



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F506

Noise Level Monitoring

Standard Operating Procedure

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Author(s)	Marc Los Huertos
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Organization	EA Program, Pomona College

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1. Purpose

This procedure describes field measurement and documentation of environmental noise levels using handheld sound level meters and logging dosimeters. Environmental noise is an increasingly recognized pollutant affecting human health (cardiovascular risk, sleep disturbance, cognitive impairment) and wildlife behavior (altered communication, habitat avoidance) (Barber et al., 2010; World Health Organization, 2018).

Noise monitoring in the EA Program supports community environmental assessments, transportation corridor studies, urban ecology research, and environmental justice analyses where noise disproportionately affects disadvantaged communities.

2. Scope

- **Applies to:** Outdoor environmental noise measurements (community noise, traffic noise, construction noise, natural soundscapes) using Type 1 or Type 2 integrating sound level meters and personal noise dosimeters
- **Does not apply to:** Occupational noise exposure assessment (governed by OSHA standards and conducted by campus EH&S); indoor building acoustics; underwater acoustics
- **Location:** All EA Program field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Approve monitoring design, coordinate site access
Trained Personnel	Calibrate instruments, collect and document measurements
New Students	Complete training before independent monitoring

4. Definitions

- **A-weighting (dBA):** A frequency-weighting filter applied to sound level measurements that approximates the frequency-dependent sensitivity of the human ear; attenuates low and very high frequencies; the standard weighting for environmental and community noise assessments.
- **Calibrator:** A portable acoustic device that produces a reference tone of known sound pressure level (typically 94 dB or 114 dB at 1,000 Hz) used to verify sound level meter accuracy before and after each measurement session.
- **Day-night average sound level (L_{dn}):** A 24-hour energy-averaged sound level with a 10 dB penalty added to nighttime (10 pm–7 am) levels to account for increased sensitivity to noise during sleep; the primary US EPA regulatory descriptor for community noise exposure.
- **Equivalent continuous sound level (L_{eq}):** The steady-state sound level that would contain the same acoustic energy as the actual time-varying sound over a defined measurement period; the primary descriptor for environmental noise measurements; expressed in dB or dBA.
- **L_{max} / L_{min} :** The maximum and minimum instantaneous A-weighted sound levels measured during a monitoring period; used to characterize the range of noise events and identify peak exposures.
- **Percentile level (L_N):** The sound level exceeded for N% of the measurement period (e.g., L_{90} is the level exceeded 90% of the time); L_{90} approximates background noise; L_{10} approximates peak intrusive noise events.

- **Sound level meter:** An instrument that measures sound pressure level in decibels; classified as Type 1 (precision, laboratory and field) or Type 2 (general purpose); Type 1 meters are required for regulatory compliance measurements; both types are acceptable for research.
- **Sound pressure level (SPL):** A logarithmic measure of the effective pressure of a sound wave relative to a reference pressure of 20 μPa (the threshold of human hearing): $SPL = 20 \log_{10}(p/p_0)$; expressed in decibels (dB).
- **Windscreen:** A porous foam or fur cover placed over the microphone to reduce turbulent airflow noise caused by wind; required for all outdoor measurements to prevent wind-induced artifacts from contaminating sound level data.

5. Safety and Hazards

Hazards

- **Traffic:** Noise monitoring often occurs near roadways. Wear a high-visibility vest. Never stand in a travel lane.
- **Hearing:** If monitoring near very loud sources (e.g., active construction, aircraft operations above 85 dBA), wear hearing protection.
- **Personal safety:** Monitoring in urban areas may involve working alone or in unfamiliar neighborhoods. Work in pairs when possible and inform someone of your schedule and locations.

5.1. Required PPE

- ☐ High-visibility vest (near roadways)
- ☐ Hearing protection (if sustained levels exceed 85 dBA)
- ☐ Closed-toed shoes
- ☐ Sun protection

6. Equipment and Materials

Item	Notes
Integrating sound level meter (Type 1 or Type 2, IEC 61672)	With A-weighting and slow/fast time weighting
Acoustic calibrator (94 dB or 114 dB reference)	Matched to the microphone; calibrate before and after each session
Windscreen (foam cover for microphone)	Required for all outdoor measurements
Tripod with microphone mount	Position microphone at 1.2–1.5 m above ground
Noise dosimeter (optional)	For unattended time-integrated measurements
GPS unit or smartphone	For recording coordinates
Field notebook and noise monitoring data sheet	Record metadata and observations

Item	Notes
Stopwatch or timer	For timed measurement intervals
Camera	For photo-documenting site and source conditions
Spare batteries	For the meter and calibrator

7. Procedure

7.1. Pre-Field Calibration

1. In a quiet indoor location, attach the acoustic calibrator to the microphone and turn on the calibrator
2. Adjust the sound level meter reading to match the calibrator reference level (e.g., 94.0 dB) per the meter's calibration procedure
3. Record the calibration date, time, calibrator serial number, and meter reading in the field notebook
4. If the meter reading deviates from the reference by more than 0.5 dB, recalibrate or service the instrument

