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Subject:	Additional Guidance on Developing Helicopter Noise Source Data for AEDT *{DRAFT}*	Date:	October 18, 2019
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1 Introduction

The following document provides guidance on methods for creating aircraft source noise-power-distance data (NPDs) using the 14 CFR Part 36[1,2,3]/SAE-AIR-1845[4] Simplified Process for A-weighted and PNL/PNLT Noise Metrics, specifically tailored for developing helicopter NPD data. An outline of the process is presented in Figure 1.

[1] Code of Federal Regulations, Title 14: Aeronautics and Space, Part 36 - Noise Standards: Aircraft Type and Airworthiness Certification

[2] Advisory Circular, Noise Standards: Aircraft Type and Airworthiness Certification, AC N0: 36-4D, 2017.

[3] *AC N0: 36-4D* and *14 CFR PART 36* are often used interchangeably in this document.

[4] SAE International, Committee A-21, Aircraft Noise, Procedure for the Calculation of Airplane Noise in the Vicinity of Airports, Aerospace Research Report No. 1845, Warrendale, PA: SAE International, September 1995.

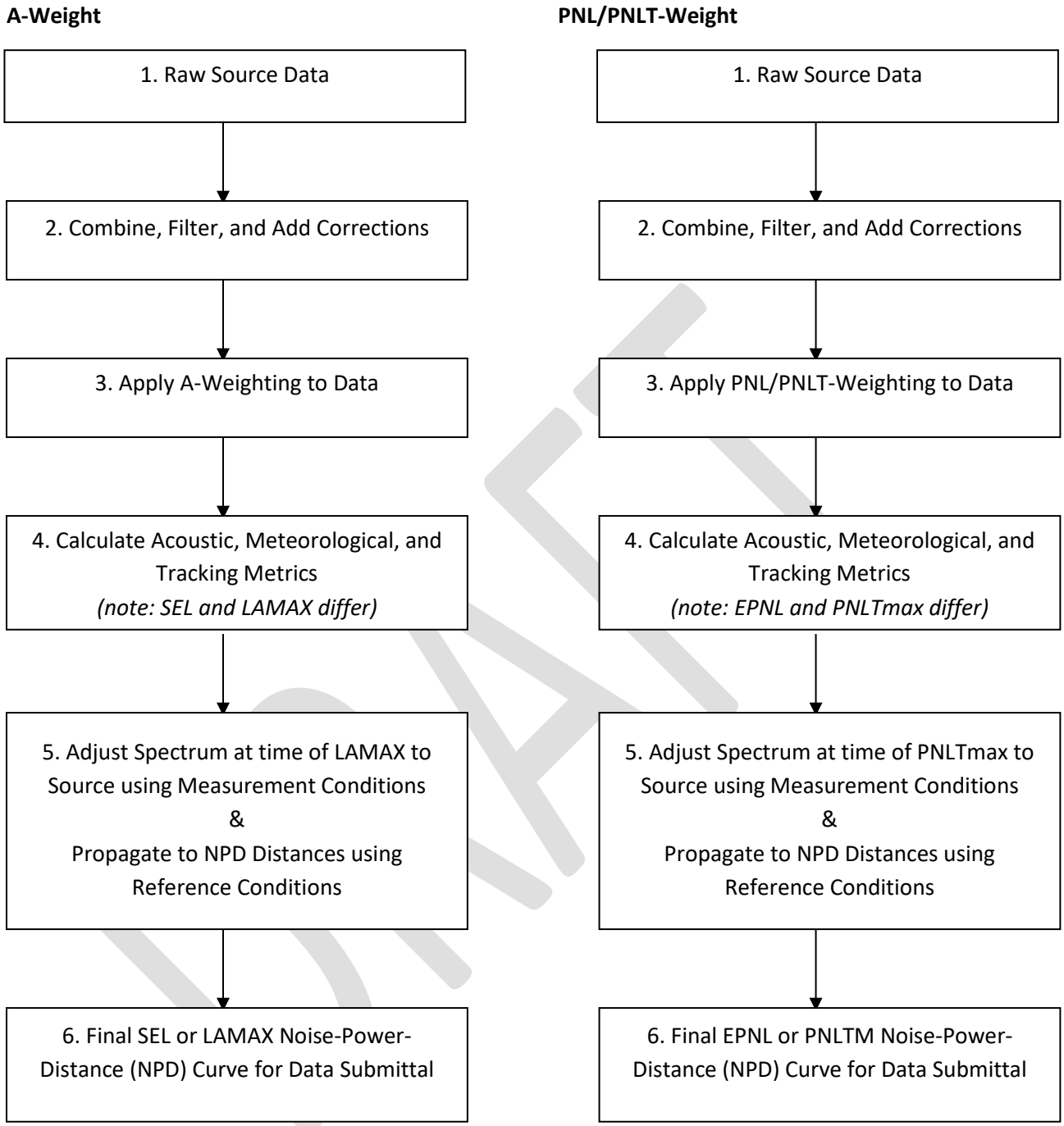

Figure 1. Steps for creating NPD curves using the 14 CFR Part 36/SAE-AIR-1845 Simplified Process for A-weighted and PNL/PNLT Noise Metrics

2 Raw Source Data

This is the raw data collected in the field according to 14 CFR PART 36. This will include measured noise data for each dynamic operation (departure, approach and level flight), including data from left, center and right measurement positions, representative of 45, 90 and -45 degree elevation angles, respectively. This should also include measured data for each static operation (ground idle, flight idle, hover in ground effect, and hover out of ground effect) collected directly in front of the helicopter (0 degrees) at a nominal distance of approximately 200 feet and at locations representative of multiple directivity angles around the helicopter. At a minimum, data should be collected at 45-degree increments around the helicopter; however, AEDT will accept data in 15-degree increments).

