater must be designed and constructed to:

a) ensure ventilation of the preheater when the engine is operated in cold air;

b) allow inspection of the exhaust manifold parts that it surrounds; and

c) allow inspection of critical parts of the preheater itself.

VLH 1103 Induction system ducts

a) Each induction system duct must have a drain to prevent the accumulation of fuel or moisture in the normal ground and flight attitudes. No drain may discharge where it will cause a fire hazard.

b) Each duct connected to components between which relative motion could exist, must have means for flexibility.

VLH 1105 Induction system screens

If induction system screens are used:

a) each screen must be upstream of the carburettor;

b) if the screen is located in any part of the air induction system that is the only passage through which air can reach the engine, means must be furnished to avoid and eliminate formation of ice (see AMC VLH 1105 b)); and

c) it must be impossible for fuel to strike any screen.

Exhaust System

VLH 1121 General

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 fire-proof shields from adjacent flammable parts of the helicopter that are outside the engine compartment.

d) No exhaust gases may discharge dangerously near any fuel or oil system drain.

e) Each exhaust system component must be ventilated to prevent points of excessively high temperature.

f) Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.

VLH 1123 Exhaust manifold

a) Each exhaust manifold must be fire-proof and corrosion-resistant, and must have means to prevent failure due to expansion by operating temperatures.

b) Each exhaust manifold must be supported to withstand the vibration and inertia loads to which it may be subjected in operation.

c) Parts of the manifold connected to components between which relative motion could exist must have means for flexibility.

VLH 1125 Exhaust heat exchangers

a) Each exhaust heat exchanger must be constructed and installed to withstand the vibration, inertia, and other loads that it may be subjected to in normal operation. In addition:

1) each exchanger must be suitable for continued operation at high temperatures and resistant to corrosion from exhaust gases;

2) there must be means for inspection of critical parts of each exchanger; and

3) each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases.

b) Each heat exchanger used for heating ventilating air must be constructed so that exhaust gases may not enter the ventilating air.

Powerplant Controls and Accessories

VLH 1141 General

a) Each control must be able to maintain any necessary position without:

1) constant attention by the pilot; or

2) tendency to creep due to control loads or vibration.

b) Each control must be able to withstand operating loads without failure or excessive deflection.

c) The portion of each powerplant control located in the engine compartment that is required to be operated in the event of fire must be at least fire-resistant.

d) Powerplant valve controls located in the cockpit must have positive stops or in the case of fuel valves suitable index provisions, in the open and closed position.

VLH 1143 Engine controls

a) The power or supercharger control must give a positive and immediate responsive means of controlling its engine or supercharger.

b) If a power control incorporates a fuel shut-off feature, the control must have a means to prevent the inadvertent movement of the control into the shut-off position. The means must:

1) have a positive lock or stop at the idle position; and

2) require a separate and distinct operation to place the control in the shut-off position.

VLH 1145 Ignition switches

a) A switch must be provided to enable each ignition circuit to be rendered inoperative. (See AMC VLH 1145 a).)

b) Each ignition circuit must be independently switched, and must not require the operation of any other switch for it to be made operative.

c) Ignition switches must be arranged and designed to prevent inadvertent operation.

d) The ignition switch must not be used as the master switch for other circuits.

VLH 1147 Mixture control

The control must require a separate and distinct operation to move the control toward lean or shut-off position.

VLH 1163 Powerplant accessories

a) Each engine-driven accessory must:

1) be satisfactory for mounting on the engine concerned;

2) use the provisions on the engine for mounting; and

3) be sealed to prevent contamination of the engine oil system and the accessory system.

b) Electrical equipment subject to arcing or sparking must be installed to minimise the probability of contact with any flammable fluids or vapours that might be present in a free state.

VLH 1165 Engine ignition systems

a) Each battery ignition system must be supplemented by a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.

b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw from the same source.

c) The design of the engine ignition system must account for:

1) the condition of an inoperative generator;

2) the condition of a completely depleted battery with the generator running at its normal operating speed; and

3) the condition of a completely depleted battery with the generator operating at idling speed if there is only one battery.

d) There must be means to warn the pilot if malfunctioning of any part of the electrical system is causing the continuous discharge of any battery used for engine ignition.

Powerplant Fire Protection

VLH 1183 Lines, fittings and components

a) Except as provided in sub-paragraph b) of this paragraph, each component, line, and fitting carrying flammable fluids, gas, or air in any area subject to engine fire conditions must be at least fire-resistant, except that flammable fluid tanks and supports which are part of and attached to the engine must be fire-proof or be enclosed by a fire-proof shield unless damage by fire to any non-fire-proof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located so as to safeguard against the ignition of leaking flammable fluid. Flexible hose assemblies (hose and end fittings) must be to a standard acceptable to the CAA. However, if the total capacity of the oil system, including tanks, lines and sumps is less than 5 litres, the components of this system need only be fire-resistant.

b) Sub-paragraph a) of this paragraph does not apply to:

1) lines, fittings, and components which are already approved as part of a type certificated engine; and

2) vent and drain lines, and their fittings whose failure will not result in, or add to, a fire hazard.

VLH 1187 Ventilation

Each compartment containing any part of the powerplant installation must have provision for ventilation.

VLH 1189 Shut-off means

a) There must be means to shut off each line carrying flammable fluids into the engine compartment.

b) There must be means to guard against inadvertent operation of each shut-off, and to make it possible for the crew to reopen it in flight after it has been closed.

c) Each shut-off valve and its control must be designed, located, and protected to function properly under any condition likely to result from an engine fire.

VLH 1191 Firewalls

(See AMC VLH 1191)

a) The engine must be isolated from the rest of the helicopter by a firewall, shroud or equivalent means.

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 helicopter.

c) Each opening in the firewall or shroud must be sealed with close fitting, fire-proof grommets, bushings, or firewall fittings.

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

VLH 1193 Cowling and nacelle

When an engine installation is cowled:

a) each cowling must be constructed and supported so that it can resist any vibration, inertia and air loads to which it may be subjected in operation;

b) there must be a means for rapid and complete drainage of each part of the cowling in the normal ground and flight attitudes. No drain may discharge where it will cause a fire hazard;

c) the cowling must be at least fire-resistant;

d) each part behind an opening in the engine compartment cowling must be at least fire-resistant for a distance of at least 600mm aft of the opening; and

e) each part of the cowling subjected to high temperatures due to its nearness to exhaust system ports or exhaust gas impingement, must be fire-proof.

Sub-Section F Equipment

General

VLH 1301 Function and installation

(See AMC VLH 1301)

Each item of required equipment must:

a) be of a kind and design appropriate to its intended function.

b) be labelled as to its identification, function, or operating limitations, or any applicable combination of these factors;

c) be installed according to limitations specified for that equipment; and

d) function properly when installed.

VLH 1303 Flight and navigation instruments

The following are the required flight and navigation instruments:

a) An airspeed indicator;

b) An altimeter; and

c) A magnetic direction indicator.

