



U.S. Department
of Transportation
Volpe National
Transportation
Systems Center

Aircraft Noise Certification Software & Methodology Validation / Audit Data Submittal Instructions

Each applicant should provide the following data:

1. **General information:**
 - a. Formal name of applicant organization
 - b. Applicant address
 - c. Technical Point-Of-Contact (POC) name
 - d. POC Title
 - e. POC Organization
 - f. POC email
 - g. POC phone
 - h. Source of validation dataset (aircraft tested)
 - i. EPNL Software Version ID
2. A **flow diagram and/or description** of measurement, analysis and adjustment systems used for obtaining EPNL values reported to certifying authorities, including system characteristics, processing sequence and general & specific methodology. Please identify which software modules / sections perform each individual portion of the process.

(Software Validation Data Submittal Form 1 should be completed.)

3. An uncorrected, contiguous, one-third octave band **SPL time-history of measured aircraft noise** for each event (ANSI/ISO bands 17-40, nominal center frequencies of 50 Hz to 10 kHz, inclusive, with records fully-encompassing the EPNL noise duration, the limits of which are defined as the 10 dB-down points in the PNLT time-history). The following should also be included:
 - a. Analysis start time (based on the common time base used to synchronize acoustic, tracking, and meteorological measurements) for each event. Note that this start time should be the time at which the one-third octave analysis was triggered, not the time at which the first spectrum of one-third octave SPLs was output;
(See Figure 2.)

- b. Type of time-averaging (linear/slow exponential)
 - c. Individual “timestamp” for each output spectrum. (Note that the nature of such timestamps should be identified – if the timestamps are associated with the time at which a spectrum was output from the analyzer, then the timestamp should be characterized as “end”; if the midpoint of the interval between consecutive spectra is used, then the timestamp should be characterized as “mid”; if slow timing is implemented in the analyzer and Part 36 timing has been applied (0.75 seconds prior to the time at which a spectrum is output from the analyzer), then the timestamp should be characterized as “slow”.
- 4. A one-third octave **spectrum of SPLs** representing the **average pre-detection noise**, including the ambient noise conditions at the test site, and active electronic instrumentation noise floor (one for each event and site combination submitted).
 - 5. A one-third octave **spectrum of SPLs** representing the **post-detection noise** at the sensitivity settings at which the individual event was processed (one for each event/site/system combination submitted). Note that post-detection noise is non-additive, and represents minimum levels below which measured values should be considered to be not valid.
 - 6. **Meteorological data** (i.e., temperature and relative humidity) versus altitude and time (per event) as used in processing for determining average test day speed of sound, atmospheric absorption, etc. A description of the meteorological data should be supplied, specifying any post-processing that was performed (such as smoothing, layering, time interpolation, or altitude extrapolation) on the measured data prior to reporting. At a minimum, the temperature and humidity measured at 10 meters and at aircraft height should be supplied for each event. Also, provide the temperature used to obtain test-day speed of sound for determination of propagation times.
 - 7. Aircraft position and performance data (**TSPI - Time Space Position Information**) for each event, including XYZ coordinates referenced to the centerline microphone location. A description of the tracking data should be supplied, specifying any post-processing that was performed (such as smoothing, curve-fitting, straight-line approximation, etc.) on the measured data prior to reporting. A time history of TXYZ values is preferred. At a minimum the following data should be supplied:
 - a. Aircraft height overhead or abeam of the microphone [**Z_{OH}**], and units
 - b. Time at overhead (or abeam) [**T_{OH}**]
 - c. Average ground speed [**V_G**] over the noise duration, and the units used (knots, feet per second, etc.)
 - d. Average climb/descent angle (Gamma) [**γ**] over the noise duration, in degrees
 - e. Average ground-track horizontal cross-angle (Chi) [**χ**] relative to the reference flight track on the ground, over the noise duration, in degrees(See Figure 1.)

Also, any additional elements used in the calculation of propagation distance [SR], emission time [t_E], or emission angle Theta [θ], (such as yaw or pitch) should be specified, as well as the processes used to apply them.

(Software Validation Data Submittal Form 2 should be completed.)

8. Any **corrections** applied to the raw one-third-octave-band spectral aircraft noise data, including:
 - a. **System corrections** for deviation from flat frequency response (based on pink noise, swept-sine, or discrete-sine tone testing)
 - b. **Microphone pressure-response and free-field sensitivity corrections** (including incidence-dependent corrections over a range of angles, if applicable)
 - c. Microphone **wind screen insertion-effects corrections**
 - d. Field **Calibration “drift” correction**
 - e. **Environmental corrections to Calibrator output level**, such as those for pressure, temperature, humidity, and coupler volume.
 - f. **System gain-change correction**, for intentional differences in system sensitivity between calibration and aircraft noise measurement.
 - g. **Other corrections**, such as bandwidth error corrections, if applied (note that justification for such corrections will also be required.)
9. If used, a **description of computer averaging applied to linear SPLs** to achieve slow exponential time-averaging after analysis, including type of averaging and values for weighting (e.g., four-sample weighted logarithmic averaging with coefficients of n_1 , n_2 , n_3 , and n_4).
10. A **description of any adjustment process** used to adjust the acoustic data for **background noise effects**, including:
 - a. Determination of masking criteria
 - b. Adjustment for effects of pre-detection noise
 - c. Type of reconstruction used for masked, high-frequency bands (e.g., frequency and/or time extrapolation utilizing atmospheric absorption, fixed-rate dB per one-third octave-band sloping, etc.)
 - d. Handling of masked low frequency bands
 - e. Identification of masked/sloped bands
 - f. Identification of records containing too many masked bands to be processed
11. If reconstruction is performed using time and/or frequency extrapolation, or if the Integrated Procedure is used for adjustment to reference conditions, provide a **time-history of processed aircraft noise geometry**. This should include: TXYZ emission coordinates, sound emission angle, and sound propagation distance at time of emission for each spectrum within the noise duration. Otherwise, such noise geometry information should be provided for at least the PNLTm record (k_M).

