Public Reaction to Low Levels of Aircraft Noise

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In several recent instances, community annoyance has resulted from noise of airplanes flying at relatively high altitudes (or relatively far from airports). In none of these instances did the noise levels involved meet the usual criteria for community annoyance or interference with individual activity, either in terms of time-averaged noise levels or single-event noise levels. Five basic concepts are presented on which criteria may be established for assessing intrusiveness of low noise levels generated by aircraft in remote, quiet locations.

In several recent instances, community annoyance has resulted from noise of airplanes flying at relatively high altitudes (or relatively far from airports). For example, as the result of changes in flight patterns associated with the major New York airports, public complaints have arisen about airplane flights over northern New Jersey, even though in many instances the airplanes were flying at 15,000 ft or higher. Troublesome noise levels on the ground may also be generated by the new, swept-blade, advanced turboprop airplanes when flying at cruise altitudes of 30,000 ft or higher (*1*). Complaints about aircraft noise over national parks and wilderness areas have resulted in a Congressional requirement to measure these noises and determine their severity (Public Law 100–91, August 1987).

In these instances, the noise levels involved did not meet the usual criteria for community annoyance or interference with individual activity, either in terms of time-averaged noise levels or single-event noise levels. A better understanding of intrusive effects of low levels of aircraft noise is needed, specially in areas of relatively low ambient noise. In particular, practical criteria are needed for improving analyses of effects of changes in air traffic patterns, setting noise standards for airplanes at cruise altitudes, and assessing aviation noise impacts and minimum overflight altitudes for national parks.

ALTERNATIVE APPROACHES

Normally, the first approach to this type of issue would include a social survey to identify the extent of noise annoyance under the conditions presented. However, such an undertaking would be extremely complex and costly and would require an extensive effort and a considerable length of time to conduct properly. Schultz (*2*) observed that "for noise sources with A-weighted levels below about 65 dB, community annoyance reactions are quite variable and do not appear to be sufficiently strongly related to level of noise exposure to support confident prediction of annoyance or activity interference." Instead of extensive research, therefore, some guidelines that are already available may be used to reach a practical conclusion. Five basic concepts from which criteria may be established for assessing low-level aircraft noise in remote, quiet locations are described in the following paragraphs.

Because the public is little aware of civil airplanes flying at cruise altitudes today, even in quiet locations, the first concept is the flyover noise level of current turbofan airplanes. Few measurements of such noise-producing events are available, but unpublished FAA measurements indicate maximum A-weighted sound levels of 45 to 50 dB for flight altitudes of 30,000 to 35,000 ft above mean sea level. Thus, 50 dB would be considered an acceptable threshold of aircraft noise impact in remote locations. However, a higher level might also be acceptable.

The second concept (based on signal-to-noise ratio) would permit as an acceptable intrusion a maximum noise level of no more than, say, 10 dB above background level. For ambient A-weighted sound levels of 30 to 40 dB typical of remote areas, an acceptable A-weighted aircraft noise level would then be 40 to 50 dB.

However, both concepts address single-event noise levels and ignore the effects of repetitive occurrences. The third concept is based on a time-averaged measure of aircraft noise, such as day-night average sound level (DNL, symbolized L_{dn}). In the 1974 EPA Levels Document (*3*), a DNL of 55 dB was identified as acceptable for remote areas, described as "outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use." In fact, at many of the locations in northern New Jersey from which complaints about changed air traffic patterns were registered, the DNL measured was consistently less than 55 dB. If an average of 100 daily overflights is assumed, the mean sound exposure level (SEL) corresponding to a DNL of 55 dB for these overflights would be 85 dB, with a corresponding maximum A-weighted sound level of about 75 dB. This value is substantially higher than the noise levels currently created by high-altitude airplane flights.

The 1974 EPA Levels Document (*3*) also suggested the use of corrections to normalize DNL to account for different non-acoustic factors that could influence public reactions to noise. An empirical adjustment of 10 dB was suggested for situations involving a "quiet suburban or rural community remote from large cities and from industrial activity and trucking" (*3,4*). This adjustment suggests an acceptable exterior DNL threshold of 45 dB for remote areas. Again for 100 daily overflights, this condition would impose a limiting mean SEL of 75 dB,

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or a maximum A-weighted sound level of about 65 dB. This value also seems too high to be useful.

As a fifth concept, a threshold DNL not to exceed the ambient DNL could be established. Again, a typical ambient DNL of 30 to 40 dB in remote areas would be reasonable. For 100 daily overflights, this range corresponds to maximum A-weighted sound levels of 46 to 58 dB. These levels are generally consistent with current experience.

SUGGESTED GUIDELINE

Thus, as a reasonable recommendation, aircraft-related DNL should not exceed the ambient DNL as a threshold for aircraft noise intrusion in quiet areas remote from an airport. Because such a guideline inherently requires that the ambient DNL must be measured (or estimated accurately) in those areas in which low levels of aircraft noise are evaluated, this requirement may present some difficulty in its implementation.

VALIDITY OF A-WEIGHTED AND DNL MEASUREMENTS

It must be emphasized that the preceding discussion is appropriate only for remote areas away from airports. DNL remains the best measure of noise impact near airports and should continue to be used for assessing land-use compatibility (*5–7*).

Because of the greater atmospheric attenuation of higher frequencies, the noise spectra from high-altitude airplanes are dominated by lower-frequency sounds. Consequently, A-weighted sound level may not be the most representative metric for evaluating these noises. In a recent project in which the taped noise histories of 24 aircraft flyovers at altitudes of 7,000 to 15,000 ft above mean sea level were correlated, maximum A-weighted sound levels were compared with a number of other possible metrics (*8*). The A-weighted sound level correlated closely with all the other metrics, including the so-called "detectability level" (*9*). Hence, there would be no significant advantage in using any one metric over the others. In particular, A-weighted sound level remains entirely appropriate as a metric for assessing the effects of low levels of aircraft noise.

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