§ 29.21  
Subpart B—Flight

GENERAL

§ 29.21  Proof of compliance.
Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—
(a) By tests upon a rotorcraft of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and
(b) By systematic investigation of each required combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.


§ 29.25  Weight limits.
(a) Maximum weight. The maximum weight (the highest weight at which compliance with each applicable requirement of this part is shown) or, at the option of the applicant, the highest weight for each altitude and for each practicably separable operating condition, such as takeoff, enroute operation, and landing, must be established so that it is not more than—
(1) The highest weight selected by the applicant;
(2) The design maximum weight (the highest weight at which compliance with each structural loading condition of this part is shown); or
(3) The highest weight at which compliance with each applicable flight requirement of this part is shown.
(c) Total weight with jettisonable external load. A total weight for the rotorcraft with a jettisonable external load attached that is greater than the maximum weight established under paragraph (a) of this section may be established for any rotorcraft-load combination if—
(1) The rotorcraft-load combination does not include human external cargo,
(2) Structural component approval for external load operations under either §29.865 or under equivalent operational standards is obtained,
(3) The portion of the total weight that is greater than the maximum weight established under paragraph (a) of this section is made up only of the weight of all or part of the jettisonable external load,
(4) Structural components of the rotorcraft are shown to comply with the applicable structural requirements of this part under the increased loads and stresses caused by the weight increase over that established under paragraph (a) of this section, and
(5) Operation of the rotorcraft at a total weight greater than the maximum certified weight established under paragraph (a) of this section is limited by appropriate operating limitations under §29.865 (a) and (d) of this part.


§ 29.27  Center of gravity limits.
The extreme forward and aft centers of gravity and, where critical, the extreme lateral centers of gravity must be established for each weight established under §29.25. Such an extreme may not lie beyond—
§ 29.33 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 maneuver, and is consistent with the kind of governor or synchro

nizer used; and

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

(b) Normal main rotor high pitch limit (power on). For rotorcraft, except helicopters required to have a main rotor low speed warning under paragraph (e) of this section, it must be shown, with power on and without exceeding approved engine maximum limitations, that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition. This must be met by—

1. Appropriate setting of the main rotor high pitch stop;

2. Inherent rotorcraft characteristics that make unsafe low main rotor speeds unlikely; or

3. Adequate means to warn the pilot of unsafe main rotor speeds.

(c) Normal main rotor low pitch limit (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.

(e) Emergency high pitch. If the main rotor high pitch stop is set to meet paragraph (b)(1) of this section, and if that stop cannot be exceeded inadvertently, additional pitch may be made available for emergency use.

(f) Main rotor low speed warning for helicopters. For each single engine helicopter, and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails, 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 a main rotor approaches a value that can jeopardize 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