VLH 1305 Powerplant instruments

The following are the required powerplant instruments:

a) Such pressure and temperature indicators and/or warnings as are necessary to operate the engine and supercharger within their limitations;

b) A fuel quantity indicator for each fuel tank, visible by each pilot when strapped in;

c) A quantity indicator for each oil tank, e.g. dipstick;

d) Fuel pressure indicator and/or fuel low pressure warning devices for non-gravity fed engines;

e) An oil temperature warning device to indicate when the temperature exceeds a safe value in the main rotor drive gearbox having an oil system independent of the engine oil system;

f) An oil pressure warning device to indicate when the pressure falls below a safe value in the pressure-lubricated main rotor drive gearbox having an oil system independent of the engine oil system;

g) A tachometer to indicate the rpm of:

   1) the engine; and

   2) the main rotor; and

h) A means of measuring elapsed running time.

VLH 1307 Miscellaneous equipment

The following is the required, miscellaneous equipment:

a) A seat for each occupant;

b) 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 VLH 561 (see AMC VLH 1307 b).);

c) An adequate source of electrical energy, where electrical energy is necessary for operation of the helicopter; and

d) Electrical protective devices.

VLH 1309 Equipment, systems, and installations

The equipment, systems, and installations must be designed to minimise hazards to the helicopter in the event of a probable malfunction or failure.

Instruments: Installation

VLH 1321 Arrangement and visibility

a) Each flight, navigation, and powerplant instrument must be clearly arranged and plainly visible to each pilot.

b) Instrument panel vibration may not damage, or impair the readability or accuracy of any instrument.

c) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.

VLH 1322 Warning, caution, and advisory lights

If warning, caution, or advisory lights are installed in the cockpit, they must be:

a) red for warning lights (lights indicating a hazard which may require immediate corrective action);

b) amber for caution lights (lights indicating the possible need for future corrective action);

c) green for safe operation lights; and

d) any other colour, including white, for lights not described in sub-paragraphs a) to c) of this paragraph, provided the colour differs sufficiently from the colours prescribed in sub-paragraphs a) to c) of this paragraph to avoid possible confusion.

VLH 1323 Airspeed indicating system

a) Each airspeed indicating instrument must be calibrated to indicate true airspeed (at sea-level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.

b) The airspeed indicating system must be calibrated in flight at forward speeds of 20 knots and over.

c) At each forward speed above 80% of the climbout speed, the airspeed indicator must indicate true airspeed, at sea-level with a standard atmosphere, to within an allowable installation error of not more than the greater of:

1) ±3% of the calibrated airspeed; or

2) five knots.

VLH 1325 Pitot and static pressure systems

a) Each instrument provided with static-pressure case connections must be so vented that the influence of moisture or other foreign matter, speed and the opening and closing of windows, will not significantly affect the accuracy of the instruments.

b) The design and installation of pitot and static pressure systems must be such that:

1) positive drainage of moisture is provided;

2) chafing of the tubing, and excessive distortion or restriction at bends in the tubing, is avoided; and

3) the materials used are durable, suitable for the purpose intended, and protected against corrosion.

VLH 1327 Magnetic direction indicator

a) The magnetic direction indicator required must be installed so that its accuracy is not excessively affected by the helicopter's vibration or magnetic fields.

b) The compensated installation must not have a deviation in level flight, greater than 10° on any heading, however when the radio is transmitting the deviation may exceed 10° but must not exceed 15°.

VLH 1337 Powerplant instruments

a) **Instruments and instrument lines**

1) Each powerplant instrument line must meet the requirements of VLH 993.

2) Each line carrying flammable fluids under pressure must:

i) have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and

ii) be installed and located so that the escape of fluids would not create a hazard.

3) Each powerplant instrument that utilises flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

b) **Fuel quantity indicator**. There must be a means to indicate to the pilot the quantity of fuel in each tank during flight. In addition each exposed sight gauge used as a fuel quantity indicator must be protected against damage.

c) Oil quantity indicators for the engine, supercharger and rotor drive gearboxes shall be provided and where appropriate do not need to be visible in flight.

d) Rotor drive system transmissions and gearboxes utilising ferromagnetic materials shall be equipped with chip detectors designed to reveal the presence of ferromagnetic particles resulting from damage or excessive wear. The chip detector must be readily removable for inspection of the magnetic element for metallic chips.

Electrical Systems and Equipment

VLH 1351 General

a) **Electrical system capacity**. Each electrical system must be adequate for the intended use. In addition:

1) Electric power sources, their transmission cables, and their associated control and protective devices, must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and

2) Compliance with sub-paragraph a) 1) of this paragraph must be shown by an electrical load analysis, or by electrical measurements, that account for the electrical loads applied to the electrical system in probable combinations and for probable durations.

b) **Functions**. For each electrical system, the following apply:

1) Each system, when installed, must be:

i) free from hazards in itself, in its method of operation, and in its effects on other parts of the helicopter;

ii) protected from fuel, oil, water, other detrimental substances, and mechanical damage; and

iii) so designed that the risk of electrical shock to occupants and ground personnel is reduced to a minimum.

2) Electric power sources must function properly when connected in combination or independently, except that alternators may depend on a battery for initial excitation or for stabilisation.

3) No failure or malfunction of any electric power source may impair the ability of any remaining source to supply load circuits essential for safe operation, except that the operation of an alternator that depends on a battery for initial excitation or for stabilisation may be stopped by failure of that battery.

4) Each electric power source control must allow the independent operation of each source, except that controls associated with alternators that depend on a battery for initial excitation or for stabilisation need not break the connection between the alternator and its battery.

c) **Generating system.** There must be at least one generator if the electrical system supplies power to load circuits essential for safe operation. In addition:

1) each generator must be able to deliver its continuous rated power;

2) generator voltage control equipment must be able to dependably regulate the generator output within rated limits;

3) each generator must have a reverse current cutout designed to disconnect the generator from the battery and from the other generators when enough reverse current exists to damage that generator;

4) there must be a means to give immediate warning to the pilot of a failure of any generator; and

5) each generator must have an over-voltage control designed and installed to prevent damage to the electrical system, or to equipment supplied by the electrical system, that could result if that generator were to develop an over-voltage condition.

d) **Instruments.** There must be a means to indicate to the pilot that the electrical power supplies are adequate for safe operation. For direct current systems, an ammeter in the battery feeder may be used.

e) **Fire resistance.** Electrical equipment must be so designed and installed that in the event of a fire in the engine compartment, during which the surface of the firewall adjacent to the fire is heated to 1100°C for 5 minutes or to a lesser temperature substantiated by the applicant, the equipment essential to continued safe operation and located behind the firewall will function satisfactorily and will not create an additional fire hazard. This may be shown by test or analysis.

f) **External power.** If provisions are made for connecting external power to the helicopter, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the helicopter's electrical system.

VLH 1353 Storage battery design and installation

a) Each storage battery must be designed and installed as prescribed in this paragraph.

b) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge):

1) at maximum regulated voltage or power;

2) during a flight of maximum duration; and

3) under the most adverse cooling condition likely to occur in service.

c) Compliance with sub-paragraph b) of this paragraph must be shown by tests unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

d) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the helicopter.

e) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.

f) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

g) Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have:

1) a system to control the charging rate of the battery automatically so as to prevent battery overheating;

2) a battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or

3) a battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.

