

Aircraft Noise Terminology

Noise 101 – CLT Airport Community Roundtable

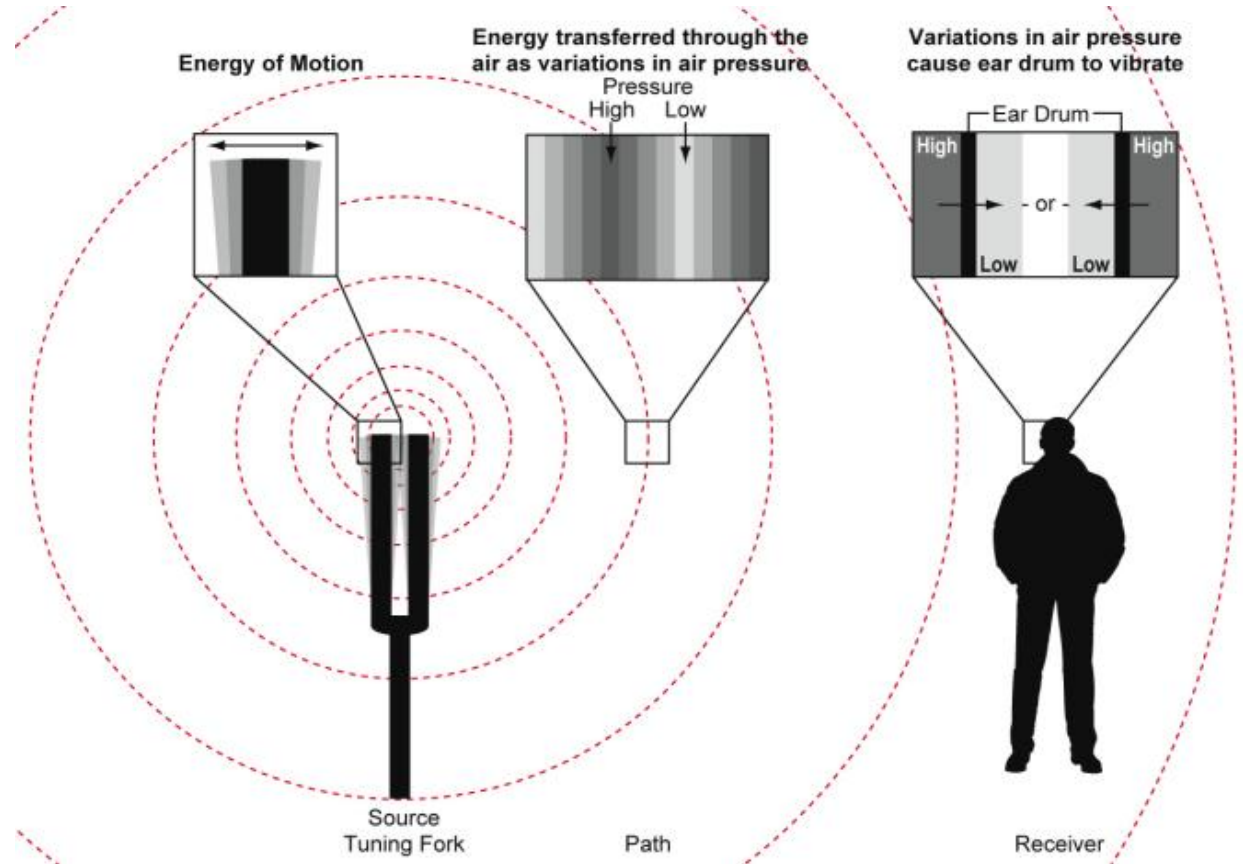
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Basic Noise Terminology

- Sound vs. noise
- The decibel scale (dB)
- The A-weighted decibel
- Single event noise metrics – e.g., L_{MAX} and SEL
- Cumulative exposure metric – e.g., DNL

What is “Noise”?

- Sound is pressure variation our ears can detect
 - An objective quantity
- Noise is “unwanted sound”
 - A subjective quantity
- We relate sound and noise by considering effects
 - Annoyance
 - Speech interference
 - Sleep disruption



The Decibel Scale

- We use a *logarithmic* scale – *decibels*, or *dB* to express sound levels and noise levels
- *Why?*
 - We hear sound pressures over a HUGE range
 - Decibels compress this range to match the way we interpret sound pressures
 - 0 to 140 dB
 - 0.000000003 to 0.003 lbs. per sq. inch (psi)
- We “hear” in decibels.

