Session 15 – The Law of Airport Noise 101

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Desk Reference
Chapters 1, 17, 18
Session Overview

• Basic noise terminology
  • What is noise?
  • What are all of these metrics?

• Legal Authority
  • What are the noise standards for aircraft types?
  • How are these aircraft types regulated?
  • How do we measure aircraft noise impacts?
  • Can I get federal funding for noise mitigation?
  • Can I impose noise restrictions at my airport?
Basic Noise Terminology

- Sound vs. noise
- The decibel scale (dB)
- The A-weighted decibel (dBA)
- Single event noise metrics - Lmax and SEL
- Cumulative exposure metric - 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 can hear sound pressures over a HUGE range
  – 0.000000003 to 0.003 pounds per square inch (psi) – the threshold of hearing to the threshold of pain
  – Decibels compress this range to match the way we interpret sound pressures
    – 0 to 140 dB

• *We “hear” in decibels.*
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” apply to cumulative exposure
  – More on that later
Caution: *Decibel addition isn’t ordinary math!*

- Decibels are a logarithmic quantity, so...
- Two equal sources:
  - $60+60\ \text{dB} = 63\ \text{dB}$
- Four equal sources:
  - $60+60+60+60\ \text{dB} = 66\ \text{dB}$
- Ten equal sources:
  - $60+60+60+60+60+60+60+60+60+60\ \text{dB} = 70\ \text{dB}$
- We are *more* sensitive to small changes and *less* sensitive to large changes
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
FAA requires use of the A-Weighted Sound Level (dBA)

• Our ear is not equally sensitive to all frequencies
  – A-weighted decibels measure sound the way we “hear” it
  – Adopted essentially worldwide
Single Event Noise Metrics: Maximum Sound Level (Lmax)

- The simplest way to describe a discrete noise "event" is its maximum sound level, Lmax.

Maximum is approximately 85 dBA
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 or Ldn)

• Describes 24-hour exposure
  – Noise from 10 pm to 7 am is factored up 10 dB
  – Equivalent to considering each night operation to be the same as 10 identical day operations
Typical Community DNL Examples

DNL is usually presented in the form of noise “contours”

- Van Nuys (CA) Airport example
- FAA requires consideration of 65, 70 and 75 DNL
  - Airports often show 60 DNL
- Key purpose is identification of non-compatible land uses
- FAA considers all land uses compatible below 65 DNL
Noise Metric Summary

• The decibel is a complex logarithmic quantity based on sound pressure
• A-weighted decibels correlate well with how we hear
• Noise levels can be expressed many ways, including but not limited to:
  – Instantaneous maximum (L_max)
  – Single event dose (SEL)
  – Long-duration exposure (DNL)
• Best metric to use depends on purpose
• There are multiple other metrics
  – *If they come up - call HMMH!*
Legal Authority - Statutes

• **Aircraft Noise Abatement Act of 1968 (49 U.S.C. 44715)**
  - FAA may prescribe standards for measurement and regulation of aircraft noise

• **Aviation Safety and Noise Abatement Act of 1979 (ASNA) (49 U.S.C. 47501 et seq.)**
  - FAA may regulate “air noise compatibility planning”
  - FAA may fund airport projects in an approved noise compatibility program
  - FAA may establish standards for measuring noise impacts

• **Airport Noise and Capacity Act of 1990 (ANCA) (49 U.S.C. 47521 et seq.)**
  - Phase-out of Stage 2 aircraft > 75,000 pounds
  - Limits on any restrictions of Stage 2 and Stage 3 aircraft

• **FAA Modernization and Reform Act of 2012 (P.L. 112-95)**
  - Ban on almost all Stage 2 aircraft after December 31, 2015
Legal Authority - Regulations

• **Part 36**
  - Noise Standards: Aircraft Type and Airworthiness Certification (1969, as amended)

• **Part 91, Subpart I**
  - Operating Noise Limits (1976, as amended)

• **Part 150**
  - Airport Noise Compatibility Planning (1984, as amended)

• **Part 161**
  - Notice and Approval of Noise and Access Restrictions (1991)
Aircraft Noise Abatement Act of 1968/
Part 36: Noise Standards

• Noise standards for newly certified aircraft types and designs
• Aircraft must meet standards to obtain certificates to operate in the U.S.