VLH 1357 Circuit protective devices

a) Protective devices, such as fuses or circuit breakers, must be installed in all electrical circuits other than:

1) the main circuit of starter motors; and

2) circuits in which no hazard is presented by their omission.

b) A protective device for a circuit essential to flight safety may not be used to protect any other circuit.

c) Each resettable circuit protective device ('trip free' device in which the tripping mechanism cannot be overridden by the operating control) must be designed so that:

1) a mutual operation is required to restore service after tripping; and

2) if an overload or circuit fault exists, the device will open the circuit regardless of the position of the operating control.

d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be so located and identified that it can be readily reset or replaced in flight.

e) If fuses are used, there must be one spare of each rating, or 50% spare fuses of each rating, whichever is greater.

VLH 1361 Master switch arrangement

a) There must be a master switch or switches arranged to allow ready disconnection of all electric power sources. The point of disconnection must be adjacent to the sources controlled by the switch. (See AMC VLH 1361 a).)

b) The master switch arrangement must be so installed that it is easily discernible and accessible to the pilot in flight.

VLH 1365 Electric cables and equipment

a) Each electric connecting cable must be of adequate capacity and correctly routed, attached and connected so as to minimise the probability of short circuits and fire hazards.

b) Each cable and associated equipment that would overheat in the event of circuit overload or fault must be at least flame-resistant and may not emit dangerous quantities of toxic fumes.

VLH 1367 Switches

Each switch must be:

a) able to carry its rated current;

b) constructed with enough distance or insulating material between current carrying parts and the housing so that vibration in flight will not cause shorting;

c) accessible to the pilot; and

d) labelled as to operation and the circuit controlled.

Lights

VLH 1385 External lights

If external lights are installed they must meet the requirements of the relevant operating rules.

Safety Equipment

VLH 1411 General

a) When safety equipment is installed it must be readily accessible; and

b) Stowage provisions for that equipment must be furnished and must:

1) be arranged so that the equipment is directly accessible and its location is obvious; and

2) protect the safety equipment from damage caused by being subjected to the inertia loads specified in VLH 561.

VLH 1413 Safety harnesses

Each safety harness must be equipped with a metal to metal latching device.

VLH 1415 Ditching equipment

Each life preserver must be installed so that it is readily available to the occupants. The storage provisions for life preservers must accommodate one life preserver for each occupant for which certification for ditching is requested.

Miscellaneous Equipment

VLH 1431 Airborne radio and radio navigation equipment

Each item of airborne radio equipment provided must comply with the following:

a) The equipment and its aerials may neither in themselves, nor by their mode of operation or by their effect upon the operating characteristics of the helicopter and its equipment, constitute a hazard to safe operation (see AMC VLH 1431 a));

b) The equipment and its control and monitoring devices must be arranged so as to be easily controllable. Their installation must be such that they are sufficiently ventilated to prevent overheating; and

c) All fixed installation airborne radio equipment must be approved by the CAA.

Sub-Section G Operating Limitations and Information

General

VLH 1501 General

a) Each operating limitation specified in VLH 1503 to 1525 and other limitations and information necessary for safe operation must be established.

b) The operating limitations and other information necessary for safe operation must be made available to the crew members as prescribed in VLH 1541 to 1589.

Operating Limitations

VLH 1503 Airspeed limitations: general

a) An operating speed range must be established.

b) When airspeed limitations are a function of weight, weight distribution, altitude, rotor speed, power, or other factors, airspeed limitations corresponding with the critical combinations of these factors must be established.

c) All flight speeds must be stated in terms of indicated airspeed (IAS).

VLH 1505 Never-exceed speed

a) The never-exceed speed, V_{NE}, must be established power-on and power-off.

b) The never-exceed speed, V_{NE}, must not exceed 0·90 times the maximum speed demonstrated in flight tests (V_{DF}).

c) Power-off V_{NE} may be established at a speed less than that in sub-paragraph b) of this paragraph.

d) V_{NE} may vary with altitude, rpm, temperature and weight.

VLH 1509 Rotor speed

a) **Maximum power-off (autorotation)**. The maximum power-off rotor speed must be established so that it does not exceed 95% of the lesser of:

   1) the maximum design rpm determined under VLH 309 b); and

   2) the maximum rpm shown during the type tests.

b) **Minimum power-off**. The minimum power-off rotor speed must be established so that it is not less than 105% of the greater of:

   1) the minimum shown during the type tests; and

   2) the minimum determined by design substantiation.

c) **Minimum power-on**. The minimum power-on rotor speed must be established so that it is:

1) not less than the greater of:

i) the minimum shown during the type tests; and

ii) the minimum determined by design substantiation; and

2) not more than a value determined under VLH 33 a) 1).

VLH 1519 Weight and centre-of-gravity

a) The weight and centre-of-gravity limitations determined under VLH 25 and 27 respectively, must be established as operating limitations.

b) The empty weight and the corresponding centre-of-gravity positions must be determined in accordance with VLH 29.

VLH 1521 Powerplant limitations

a) **General**. The powerplant limitations prescribed in this paragraph must be established so that they do not exceed the corresponding limits for which the engine is type certificated or accepted.

b) **Take-off operation**. The powerplant take-off operation must be limited by:

1) the maximum rotational speed, which may not be greater than:

i) the maximum value determined by the rotor design; or

ii) the maximum value shown during testing;

2) the maximum allowable manifold pressure if appropriate to the engine installation; and

3) the time limit for the use of the power corresponding to the limitations established in sub-paragraphs b) 1) and 2) of this paragraph.

c) **Continuous operation**. The continuous operation must be limited by:

1) the maximum rotational speed which may not be greater than:

i) the maximum value determined by the rotor design; or

ii) the maximum value shown during testing; and

2) the minimum rotational speed shown under the rotor speed requirements in VLH 1509 c).

d) **Fuel grade or designation**. The minimum fuel grade must be established so that it is not less than that required for the operation of the engines within the limitations in sub-paragraphs b) and c) of this paragraph.

VLH 1527 Maximum operating altitude

The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.

VLH 1529 Maintenance manual

(See AMC VLH 1529)

A maintenance manual containing the information essential for proper maintenance must be provided.

Markings and Placards

VLH 1541 General

a) The helicopter must be marked with:

1) the markings and placards specified in VLH 1542 to VLH 1557; and

2) any additional information, instrument markings, and placards required for the safe operation of the helicopter.

b) Each marking and placard prescribed in sub-paragraph a) of this paragraph:

1) must be displayed in a conspicuous place; and

2) may not be easily erased, disfigured or obscured.

c) The units of measurement used to indicate air speed on placards must be the same as those used on the indicator.

VLH 1542 Operating limitations placards and instrument markings

(See AMC VLH 1542)

Limitations essential to the safe operation of the helicopter must be plainly visible to the pilot. Where this cannot be achieved by instrument markings, a placard must be provided. Where these limitations are shown by instrument markings, each maximum and minimum safe operating limit must be marked by a red line.

VLH 1543 Instrument markings: general

For each instrument:

a) when markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and

b) each arc and line must be wide enough and located to be clearly visible to the pilot.

