§ 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, at the most critical combinations of weight and airspeed; and

2. It is possible to prevent over-speeding of the rotor without exceptional piloting skill.

(d) **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.

(e) **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