• Noise standards for most aircraft are in terms of “stages”
  – **Caution**: The meaning of stage levels varies among categories!

• Standards vary with “design” criteria, including (in part):
  – Subsonic versus supersonic speed capabilities
  – Type of propulsion (e.g. turbojet- or propeller-driven)
  – Weight (e.g., “small” or “large” aircraft under or over 12,500 pounds)
  – Rotary-winged versus fixed-wing aircraft
  – Operating category (e.g., “acrobatic,” “agricultural,” “commuter,” etc.)
  – Use (e.g., “fire fighting” or “carrying external loads”)
  – Date of initial flight or of application for type certificate
Part 36: Noise Standards

• Heavier aircraft are allowed to make more noise
• Certification for most – but not all – fixed-wing aircraft is based on three measurements
  – Landing, sideline, takeoff

Locations can vary with aircraft stage, number of engines, and lift mechanism. Some types are certificated based on level flyover.
Part 36 “Stages”

- Most relevant for civil subsonic jets and large transport-category (over 12,500lbs.) props
- “Stage 1” aircraft have never been shown to meet any noise standards
  - Either never tested, or tested and failed
- “Stage 2” aircraft meet original (1969) limits
- “Stage 3” meet more stringent (1977) limits
- “Stage 4” meet newest (2006) limits
- ICAO is considering “Stage 5”
Improvements in Aircraft Noise Technology

Figure 1 – Progress in commercial aircraft noise reduction, 1955-2015 (Source: Boeing)
Part 91 (Subpart I):
Phases out older, noisier jets

- Stage 1 airliners (over 75,000 pounds) phased out in 1980s
- Stage 2 airliners phased out in 1990s
- Stage 1 and 2 jets under 75,000 pounds phased out by 2016
- No Stage 3 phase out planned at this time
- Some Stage 2 jets were “hushkitted” to meet Stage 3
Graphic example:
Relative noisiness of Stage 1 - 4 aircraft

- Lear 25 corporate jet
  - Stage 1 or 2
  - 7,500 lb. MGTOW
- Boeing 727-200
  - Stage 3 hushkit
  - 180,000 lb. MGTOW
- Boeing 737-300
  - Early “true” Stage 3
  - 135,000 lb. MGTOW
- Boeing 737-700
  - Stage 4
  - 155,000 lb. MGTOW
- Boeing 757-200
  - Stage 4
  - 250,000 lb. MGTOW

Note: Representative maximum gross takeoff weights (MGTOW).

Figures show SEL contours for left-to-right landing-takeoff cycles.
Aviation Safety and Noise Abatement Act and Part 150

- Aviation Safety and Noise Abatement Act of 1979 (ASNA)
  - Requires FAA to establish a single system of measuring noise
  - Required FAA to issue regulations on "noise compatibility planning"

- FAA promulgated Part 150
  - Selected the A-weighted sound level (dBA)
  - Selected the Day-Night-Average Sound Level (DNL)
  - Defined a voluntary noise compatibility planning process
Part 150: Identifying Compatible Land Uses

• Identifies variety of land use categories considered to be compatible with aircraft operations for a range of noise levels
  – Suggests 65 dB DNL threshold of compatibility for residential uses
  – See generally: Table at 14 CFR Part 150, Appendix A.

• **NOTE!** This guidance may change
  – Was based in part on economic and technological feasibility
  – Aircraft source levels have been reduced significantly
  – Part 150 programs have mitigated most other impacts
  – So, lower threshold may be technologically and economically feasible
  – FAA is sponsoring research into relationship of noise to annoyance and sleep disturbance which may provide scientific justification for lowering compatibility criterion below 65 DNL
  – Legislation proposed in Congress to require FAA to change guidance
Population within 65 DNL has declined sharply, despite increasing numbers of airline passengers.
Part 150: Noise Compatibility Planning

• Establishes a voluntary process for airport noise studies
  – Participation provides access to FAA funding of some approved measures
  – ASNA Sec. 107
    • “Protects” airports against damage claims for properties purchased after NEM has been submitted
    • Never tested in court

• Limited consultation requirements
  – But extensive “voluntary” stakeholder outreach is the norm
Part 150: Noise Compatibility Planning

• **Noise Exposure Map (NEM)**
  – Detailed description of airport layout, operations, noise, land uses, and noise/land use compatibility
  – FAA “accepts” the NEM
    • Prepared according to accepted methodology?