VLH 1547 Compass

Unless the deviation is less than 5 degrees on all headings, the deviation values for magnetic headings in not more than 30 degree increments must be placarded near the compass.

VLH 1551 Oil quantity indicator

Each oil quantity indicator must be marked to clearly indicate the maximum and minimum quantity of oil that is acceptable.

VLH 1553 Fuel-quantity indicator

Each fuel-quantity indicator must be calibrated to read 'zero' during level flight, when the quantity of fuel remaining in the tank is equal to the unusable quantity determined in accordance with VLH 959.

VLH 1555 Control markings

a) Each cockpit control, other than primary flight controls, must be clearly marked as to its function and method of operation.

b) Emergency controls must be coloured red.

c) For powerplant fuel controls:

1) each fuel tank selector control must be marked to indicate the position corresponding to each tank; and

2) if safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on or near the selector for those tanks.

VLH 1557 Miscellaneous markings and placards

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.

2) Oil-filler openings must be marked at or near the filler cover:

i) with the grade; and

ii) with whether 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) **Loading.** 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 each removable ballast is necessary. The following data must be placarded in each helicopter so that they are plainly visible to the pilot:

1) Empty weight;

2) Maximum weight;

3) Maximum and minimum cockpit load; and

4) Cockpit load conditions for two-seater flown solo.

e) **Aerobatic manoeuvres.** A placard prohibiting aerobatic manoeuvres must be plainly visible to the pilot.

f) **Occupant warning.** A placard showing the standard occupant warning must be plainly visible to the pilot and, if applicable, the passenger, as follows:

Occupant Warning
This helicopter has not been certificated to an international requirement

g) When an emergency exit is provided in compliance with VLH 807, each operational control must be red. The placards must be near each control and must clearly indicate its method of operation.

VLH 1561 Safety equipment

a) When installed, safety equipment must be plainly marked as to the method of operation; and

b) Stowage provisions for that equipment must be marked for the benefit of occupants.

VLH 1565 Tail rotor

Each tail rotor must be marked so that its disc is conspicuous under normal daylight ground conditions.

Pilot's Handbook

VLH 1581 General

a) A pilot's handbook must be furnished with each helicopter. Each pilot's handbook must contain at least:

1) the information specified in VLH 1583 to VLH 1587;

2) the information required in VLH 1583 to 1589 including the explanation necessary for proper use and the significance of the symbols used; and

3) other information that is necessary for safe operation because of design, operating or handling characteristics, including the effect of rain, rotor blade leading edge erosion, and surface build up of contaminants on the flight characteristics and performances as determined under VLH 21 d). (See AMC VLH 1581 a) 3).)

b) **Units**. The units of measurement used must be the same as those used on the indicators.

VLH 1583 Operating limitations

a) The air-speed limit V_{NE} as required by VLH 1503 together with information on the significance of this limit must be furnished.

b) **Weights.** The following limitations must be furnished:

1) the maximum weight;

2) the empty weight and the position of the empty weight centre-of-gravity; and

3) the composition of the useful load.

c) **Loading.** The following limitations must be furnished:

1) The weight and centre-of-gravity limits required by VLH 23 and VLH 25, together with the items included in the empty weight in VLH 29;

2) Information enabling the pilot of the helicopter to determine whether the centre-of-gravity, and the distribution of the useful load in the different loading combinations, are still within the allowable range; and

3) Information for the proper placement of removable ballast under each loading condition for which removable ballast is necessary.

d) **Manoeuvres.** Authorised manoeuvres established in accordance with VLH 1.

e) **Kinds of operation.** The kind of operation, i.e. day VFR, in which the helicopter may be used, must be stated. The minimum equipment required for operation must be listed.

f) The maximum wind limitations must be furnished.

g) If certification for water operations is requested, the maximum wind and wave conditions established under VLH 238 must be furnished.

h) **Powerplant and rotor system limitations.** The following information must be furnished:

1) Limitation required by VLH 1509 and 1521.

2) Information necessary for marking the instruments required by VLH 1542 to 1553.

3) Fuel and oil designation.

4) For two-stroke engines, fuel/oil ratio.

i) **Placards.** Placards required by VLH 1555 to 1561 must be presented.

j) The altitude established under VLH 1527 and an explanation of the limiting factors must be furnished.

VLH 1585 Operating procedures

(See AMC VLH 1585)

a) Information concerning normal and emergency procedures and other pertinent information necessary for safe operation and for the achievement of the scheduled performance must be furnished including:

1) each appropriate climb out speed; and

2) appropriate approach and glide airspeeds.

b) For helicopters for which a V_{NE} (power-off) is established under VLH 1505 c), information must be furnished to explain the V_{NE} (power-off) and the procedures for reducing airspeed to not more than the V_{NE} (power-off) following failure of the engine.

c) For each helicopter showing compliance with VLH 1353 g) 2) or g) 3), the operating procedures for disconnecting the battery from its charging source must be furnished.

d) If the unusable fuel supply in any tank exceeds 5% of the tank capacity, or 3·8 litres (0·8 Imperial gallon/1 US gallon), whichever is greater, information must be furnished which indicates that when the fuel quantity indicator reads 'zero' in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

e) Information on the total quantity of usable fuel for each fuel tank must be furnished.

f) The procedure(s) for abandoning a take-off due to engine failure or other cause must be furnished.

g) The airspeeds and rotor speeds for minimum rate of descent and best glide angle as prescribed in VLH 71 must be provided.

h) Use of any carburettor heat control, (if fitted).

VLH 1587 Performance information

(See AMC VLH 1587)

a) The helicopter must be furnished with the information determined in accordance with VLH 51 to 79 and VLH 143 c) as well as the following:

1) Enough information to determine the limiting height-speed envelope;

2) Information relative to:

i) the hovering ceilings and the steady rates of climb and descent, as affected by any pertinent factors such as airspeed, weight, altitude and temperature;

ii) the maximum safe wind for operation near the ground. If there are combinations of weight, altitude, and temperature for which performance information is provided and at which the helicopter cannot land and take-off safely with the maximum wind value, those portions of the operating envelope and the appropriate safe wind conditions shall be identified in the pilot's handbook;

iii) the maximum atmospheric temperature at which compliance with the cooling provisions of VLH 1041 to 1043 is shown; and

iv) glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide as determined in VLH 71.

b) The Pilot's Handbook must contain in its performance information section, any pertinent information concerning the take-off weights and altitudes used in compliance with VLH 51.

VLH 1589 Loading information

There must be loading instructions for each possible loading condition between the maximum and minimum weights determined under VLH 25 that can result in a centre-of-gravity beyond any extreme prescribed in VLH 27, assuming any probable occupant weights.

Part 2 Acceptable Means of Compliance and Interpretative Material (AMC)

Sub-Section A General

AMC VLH 1 (Interpretative material)

a) The CAA will decide on a case by case basis whether a helicopter qualifies for amateur constructed status.

c) Non-aerobatic operation is intended to include:

1) any manoeuvre necessary for normal flying;

2) steep turns in which the angle of bank does not exceed 60 degrees; and

3) autorotational descents.

Sub-Section B Flight

AMC VLH 21 (Interpretative material)

a) Instrumentation for flight test.