“Energy”	dB	Common sounds
100,000,000,000,000	140	Near a jet engine at start of takeoff
10,000,000,000,000	130	Threshold of pain
1,000,000,000,000	120	On stage at a loud rock concert
100,000,000,000	110	
10,000,000,000	100	Jack hammer at 6 feet
1,000,000,000	90	
100,000,000	80	Vacuum cleaner at user’s ear
10,000,000	70	Vacuum cleaner at 10 feet
1,000,000	60	Normal speech
100,000	50	
10,000	40	Quiet residential area
1,000	30	
100	20	Whisper
10	10	
1	0	Threshold of hearing
0.1	-10	



Real-Time Decibel Change “Rules of Thumb”

- In a laboratory test, a 1 dB change is generally detectible
- In a normal environment, a 3 dB change is generally the threshold of detectability for a careful listener
 - Why? Distinct A:B comparisons are rare
- A 6 dB change is clear in most day-to-day situations
- In general, a 10 dB change seems twice as loud
- Different rules of thumb apply to cumulative exposure
 - More on that in a few slides

Caution: Decibel Addition Isn't ordinary math!

- Decibels are a logarithmic quantity, so...
- Two equal sources:
 - $60 + 60 \text{ dB} =$ ~~120 dB~~ **63 dB**
- Four equal sources:
 - $60 + 60 + 60 + 60 \text{ dB} =$ **66 dB**
- Ten equal sources:
 - $60 + 60 + 60 + 60 + 60 + 60 + 60 + 60 + 60 + 60 \text{ dB} =$ **70 dB**

Other factors to consider...

- Sound *quality* matters
 - Sources with the same overall dB level may “sound” different



Other factors to consider...

- Duration matters
 - Longer durations increase exposure, even for sources with the same dB level



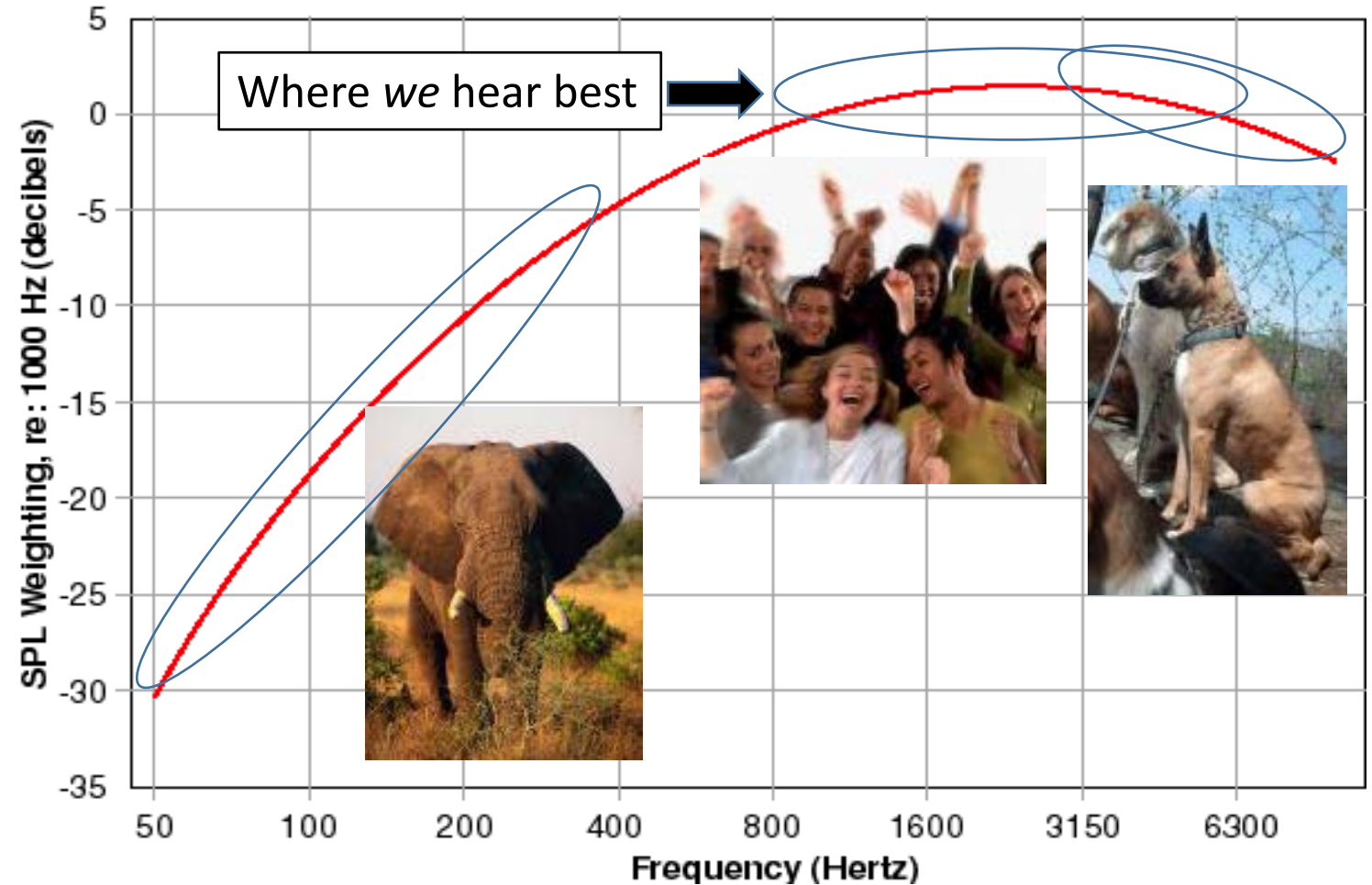
Other factors to consider...

