Appendix M

AIRWORTHINESS QUALIFICATION REQUIREMENTS

MODAL TESTING

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.
MODAL TESTING

A frequency response/modal survey impact (a.k.a. rap) test shall be conducted on components installed on an aircraft. The components requiring testing shall be those that have not previously flown, have been modified in some form, have had their installations changed, or have had their installation locations changed. Components shall be tested in the longitudinal, lateral, and vertical directions as installation constraints permit. Components that move shall be tested in the extremes of motion, as a minimum. Airframe components not located near drive train components shall be tested, as a minimum, in the frequency range of 0 to 100 (hertz) Hz. Components located near drive train components shall be tested, as a minimum, in the frequency range of 0 to 2 kilohertz (kHz).

The component response frequencies shall not occur within +/-10% of the primary main and tail rotor forcing frequencies. Engineering analysis and judgment shall be used in determining the criticality of each modal frequency placement. Modal frequency placement, amplitude, and damping shall be taken into account in this analysis. Should the response characteristics be determined to be of concern, one or all of the following shall occur:

a) Retain Current Design – If the measured natural frequencies are between a ±3% avoid band and the ±10% avoid band, then engineering judgment is utilized to disposition the findings. No flight test measurements on that item are generally recommended. This disposition process includes, but is not limited to:
   • Determining if the component is flight critical,
   • Evaluation of the actual on-aircraft forcing frequency amplitude,
   • Comparing to rap test data on a similar installation,
   • Modal damping ratio (above 6% is considered sufficient to assure an installation with adequate component life),
   • Exposure duration (less exposure time towards extreme ends of the ±10% band),
   • Amplitude reduction of 35% or more relative to resonance peak at rotor forcing frequency,
   • Visually observe item in flight for excessive vibration relative to its attaching structure.

b) Redesign – Modify the component/structure to move the response frequency away from the forcing frequency, with results confirmed by post-modification rap test.

c) Flight Test – The aircraft will be instrumented and flight tested to determine if the in-flight vibration levels remain within the qualification levels of the unit(s) in question. In general, the flight test profile shall include level flight airspeed sweeps and a rotor speed sweep at one typical cruise airspeed.
- If measured flight test levels are equal to or lower than the unaccelerated vibration qualification test levels, the component installation is considered acceptable.
- If the measured flight test levels are higher than those of the component’s unaccelerated vibration qualification test, then further evaluation of the installation (installation retuning, relocation, risk assumption, etc.) may be required.