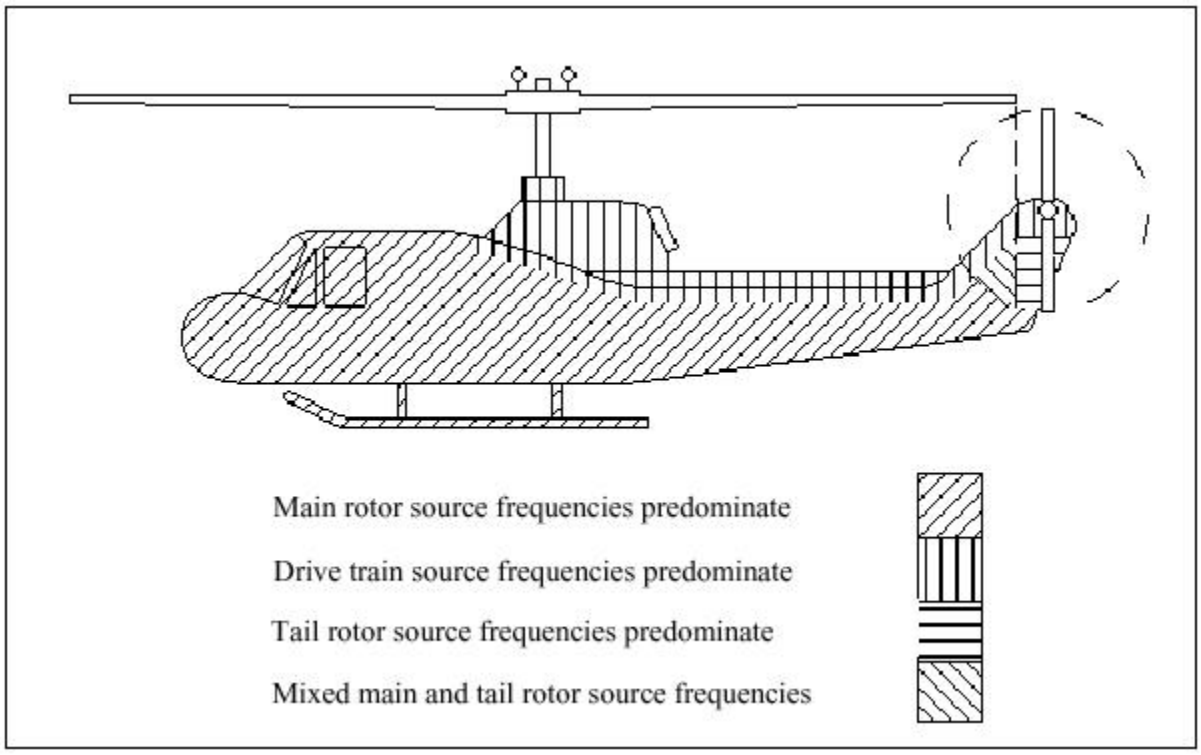
Helicopter Vibration per MIL-STD-810F, Method 514.5 by Tom Irvine



MIL-STD-810F, Figure 514.5C-11. Helicopter vibration zones

MIL-STD-810F, Method 514.5, paragraphs 2.2.6 and 2.3.3 are concerned with the vibration levels that helicopter components and cargo must withstand.

The helicopter vibration environment is a combination of many sinusoidal components due to the main rotor, tail rotor, gearbox, and engine. In addition, there is low-level random due to aerodynamic flow. The April 2003 Vibration Newsletter featured an article on Apache Noise that described these sources in some detail.

The following tables show the main rotor and tail rotor frequencies of typical military helicopters. Sinusoidal vibration occurs at these frequencies, as well as at the blade passing frequencies.

The blade passing frequency is the rotor speed multiplied by the number of blades. Both the main rotor and the tail rotor produce blade passing frequencies. Furthermore, harmonics occur at integer multiples of the blade passing frequencies. MIL-STD-810F specifies component and cargo vibration test levels based on these rotational frequencies.

Note that the frequencies in the following tables are nominal values. MIL-STD-810F, Method 514.5, paragraph 2.3.3, subparagraph b states:

> The dominant sinusoids are generated by rotating components of the helicopter, primarily the main rotor(s), but also tail rotor, engine(s), drive shafts, and gear meshing. The normal operating speeds of these components are generally constant, varying less than five percent. However, recent designs have taken advantage of variable rotor speed control that generates a pseudo steady state rotor speed at values between 95 and 110 per cent of the nominal rotor speed.

	**AH-1 Super Cobra** Attack and Reconnaissance Helicopter Main Rotor Speed = 5.40 Hz 2 Blades Tail Rotor Speed = 27.2 Hz 2 Blades
	**AH-64 Apache** Attack Helicopter Main Rotor Speed = 4.82 Hz (early version) Speed = 4.86 Hz (late version) 4 Blades Tail Rotor Speed = 23.4 Hz (early version) Speed = 23.6 Hz (late version) 4 Blades
	**Little Bird** AH-6J – Armed Variant MH-6H – Utility Variant Main Rotor Speed = 7.80 Hz 5 Blades Tail Rotor Speed = 47.5 Hz 2 Blades

	**CH-47D Chinook** Heavy Lift and Transport Helicopter Main Rotor Speed = 3.75 Hz 3 Blades (Two main rotors, but no tail rotor)
	**OH-6A Cayuse** Light Observation Helicopter Main Rotor Speed = 8.10 Hz 4 Blades Tail Rotor Speed = 27.2 Hz 2 Blades
	**OH-58A/C Kiowa** Light Observation Helicopter Main Rotor Speed = 5.90 Hz 2 Blades Tail Rotor Speed = 43.8 Hz 2 Blades

	**OH-58D Kiowa Warrior** Light Observation Helicopter Main Rotor Speed = 6.60 Hz 4 Blades Tail Rotor Speed = 39.7 Hz 2 Blades
	**Huey UH-1** Utility Helicopter Main Rotor Speed = 5.40 Hz 2 Blades Tail Rotor Speed = 27.7 Hz 2 Blades
	**UH-60 Blackhawk** Multi-mission Helicopter Main Rotor Speed = 4.30 Hz 4 Blades Tail Rotor Speed = 19.8 Hz 4 Blades