- *Time of day matters*



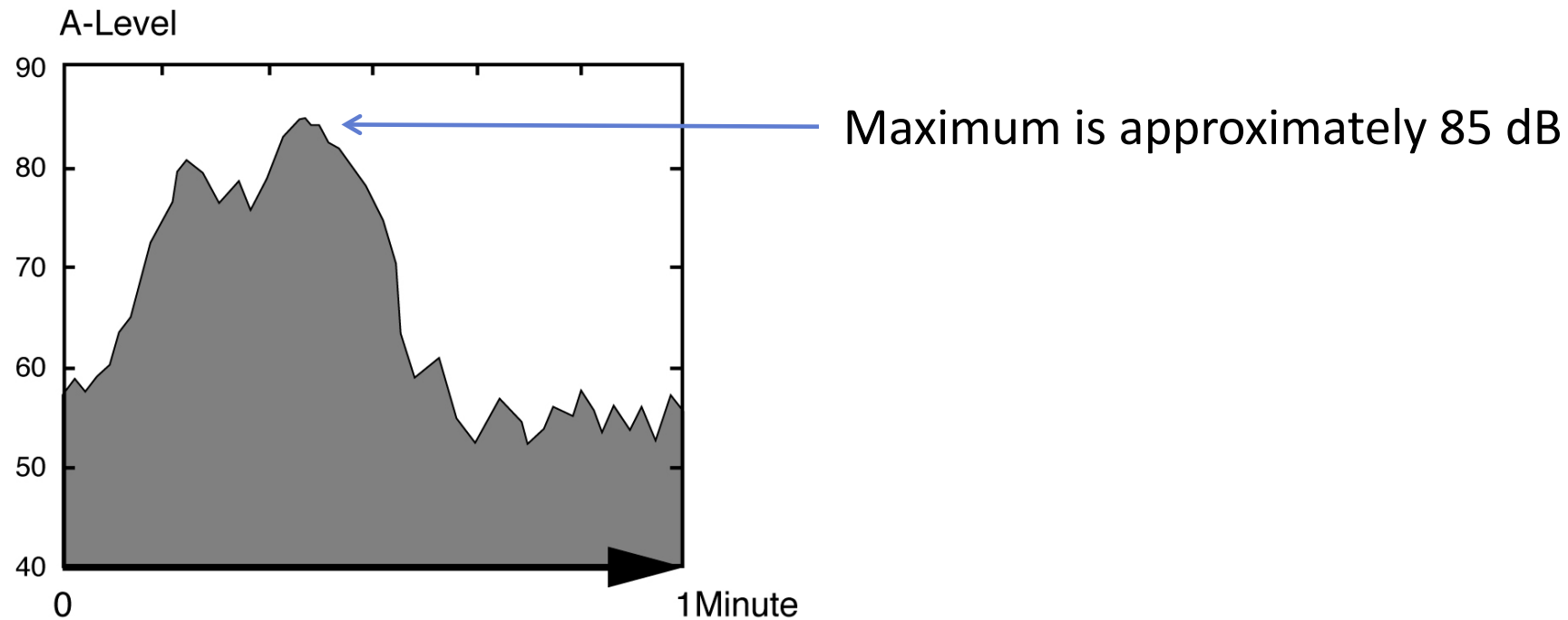
The A-Weighted Sound Level

- Our ears are not equally sensitive to all frequencies
- A-weighted decibels (dB) measure sound the way we “hear” it