7.2. Site Setup

1. Select a measurement location that represents the receptor of interest (e.g., residential facade, park boundary, school playground)
2. Position the microphone on a tripod at 1.2–1.5 m above the ground, at least 3.5 m from any large reflecting surface (building wall, barrier, parked vehicle) to minimize reflections (Acoustics – Description, Measurement and Assessment of Environmental Noise – Part 2, 2017)
3. Orient the microphone toward the dominant noise source (or upward if the sound field is diffuse)
4. Attach the windscreen
5. Record: site ID, GPS coordinates, date, time, weather conditions (wind speed and direction, temperature), distance and bearing to the dominant source(s), ground cover, and any shielding

Important

Do not measure when wind speed exceeds 5 m/s (approximately 11 mph). Wind noise inflates readings even with a windscreen. Record the wind speed at the start and end of each measurement period.

7.3. Measurement Protocol

The following protocol collects standard community noise metrics. Adjust the duration and intervals to match the study design.

1. Set the meter to: A-weighting, fast time constant, and L_{eq} (equivalent continuous level) integration mode
2. Start the measurement and let it run for the designated period:
 - **Short-term survey:** 15 minutes per measurement location (the minimum recommended by most community noise standards)
 - **1-hour L_{eq} :** Run for 60 minutes if comparing to local noise ordinance limits
 - **Long-term (24-hour):** Use a dosimeter or logging meter; deploy and secure the instrument
3. During the measurement, note all significant noise events in the field notebook: vehicle pass-bys, aircraft overflights, dog barking, construction activity, etc. Record the time and estimated duration of each event.
4. At the end of the measurement period, record the following metrics from the meter display:
 - L_{eq} (equivalent continuous level)
 - L_{max} (maximum level)
 - L_{min} (minimum level)
 - L_{10} , L_{50} , L_{90} (statistical levels, if the meter computes them)
5. If the meter logs time-history data, download the file after the session

7.4. Post-Field Calibration Check

1. After the final measurement at the last site, re-check the calibration with the acoustic calibrator
2. Record the post-measurement calibration reading. If it differs from the pre-measurement value by more than 1.0 dB, flag all data from that session for review.

7.5. Data Recording

For each measurement, record on the data sheet:

- Site ID, GPS coordinates, date, start/end times
- Meter make, model, serial number
- Calibration readings (pre and post)
- Weather: wind speed/direction, temperature, sky conditions
- Source description and distance
- Measurement duration and metrics (L_{eq} , L_{max} , L_{min} , L_{10} , L_{50} , L_{90})
- Notable noise events and their times
- Observer name

8. Data Interpretation

Metric	Meaning
L_{eq}	Energy-averaged sound level over the measurement period; the single most important descriptor of community noise exposure
L_{max}	Highest instantaneous level recorded
L_{min}	Lowest instantaneous level recorded
L_{10}	Level exceeded 10% of the time (approximates “loud” events)
L_{50}	Median level
L_{90}	Level exceeded 90% of the time (approximates background or residual noise)
L_{dn}	Day-night average; L_{eq} with a 10 dB penalty applied to nighttime (10 PM–7 AM) hours

Note

Community noise standards in California (Title 24, local general plans) typically set limits in terms of L_{dn} (CNEL) or L_{eq} for specific land use categories. A residential exterior standard of 60–65 dB L_{dn} is common.

9. Quality Control

- Calibrate before and after every measurement session; flag data if drift exceeds 1.0 dB
- Use the windscreen for all outdoor measurements
- Do not measure when wind speed exceeds 5 m/s
- Record all extraneous noise events so they can be identified in the time-history data
- For long-term deployments, perform a calibration check at each data retrieval visit
- Maintain a calibration and maintenance log for each meter

10. Waste Disposal

No waste is generated by noise monitoring. Dispose of used batteries per campus battery recycling procedures.

11. References

- Acoustics – Description, Measurement and Assessment of Environmental Noise – Part 2: Determination of Sound Pressure Levels, Pub. L. Nos. ISO 1996-2:2017 (2017).
- Barber, J. R., Crooks, K. R., & Fristrup, K. M. (2010). The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution*, 25(3), 180–189. <https://doi.org/10.1016/j.tree.2009.08.002>
- World Health Organization. (2018). *Environmental noise guidelines for the European Region*. WHO Regional Office for Europe. <https://www.who.int/europe/publications/i/item/9789289053563>

12. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F502	Portable PM Sensors	Companion air monitoring SOP
F505	Passive Air Samplers	Companion air monitoring SOP

13. Training Record

Before performing noise monitoring independently, personnel must:

1. Read this SOP and [SOP-F001](#) in full
2. Demonstrate proper calibration of the sound level meter
3. Perform a supervised 15-minute measurement at one site, including correct microphone positioning, windscreen use, event logging, and post-calibration check
4. Demonstrate ability to read and record L_{eq} , L_{max} , L_{min} , and statistical levels from the meter
5. Be signed off by the PI or field lead