

**ACRP Problem Statement: 16-02-29**

**Recommended Allocation: --**

***Alternative Noise Metrics for Addressing Aircraft Annoyance***

**ACRP Staff Comments**

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**TRB Aviation Committee Comments**

ENVIRONMENTAL IMPACTS OF AVIATION (AV030): The proposed research topic is of interest. Reviewers noted this could be helpful to a wide range of airports and to the evaluation of policy about metrics other than DNL.

**Review Panel Comments**

Not recommended. This is a good research topic; however, its undertaking should wait until the completion of FAA's national community annoyance survey.

## Alternative Noise Metrics for Addressing Aircraft Annoyance

**Background:** Community annoyance associated with aircraft noise is a key concern in the understanding of how aircraft noise affects people and the development of aviation noise policy. In the years since the 1950s a veritable alphabet soup of metrics has been studied. The seminal work by Schultz published in 1978 drew a correlation between transportation noise exposure levels in decibels of average DNL and the percent of the population highly annoyed by that transportation noise. Schultz' work was re-affirmed by the Federal Interagency Committee on Noise (FICON) in 1992. In reviewing human response to noise, the conclusion was that DNL was the metric of choice. The problem is that use of DNL is often criticized by the communities around airports as not representing adequately the effect of noise on those communities. This concern is exacerbated by the observation that many, if not most, noise complaints at some airports are from people living well outside the 65 DNL contour.

Clearly the problem with describing the extent of aircraft noise impact is more than just the metric but the noise level associated with that metric. This problem statement was written to address only the issue of whether DNL is the best metric to use in aviation noise policy, including whether it should be replaced or supplemented with other metrics.

**Objective:** The proposed research includes an updated review of aviation noise metrics, taking into account research synthesized by Schultz and FICON, and research conducted in the last 20 years (since FICON). While this study is focused on metrics to measure annoyance, recent studies on sleep interference have focused on single event noise metrics as the better measure of how noise affects sleep. A review of noise effects on classrooms and physiological effects should be reviewed as well, as community reported annoyance may be correlated to these other effects and communities often cite them as community wide concerns. The goal is to present an updated summary of which noise metrics best correlate noise dose to the critical effects of annoyance, sleep disturbance, physiological responses and classroom effects.

The anticipated outcome of this project would be to improve aircraft noise management and public perception by understanding the relationship between different airport operations today and community response through the review of noise dose response studies completed in the last two decades.

**Research Proposed:** This problem statement for an ACRP project proposal would seek to compare alternative noise metrics beyond DNL. The research should review 'noisiness' based metrics and well as 'loudness' based metrics. The research should review single event, cumulative, equivalent, and maximum based metrics, as well as the time- and frequency-weightings used in the alphabet soup of metrics, including the time- and number-above metrics developed more recently.

The research should begin with a study design, drawing on a review of the literature available that addresses the relationship between aircraft noise levels and annoyance, and includes a review of metrics used to study other effects and those proposed in recent European Union standards and guidelines. The research should include a comparison of metrics in terms of purpose, computational

basis (in layman's terms as well as frequency weighting, time weighting, time averaging, etc.), and list the advantages and disadvantages of each in terms of rating annoyance. The comparison should include comments such as those that might be said for single event metrics, i.e., represents an individual immediate response to a noise event and is insensitive to number of events. It shall be part of the research project to develop the structure of this comparison matrix.

It is not a part of the project to determine the appropriateness of a specific noise level policy, such as 65 dB, only the metric itself is to be studied here.

**Estimated Funding:** The primary costs associated with this research effort are those of conducting extensive literature reviews and documents used in other countries that have more recently addressed aviation noise policy issues, and developing an extensive comparison matrix. The estimated funding is \$400,000.

**Estimated Research Period:** We believe the time necessary to complete the effort will be 12 months, including periods for review by the project panel of the study design, and the results.

**Urgency and Payoff Potential:** The FAA is embarking on a road mapping process for aviation noise policy. This work would contribute directly to that effort. This work would lead to resource materials on what is the best metric in isolation from what is the best level to use for aviation policy. It may ultimately lead to the use of a multi- or single-metric directed policy.

**Related Research:** There is much literature on this topic developed over at least the last 60 years. There are certain key documents that address the definition of, use, and applicability of various noise metrics. These include, but are not limited to:

- Schultz, T. J. (1978). "Synthesis of social surveys on noise annoyance," J. Acoust. Soc. Am. 64(2), 377–405.
- Federal Interagency Committee on Noise (FICON) (1992). Federal Agency, Review of Selected Airport Noise Analysis Issues, Report for the Department of Defense, WA, DC., pp. 1–192.
- Mestre, V., Schomer, P., Fidell, S., and Berry, B. (2011). "Technical support for Day-Night Average Sound Level (DNL) replacement metric research," Report Number: DOT/FAA/AEE/2011-02, [https://www.faa.gov/about/office\\_org/headquarters\\_offices/apl/research/science\\_integrated\\_modeling/noise\\_impacts/media/6-14-2011\\_FinalReport\\_Metrics](https://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/noise_impacts/media/6-14-2011_FinalReport_Metrics), Mestre\_etal\_061411\_part1.pdf, 34-46.
- Pearsons, K., and Bennett, R., (1981) "Handbook of Aircraft Noise Metrics", NASA CR 3406, U.S. Department of Commerce, National Technical Information Service, N81-21871.
- Wyle Laboratories (1971), Supporting information for the adopted noise regulations for California Airports, Final Report to the California Department of Airports, Report No. WCR 70-3(R), January 1971.
- EPA (1974), Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety, U.S. Environmental Protection Agency, March 1974.

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**Process Used to Develop Problem Statement:** The problem statement was developed by the two individuals indicated under Section VIII, subsequent to online webinars conducted by ACRP staff and their contractors as a follow up the TRB Annual Meeting/Development of ACRP Problem Statements.

This problem statement follows the results of discussions held at FAA workshops to generate a research roadmap addressing critical aircraft noise impacts research needs. The draft statement was circulated among interested parties and revised based on group comment.

**ACRP Environmental Problem Statement Development Panel Comments:** Not supported at present. This research should wait until FAA's annoyance research is further developed.

**Person Submitting Problem Statement:**

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