- Part 150 specifies noise metrics to describe
 - Single events
 - Cumulative exposure
- Consistent with worldwide practice



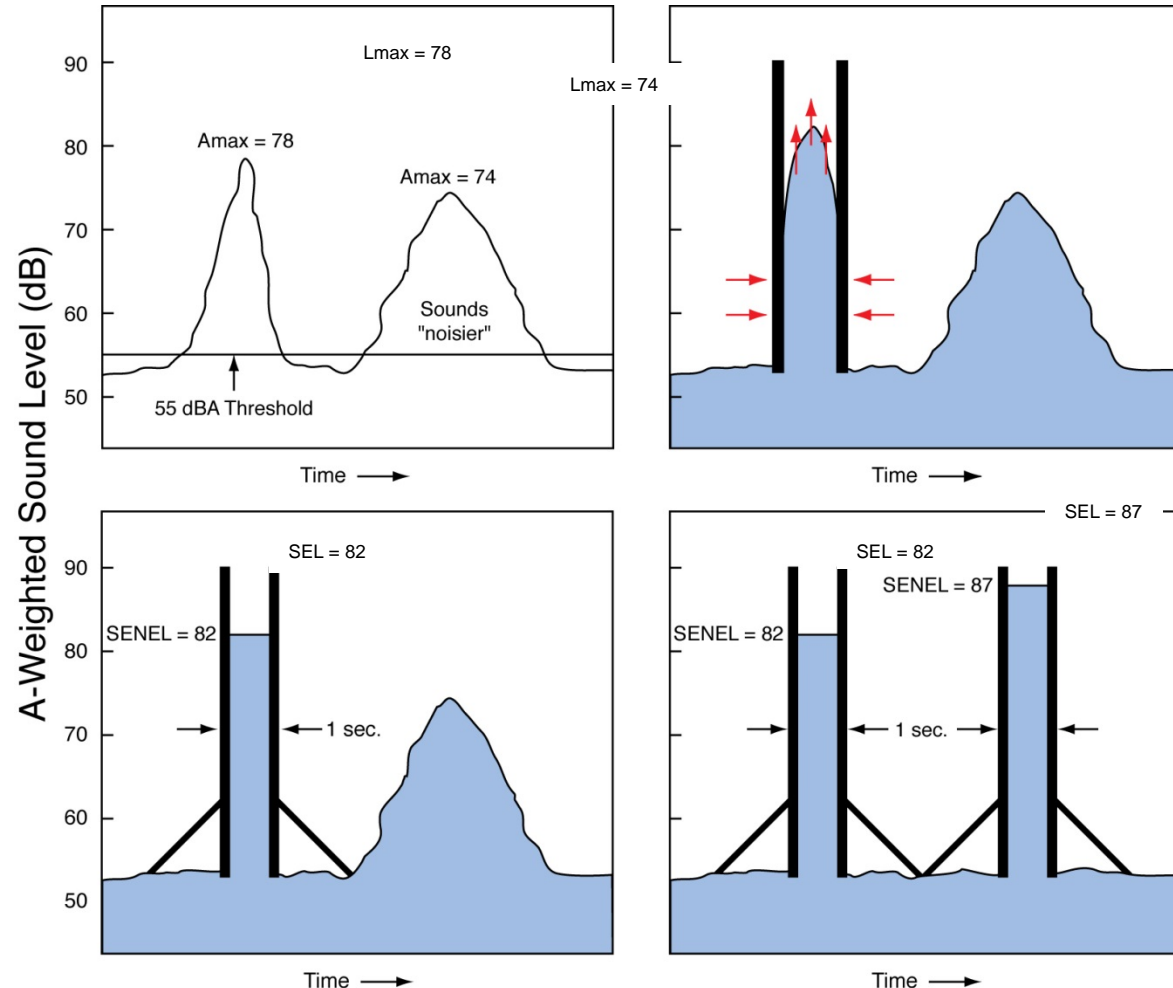
Single Event Noise Metrics: Maximum Sound Level (L_{MAX})