1) For test purposes, the helicopter should be equipped with suitable instruments for conducting the required measurements and observations in a simple manner. If reliable results cannot be obtained otherwise, the CAA may request the installation of special test equipment. In particular, it is recommended that a means be provided for recording the indications of the flight instruments, the stick position and the aircraft attitude; e.g. a data recorder or fixed video camera. Provision should also be made to record the pilot's comments as he conducts the flight tests.

2) At an early stage in the programme the accuracy of the instruments and their calibration curves should be determined, and particular attention should be paid to the position error of the airspeed indication system.

b) Prior to flight test, ground tests should be conducted to measure the following:

1) Friction of controls;

2) Control-cable tension of closed control circuits; and

3) Maximum deflection of control surfaces and their respective controls.

c) Functioning tests: Before starting the flight tests, all ground functioning tests should be carried out.

d) With reference to VLH 21 c), if, for example, a helicopter is equipped with doors and it is intended that the helicopter may be operated with the door(s) removed, then the helicopter must be shown to comply with the requirements both with and without the door(s) installed.

AMC VLH 21 b) (Interpretative material)

This alleviating requirement is not intended to include the performance and handling requirements or those calling for practical flight testing, e.g. VLH 928 and VLH 1043.

AMC VLH 238 (Interpretative material)

a) This paragraph is intended to establish safe limits of flotation stability for the helicopter with rotors moving and during rotor start up and shut down.

b) In determining the safe limits in paragraph a), the most critical combinations of wave height, frequency and direction in conjunction with wind speed and direction should be considered.

Sub-Section C Strength Requirements

AMC VLH 301 (Interpretative material)

In applying the forces to the rotorcraft, the resultant rotor forces may be represented as a single force applied at the rotor hub attachment point.

AMC VLH 307 a) (Interpretative material)

a) Substantiating load tests made in accordance with VLH 307 should normally be taken to ultimate load.

b) The results obtained from strength tests should be so corrected for departures from the mechanical properties and dimensions assumed in the design calculations as to establish that the possibility of any structure having a strength less than the design value, owing to material and dimensional variation, is extremely remote.

AMC VLH 337 (Interpretative material)

The structure of the helicopter must be shown to be able to withstand these loads. It is not necessary to show that the helicopter is controllable, or that the fuel or other helicopter systems work at these extremes.

AMC VLH 405 (Interpretative material)

Hand and foot loads, assumed for design, should not be less than the following:

a) Hand loads on small hand-wheels, cranks etc., applied by finger or wrist force: P = 150 N.

b) Hand loads on levers and hand-wheels applied by the force of an unsupported arm without making use of body weight: P = 350 N.

c) Hand loads on levers and hand-grips applied by the force of a supported arm or by making use of the body weight: P = 600 N.

d) Foot loads applied by the pilot when sitting with his back supported (e.g. toe-brake operating loads): P = 750 N.

AMC VLH 547 c) 1) (Interpretative material)

This load is not less than that obtained on a stationary rotor from application of a vertical load on each landing gear unit of 1·67 times the maximum reaction, and any combination of drag and side loads on each landing gear unit equal to from 0 to 0·25 times the vertical load. Where skid landing gear is used the helicopter is assumed to be standing on its ground handling wheels.

AMC VLH 561 d) (Interpretative material)

The purpose of this requirement is to ensure that the engine and associated high mass items are adequately restrained in the event of a heavy landing. In order to show compliance with the requirement the inertial loads resulting from the deceleration of 15g must be diffused through the helicopter structure in a realistic manner.

AMC VLH 563 (Interpretative material)

The intention of this paragraph is to provide for adequate structural strength in the event of a forced landing on water following loss of engine power during take-off or landing on water.

AMC VLH 571 (Interpretative material)

a) The maintenance schedule for the helicopter should identify each part of the helicopter the failure of which could be catastrophic. Means should be defined that will ensure that the likelihood of a fatigue failure is minimized, e.g. periodic replacement of parts on a safe life basis.

b) Notwithstanding the requirement for a factor of safety of 10 in sub-paragraph c), all other parts subject to cyclic stresses should aim to have a factor of safety in excess of 3, unless it can be shown by analysis or test that a lower figure is adequate for the part in question.

c) The use of stress relieving annealing followed by compressive shot peening should be used where appropriate and practical. Strict process controls should be employed.

Sub-Section D Design and Construction

AMC VLH 602 (Interpretative material)

Critical parts are defined as those whose failure could have a hazardous or catastrophic effect on the helicopter.

a) All such parts should be identified for the purposes of manufacture, assembly and maintenance, and highlighted in the appropriate publications.

b) Strict attention to detail should be paid during manufacture, assembly and maintenance in such areas as:

1) hole preparation and finish;

2) smooth and continuous deburring of holes and sharp edges;

3) general surface finish:

i) elimination of stress raising nicks, dents and scratches;

ii) elimination of machining marks;

4) proper use of corner radii in machined grooves;

5) stress relieving of welds;

6) heat treatment;

7) shot peening;

8) prevention of grinding abuse;

9) post plating de-embrittlement process;

10) corrosion resistance;

11) grain flow; and

12) proper assembly techniques and post assembly testing.

This list is not exhaustive.

See also AMC VLH 571 1).

AMC VLH 603 b) (Interpretative material)

If non-aerospace specifications are to be used they must be from a source acceptable to the CAA.

AMC VLH 613 a) (Interpretative material)

Material specifications should be those contained in documents accepted either specifically by the CAA or by having been prepared by an organisation or person which the CAA accepts has the necessary capabilities. In defining design properties, these material specification values should be modified and/or extended as necessary by the constructor to take account of manufacturing practices (for example, method of construction, forming, machining and subsequent heat treatment).

AMC VLH 613 c) (Interpretative material)

Hot soak temperatures up to 54° C are considered to correspond to normal operating conditions.

AMC VLH 619 a) (Interpretative material)

Appropriate combinations of the special factors should include all of the following appropriate to the part:

a) The casting factor derived in accordance with VLH 621; and

b) The highest pertinent special factor prescribed in VLH 619 b), VLH 623, VLH 625 or VLH 693.

AMC VLH 626 (Interpretative material)

Nominal cable strength is defined by the minimum breaking load for the particular type of cable specified in the British Standard, or other acceptable recognised specifications to which the cable is made. Reference to the relevant specification should be made in the design documentation. These criteria apply to steel cables. Design assumptions for cables of other materials should be agreed with the CAA.

AMC VLH 661 (Interpretative material)

It will be necessary to conduct ground and flight trials and to record, by some suitable means, the clearance between the rotor blades and hub, and the airframe and stops, to show compliance with this requirement. The range of conditions covered should be adequate to ensure that the most severe conditions that can be expected to occur in flight or on the ground are covered, including starting and stopping the rotor in windy conditions.

AMC VLH 685 b) (Interpretative material)

For the purpose of this requirement a cockpit can be assumed to be either a conventional structure or an enclosed or semi-enclosed nacelle.

AMC VLH 689 b) (Interpretative material)

The inside diameter of the pulley groove should not be less than 300 times the diameter of each elemental strand.