3 Combine, Filter, and Add Corrections

The first step is to synchronize and combine all data types into a format where each record contains acoustic, meteorological, and tracking information pertaining to that record. Once the data are combined into one file it will allow for the easy identification and elimination of erroneous or corrupt data. Erroneous or corrupt records should be filtered out of the data.

The tracking system must comply with section H36.103, H36.105, and H36.107 of 14 CFR PART 36. Acoustic data must be obtained with acoustical equipment that complies with section H36.103 of 14 CFR PART 36. In addition, data should be check for any erroneous or corrupt data according to the equipment manufacturers' recommendations (both tracking and acoustic instrumentation).

Corrections should be applied to the data to account for the physical effects of the microphone and windscreen along with any correction for calibration drift. The microphone and windscreen corrections can be derived from the response curves provided by the manufacturer or by a laboratory that provides calibration traceable to national standards. These corrections should be applied to the spectral data.

Meteorological data tolerances can be seen in Table 1. Data measured outside of these tolerances should be filtered out.

Table 1. Meteorological Condition Requirements for Helicopters

Data Type	Measurement Units	Tolerance
Barometric Pressure	Millibars	800 to 1,100 mB
Temperature	°C	-10 to 35 °C
Relative Humidity	Percent	20 to 95%
Atmospheric Absorption	dB/100m	12 dB/100m
Wind Direction	Degrees	5 degree error
Average Cross-wind Speed (averaged over 30 seconds)	Knots	< 5 kt
Average Wind Speed (averaged over 30 seconds)	Knots	< 10 kt
Maximum Instantaneous Wind Speed	Knots	< 15 kt
Maximum Instantaneous Cross-wind Speed	Knots	< 10 kt

4 Apply Weighting

There are two types of weighting used in generating NPD curves, A-weighting and PNL/PNLT corrections. Each will have to be handled as follows:

Apply A-Weighting to Data

A-weighting is curve of set values that are applied to each record of 1/3 octave frequency band. This process is described in detail in ANSI S1.42-1986, American National Standard Design Response of Weighting Networks for Acoustical Measurements.

Apply PNL/PNLT Correction to Data

The PNL is Perceived Noise Level and PNLT is Perceived Noise Level corrected for spectral irregularities, and for duration. This process is described in detail in 14 CFR PART 36 section A36.4, Calculation of Effective Perceived Noise Level From Measured Data.

5 Calculate Acoustic, Meteorological, and Tracking Metrics

After the data has been adjusted and weighted the next step is to calculate acoustic (see Table 2), meteorological (see Table 3), and tracking (see Table 4) metrics for each event.

An event will refer to time encompassing the data that is with the 10 dB down point on each side of the maximum level.

Table 2. Acoustic Metrics

Metric	Weighting Used For	Description
LAMAX	A	This is the maximum A-weighted value for an event.
SEL	A	Sound Exposure Level is the total noise energy produced from a single noise event.
Max Spectra	A & PNLT	This is the maximum un-weighted spectra associated with LAMAX or PNLTmax.
PNLTmax	PNLT	This is the maximum PNLT-weighted value for an event.
EPNL	PNLT	Effective Perceived Noise Level is a single number evaluator of the subjective effects of airplane noise on human beings.

Table 3. Meteorological Metrics

Metric	Description
Temperature	Average temperature averaged over the event
Humidity	Average humidity averaged over the event
Average wind speed	Average wind speed averaged over the event
Average cross wind speed	Average cross wind speed averaged over the event

Table 4. Tracking Metrics

Metric	Description
Aircraft distance from microphone	Distance between the aircraft and microphone at time of LAMAX or PNLTmax
Aircraft Speed	Aircraft speed at time of LAMAX or PNLTmax

6 Adjust to Reference Conditions & Extrapolate to NPD Distances

The acoustic, meteorological, and tracking metrics for each event are now used to calculate NPD data for each event and each metric for each measurement location (left, center, right). This process is described in detail in SAE Aerospace Information Report "Procedure for the calculation of airplane noise in the vicinity of airports," SAE AIR 1845 for A-weighted NPDs (SEL and LAMAX), and can be modified for calculating tone-corrected NPDs (EPNL and PNLTmax). For each noise metric and each event, the corresponding acoustic data (level and spectrum, see Table 2) are propagated back to the source using the event-specific aircraft tracking information (distance and speed, see Table 4) and meteorological conditions (temperature and humidity, see Table 3), adjusting for spherical spreading, distance duration, time-varying aircraft speed, and atmospheric absorption in accordance with the methodology presented in SAE-AIR-1845. These source data are then extrapolate out to the standard 10 distances used in AEDT using reference meteorological conditions and the aforementioned adjustments (including an operation-specific reference speed). The result from this process is an event-specific and metric-specific NPD curve (and measurement location specific for dynamic operations).

7 Final Data Submittal

Final processed data should be submitted for inclusion in AEDT using the data submittal form in Section 11.2.3 of the AEDT 3b Technical Manual (Section 11.2.3.1 for fixed wing aircraft, and 11.2.3.3 for helicopters).

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