- The simplest way to describe a discrete noise “event” is its maximum sound level, L_{MAX}



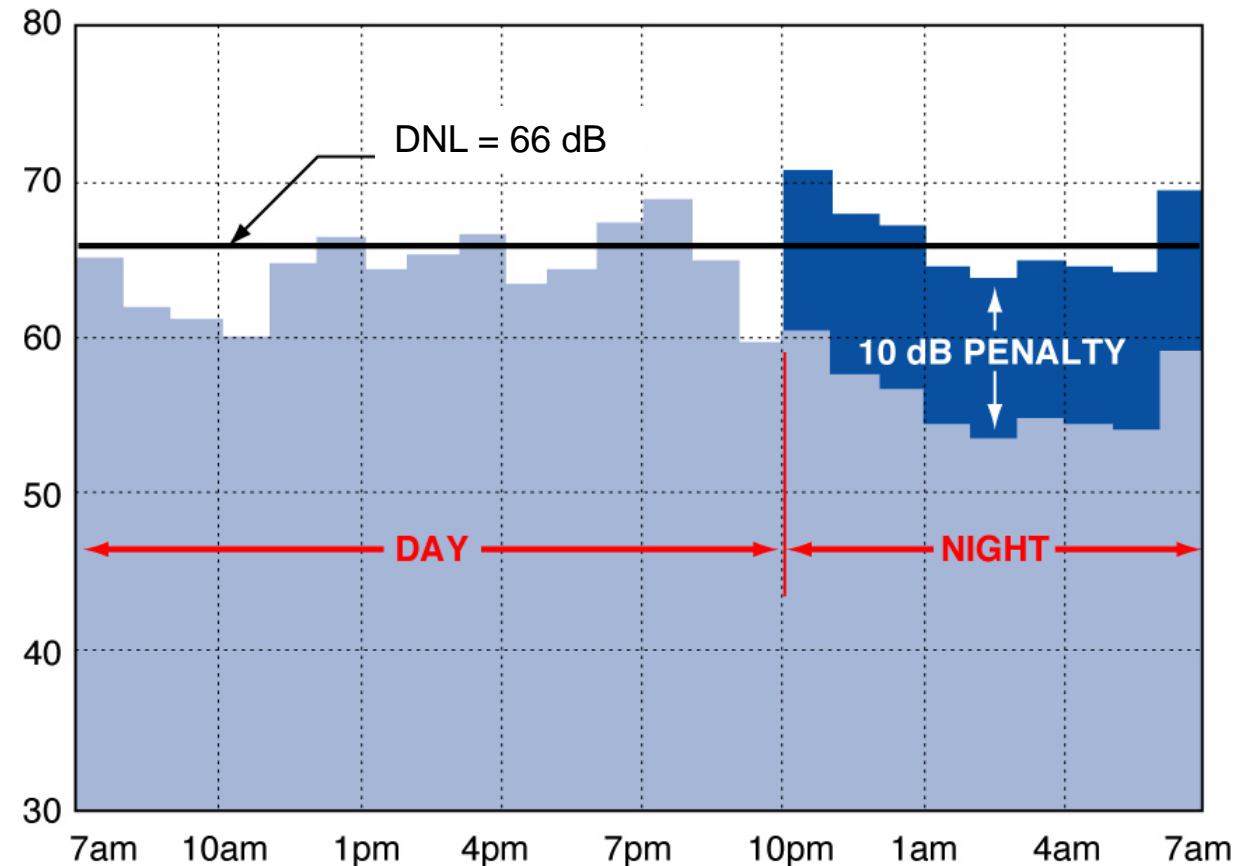
Single Event Noise Metrics: Sound Exposure Level, SEL

- Duration matters: A longer event may seem “noisier,” even if it has a lower or equal maximum level
- SEL measures the total “noisiness” of an event by taking duration into account