AMC VLH 725 (Interpretative material)

a) Acceptable methods for demonstrating compliance with VLH 725 c) are:

   1) the helicopter should be at its most critical weight and unfavourable centre-of-gravity position for the tests.

   2) structural yielding of the elastic spring member under the limit loading conditions should be acceptable. The design ultimate loads considered for the elastic spring member need not exceed those obtained in a drop test of the skid gear from a drop height equal to 1·5 times that specified in VLH 725 a).

   3) the ground loads resulting from the landing conditions specified in sub-paragraph b) of this paragraph should be applied to the skid gear in its most critically deflected position for the particular landing condition being considered and a rational distribution of the ground reactions along the skid tube bottom should be made.

   4) the test programme may include elements of the following, but as a minimum should include the landing condition at paragraph b) 1).

b) Consideration should be given to the following landing conditions:

   1) **Level landing; vertical reactions.** The helicopter should be assumed to contact the ground along the bottom of both skids. Vertical ground reactions should be applied in accordance with the provisions of sub-paragraphs 2) and 3) of this paragraph.

2) **Level landing with drag.** The helicopter should be assumed to contact the ground along the bottom of both skids with vertical ground reactions in combination with a horizontal drag reaction equal to 50 percent of the vertical reaction applied at the ground. The resultant ground load should be equal to the vertical load specified in sub-paragraph 1) of this paragraph and should be directed through the centre-of-gravity of the helicopter.

3) **Level landing with side load.** The helicopter should be assumed to contact the ground along the bottom of both skids with vertical ground reactions in combination with a side reaction equal to 25 percent of the vertical ground reaction. The vertical ground reaction should be equal to the vertical load specified in sub-paragraph 1) of this paragraph and should be equally divided between the two skids. The total side load should be applied along the length of one skid only. Unbalanced moments shall be assumed to be resisted by angular inertia forces. Both the inward and outward acting side loading conditions for the skid gear should be investigated.

4) **One-skid landing condition.** In the level attitude, the helicopter should be assumed to contact the ground on one skid only. The vertical load should be the same as that obtained on the one side in the condition specified in sub-paragraph 1) of this paragraph. Unbalanced moments should be assumed to be resisted by angular inertia forces.

c) Special conditions for the skid gear.

1) A ground reaction load equal to 1·33 times the maximum weight of the helicopter acting up and aft at an angle of 45 degrees to the horizontal should be assumed. The load should be distributed symmetrically between the two skids and should be assumed concentrated at the forward end of the straight portion of the skid tube. This loading condition should apply only to the forward end of the skid tube and its attachment to the helicopter.

2) A vertical ground reaction load equal to one-half the vertical load of AMC VLH 725 5) i) should be assumed with the helicopter in the level attitude. This load should be applied to the skid tube and should be assumed concentrated at a point midway between the skid tube attachments. This loading condition should apply only to the skid tube and its attachment to the helicopter.

d) For helicopters designed to be equipped solely with skis or floats, advice should be sought from the CAA on suitable tests to be conducted.

AMC VLH 773 a) (Interpretative material)

In order to show compliance with this requirement it will be necessary to assess the effects of any "misting up" of the windscreen.

AMC VLH 773 b) (Interpretative material)

Compliance with VLH 773 b) may be provided by any canopy having a suitable opening.

AMC VLH 777 b) (Interpretative material)

When assessing whether the cockpit controls comply with VLH 777 b) allowance must be made for bulky winter clothing.

AMC VLH 801 (Interpretative material)

The intention of this paragraph is to provide for adequate provisions for fixed float equipped helicopters in the event of a forced landing on water following loss of engine power during take-off and landing on water. Further it is intended that the operation is from sheltered water courses exhibiting minimal surface motion.

See also AMC VLH 238.

AMC VLH 801 c) (Interpretative material)

a) Investigation may be by model tests or by comparison with helicopters of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the helicopter should be considered.

b) It should be shown that, under reasonably probable water conditions, the flotation time and trim of the helicopter will allow the occupants to leave the helicopter. If compliance is shown by buoyancy and trim computations, appropriate allowances should be made for probable structural damage and leakage.

Sub-Section E Powerplant

AMC VLH 901 (Interpretative material)

Good aeronautical practices should be used throughout.

AMC VLH 903 b) (Interpretative material)

The following tests can only be conducted after satisfactory conclusion of the tests required by VLH 923.

Evidence of safe and satisfactory operation of the engine in the helicopter, for a period of 25 hours flying without significant problems, is an acceptable means of demonstrating compliance. For unapproved engines, see also AMC VLH 923 d) sub-paragraph h).

Note that if significant changes are made to the engine, additional flying may be necessary to ensure that a complete period of 25 hours is achieved with the final standard of engine.

The 25 hour flight test should be representative of the most severe manoeuvres likely to be experienced during normal operation, including manoeuvres which cause high rates of angular acceleration.

Overhaul lives for unapproved engines are to be agreed with the CAA.

AMC VLH 923 b) (Interpretative material)

The evidence submitted should relate to all the examples which have achieved their overhaul lives and flown to service profiles to the extremes of the transmission limitations requested.

AMC VLH 923 c) (Interpretative material)

a) The test is meant to be a ground endurance test with the helicopter tied down.

b) For the test programme the helicopter need not be in its flight ready condition i.e. doors and cowlings may be removed, but it should be structurally and dynamically representative of a flight ready vehicle for which a Permit to Fly is requested.

c) An acceptable programme would be as follows:

   The test schedule would be agreed with the CAA and be representative of expected flight profiles. It would include:

   1) at least 30 hours running at maximum continuous torque and speed. The cyclic control would be in the maximum forward position which simulates forward flight. The tail rotor controls would be set to match this condition.

   2) at least 15 hours running at 75% power and minimum speed associated with this power. The main and tail rotor controls would be set to their normal position to match this condition.

   3) at least 5 hours running at maximum take-off power and maximum speed associated with this power. The main and tail rotor controls would be set to their normal positions for vertical ascent.

d) the parts of the test prescribed in sub-paragraphs 1) and 2) above would be conducted at intervals of not less than 15 minutes. The part of the test prescribed in sub-paragraph 3) above would be conducted at intervals of not less than 2½ minutes.

e) At intervals of not more than 2½ hours during the tests prescribed in paragraph c) sub-paragraphs 1), 2) and 3) the engine would be stopped rapidly enough to allow the engine and rotor drive to be automatically disengaged from the rotors.

f) During the testing prescribed in paragraph c) sub-paragraph 1) the cyclic control would undergo at least 250 full reversals in the lateral and longitudinal axis. Similarly the tail rotor would undergo at least 250 full reversals. The loads induced into the rotor systems by these tests need not exceed the maximum loads or motions encountered in flight.

g) At least 100 start up clutch engagements would be made so that the shaft on the driven side of the clutch is accelerated from rest to its maximum speed.

h) The CAA may require to witness certain aspects of the tests.

i) For engines which are not type approved this series of tests can be used in part to establish the suitability of the engine in the helicopter for which a Permit to Fly is requested; but this does not exclude the requirements for 25 hours flight testing required in VLH 903.

j) The test programme would be comprehensively recorded and the results submitted to the CAA.

k) At the satisfactory conclusion of the agreed testing, the complete rotor drive system would be stripped and inspected, and the results submitted to the CAA.