12. If atmospheric layering is performed, a table of **atmospheric absorption coefficients** ("alphas") **for each layer**, in dB per 100 meters or dB per 1000 feet should be provided for each event.
13. A **spectrum** (or series of spectra) for each event of **cumulative test-day atmospheric absorption coefficients**, in dB per 100 meters or dB per 1000 feet, should be provided.
14. A **description of the tone-correction process used**, including any upper or lower frequency limits, exclusion of tones in masked bands, special handling of pseudotones, etc. (If pseudotone elimination is performed, provide a description of the process used for identification of pseudotones.)
15. For each event, provide a **time-history of test-day "adjusted, as-measured" aircraft noise SPLs** (one-third-octave-band data) along with **calculated metrics** including **PNL** and **PNLT** values and **frequency band for maximum tone correction** for each spectrum. Additionally, the **test-day EPNL**, band-sharing adjustment Δ_B , and **timestamp of PNLT record** should be included. The **PNLT record** (k_M), the **first** (k_F) **and last** (k_L) **10 dB-down records, and any secondary peaks within 2 dB of PNLT** should also be identified.

(Software Validation Data Submittal Form 3 should be completed.)

16. Provide **parameters used for adjustment to reference conditions** for each event, including:
 - a. Reference height [Z_{OHR}], and units
 - b. Reference ground speed [V_{GR}], and units
 - c. Reference climb/descent angle [γ_R] in degrees
 - d. Reference microphone lateral offset from reference ground track [Y_{MICR}], and units
17. The values used for **reference condition atmospheric absorption coefficients** in dB per 100 Meters or dB per 1000 feet, should be provided.
18. **Identification of process** to be validated for adjustment to reference conditions: Simplified Procedure, Integrated Procedure, or both.
19. The following items are required for each event for validation of the **Simplified Procedure**:
 - a. **EPNL_R** : reference condition EPNL
 - b. **PNLT_M** : reference condition PNLT
 - c. $\Delta_1 = \text{PNLT}_{M_R} - \text{PNLT}_M$
 - d. $\Delta_2 = -7.5 \log[SR(k_M) / SR_R(k_M)] + 10 \log(V_G/V_{GR})$

- e. Δ_{peak} : correction resulting from secondary as-measured peaks within 2 dB of PNLTM
- f. Δ_B : band sharing adjustment
- g. For **PNLTM and any records within 2 dB of PNLTM**, the following should be provided:
 - i. reference condition **PNL_R**, **PNLT_R**, and **maximum tone correction and frequency band**
 - ii. reference condition one-third-octave-band **aircraft noise SPL_R spectrum**
 - iii. **noise geometry** at emission time (i.e., test-day sound propagation distance [**SR**]; sound emission angle [**θ**]; **XYZ coordinates**; and reference condition sound propagation distance [**SR_R**])

(Software Validation Data Submittal Form 4a should be completed.)

20. The following items are required for each event for validation of the **Integrated Procedure**:

- a. **EPNL_R** : reference condition EPNL
- b. **PNLTM_R** : reference condition PNLTM
- c. A **time-history** of reference condition **aircraft noise SPL_Rs** (one-third-octave-band data) with calculated **PNL_R**, **PNLT_R**, **maximum tone correction and frequency band**, and the calculated **effective duration** time for each record
- d. A **time-history of reference noise geometry** (i.e., reference slant range [**SR_R**]; and reference **XYZ emission coordinates**)
- e. Identification of **PNLTM_R record** (k_{MR}) and **reference condition 10 dB-down records** (k_{FR} and k_{LR})
- f. Δ_{BR} : reference condition bandsharing adjustment

(Software Validation Data Submittal Form 4b should be completed.)

- 21. A set of **simple EPNL statistics**, including at least six input values for **EPNL_R**, the calculated average **EPNL_R**, the **standard deviation**, and the **90% confidence interval**.
- 22. Please also **complete the Software Validation Dataset Identification Form** (2nd Attachment)

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Note: Microsoft-Windows-compatible **ASCII text file versions of all data sets are required.**

Please provide as **comma-separated value (.csv)** format files, or alternatively as Microsoft **Excel worksheet files**. All noise level data should be provided to the **nearest .01 dB**.

Please direct any questions to:

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