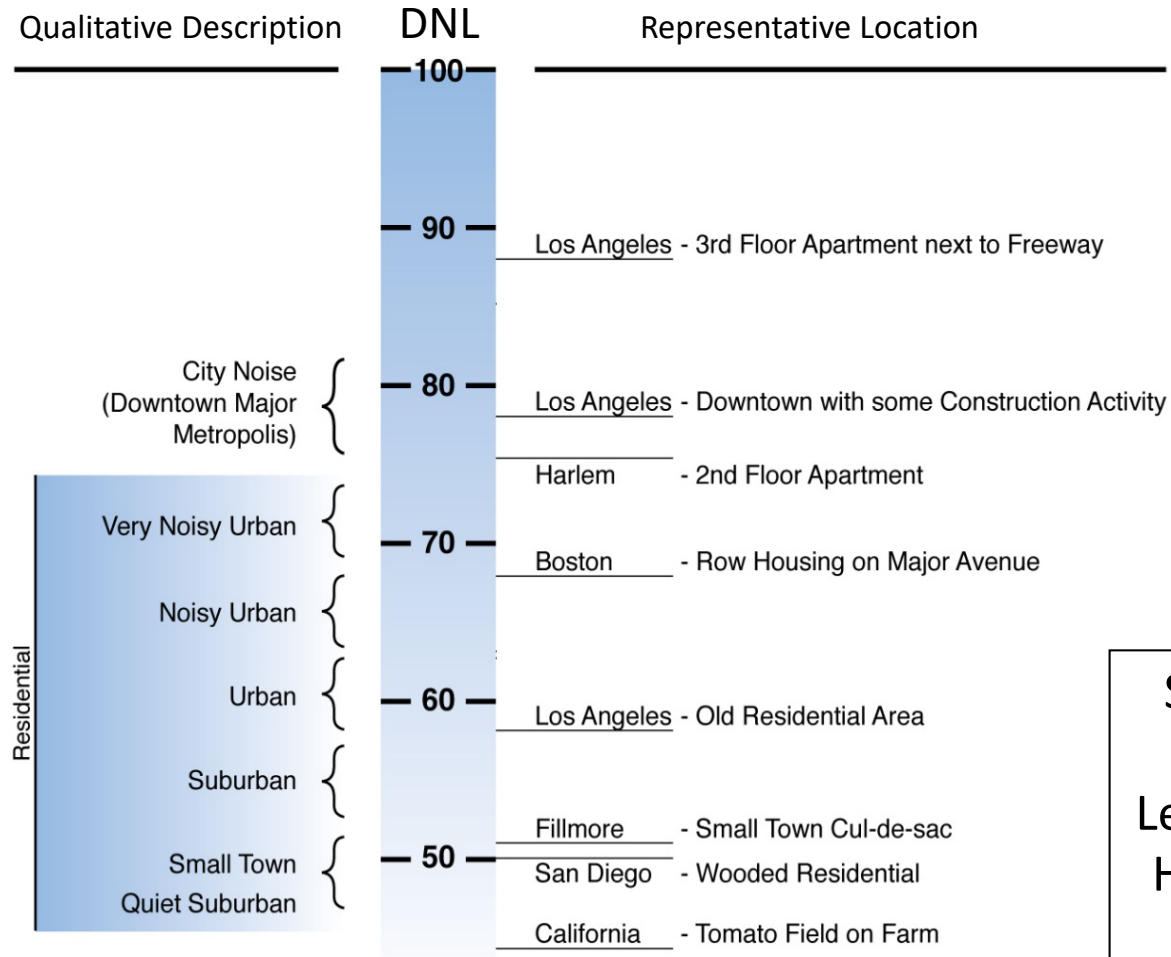


Cumulative Exposure: Day-Night Average Level (DNL)

- Describes 24-hour exposure
- Noise from 10 pm to 7 am is factored up by 10 dB
 - “Penalty” is equal to counting each night aircraft 10 times
- Sometimes abbreviated Ldn



Typical Community DNL Examples



Source: United States Environmental Protection Agency, Information on Levels Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974, p. 14.



