What is Noise?

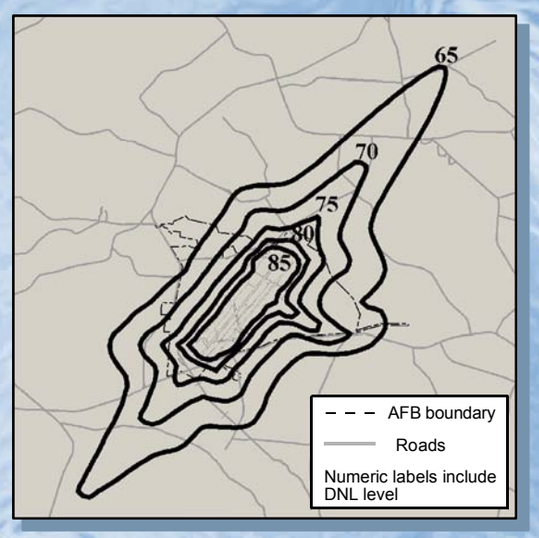
The words 'noise' and 'sound' both relate to hearing and can be used interchangeably. The difference is we typically refer to 'sound' when discussing something pleasant such as music, and 'noise' when discussing something unpleasant, unwanted, or undesired. When aircraft fly overhead at low altitudes, many people consider it annoying and refer to what they hear as "noise." This "noise" can interrupt an activity whether it is disturbing the peace and/or quiet, interfering with communication, or disrupting sleep.

Why and When Does the Air Force Evaluate Noise?

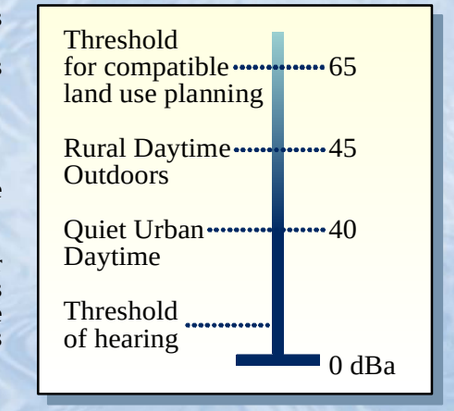
The Air Force evaluates aircraft noise so they know how their flight operations affect land uses, humans, animals, and structures. The results of noise analysis are primarily used by two programs: the Air Installation Compatible Use Zone (AICUZ) program and the Environmental Impact Analysis Process (EIAP).

The AICUZ program applies specifically to the installation vicinity. Evaluations occur on a 2-year cycle or when a change in the airfield or airspace noise environment is anticipated as a result of new or revised flight activity. With this program, noise levels from daily aircraft operations are calculated over a 24-hour period and presented as day-night average sound level or DNL (mathematically denoted as L_{dn}) in the form of noise contours.

The noise contours are used in conjunction with land use guidelines to assist local, regional, state, and federal officials in protecting public health, safety, and welfare by promoting compatible development adjacent to the installation. Adoption of AICUZ recommendations by local communities helps to protect the installation's flying mission and future capabilities.



Noise evaluated during the Environmental Impact Analysis Process applies to installations as well as military training ranges and airspace. A noise analysis occurs when the Air Force proposes a change in aircraft and/or operations. During the analysis process, noise levels are used as one of the gauges to measure the significance of changing the type and/or number of aircraft overflights. The results help Air Force leaders inform the public of potential noise impacts and assists in the decision-making process for proposed operational changes.



What does an assessment of military aircraft noise include?

When the Air Force assesses aircraft noise they must first characterize the existing noise environment. This includes identifying the types of aircraft flying in the area, how often they fly, and at what altitude and airspeed. These parameters are used as input to computerized noise models that produce various noise metrics. The most common metrics are DNL, DNL_{mr} (or L_{dnmr}), SELs (sound exposure levels), and L_{max} (maximum noise levels).

DNL represents daily aircraft operations averaged over a 24-hour period with a 10-decibel penalty to flights occurring between 10 p.m. and 7 a.m. to account for the added intrusiveness during these hours (*note*: in California, CNEL [or community noise level] adds a 5-decibel penalty to flights occurring between 7 p.m. and 10 p.m.).

DNL_{mr} is similar to DNL but incorporates an additional penalty of up to 11 decibels to account for the startling effect caused by aircraft flying at low-altitudes and high speeds.

SEL and L_{max} are metrics used to describe the sound level of one aircraft overflight; both are determined by aircraft power, altitude, and airspeed and its distance from the receiver.

Noise metrics are used to measure the potential effects of an Air Force action on humans, wildlife and domestic animals, and noise sensitive areas such as critical habitats, national wildlife refuges, parks, national forests, historic structures, and others. Computerized, geographic information systems as well as other data are used to identify these receptors and the existing and proposed areas of influence are delineated and examined for noise effects. Once the areas of influence are identified, noise effects are characterized based on existing and proposed overflight changes and the resources potentially affected.

These resource areas are examined, changes are compared, and in turn, the significance of the proposed change is then determined. The specific metric (e.g., DNL, DNL_{mr}, SEL) used for analysis is determined by the resource being analyzed.

What resources are analyzed?

Noise is presented as an individual resource area in an environmental analysis; however, because noise affects many resources it is also presented in specific resource areas such as land use, cultural resources, biological resources, and environmental justice. When a noise analysis is conducted as part of the environmental impact analysis process, the analyst determines how the change in noise levels affects humans, animals, and/or structures in the vicinity of the airfield and beneath military airspace.

What is the focus of Air Force noise analysis?