AMC VLH 927 a) (Interpretative material)

Additional tests could include:

a) Overspeed and overtorque with the aim of substantiating the structural integrity of the rotor and transmission system.

b) Any tests to be agreed with the CAA to support the substantiation of novel or unusual features.

c) Any tests to be agreed with the CAA to support substantiation of the rotor and transmission system where doubt exists over its integrity as determined from evidence submitted in showing compliance with other paragraphs of this BCAR.

AMC VLH 928 (Interpretative material)

These tests can only be conducted after satisfactory demonstration of the requirements of VLH 923.

The flight test schedule should be made up of a number of flights representative of normal use. These flights should cover the range of ground and flight conditions that the helicopter is expected to experience in normal use. The applicant may count any development flight hours flown towards the 25 hours of endurance testing, provided the helicopter is in the final configuration and the test flying was representative of the operational use.

These conditions should be flown over the permitted range of engine power and rotor rpm, all-up weight, centre-of-gravity position and altitude.

The helicopter should be inspected carefully at regular intervals as the trial proceeds. Records should be kept of the results of these inspections and of the flying carried out. If any problems or failures occur, the CAA should be advised of the problem and the proposed solution. Depending on the severity of the problem, extra flying may be necessary to ensure that the proposed solution has accrued 25 hours without a recurrence of the problem.

If testing has been undertaken in accordance with VLH 923, and unless otherwise agreed with the CAA, the engine and rotor system (power train) used for the VLH 923 test programme should be used for the VLH 928 tests without intervening major overhaul. Any disassembly and/or part replacements would need to be declared to the CAA.

AMC VLH 967 c) (Interpretative material)

If the tank is mounted above, below or behind the engine or the exhaust, a fire-proof shield must be placed between the fuel tank and the engine or exhaust. There must be at least 13 mm of clearance between the fuel tank and the fire-proof shield. If the fuel tank is mounted above the engine or exhaust, there must be provision to catch and drain fuel leaks away from the engine and exhaust.

AMC VLH 977 d) (Interpretative material)

Additives in many two-stroke engine oils can, under certain conditions, produce materials which will block paper filter elements with pore sizes of less than 10 microns. Such paper elements will not be considered compatible with two-stroke pre-mix fuel systems.

AMC VLH 993 a) (Interpretative material)

Compliance with the requirements of this sub-paragraph may be shown by flight test.

AMC VLH 1011 c) (Interpretative material)

In assessing the reliance that can be placed upon the means for providing the appropriate fuel/oil mixture to the engine to prevent a hazardous condition, account should be taken of, for example:

a) The tolerance of the engine to fuel/oil mixture ratios other than the optimum;

b) The procedure established for refuelling and introducing the appropriate amount of oil; and

c) The means by which the pilot may check that the fuel contains an adequate mixture of oil.

AMC VLH 1043 (Interpretative material)

The most critical conditions for test are likely to be extended hovering (OGE) in still air conditions or extended full power climbs at low forward airspeed. The climb should be not less than 5 minutes.

AMC VLH 1091 a) (Interpretative material)

Compliance with this requirement may be shown by satisfactory completion of the flight endurance test of VLH 928.

AMC VLH 1093 (Interpretative material)

Carburettor air preheater should be able to provide a minimum heat rise of 32°C at 75% of maximum continuous power.

For helicopters with an engine having a supercharger to pressurise the air before it enters the carburettor, the heat rise in the air caused by that supercharging at any altitude may be utilised in determining compliance with this paragraph if the heat rise utilised is that which will be available, automatically, for the applicable altitudes and operating condition because of supercharging.

AMC VLH 1105 b) (Interpretative material)

The de-icing of the screen may be provided by heated air.

AMC VLH 1145 a) (Interpretative material)

Magneto ignition switches should be rendered inoperative by grounding the appropriate circuit to earth.

AMC VLH 1191 (Interpretative material)

a) The following materials are accepted as fire-proof, when used in firewalls or shrouds, without being tested:

   1) Stainless steel sheet, 0·38 mm thick;

   2) Mild steel sheet (coated with aluminium or otherwise protected against corrosion) 0·5 mm thick; and

   3) Steel or copper base alloy firewall fittings.

b) Other materials should be able to withstand a 1100 ± 25°C flame played over an area of 13mm square for at least 15 minutes. The test piece should be approximately 64 cm^2.

Sub-Section F Equipment

AMC VLH 1301 (Interpretative material)

Each item of required equipment should function correctly when subjected to the most adverse likely operating conditions including extremes of temperature, rain and humidity. Instruments and other equipment must not in themselves, or by their effect upon the helicopter, constitute a hazard to safe operation.

AMC VLH 1307 b) (Interpretative material)

A four or five point harness must be fitted to comply with this requirement, unless a case can be made to show that upper torso restraint would increase the hazard to the occupant.

Installation of Shoulder Harness

Figures 1, 2 and 3 show the recommended installation geometry for this type of restraint.