Major Federal Aviation Noise-Related Legislation (slightly out of chronological order)

Statute	Aircraft Noise Related Purpose	Most Relevant FAA Regulation(s)
National Environmental Policy Act of 1969 (NEPA)	Directs all federal executive agencies to assess <i>all</i> environmental effects of proposed federal agency actions.	FAA Orders 1050.1F, 5050.4B
Aircraft Noise and Sonic Boom Act of 1968	Authorizes FAA to prescribe standards for measurement of aircraft noise and establish regulations to abate noise.	49 CFR parts 36 and 91
The Noise Control Act of 1972 (Noise Act)	Amends 1968 act to add consideration of public health and welfare and to add EPA to the rulemaking process for aircraft noise and sonic boom standards.	None directly; EPA responsibility
Aviation Safety and Noise Abatement Act of 1979 (ASNA)	Directs FAA to establish single system to measure noise and determine exposure of people to noise, and identify land uses normally compatible with various noise levels	14 CFR part 150
Airport and Airway Improvement Act of 1982	Authorizes FAA funding for noise mitigation/compatibility planning and projects, and establishes noise compatibility requirements for FAA-funded airport development.	FAA Airport Improvement Program (AIP)
Airport Noise and Capacity Act of 1990 (ANCA)	Mandates phase out of Stage 2 jet aircraft over 75,000 pounds, and established requirements regarding airport noise and access restrictions for Stage 2 and 3 aircraft.	14 CFR part 161
Section 506 of the FAA Modernization and Reform Act of 2012	Prohibition after 12/31/2015 of operation of civil subsonic jet airplanes with maximum weights of 75,000 pounds or less that do not meet stage 3 noise standards	14 CFR part 91
FAA Reauthorization, 2018	Reauthorizes FAA through 2023	None yet



National Environmental Policy Act, 1969

- Governs federal actions with possible environmental impacts
 - President's Council on Environmental Quality (CEQ) provides oversight
 - Defined procedures for all federal agencies to prepare environmental assessments (EAs) and environmental impact statements (EISs)
- FAA Order 1050.1F, "Policies and Procedures for Considering Environmental Impacts"
 - Applies to all FAA "lines of business"
- FAA Order 5050.4B, "Airport Environmental Handbook"
 - Airports Division guidelines
- Draft FAA Order 7490, "Air Traffic Environmental Order"
 - Air Traffic Division guidelines
- Compliance with NEPA is responsibility of FAA – *not airports*
 - Airports should participate as fully as feasible to monitor their interests



NEPA has led to thresholds defining significant change in noise exposure

- Federal Interagency Committee on Noise (“FICON”), 1992
 - 1.5 dB increase in DNL within 65 dB DNL
 - 3 dB increase in DNL between 60 and 65 dB DNL
- Expanded East Coast Plan (“EECP”) EIS, 1992-3
 - Prior to EECP, changes in tracks only reviewed below 3,000’
- FAA Order 7490xx (Policies and Procedures for Air Traffic Environmental Actions)
 - Analyze arrivals to 7,000, departures to 10,000 (AGL)
 - 5 dB increase in DNL to these altitudes or between 45 and 60 DNL triggers additional analysis
- Order 1050.1F “Desk Reference” provides detailed guidance
 - Best single source for information on FAA regulations, policies, procedures, etc. for assessing noise impacts



FAA Noise Abatement Policy, November 1976

- Airport Noise and Capacity Act of 1990 (ANCA) requirement
- Established roles and responsibilities for:
 - **federal government** – source emissions, air traffic control, funding, and safety oversight
 - **state and local governments** – compatible land use planning and control
 - **aircraft operators** – noise-sensitive schedules, cockpit procedures, and fleet improvements
 - **air travelers and shippers** – bear the costs
 - **current and prospective residents** – seek to understand and act accordingly
 - **airport operators** – primary responsibility for planning and implementing all noise abatement and compatible land use measures



Airport Noise and Capacity Act of 1990, ANCA

- Required FAA to establish phase-out of Stage 2 aircraft over 75,000 pounds
 - FAA promulgated Part 91 amendment (1991)
- Required FAA to establish regulations regarding analysis, notice, and approval of airport noise and access restrictions
 - FAA implemented through FAR Part 161 (1991)
- Required FAA to develop “national aviation noise policy” by July 1, 1991
 - FAA published draft “Aviation Noise Abatement Policy 2000” on July 14, 2000 - never finalized
 - 1976 Federal Noise Abatement Policy still in effect