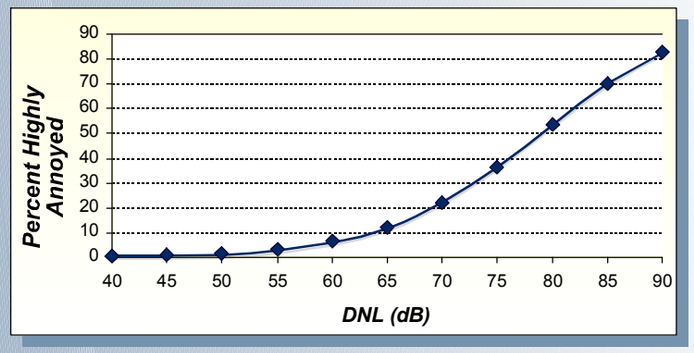
Air Force noise analyses evaluate both the cumulative and individual effects of noise on specific resources. The metric used depends on the resource evaluated.

DNL is the most common metric used to evaluate noise effects on humans. Its use was recommended by the Environmental Protection Agency in 1974. After social surveys and other scientific studies, DNL was adopted by the Federal Interagency Committee on Urban Noise (FICUN) in 1980 as the most appropriate metric for predicting cumulative human effects. DNL is used by all federal agencies (Department of Defense, Federal Aviation Administration, Department of Transportation, etc.) for predicting human annoyance and other potential noise effects to humans.

DNL rules of thumb…

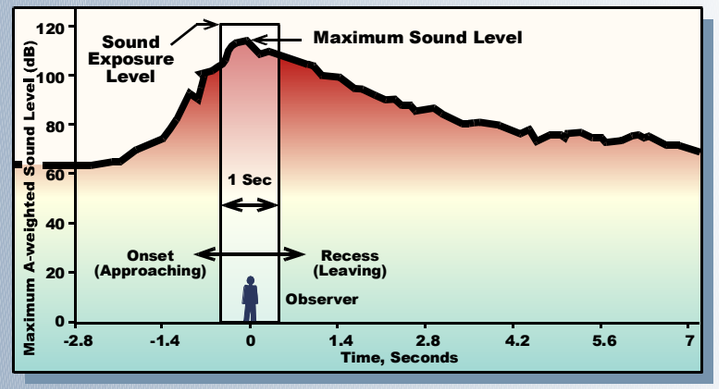
- Doubling the number of operations at an installation yields an increase in DNL of approximately 3 decibels.
- In terms of cumulative DNL, one operation occurring during environmental night has the same impact as 10 daytime operations.
- Noise sources 10 decibels less powerful than the dominant noise source, will have little to no effect on the total DNL.
- Low-altitude, high speed flights have a startling effect that can add a penalty of up to 11 decibels.

DNL is the energy average of all noise events that occur during a 24-hour period—it is not the sound level heard at any given time. It is more reliable than individual sound levels when analyzing noise effects because it allows the analyst to take into account the entire exposed population rather than a few individuals. The percentage of the population annoyed is based on community surveys of noise annoyance; most commonly referred to as the Schultz Curve (Schultz 1978). The curve was updated in 1994 (Finegold *et al.*) showing only minor changes from the original curve.



Cumulative noise levels in military airspace are presented using DNL_{mr}, which is defined as an "onset-rate" adjusted monthly DNL. DNL_{mr} is used in a similar manner to DNL when assessing noise impacts in military training areas.

Sound exposure levels (SELs) are a measure of the total physical energy of a single noise event, which takes into account both intensity (loudness) and duration. SELs are used as an indicator of activity interference for humans and for impacts to domestic animals and wildlife. L_{max} is also presented for comparison purposes and represents the peek noise level of a single event.



Some aircraft operations may result in structural vibrations and, in extreme cases, structural damage. Damage may be associated with sonic booms produced by supersonic operations or overpressures and is denoted as CSEL or CDNL.

What tools are used to conduct the analysis?

The Department of Defense has various approved computerized models that assist in analyzing aircraft noise impacts including NOISEMAP, MR_NMAP, BOOMAP, PCBOOM, and CORBOOM.

NOISEMAP is the primary tool for evaluating military aircraft noise in the vicinity of a military installation. NOISEMAP predicts noise exposure based on aircraft flights and maintenance activities occurring during an average busy day. NOISEMAP also generates reports that provide the analyst with the primary contributors to the overall DNL at any given location.

MR_NMAP, known as Military Operations Area (MOA) Range NOISEMAP, calculates noise levels under special use airspace such as Restricted Areas (RAs), MOAs, Military Training Routes (MTRs), and Ranges. This program produces noise level data in table format and contours; the data are then used to analyze effects in EIAP documents.

In conclusion . . .

Noise analysis is a very important part of the environmental impact analysis process. The Air Force strives to present aircraft noise information in a detailed, yet accessible manner for the public. More information about noise analysis and metrics can be found by visiting www.a7zpintegratedplanning.org and reviewing the noise appendix in EIAP documents (*e.g.*, F-22 Initial Operational Wing Beddown EIS, Appendix AO-2). For assistance or any questions about noise analysis, please contact:

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Aircraft Noise
An Environmental Perspective

The Air Force's mission is to defend the United States and protect its interests through aerospace power. To fulfill this mission Air Force pilots require continuous, realistic training in offensive and defensive flight maneuvers and weapons delivery. Aircraft noise resulting from this training is of special concern for the Air Force because it is not confined to a specific area and has the possibility of affecting humans, animals, and structures wherever aircraft fly. The purpose of this brochure is to assist the general public in understanding basic information about how noise studies are used to characterize the noise environment and support community relations.