• **Noise Compatibility Program (NCP)**
  – Noise abatement measures to reduce noise exposure
  – Land use measures to address non-compatible uses
  – Program management/implementation measures
  – FAA “approves” the NCP
    • Any undue burden on interstate commerce?
    • Reduces existing noncompatible land uses?
    • Prevents future incompatible uses?
Example: Akron-Canton Airport NEM

Note: includes 60 dB DNL contour for “informational purposes,” a common practice today, since sensitive land uses within 65 dB DNL are rare or already mitigated at most airports.
Example: Akron-Canton
Noise Abatement Recommendations

• Existing measures (FAA approved on voluntary basis)
  – NA1 - Jet use of noise abatement departure procedures
  – NA2 - Control tower approve maximum climb for OANG helicopters
  – NA3 - Pilots restrict nighttime use of reverse thrust
  – NA4 - Eastbound Runway 23 jet departures fly runway heading until
        3 nautical miles from radar, or 2,500’ MSL (1,300’ AGL)
  – NA5 - Eastbound and southbound Runway 19 jet departures turn to
        a heading of 160 degrees at 2 nautical miles from the radar
  – NA6 - Use designated maintenance runup location / orientation

• Existing measures not supported
  – NA7 - Ground runup enclosure
  – NA8 - Engine runup and taxiing procedures

• New measure proposed for voluntary implementation
  – NA9 - Night preferential use of Runway 19 when in south flow
Example: Akron-Canton Land Use and Program Management Measures

• Land Use: Implement Airport Overlay Zone
  – Jurisdictions will provide notice of land use actions, to provide opportunity to comment on potential noise or airspace issues
  – Boundary based on FAA “transitional” obstruction “surfaces” adjusted to follow major roads and parcel boundaries
  – Jurisdictions will incorporate into comprehensive plans, zoning ordinances, or other mechanisms as most appropriate

• Continue existing program management measures
  – Noise complaint receipt and response
  – Public information and pilot outreach
  – Noise abatement contact
  – Air terminal information service (ATIS) advisory
  – Airside informational signs
  – NEM and NCP review and revision
Example: Akron-Canton NCP

2014 Noise Exposure Map with and without Night Preferential Runway, with Airport Overlay Zone
Airport Noise and Capacity Act of 1990, ANCA

• Required FAA to complete phase-out of Stage 2 aircraft over 75,000 pounds by 12/31/91
  – 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)
Part 161: Airport Noise and Access Restrictions

- Establishes federal program for reviewing noise and access restrictions on use of Stage 2 and 3 aircraft
  - Stage 2 restrictions are moot as of January 1, 2016
- Comprehensive analysis required, e.g.:
  - Evidence of noise problem
  - Impacts analysis
  - Benefit-cost analysis
- Encourages voluntary agreements
Part 161: Airport Noise and Access Restrictions

• Statutory conditions for approval of an access restriction
  – Reasonable, nonarbitrary and nondiscriminatory
  – No undue burden on interstate or foreign commerce
  – Maintains safe and efficient use of navigable airspace
  – No conflict with existing Federal law
  – Adequate opportunity for public comment
  – No undue burden on national aviation system
Part 161: Airport Noise and Access Restrictions

- Many potential roadblocks
  - No guidance for benefit/cost analysis
  - Aviation interests - a key data source, unlikely to assist
  - FAA has made its opposition clear

- Study of last resort - perhaps a dozen airports have pursued
  - Some abandoned, some disapproved by FAA, some resulted in voluntary agreements
  - Two new restrictions
    - Naples Stage 2 ban and Van Nuys Stage 2 phaseout
In Summary:

• Part 36 sets aircraft noise limits
• Part 91 sets phase-out schedules
• Part 150 guides compatibility planning
  – Most easily attained benefit has been achieved at most airports
• Part 161 regulates use restrictions
  – Strong FAA opposition to application
Questions?

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