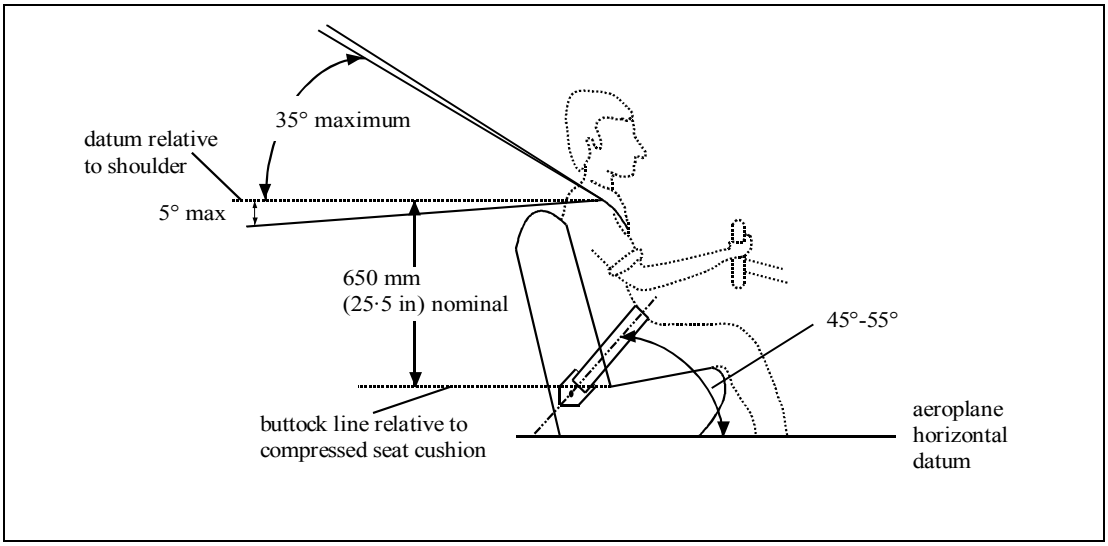

Figure 1

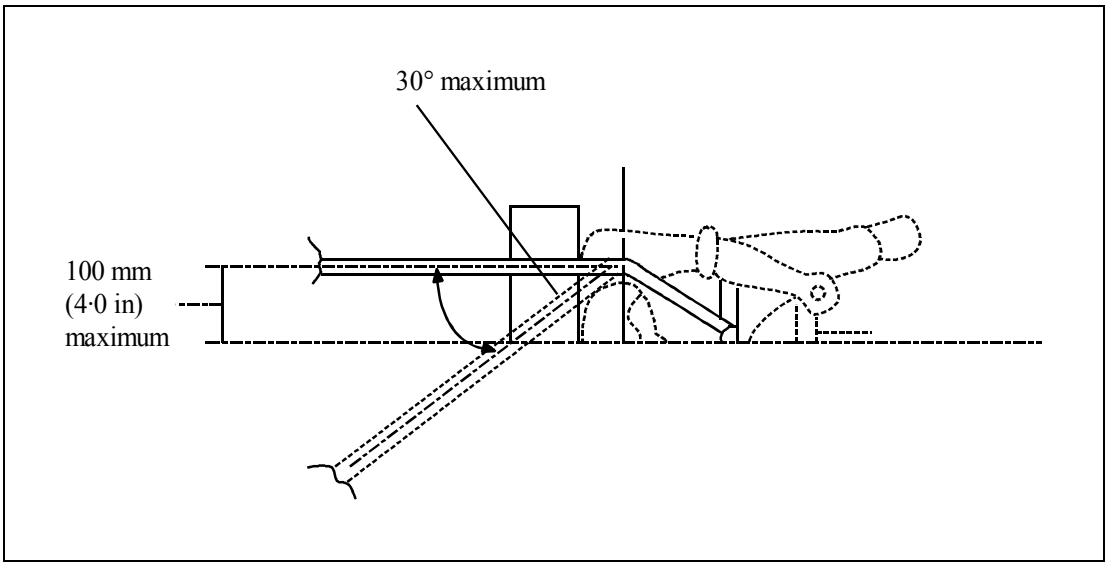

Figure 2

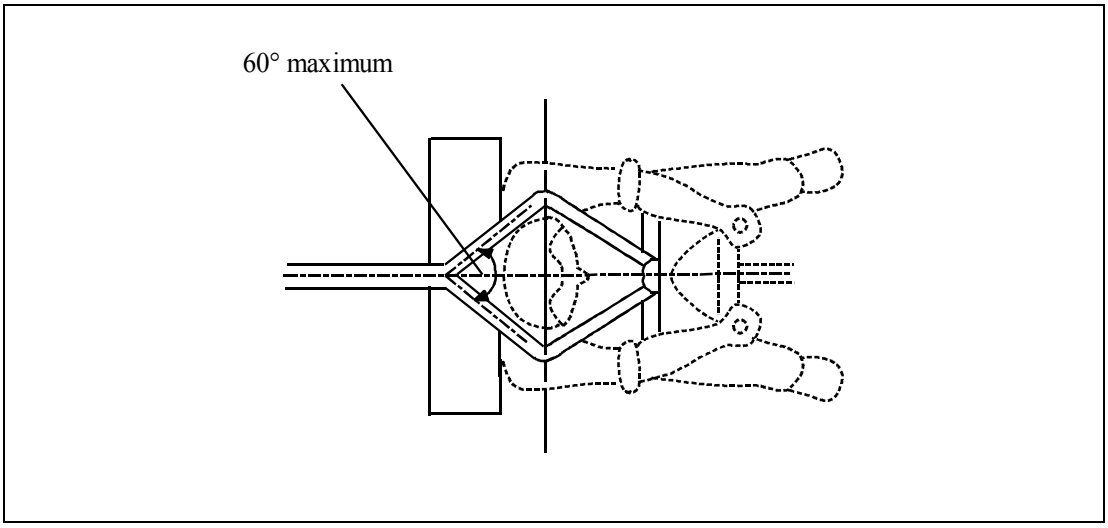

Figure 3

AMC VLH 1361 a) (Interpretative material)

The master switch arrangement should consist of separate switches, one for each source of electrical power i.e. generator(s) and battery.

AMC VLH 1431 a) (Interpretative material)

Particular care should be taken to ensure electronic ignition systems are not adversely affected by electromagnetic interference.

Sub-Section G Operating Limitations and Information

AMC VLH 1529 (Interpretative material)

The maintenance manual should contain at least the following:

a) Description of systems;

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 gearbox backlash values, rotor feathering hinge rotational drag load values and limits of rotor pitch angles relative to the hubs;

e) Method of determining centre-of-gravity position;

f) Methods of rotor tracking and maximum permissible values of play at hinges 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 helicopter;

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) Identification of critical parts (see VLH 602 and interpretative material);

o) The materials necessary for small repairs;

p) Care and cleaning recommendations;

q) Instructions for inspection and cleaning of the main and tail rotor blades such that they maintain their optimum aerodynamic performance;

r) Instructions for rigging and de-rigging;

s) Information on supporting points and measures to be taken to prevent damage during ground transportation; and

t) List of placards and markings and their locations.

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

AMC VLH 1542 (Interpretative material)

Limitations essential to the safe operation of the helicopter should include:

a) Airspeed limitations: the never-exceed speed V_{NE}.

b) If feasible the airspeed indicator should be marked as follows, with the marks located at the corresponding indicated airspeeds.

i) A red radial line at V_{NE} (power-on).

ii) A red cross-hatched radial line at V_{NE} (power-off), if V_{NE} (power-off) is less than V_{NE} (power-on).

iii) For the caution range, a yellow arc.

iv) For the safe operating range, a green arc.

c) Powerplant limitations: such pressure, temperature, rpm and other limitations as may have been determined under VLH 1521.

d) For each required powerplant instrument, as appropriate to the type of instruments the following should be marked:

i) A red radial or a red line for each maximum and if applicable, minimum safe operating limit;

ii) A green arc or green line not extending beyond the maximum and minimum safe limits for each normal operating range;

iii) A yellow arc or a yellow line for each take-off and precautionary range; and

iv) Red arcs or red lines for each engine range that is restricted because of excessive vibration stresses.

Otherwise placards must be provided.

AMC VLH 1581 a) 3) (Interpretative material)

a) This should include advice on the hazards associated with low 'g' manoeuvres. This advice should address which sorts of manoeuvre can lead to a reduction in normal 'g' and how to avoid them.

b) The pilot's handbook should also contain guidance material to advise the pilot that, in the event of a change in the vibration characteristics of the helicopter, the primary structure, controls and rotor of the helicopter should be inspected for signs of cracks, damage etc. in accordance with the procedures specified in the maintenance manual.

c) Advice should be included on any conditions which can lead to engine stoppage at low fuel levels.

d) If appropriate, advice on the inadvisability of flight in rain and the deleterious effects on performance due to leading edge erosion, accumulation of dead insects and other "surface finish" degrading contaminants on the rotor blades should be given.

AMC VLH 1585 (Interpretative material)

Data relevant to the appropriate undercarriage configurations (skid, float or ski) should be included where necessary.

AMC VLH 1587 (Interpretative material)

Data relevant to the appropriate undercarriage configurations (skid, float or ski) should be included where necessary.