AMA: 549/11

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AIRWORTHINESS MANUAL ADVISORY (AMA)

Subject: Amateur-Built Aircraft Noise Emission Control

1. Purpose.

This advisory material provides information on identifying noise sources to aircraft designers, kit manufacturers and builders of amateur-built aircraft.

2. Reference Airworthiness Standards.

Chapter 549, "Amateur-Built Air craft", section 549.11.

3. Discussion.

As stated in Air Navigation Order (ANO) II, No. 21, subsection 5.(3)(b), amateur-built aircraft are specifically excluded from complying with noise standards in order to obtain a Special Certificate of Airworthiness for Amateur-built Aircraft.

Although some countries are studying the need for such standards, Transport Canada does not, at this time intend to impose noise certification for amateur-built aircraft. However awareness of the need to reduce noise emission by designers, builders and operators is strongly sought.

Regulated noise control for amateur-built aircraft may not become necessary as long as these aircraft are not perceived by the public as significant contributors to the environment noise.

Continued awareness of and adherence, by the pilot, to published noise abatement operational procedures particular to his/her aircraft and airfield, and generally a "fly neighbourly" attitude will do much to reduce noise annoyance to ground observers.

4. Noise Control Considerations In Design.

In the design of type certificated aircraft, much consideration is given to identifying noise sources and means to reduce their effect. In the small aircraft category, these considerations have been confined to the propeller and engine. The following are a few potential noise sources given in order of their relative influence on total noise emissions.

(a) *Helical Tip Mach No.* From experience gained with heavy propeller driven aeroplanes and helicopters, the helical tip Mach No. has been identified as generally the dominant noise source. It is directly proportional to propeller/rotor shaft RPM and propeller/rotor diameter, and a small reduction of either of the latter should produce a significant reduction in perceived noise level.

For example a changeover from a two bladed propeller to a slower turning three bladed propeller will reduce helical tip Mach No. and generally reduce overall propeller created noise.

(b) *Blade passage frequency*.

(1) Each propeller blade produces noise and so the addition of blades will increase the noise. On the other hand, noise addition is logarithmic such that two equal noise levels added together will not result in doubling the noise emission but rather increase it only slightly. (For example, a noise level of 80 decibels (dB) combined with another noise level of 80 dB yields 83 dB and not 160 dB). As a consequence, a conversion to a slower turning three bladed propeller will have a greater effect in reducing noise by reducing helical tip Mach No. at the expense of a smaller increase in noise due to the increase in blade passage frequency.

(2) For rotary-wing aircraft, the influence of the main rotor as a noise source is usually much more dominant than the tail rotor. However, it is observed that during some manoeuvres, depending upon the location of the ground observer with respect to the rotorcraft, the tail rotor becomes dominant. This is recognizable as the tail rotor noise has a high frequency characteristic as compared to the relatively low frequency signature of the main rotor. Another phenomenon known as main rotor "blade slap", occurring during manoeuvres and during landing approaches, is particularly annoying. The above noise characteristics are common to all helicopters and for the designers of amateur built aircraft there may be little guidance available on means to reduce them other than to consider options available with respect to helical tip Mach No., shaft RPM, number of blades and blade shape. Trial and error methods will be necessary to optimize rotorcraft design with respect to performance and perhaps with some noise reduction.

(c) Blade shape and pitch. Blade shape and pitch are chosen for performance considerations and the noise reduction considerations must remain secondary. There are no general guidelines for noise reductions but rather the designer should experiment with various propeller designs. Constant speed propellers generally are quieter but cost and weight considerations remove them from the reach of most amateur aircraft builders.

(d) Engine RPM. A reduction in engine RPM will make a significant reduction in noise emissions. On the other hand, the engine noise often will be masked by the higher level noise emissions created by the propeller.

Generally speaking, a four stroke piston engine is quieter than an equivalent two stroke design, the latter of which gives a pronounced tonal characteristic.

(e) Exhaust noise. For piston engines, the introduction of efficient exhaust systems (mufflers) has greatly reduced this noise source to an acceptable minimum.

On the other hand for aircraft employing gas turbine engines, the exhaust noise is a dominant noise source. Designers/builders should consult with engine manufacturers about the feasibility of installing some form of acoustic treatment (hush kits) around the compressor and turbine cases and particularly around the exhaust nozzle.

(f) Transmission and Gearbox Noise. With the possible exception of rotorcraft, transmission noise is not normally significant to the ground observer. Transmissions and gearbox noise sources, while being considered for cabin noise reduction, are not considered dominant for the ground observer and can generally be ignored. If however, significant noise emissions are observed originating from either the transmission or gearbox and some form of acoustic liner is feasible to install, this should be considered.

(g) Airframe Noise. Airframe source noise is not recognized as a significant noise source for small aircraft and may be ignored.

5. Noise Control Considerations In Operation.

Pilots are reminded that while aircraft design is a significant factor, major contributors to effective noise control are the operational procedures.

Unnecessary low-flying, particularly at high power, near populated areas is not only dangerous, it is considered poor etiquette.

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